frontiers | Research Topics

The changed life: How COVID-19 affected people's psychological well-being, feelings, thoughts, behavior, relations, language and communication

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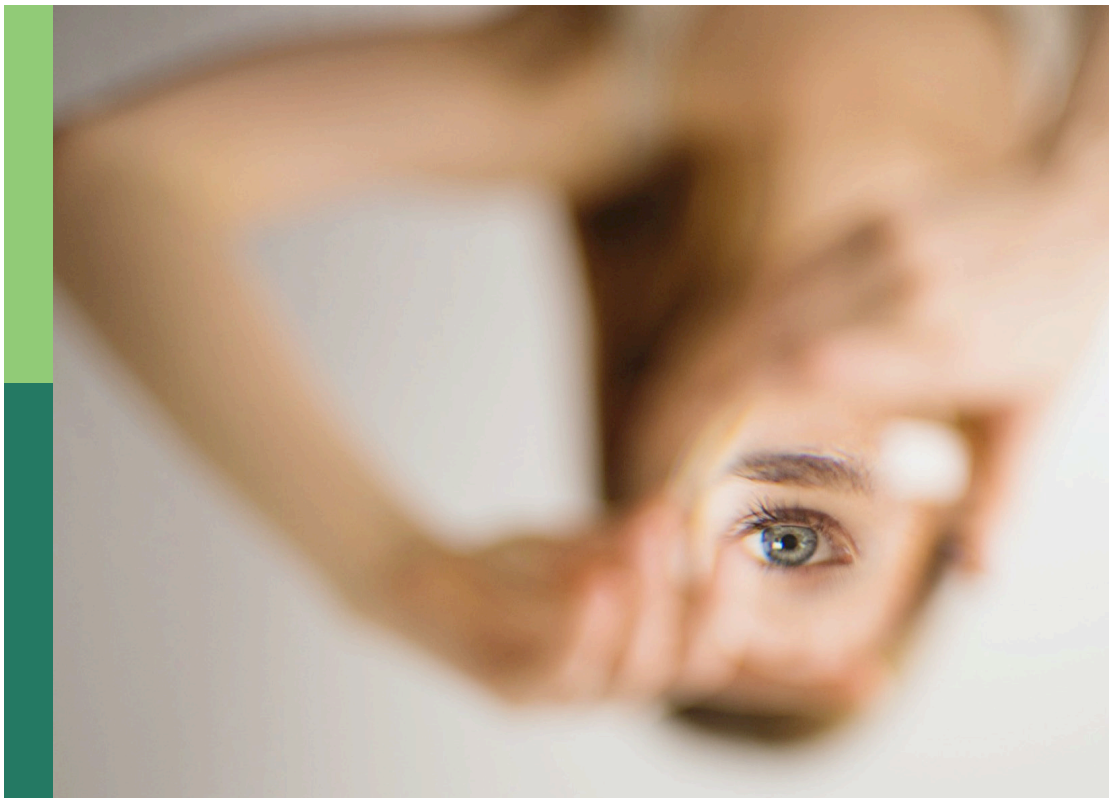

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The changed life: How COVID-19 affected people's psychological well-being, feelings, thoughts, behavior, relations, language and communication

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Editorial: The changed life: how COVID-19 affected people's psychological well-being, feelings, thoughts, behavior, relations, language and communication

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Editorial on the Research Topic
The changed life: how COVID-19 affected people's psychological well-being, feelings, thoughts, behavior, relations, language and communication

1. Introduction

The COVID-19 pandemic impacted deeply on the lives of millions of people around the world. In addition to the effects of the virus on physical health, the pandemic also had considerable psychological and social effects on individuals, the outcomes of which, just like the physical ones, are slow to disappear.

Thus, the expression "long-COVID" seemed to be applicable not only to describe the long-term effects on the physical health of people who have contracted the virus, but also to refer to the long-term psychological outcomes, identifiable both in those who have been infected and, more generally, in all those who had to cope with the loss of relatives and friends, the fear of being infected and/or infecting others, as well as with social restrictions, lockdown, distancing, working and studying remotely, and other similar challenges.

The way of handling these difficulties has been very different and, while there were people who were overwhelmed by fear, uncertainty, anxiety, and depression, there were others who have shown remarkable resilience.

2. The Research Topic

In the context of a pandemic from which—at least in medical terms—the world was slowly emerging, in May 2022 we launched our Research Topic entitled "The changed

life: how COVID-19 affected people's psychological well-being, feelings, thoughts, behavior, relations, language and communication."

In response to the call, we received many highly interesting papers and 42 of them (34 original research papers, 2 brief research reports, 4 reviews, 1 opinion paper, and 1 empirical study), authored by 215 researchers from 27 different countries, were successfully published: 36 in *Frontiers in Psychology* (sections Health Psychology, Education, Positive Psychology, Personality and Social Psychology, Pediatric Psychology, Quantitative Psychology and Measurement), 5 in *Frontiers in Education* (section Educational Psychology), and 1 in *Frontiers in Aging Neuroscience* (section Neurocognitive Aging and Behaviors).

The papers in this Research Topic cover a wide range of topics. Although the majority focuses on the negative psychological effects of the pandemic [such as increased anxiety, depression, fear, powerless, post-traumatic stress disorder (PTSD), burnout, emotion dysregulation (ED)], as well as on individuals' dysfunctional behaviors (e.g., excessive hoarding behavior, academic procrastination, epidemic information-avoidance behavior, nomophobia, and smartphone addiction), other papers focus on personal characteristics (e.g., specific traits of personality, resilience, and psychological flexibility) and behavioral habitus (e.g., performing physical exercise, participating in artistic and cultural activities, using social media to access medical information, and resorting to positive coping strategies), which seem to help people live more adaptively and functionally in a highly stressful situation, suggesting that the pandemic have been also a time of opportunity for personal growth and development. Lastly, some other papers specifically focus on distance learning, and more generally, on the use of online environments and social media.

Thus, despite the diversity of the contributions, they appear to fall within three main areas of research:

1. Psychological negative outcomes;
2. Resilience, post-traumatic growth, and adoption of functional coping strategies;
3. Distance learning, online environment, and social media.

2.1. Psychological negative outcomes

A first line of research includes papers examining the negative psychological outcomes of the pandemic. Indeed, as previously mentioned, a significant portion of the studies featured in this dedicated issue has mainly focused on the negative psychological and behavioral consequences resulting from the COVID-19 pandemic across diverse socio-demographic groups.

For instance, the study conducted by Park and Park drew attention to the impact of the pandemic on the quality of life and the manifestation of depressive symptoms among Korean patients coping with chronic illnesses. In a similar vein, Mao et al. delved into the influence of COVID-19-related fear among a cohort of Chinese individuals diagnosed with cancer. The findings of their investigation revealed that the level of fear associated with COVID-19 exhibited an inverse correlation with quality of life, while concurrently displaying a positive correlation with safety-conscious behavior.

The impact of COVID-19 affected patients and medical students' mental wellbeing (see for example, Abdolkarimi et al.) and healthcare practitioners. This is evident from the systematic meta-analyses carried out by Paz et al. and Tong et al., which showed elevated levels of stress, anxiety, and depression within these two distinct groups.

COVID-19 has had negative psychological consequences not only on medical students but more generally, on all students, especially those with specific personality traits. For example, in a study carried out by Zhang Y. et al., involving a group of 2,485 Chinese university students, the authors brought to light that individuals characterized by alexithymic tendencies and lower self-esteem were more prone to manifest symptoms indicative of PTSD as well as to encounter sleep-related issues. The adverse impacts of COVID-19 on the student population appear to transcend merely their current mental wellbeing, also encompassing their capacity to envision their future. The anxiety experienced by students appears to exert an adverse influence on their confidence regarding employment prospects and career expectations (Nazir and Özçiçek; Zhao; Zheng et al.).

Even teachers were not immune from the consequences of COVID-19 either (Weiher et al.). A considerable number of them grappled with the imbalance between the demands of their work and the available resources within the educational setting. The findings of a study undertaken by Rastegar and Raimi underscored the significance of avoidant strategies in detrimentally affecting teachers' overall wellbeing, while highlighting the role of problem-focused strategies in fostering enhancements in their mental health.

Chen et al. instead attempted to identify some social variables responsible for the negative impact of COVID-19 on adolescents' mental health, identifying them in the reduction of social trust and in the increase in inequality caused by the digital and economic divide. Also among the younger people the situation has been very complex. The main results of a cross-sectional analysis of quality of life and loneliness among United States (US) children early in the COVID-19 pandemic (Skeens et al.) revealed that children experienced a worse quality of life and a greater loneliness when compared to normative samples. These outcomes were worse for girls and older children and raise concern for short- and potentially long-term mental health sequelae due to the pandemic. The impact of the pandemic on children was partially explained by the distress related to COVID-19 experienced by parents. While social interactions with friends did not mitigate this indirect impact, enhanced family functionality appeared to offer a protective effect.

Other research has investigated the effects of COVID-19 and lockdown on the general population. Covelli et al., for example, examining an Italian sample, found that participants reported lower levels of general wellbeing and a higher level of both perceived stress and fear related to COVID-19 during the first lockdown period than at the time of the survey (a month after the first wave). In other terms, participants were observed to be enhancing their overall sense of wellbeing 1 month after the initial wave of the pandemic. Nonetheless, the persistence of fear and emotional ambivalence suggests paying attention to the sense-making of that event in order to support the correct reconstruction of experiences and emotions

experienced in that period. Camisasca et al., in a sample of Italian women, found that the marital dissatisfaction experienced during the pandemic explains the indirect effects of economic difficulties on psychological maladjustment.

Within the spectrum of COVID-19-related negative behaviors, the contributors of this Research Topic identified positive correlations between fear of COVID-19 and hoarding tendencies (Zhao Y. et al.). Additionally, a correlation has been noticed between the perception of epidemic risk and the adoption of information avoidance behavior (Zhang K. et al.). On the contrary, anxiety seems to correlate positively with an excessive reassurance-seeking tendency (that can be considered as a form of maladaptive coping strategy), which was measured by Manrique-Millones et al. through the Coronavirus Reassurance Seeking Behavior Scale among a sample of 661 Peruvian adults. Obviously, many other dysfunctional behaviors were observed during the pandemic period. Among these there is a high alcohol consumption (Šulejová et al.).

2.2. Resilience, post-traumatic growth, and functional coping strategies

A second line of research includes papers focusing on psychological resilience, post-traumatic growth, as well as on the use of functional coping strategies.

Matsumoto et al., for example, conducted a study on changes in psychological resilience among a sample of 130 older adults with mild cognitive impairment (MCI) during the stressful period related to the COVID-19 pandemic. The results of their research show that the improvement in psychological resilience was associated with a good sleep quality. In other words, the better you sleep, the more resilient you are.

Marashi and Heisz found, instead, that resilience and physical activity (as for the protective role of physical activity, see also Drole et al.; Zhao W. et al.) seem to be protective factors against symptoms of anxiety and depression in graduate students experiencing increased academic stress during COVID-19. Analogously Reilly et al., in a sample of US military veterans, found that psychological flexibility, a process of modifiable resilience, buffered some of the negative impacts of the pandemic on mental health and quality of life.

Paoletti et al., following a shared reflection with resilience researchers—convinced that the pandemic can be a catalyst for change in building more resilient communities and social structures—identified and discussed in their paper four interdisciplinary lessons that COVID-19 can teach: (1) Being more aware of brain functioning and its potential can help us face the global increase in anxiety and depression; (2) It is necessary to develop an awareness of human interconnectedness to overcome adversity; (3) School-programs should educate next generations in resilience; (4) Self-training resilience tools can allow individuals, groups, and communities to access neuro-psycho-pedagogical knowledge to face adversities, uncertainty, and changes in everyday life.

As regards post-traumatic growth, the results emerging from Hao et al. study show interesting insights. The authors undertook an empirical investigation involving a cohort of 2,990 volunteer university students, enrolled at various universities and actively engaged in the containment and management of the epidemic situation. According to their findings, the adoption of a positive coping style and the perception of robust social support among university student volunteers showed a positive association with higher levels of post-traumatic growth. Conversely, the manifestation of a negative coping style showed a positive relationship with the amplification in the severity of PTSD symptoms experienced by these volunteers.

The role of social support has been also investigated by Dhruve et al.. Specifically, the authors explored ED and perceived social support (PSS) as potential mechanisms for the relation between COVID-19 stress and depressive symptoms among a sample of 489 students at a Southern university in the US. The results of their path analysis revealed that PSS buffered the effect of ED on depressive symptoms, suggesting that the perceived social connection may be an essential factor for psychological outcomes during periods of stress and isolation, particularly for those reporting high ED.

Consistent with these findings, also the results of Li et al., who have carried out a study among a cohort of Chinese female undergraduate students in the field of liberal arts, highlighted the protective role of social support against the negative effects of the pandemic.

With regard to adaptive coping strategies, Burro et al. examined the role that personality traits can play in their promotion. Investigating a sample of 2,995 Italian university students in the early stages of the pandemic, their research showed that in reference to the four families of coping strategies (Burro et al., 2021) called Despair, Aversion, Proactivity, and Adjustment: (a) university students reacted more frequently using adaptive coping strategies (with Proactivity used more frequently than Adjustment) rather than maladaptive strategies (with Despair higher than Aversion); (b) Agreeableness, Conscientiousness, and Open-Mindedness clearly revealed their protective role; (c) these personality traits were generally significantly related with each of the four families of coping strategies, specifically negatively with Despair and Aversion (albeit with some exceptions, in which the direction of the links was in line with our hypotheses but the relations were not significant) and positively with Proactivity and Adjustment.

Staying within the realm of education and delving into the viewpoint of educators, Duong et al. similarly emphasized the significance of perceived support. The outcomes of their investigation indeed unveiled that the support provided by school leaders played a pivotal role in enhancing the occupational wellbeing of teachers amidst the challenges posed by the COVID-19 pandemic.

In the general population, the perception of positive or negative changes related to COVID-19 also seems to be linked, according to the results of Jurišová et al., to optimism, pessimism, and levels of hope experienced by individuals. David and Truta also found interesting associations between personological characteristics (dedicated type), on the one hand, and personal internal resources (e.g. creativity, playfulness, wellbeing, and personal meaning) and

psychological wellbeing, on the other. According to the authors, in order to promote the psychological and mental health of individuals, it is necessary to provide interventions that elicit meaning, stimulate creativity, and guide people in their search for purpose.

2.3. Distance learning, online environment, and social media

A third line of research includes papers highlighting issues concerning distance learning and the use of social media as information tools. Specifically, the studies on distance learning have primarily focused on evaluating the relationships between, on the one hand, students' abilities to organize and plan learning or to procrastinate, that is, to postpone work on a task (e.g., Muarifah et al.) and, on the other hand, their academic performance (e.g., Xu et al.; Lv et al.) or the perceived quality of learning (e.g., Roberts et al.; Sergi et al.). A meta-analysis conducted by Xu and Xue, examining the views of parents, teachers, and students, showed the prevalence of satisfaction with online education. However, it was observed that the percentage of satisfied students was relatively lower than that of teachers and parents.

As far as social media and more in general online environments are concerned, although some research has highlighted, during the COVID-19 home confinement, the worsening of psychological addiction related to the use of smartphones, especially among adolescents (see, for example, Aydin and Kus), other research has, on the contrary, emphasized the functional use of social media, which can provide a broader access to health information, offer greater opportunities for health surveillance (Kim et al.), and may influence (along with the exposure to other media channels) health behaviors, especially in some older segments of the population (He et al.). Furthermore, other studies have shown how remote engagement provided important mental health support throughout the pandemic lockdown, although with limitations on feelings of social connectedness within online environments (Chapple et al.).

3. Conclusion

As evident from the provided summary, the articles featured in this Research Topic are very different in terms of the aims pursued, the samples under examination, the methodologies employed, and the outcomes observed. It is precisely this diversity that enriches their insights, contributing to drawing an exceptionally comprehensive overview of the pandemic outcomes. Aside from enhancing comprehension of the impacts of the COVID-19 pandemic on individuals' lives, these articles can also have practical implications, contributing to the identification of interventions geared toward enhancing mental wellbeing in the midst of, and following, catastrophic events like the COVID-19 pandemic. Governments should adopt public health policies that take into account not only the physical, but also the psychological, mental, emotional, and relational health of individuals.

Author contributions

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Students' academic procrastination during the COVID-19 pandemic: How does adversity quotient mediate parental social support?

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The COVID-19 has had a widespread impact on all aspects of life. The government has undertaken numerous restrictive attempts to sever the virus transmission chain. In the education sector, one of the attempts is to apply certain learning models. For instance, the online model has been used in place of the face-to-face one across all academic and non-academic services. Educators have faced several obstacles, including academic procrastination. Academic procrastination refers to intentionally putting off working on an assignment, which negatively influences academic achievement. This study aimed to examine the role of parental social support in academic procrastination with the mediation of the adversity quotient. The subjects consisted of 256 state Madrasah Aliyah students in Magelang aged 15–18 years (M = 16.53, SD = 1.009). Data collection employed the academic procrastination scale, parental social support scale, and adversity quotient scale. Data analysis used descriptive statistics and structural equation modeling (SEM) with the aid of the IBM SPSS 23 and AMOS Graphics 26. The research results showed that all variables fell into the medium category. Parental social support had a negative role on academic procrastination and a positive one on adversity quotient. Meanwhile, the adversity quotient had a negative role in academic procrastination and a significant role as a mediator in the relationship between parental social support and academic procrastination. Therefore, parental social support is required to increase students' adversity quotient in suppressing academic procrastination. Special attention from parents to students is thus critical during the COVID-19 pandemic, with the mediation of adversity quotient.

KEYWORDS

adversity quotient (AQ), academic procrastination, COVID-19, school education, parental social support

Introduction

During the COVID-19 pandemic, learning and teaching activities are experiencing systemic alterations from offline to online-based. Nearly all over the world, students face the challenges of independent learning, learning on the computer, and a lack of contact with teachers and peers, thereby demanding sound time management (Pelikan et al., 2021). This learning model is unprecedented in educational systems around the globe, and this is particularly true in Indonesia, where understanding of information technology (IT) has yet to be equal on all lines. The online learning model requires thorough, systematic preparation, but the state of emergency in which it is implemented has spawned a multitude of issues, both academic and non-academic. A frequent issue among them is academic procrastination, which refers to students' purposeful deferment in various academic activities, which is extensively impactful on their future (Wiguna et al., 2020; Pelikan et al., 2021; Tian et al., 2021; Laia et al., 2022). There has been a significant rise in academic procrastination among students (Tezer et al., 2020; Pelikan et al., 2021; Buana et al., 2022), and this phenomenon during the online learning policy is confirmed by previous studies that suggest that online learning is linked to the postponement of completing tasks related to the learning (Steel and Klingsieck, 2016). Students procrastinate although it may lead to negative consequences (Goroshit, 2018). It results in students' low final grades (Kljajic and Gaudreau, 2018). Students put off completing academic work for several reasons, do and submit tasks late, and face difficulties in time management in learning (Laia et al., 2022). If the indiscipline habit is left uncorrected, it will result in a bad mentality for students' psychological development (Zacks and Hen, 2018; Amir et al., 2020; Maqableh and Alia, 2021; Peixoto et al., 2021; Pelikan et al., 2021; Prasetyanto et al., 2022).

Despite realizing that it has negative effects, students still engage in academic procrastination for internal or external reasons. Still, due to the pandemic situation, some teachers consider it normal and understandable. Some factors associated with academic procrastination are weak learning dedication, low learning performance, and poor learning objectives achievement (Tian et al., 2021). Academic procrastination is spurred by certain situations, including task difficulty and low task attractiveness, being compelled to learn autonomously, and unattractive teacher characteristics (Klingsieck, 2013). Students experience difficulties in learning and managing the learning process and lack independence and maturity, thereby finding it difficult to motivate themselves, especially when faced with difficult, lengthy learning tasks (low adversity quotient) (Zacks and Hen, 2018). Other reasons include the unattractive way of delivering materials, difficulty adapting to online learning, connection instability, and extra financial burden to access the Internet (Amir et al., 2020; Maqableh and Alia, 2021; Peixoto et al., 2021; Pelikan et al., 2021; Prasetyanto et al., 2022). In addition, there are issues of ineffectively delivered curriculum and a lack of interaction between teacher and student or between student and student (Mohalik and Sahoo, 2020). Students also have difficulty concentrating when learning, psychological problems, and poor time management (Maqableh and Alia, 2021). They are often confused about completing their tasks because the instructions are hard to understand (Peixoto et al., 2021). Besides, procrastination can also result from laziness in completing the tasks from the teacher and low learning motivation (Pelikan et al., 2021). The following issues are also present: the homework given by the teacher overweight's the assignment given during face-to-face meetings; the intensity of looking at a laptop or handphone screen causes disturbance to health; the conditions at home make it difficult to stay focused; being burdened by other works; vagueness in the teacher's explanation; and difficulty discussing with or asking questions to the teacher (Prasetyanto et al., 2022). Finally, the unattractiveness of the online learning model serves as an important factor in the high degree of procrastination during COVID-19 (Latipah et al., 2021; Prasetyanto et al., 2022).

Following the description above, it is necessary to further scrutiny the students' academic procrastination during the COVID-19 pandemic. However, research among senior high school students in Indonesia is still limited to the non-Islamic-based school (Latipah et al., 2021; Habibi et al., 2022; Irawan and Widyastuti, 2022). Studies showed that 47.2% of senior high school (SMA) students in Temanggung engaged in a medium level of academic procrastination (Latipah et al., 2021), 34.3% of vocational high school (SMK) students in Bojonegoro demonstrated a medium level of academic procrastination (Irawan and Widyastuti, 2022), and 652 or 78.6% state senior high school (SMAN) students in Mojokerto engaged in a medium level of academic procrastination (Habibi et al., 2022). Meanwhile, in Indonesia, Islamic-based senior high schools named Madrasah Aliyah also exist, numbering 9,131 or accounting for 24.6% of all schools at that level (Statistik, 2021; Kementerian Agama, 2022). Madrasah Aliyah (MA) is a public high school with an Islamic character administered by the Department of Religious Affairs (Suhardi, 2019). The curriculum load borne by MA students is higher than that of SMA and SMK students. The public senior high school (SMA) curriculum emphasizes the student's theoretical mastery by providing in-depth general subjects (Putri, 2020). Meanwhile, the vocational high school (SMK) focuses more on students' vocational skills to ensure students' readiness to work in certain work fields (e.g., engineering, cuisine, hospitality, and craft industries, among others) (Putri, 2020). In Islamic high school (MA), students should learn Islamic knowledge, characters, and general knowledge like in SMA (Alawiyah, 2014). This difference poses MA students with issues of greater complexity in online learning during COVID-19 than those faced by non-Islamic-based school students (Latipah et al., 2021). Previous studies revealed that in online learning during COVID-19,

40.4% of students of state Madrasah Aliyyahs in Bengkulu demonstrated a high level of academic procrastination, and 28.6% even did a very high level of procrastination (Buana et al., 2022). These findings contrast with the SMA and SMK cases, where the students' procrastination was within the medium category. Research on procrastination in the Madrasah Aliyah environment during COVID-19 is still minimal. Previous studies have examined the roles of self-efficacy and emotional intelligence on procrastination, but it was only focused on personal factors (Buana et al., 2022).

To enrich the literature on academic procrastination during online learning implementation, this research focused on Madrasah Aliyah. It included external (parental social support) and internal (personal) factors in reducing academic procrastination. Over the course of COVID-19, online learning took place at home. Therefore, parents' involvement during the learning implementation is critical. Moreover, parents are the most prominent and pivotal figures in the provision of resources for children, hence holding a central place in creating social and emotional contexts (Wray-Lake et al., 2022).

Parental social support and academic procrastination in online learning

During COVID-19 in 2021, Indonesia still implemented online learning across all levels, including senior high school. Throughout online learning, students require parental social support for smooth learning, both financially and psychologically, since parents have the primary responsibility for their children's education, including establishing social and emotional communication. However, many parents in Indonesia were found to be faced with psychological, social, and financial problems during COVID-19 (Kaligis et al., 2020; Alam et al., 2021; Anindyajati et al., 2021). Anxiety and stress problems in the family were also emerging (Anindyajati et al., 2021). Various hoaxes have triggered panic and fear (Kaligis et al., 2020). Problems also encompassed family's financial problems caused by the social distancing policy, including decreased income, increased unemployment rate, and difficulty finding a new job, all of which undermined parental social support for children (Alam et al., 2021). Study results revealed that parents with children attending school during the early stage of COVID-19 in Indonesia were suffering from a moderate stress level due to having to allocate time for working from home and assisting their children in studying from home at the same time. Parents were also overwhelmed by their children's assignments, especially mothers whose time was already mostly spent doing household chores and working from home (Susilowati and Azzasyofia, 2020). Thorell et al. (2021) discovered that online learning harmed parents' lives by increased stress levels due to high workloads, fear that their children's academic performance would drop, social isolation, and domestic conflict.

Although many parents encounter a multitude of difficulties that lead to psychological, social, and financial issues, parental social support occupies a core place within a crowded situation, raising students' spirit albeit being under restrictions (Ikeda and Echazarra, 2021; Klootwijk et al., 2021; Maqableh and Alia, 2021). Research results reported a significant increase in parental social support during online learning from face-to-face learning, where parents felt a sense of responsibility for the online learning process (Wray-Lake et al., 2022). Parental social support appropriate to students' needs during online learning may take the following forms: an internet facility, a material device such as a laptop or personal computer, and a home with a conducive environment for the learning (Maqableh and Alia, 2021).

Being related to various learning problems during online learning implementation, parental social support helps overcome academic procrastination optimally. A United States-based education longitudinal study on 15,240 ten graders showed that parents' involvement in their children's education, both at home and in school, had a significant effect on the children's learning success (Benner et al., 2016). Results of another study on 313 upper secondary school students in Turkey showed that social support from the family contributed to academic procrastination (Erzen and Çikrıkci, 2018). Parental social support is pivotal and considerably influential to students' social, psychological, and academic functions (Won and Yu, 2018). It was also reported that 177 United States parents of kindergarten to senior high school-aged children found it difficult to motivate their children to learn online (Garbe et al., 2020). Meanwhile, parental emotional support, such as motivational support, is grievously needed by students (Ikeda and Echazarra, 2021; Klootwijk et al., 2021). A lack of attention and learning motivation from parents for children are among the most responsible for the high level of academic procrastination behavior in online learning (Wulandari et al., 2021).

The effects of parental social support and adversity quotient on academic procrastination

Parental social support affects students' adversity quotient and, subsequently academic procrastination. Parents, who are responsible for their children's education and future, feel called to think about how their children will reach success in learning, so they try to provide their children with social and emotional support well and openly. This support raises the children's motivation and spirit to put an effort to reach success, giving them the strength to take on challenges and hold on in the face of obstacles (Hidayati and Taufik, 2020). Adversity quotient is

how well an individual persists in hardships and turns difficulties into opportunities (Stoltz, 2006). A qualitative study on students from low-income (poor) families and students falling victim to domestic violence or broken homes showed that parents had a strong association with adversity quotient development because the family is a motivator for students' improved endurance (Hidayati and Taufik, 2020). Therefore, parents play an essential role in improving students' adversity quotient. This is supported by the results of a study on 232 first-year students in Makassar, which revealed that parental social support had a role in forming the ability to cope with academic obstacles during the COVID-19 period (Sihotang and Nugraha, 2021). Parental social support may give the children opportunities to make decisions, provide a clear, consistent guide to their expectations and rules, and give the students adaptive and constructive responses to face academic obstacles (Sihotang and Nugraha, 2021).

Adversity quotient is essential for students during COVID-19. Given that during online learning, senior high school students in Indonesia face obstacles and barriers that may influence their learning quality and outcomes (Amir et al., 2020; Prasetyanto et al., 2022). With an adversity quotient, students can take situations under control, take advantage of opportunities, and have higher success chances (Juwita and Usodo, 2020). Research also unveiled that academic procrastination was influenced by the adversity quotient (Tuasikal et al., 2019). It stated that the higher the student's adversity quotient, the lower the procrastination tendency, and the lower the student's adversity quotient, the higher the procrastination tendency (Tuasikal et al., 2019).

Students need an adversity quotient to successfully deal with problems and fulfill their tasks and responsibilities in the online learning Field (Safi'i et al., 2021) and tackle academic issues (Parvathy and Praseeda, 2014). Students with high adversity quotients have a better self-motivation ability. In contrast, those with low adversity quotients will tend to give up and yield easily display pessimism, and exhibit a negative attitude (Stoltz, 2006). Earlier research findings showed that the adversity quotient affected students' ability to adapt to online learning from offline learning, not excluding the ability to access and use online learning to establish a learning standard (Safi'i et al., 2021).

Present study

According to the explanation above, especially in the case of Madrasah Aliyah students, online learning has caused high levels of academic procrastination behavior. Earlier studies have explained that parental social support had a role in adversity quotient and academic procrastination, while adversity quotient had a role in academic procrastination. It can be concluded that parental social support contributes to students' adversity quotient and subsequently affects academic procrastination. Thus far, there is minimal research on the mediating role of adversity quotient in the relationship between parental social support and academic procrastination. Therefore, the goal pursued by this research was to explain how parental social support influences academic procrastination with the mediation of adversity quotient in the case of Madrasah Aliyah students. The hypotheses model of this research is presented in **Figure 1**, while the hypotheses themselves are as follows:

H_1: Parental social support has a negative role in academic procrastination.

H_2: Parental social support has a positive role in the adversity quotient.

H_3: Adversity quotient has a negative role in academic procrastination.

H_4: Adversity quotient has a mediating role in the relationship between parental social support and academic procrastination.

Material and methods

Methods research participants and procedure

As many as 256 students from two Public Madrasah Aliyahs in Magelang aged 15–18 years (M = 16.53, SD = 1.009), consisting of 131 men and 125 women students, participated in this research. The participants were recruited by proportionate random sampling. This research acquired a research permit from Ahmad Dahlan University (F4/387/PS44/D.66/IV/2021) and from schools where this research was conducted. The researchers coordinated

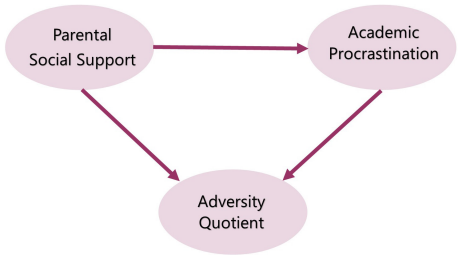

FIGURE 1
Research hypotheses model.

with school counselors to access participants' phone numbers and form a WhatsApp group. Data collection was carried out using the Google Forms application. The researchers provided information on the research and instructions on completing the questionnaire via the WhatsApp group. Participants' informed consent was asked ahead of the Google Forms questionnaire completion. Each participant spent around 15 min collecting the data. This research was conducted in July 2021.

Instruments

The academic procrastination scale was formulated using a 24-item Likert scale about the procrastination signs according to Ferrari Jonson and McCown: students put off starting and finishing a task, students complete a task late, there is a gap between the plan and the actual performance, and students prefer doing a more pleasurable activity (Ferrari et al., 1995). Four answer alternatives were used: SA (strongly agree), A (agree), D (disagree), and SD (strongly disagree). A higher score indicates a higher level of students' procrastination. The academic procrastination scale was deemed valid (chi-square value of 14.58; p = 0.01), reliable (Cronbac's alpha = 0.803), and having a fit model (CFI = 0.983; GFI = 0.73; TLI = 0.948; RMSEA = 0.098).

The parental social support scale was composed of 28 items. It took on the form of a Likert scale that was formulated about the social support aspects according to Sarafino and Smith; emotional support (a. empathy, b. comforting support); companionship support (a. spending time together, b. having a mutually supportive companionship bond); information support (a. receiving suggestions and advice, b. acquiring information); and instrumental support (a. non-material direct aid, b. action direct aid) (Sarafino and Smith, 2014). Four answer alternatives were used, namely SA (strongly agree), A (agree), D (disagree), and SD (strongly disagree). A higher score indicates higher students' perceived parental social support. The parental social support scale was deemed valid (chi-square value of 15.978; p = 0), reliable (Cronbac's alpha = 0.863), and having a fit model (CFI = 0.995; GFI = 0.71; TLI = 0.985; RMSEA = 0.099).

Lastly, the adversity quotient scale was a Likert scale with 22 items. This scale referred to Stolz's dimensions, namely control, ownership, reach, and endurance (Stoltz, 2006). Five alternative responses were provided, namely SA (strongly agree), A (agree), N (neutral), D (disagree), and SD (strongly disagree). A higher score indicates a higher student's adversity quotient. The adversity quotient scale was deemed valid (chi-square value of 6.278; p = 0.043) and reliable (Cronbac's alpha = 0.863), and having a fit model (CFI = 0.998; GFI = 0.989; TLI = 0.994; RMSEA = 0.092).

Data analysis

Statistical-descriptive analysis was employed to gain an overview of each research variable. Structural Equation Modeling (SEM) was applied to assess the mediating role of adversity quotient in the relationship between parental social support and academic procrastination. This technique is commonly used to see the structural relationship between the measured variable and the latent construct by performing a simultaneous analysis like linear regression and path estimates. This study also measured the relationship between each aspect of parental social support and adversity quotient and academic procrastination, and the relationship between each aspect of parental social support and academic procrastination. It was done to identify the aspect with the highest contribution to academic procrastination and adversity quotient. The normality was done as a prerequisite of SEM-based on covariance. The goodness of fit index was evaluated using the following indices: probability, DF, CMIN/DF, GFI, NFI, CFI, IFI, TLI, and RMSEA (Kline, 2015). This research used the IBM SPSS 23 for the descriptive statistical analysis and normality test, and AMOS Graphics 26 for the Structural Equation Modeling.

Results

Variable descriptive data

This research showed that academic procrastination, parental social support, and adversity quotient scores were within the 30–88, 51–103, and 47–85 ranges, respectively. Based on the mean scores and frequency distributions of the variables, most of the participants engaged in a medium level of academic procrastination (69.92%), perceived a medium level of parental social support (66.02%), and had an adversity quotient at the medium level (67.97%). The descriptive data of the variables are provided in **Table 1**, and the frequency distributions of the variables are presented in **Table 2**. Following the Kolmogorov-Smirnov test score and $p \geq 0.05$, the data in this study were normally distributed. The academic Procrastination showed a *Kolmogorov – Smirnov value of* 1.17 with $p = 0.129$. Parental social support showed a *Kolmogorov – Smirnov* score of 1.072 with $p = 0.2$. Adversity quotient showed a *Kolmogorov – Smirnov* of.957 with $p = 0.319$.

Goodness of fit

The overall model fit is presented in **Table 3**. Based on **Table 3**, the Goodness of Fit index showed good fit according to DF, CMIN/DF, GFI, NFI, IFI, and TLI and close fit according to RMSEA. Meanwhile, the sig. Probability demonstrated marginal

TABLE 1 Descriptive data of the variables.

Variable	N	Minimum	Maximum	Mean	SD
Academic procrastination	256	30	88	55.96	8.973
Parental social support	256	51	103	80.24	9.607
Adversity quotient	256	47	85	66.09	6.486

TABLE 2 Frequency distributions of the variables.

Category	Academic procrastination		Parental social support		Adversity quotient	
	Frequency	%	Frequency	%	Frequency	%
Low	43	16.80%	45	17.58%	41	16.02%
Moderate	179	69.92%	169	66.02%	174	67.97%
Hight	34	13.28%	42	16.41%	41	16.02%

TABLE 3 Model goodness of fit test.

No	Goodness of fit index	Cut-off value	Result	Conclusion
1	Sig. Probability	= 0.05	0.011	Marginal Fit
2	Df	> 0	51	Good Fit
3	CMIN/DF	= 2.00	1.508	Good Fit
4	GFI	= 0.90	0.954	Good Fit
5	NFI	= 0.90	0.987	Good Fit
6	CFI	= 0.90	0.996	Good Fit
7	IFI	= 0.90	0.996	Good Fit
8	TLI	= 0.90	0.994	Good Fit
9	RMSEA	= 0.08	0.045	Close Fit

fit, which was still acceptable. Therefore, the model goodness of fit assumption used in this research was accepted.

Hypotheses test

The hypotheses were tested to determine whether parental social support had a direct effect on academic procrastination or whether it had an indirect effect after mediation by adversity quotient. The analysis results are shown in Table 4 and Figure 2. The findings revealed that parental social support had a significant negative role in academic procrastination ($\beta = -0.299$; $p < 0.01$), parental social support had a significant positive role in adversity quotient ($\beta = 0.411$; $p < 0.01$), adversity quotient had a significant negative role in academic procrastination ($\beta = -0.339$; $p < 0.01$), and adversity quotient had a mediating role in the relationship between parental social support and academic procrastination ($\beta = -0.139$; $p < 0.01$). Parental social support had a greater role in academic procrastination after mediation by adversity quotient ($\beta = -0.438$; $p < 0.01$).

This research also showed that every variable aspect had a significant correlation ($p < 0.01$), as seen in Table 5. Parental social support had a significant positive role in each adversity quotient aspect and a significant negative role in each academic procrastination aspect. In contrast, the adversity quotient negatively affected all academic procrastination aspects. Parental social support had the greatest role in the control aspect of the adversity quotient. Parental social support and adversity quotient had the greatest roles in academic procrastination: "putting off starting and completing a task" and "a gap between

TABLE 4 Hypotheses analysis results.

Path	Coefficient (β)	*P*-value
Direct effect		
Parental social support -> Academic procrastination	−0.299	0.000***
Parental social support -> Adversity quotient	0.411	0.000***
Adversity quotient -> Academic procrastination	−0.339	0.000***
Indirect effect		
Parental social support -> Adversity quotient -> Academic procrastination	−0.139	0.000***
Total effect		
Parental social support -> Academic procrastination	−0.438	0.000***

***P < 0.001.

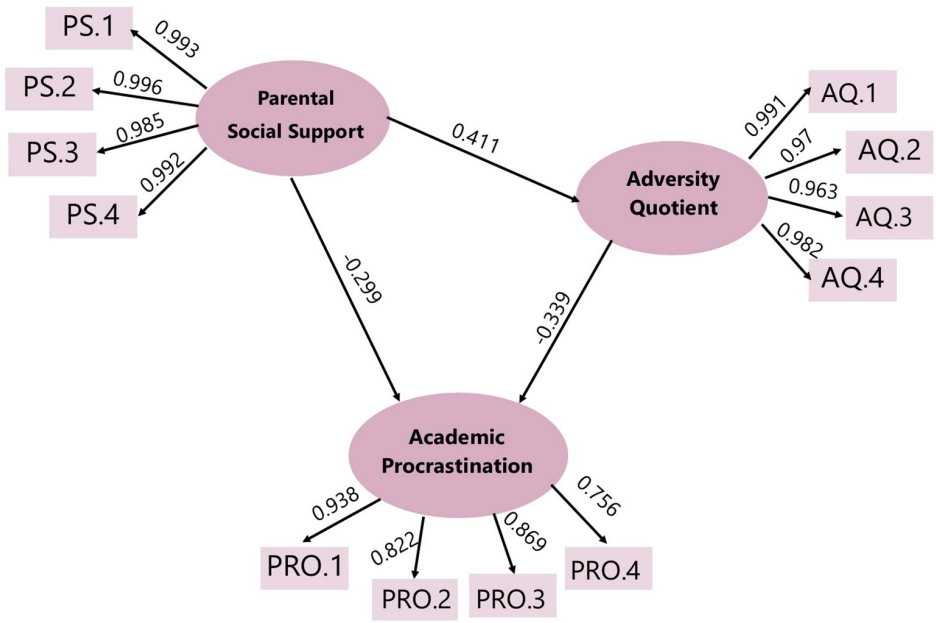

FIGURE 2
Parental social support-adversity quotient-academic procrastination model.

TABLE 5 Correlation between variable aspects.

	PR.1	PR.2	PR.3	PR.4	PS.1	PS.2	PS.3	PS.4	AQ.1	AQ.2	AQ.3	AQ.4
PR.1	1											
PR.2	0.785	1										
PR.3	0.806	0.717	1									
PR.4	0.709	0.556	0.698	1								
PS.1	−0.403	−0.414	−0.402	−0.421	1							
PS.2	−0.374	−0.368	−0.376	−0.384	0.989	1						
PS.3	−0.357	−0.351	−0.352	−0.367	0.978	0.979	1					
PS.4	−0.330	−0.332	−0.331	−0.339	0.982	0.987	0.980	1				
AQ.1	−0.425	−0.361	−0.399	−0.388	0.406	0.406	0.407	0.415	1			
AQ.2	−0.413	−0.346	−0.396	−0.382	0.391	0.389	0.390	0.399	0.97	1		
AQ.3	−0.429	−0.366	−0.408	−0.372	0.396	0.395	0.399	0.401	0.956	0.935	1	
AQ.4	−0.410	−0.348	−0.402	−0.373	0.396	0.393	0.394	0.405	0.972	0.962	0.948	1

$p < 0.01$.
Academic procrastination aspects:
PR.1: Putting off starting or completing a task; PR.2: Completing a task late; PR.3: A gap between the plan and the actual performance; and PR.4: Performing a more pleasurable activity.
Parental social support aspects:
PS.1: Emotional support; PS.2: Companionship Support; PS.3: Information Support; and PS.4: Instrumental support.
Adversity quotient aspects:
AQ.1: Self-regulation; AQ.2: Endurance; AQ.3: Reach; and AQ.4: Ownership.

the plan and the actual performance." The regression test results on the variables' aspects can be seen in Table 6.

Discussion

This research demonstrated that most Madrasah Aliyah participants engaged in academic procrastination during online learning in the COVID-19 pandemic. Meanwhile, previous research found that academic procrastination among state Madrasah Aliyah students in Bengkulu fell into the high category due to minimum knowledge and skills for using learning media, difficulties participating in online learning because of Internet access issues, and, in the case of delays in assignment submission, poor understanding of the materials and concepts delivered by the teacher during online learning

TABLE 6 Results of regression test on the aspects of the variables.

	Coefficient (β)	*P*-value
Parental social support —> Adversity quotient aspects		
Self-regulation	0.407	0.000***
Endurance	0.402	0.000***
Reach	0.396	0.000***
Ownership	0.403	0.000***
Adversity quotient —> Academic procrastination aspects		
Putting off starting and completing a task	−0.318	0.000***
Completing a task late	−0.278	0.000***
A gap between the plan and the actual performance	−0.294	0.000***
Performing a more pleasurable activity	−0.256	0.000***
Parental social support —> Academic procrastination aspects		
Putting off starting and completing a task	−0.411	0.000***
Completing a task late	−0.360	0.000***
A gap between the plan and the actual performance	−0.381	0.000***
Performing a more pleasurable activity	−0.331	0.000***

***$p < 0.001$.

(Buana et al., 2022). This gap might be attributable to the demographic aspect related to Internet access. As reported by UNICEF, only 54.49% of households in Bengkulu Province had Internet access, while in Central Java Province, of which Magelang is part, the figure was 66.73% (UNICEF, 2020). The previously reported limitations in access to affordable Internet services and suitable digital devices have caused it difficult for the larger portion of students to participate in the online learning process (UNICEF, 2020).

These findings were in line with previous studies conducted on SMA and SMK students in the same province this research was conducted, which reported medium levels of academic procrastination (Latipah et al., 2021; Habibi et al., 2022). This portrays that the greater curricular burden borne by MA students than by their SMA and SMK peers in Central Java did not necessarily make the former procrastinate to a greater degree than the latter. A further investigation concerning this matter is thus needed since other factors may also influence it.

The next finding was that most of the students perceived their parents' support to be within the moderate category, suggesting that parental social support for MA students in implementing online learning was fair food. These findings align with previous research, which reported a moderate level of parental social support after an increase from when learning was conducted face-to-face (Wray-Lake et al., 2022). It was also found that most students had a moderate level of adversity quotient and that many were even found to demonstrate a high level of adversity quotient. This depicts that students had a fairly good adversity quotient (Wray-Lake et al., 2022).

This research revealed that parental social support had a negative role in academic procrastination. This explains that the better the parental social support perceived by the students, the lower the academic procrastination. Contrarily, the lower the parental social support was in the students' perception, the higher the academic procrastination level. Pre-pandemic research supported this finding, stating that parental social support could suppress academic procrastination behavior (Erzen and Çikrıkci, 2018). This means that both during and before the COVID-19 pandemic, parental social support played a role in academic procrastination. This result also confirmed that parents held a key role in students' learning process, particularly during COVID-19 (Wray-Lake et al., 2022).

Every aspect of academic procrastination, parental social support, and adversity quotient also demonstrated correlation. Parental social support contributed negatively to all academic procrastination aspects. Parental social support, particularly instrumental support, had the most significant role in the delay in starting or completing a task. Instrumental support refers to providing financial aid, material resources, or necessary services (Murray et al., 2016). The results showed that support in financial aids, devices, and services helped students suppress the rate at which they put off starting and completing a task. This is because, during the online learning process, students need parental social support for smooth learning in terms of material (money to buy Internet quotas), device (laptop or personal computer), and home condition (a conducive environment for learning) (Maqableh and Alia, 2021).

In addition, parental social support was also found to positively contribute to the adversity quotient. This explains that the better the parental social support perceived by students, the higher the adversity quotient, and vice versa. This finding is in parallel with the finding of the qualitative study by Hidayati and Taufik (2020), according to which the social support from the family served as an additional factor in the adversity quotient. It was also supported by another study on first-year students, according to which parental social support had a role in forming the ability to cope with academic obstacles during COVID-19 (Sihotang and Nugraha, 2021). Parental social support promotes students' adaptive and constructive responses to academic challenges field (Sihotang and Nugraha, 2021). Results of a literature review revealed that the support and encouragement from parents in the forms of praises for the child's performance, progress, and efforts, attention to the child's self and their school performance, and provision of a conducive environment and materials for the child's learning predicted the child's academic achievements (Boonk et al., 2018).

According to this study, parental social support had the most considerable contribution to the control aspect of the adversity quotient. This shows that senior high

school students still needed parents' aid in positively controlling their responses to coping with online learning difficulties. Senior high school students are adolescents with a higher degree of independence than in the previous phases and with a need for self-autonomy (Branje et al., 2021). However, this aspect is still in a developmental stage and thus requires support from parents who serve as the primary support system for these senior high school students (Kagitcibasi, 2013). As stated previously, this research also discovered that all parental social support aspects, namely emotional support, companionship support, information support, and instrumental support, were positively correlated with this control aspect of the adversity quotient, with the last of the four demonstrating the highest degree of correlation. This shows that the fulfilling facilities aided students in controlling their constructive responses to online learning difficulties. Previous research stated that students experienced hardships during online learning due to non-conducive home environments, bad Internet connections, and financial burden for purchasing Internet quotas (Amir et al., 2020; Prasetyanto et al., 2022)

The further finding indicated that the adversity quotient negatively contributed to academic procrastination. The higher the adversity quotient of the student, the lower the academic procrastination, and the lower the adversity quotient, the higher the academic procrastination. In other words, the adversity quotient helped students respond to difficulties in online learning positively, hence minimizing academic procrastination behavior. This finding supported earlier research on 218 state Madrasah Aliyah students in Pontianak, Indonesia, according to which adversity quotient influenced students' adaptability from offline to online learning, including in terms of the ability to access and use online learning to establish a learning standard (Safi'i et al., 2021). Students with a higher adversity quotient found it easier to deal with any problems (Parvathy and Praseeda, 2014). It was also in line with the results by Tuasikal et al. (2019), which reported that the adversity quotient had a negative relationship with academic procrastination in students before the COVID-19 pandemic. This explains that the adversity quotient suppresses academic procrastination behavior in students of senior high school or higher educational levels during or before COVID-19.

Adversity quotient was found to have the highest contribution to students' putting off the start and completion of a task. Students with good adversity have a positive perception as they regard difficulties as opportunities (Stoltz, 2006). On the other hand, negative perception in handling tasks will cause students to be inclined toward delaying task completion (Pollack and Herres, 2020). Therefore, the adversity quotient reduces the tendency to put off starting or completing a task. In addition, the reach aspect of the adversity quotient exhibited the strongest correlation with postponing the start or completion of a task. Students with high adversity quotient had reached their problem limits in the event they faced (Stoltz, 2006). They make improvements across various aspects to prevent the problem from affecting other aspects (Juwita and Usodo, 2020). This explains that students who focus on overcoming learning difficulties to minimize academic procrastination tend not to cause any other problems. As discovered in previous works, academic procrastination that is left unresolved may lead to other problems, such as low final grades (Kljajic and Gaudreau, 2018) low learning dedication, low learning performance, and outcomes (Tian et al., 2021), and decreased life satisfaction and increased psychological stress (Peixoto et al., 2021).

This research also demonstrated that the adversity quotient mediates the relationship between parental social support and academic procrastination. This means that students' ability to cope with difficulties could be enhanced by parental social support when they have a high adversity quotient, hence showing a low tendency for academic procrastination. Based on these findings, in conjunction with the existing literature, it is fair to say that parental social support drives the decline in academic procrastination (Erzen and Çikrıkci, 2018) and, at the same time, contribute to the rise in the adversity quotient (Hidayati and Taufik, 2020; Sihotang and Nugraha, 2021). Furthermore, the adversity quotient has a role in students' tendency to engage in academic procrastination (Parvathy and Praseeda, 2014; Safi'i et al., 2021).

The results presented above have several important implications. They contribute to the literature on COVID-19 impacts on students' academic aspects and supporting factors. It was revealed that parental social support affected academic procrastination and adversity quotient. Therefore, it is deemed necessary to pay special attention to the COVID-19 impact on parents, allowing them to provide support for their children optimally. In addition, there were also results showing that the adversity quotient contributed to the relationship between parental social support and academic procrastination. These findings have a key contribution to the academic procrastination literature, given that studies that use adversity quotient as a mediator have thus far been minimal.

This research came with several limitations. Uneven distribution of education facilities throughout Indonesia might have influenced the research results. This study was convened only to subjects in Magelang, and Madrasah Aliyah students in that. Future studies may be conducted at international schools and with the involvement of subjects in a wider area in Indonesia. Other internal and external factors may be examined in greater depth in future works since this study was restricted only to parental social support and adversity quotient. Moreover, descriptive data of parents' situations (e.g., occupation, educational status, and income) had yet to be revealed in this research. Hopefully, future research may explain these data.

Conclusion

This study found that parental social support negatively contributed to academic procrastination and adversity. Meanwhile, the adversity quotient negatively contributed to academic procrastination and mediated the relationship between parental social support and academic procrastination. This research also discovered that each aspect of the variables demonstrated a significant correlation. Finally, both parental social support and adversity quotient could negatively predict every aspect of academic procrastination.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Lembaga Penelitian dan Pengabdian Kepada Masyarakat Universitas Ahmad Dahlan. Written informed consent from the participants or their legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

AM: conceptualization and writing—initial draft preparation. AM, NR, and FO: data curation. MM, ZM, NR, and FO: formal analysis. AM, MM, and ZM: investigation and validation. AM, MM, ZM, and NR: methodology. NR and FO: visualization. AM, MM, ZM, NR, and FO: writing—review and editing. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The relationship between spiritual health and happiness in medical students during the COVID-19 outbreak: A survey in southeastern Iran

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It is necessary to study the various dimensions of health and their affecting factors during the coronavirus disease-19 (COVID-19) pandemic to identify the necessary interventions. The study aims to determine the relationship between spiritual health and happiness in medical students during the COVID-19 outbreak. In this analytical cross-sectional design study, 409 medical students were examined for the state of happiness and spiritual health and the relationship between them. Student information was collected through Web-based sampling by using standard tools from 20 April to 20 June 2020. Medical students completed the demographic questionnaire as well as Oxford Happiness Questionnaire (OHQ) and Paloutzian and Ellison spiritual health questionnaire. The results showed that while the score of spiritual health and happiness was related to factors such as marriage, interest in a field of study, and socioeconomic status, the relationship between spiritual health and happiness was significant (r = 0.72). This study showed that students' happiness scores were not optimal during the COVID-19 pandemic. Due to the strong relationship between spiritual health and happiness scores, spiritual health promotion, in conjunction with other interventions, can be used to improve happiness in this group.

KEYWORDS

COVID-19, happiness, health, spiritual, students

Introduction

According to the World Health Organization's (WHO) definition of health, health is a multidimensional issue in which in addition to the physical, mental and social dimensions, the spiritual aspect is an integral and important part of health and also it should be noted that different dimensions of health are affected by each other

(Chirico, 2016). Spiritual health is so important that studies have shown that without it, other biological, psychological, and social dimensions of health cannot function properly, and thus the highest level of quality of life cannot be achieved (Akbari and Hossaini, 2018). Spiritual health, which consists of two components: religious health (feeling of health and relationship with supernatural power) and existential health (relationship with others and the environment), is manifested by characteristics such as life stability, peace and harmony, a sense of closeness to oneself, a relationship with God, society, and the environment (Ebadi et al., 2017). Despite all the theoretical advances in the field of health, most health promotion programs ignore the spiritual dimension of health and the development of the concept of spiritual health is very slow and has been delayed in the field of health and disease prevention (Abbasian et al., 2016).

Spirituality is another human capability that provides problem-solving and coping strategies, as well as an increased sense of indirect control over events (Shah et al., 2011), and it is an important part of human life (Juškienė, 2016). Spiritual health is defined as a sense of meaning and purpose in life, as well as a connection to a higher power that enables people live better lives (Kamian, 2014). When people voluntarily reinforce their spiritual strengths through prayer, relaxation, communication with like-minded people, and learning from a spiritual guide and study, they achieve spiritual health (Carmody et al., 2008; Razaghi et al., 2019).

When a person's spiritual health is seriously compromised, he or she may experience mental disorders such as loneliness, depression, and loss of meaning in life (Bonelli et al., 2012). Recent studies have shown that religious duties and interests have a significant and positive relationship with human health and longevity (Flannelly and Galek, 2010). Several other studies have also found an association between spirituality, better physical and mental health (VanderWeele et al., 2017). Strengthening one's spiritual health improves one's ability to adapt to changing circumstances. Spirituality also improves a person's outlook on the world (Aramideh et al., 2018). Spirituality improves human mental health by providing social support and increasing self-efficacy and cohesion (Chen and VanderWeele, 2018). Happiness is one of the factors that influence spiritual health (Jalali et al., 2019). Spirituality is one of the most important factors in increasing happiness and public health. Moreover, people with higher religious beliefs have higher levels of happiness and health (Banisi, 2019). Happiness is a positive and pleasant emotional state associated with experiences such as life satisfaction (Varee et al., 2017). Some studies have shown that the spiritual dimension of health has an impact on happiness (Pandya, 2017). People who are unhappy are more likely to suffer from depression, anxiety, and its consequences, and they are more prone to addiction and abnormal social behaviors, as well as having a shorter life expectancy (Hosseini Kasnavieh et al., 2015). Therefore, it is necessary to focus on promoting spiritual health and happiness in youth, and this is especially important in students who are always exposed to a scientific and research environment (Mozafarinia et al., 2014). Iranian students face a lot of stress daily that compromises their mental and physical health. In such cases, spirituality is the only source that can help them (Ebadi et al., 2017) and promoting their spiritual health will play an effective role in improving mental health and coping with mental disorders (Murali et al., 2016).

The COVID-19 is currently causing one of the worst global crises in human history (Wang et al., 2020; Zakeri et al., 2021a). COVID-19 was discovered in China at the end of 2019 and quickly became a pandemic in the world (Rothan and Byrareddy, 2020). COVID-19 has an impact on physical health, individual, society and global psychosocial implications due to the increasing number of cases and deaths (Bo et al., 2020; Wang et al., 2020). With more and more reports, the COVID-19 virus in China has caused public panic and psychological health distress. Other countries are also experiencing COVID-19 problems (Ho et al., 2020). COVID-19 puts a lot of pressure on people, both physically and psychologically, culturally and socially, and has resulted in some behavioral and cultural changes such as home quarantine and social restrictions, in addition to physical problems (Sheivandi and Hasanvand, 2020; Zakeri et al., 2021b). It should be noted that both the epidemic diseases themselves and the strategies used to combat them have had negative psychological effects, and that a lack of attention of researchers to this area can lead to wider psychological damage (Shahyad and Mohammadi, 2020). Critical disease conditions can create new symptoms and disorders such as increased feelings of loneliness, decreased life expectancy, anxiety, and panic and reduced social support, all of which have negative psychological and social consequences that affect the mental health of society in some way (Hossini Rafsanjanipoor et al., 2021; Zakeri et al., 2021c). Several studies have found that the COVID-19 pandemic has had a devastating impact on various aspects of mental health (Olashore et al., 2021; Rajabimajd et al., 2021; Zakeri et al., 2021d). As the outbreak of COVID-19 has had a significant impact on students' lives and academic activities, they are more likely to develop psychological symptoms during the outbreak of COVID-19 (Pramukti et al., 2020; Ahorsu et al., 2021; Nayan et al., 2022). When compared to students in other fields, the prevalence of mental health problems among medical students is constantly increasing (Stewart-Brown et al., 2000). During the outbreak of the COVID-19, many problems have been reported among medical students, such as perceived stress and anxiety (Sharma et al., 2021) and decreased sleep quality (Tahir et al., 2021). The students studying in the medicine-related programs are one of the groups at risk of impaired mental wellbeing, and this group has rarely been studied in terms of side effects such as decreased happiness (Arslan, 2021). Despite these complications, and due to the new nature of this pandemic, there is little information

on how to prevent and control potential complications on people's mental health status (Zakeri et al., 2021b). On the other hand, some studies show that spiritual health, as a meaning-based coping strategy, can be effective in reducing the stress of COVID-19 crisis and its effects on mental health (Arslan and Yıldırım, 2021). Therefore, if the level of happiness is low and is related to spiritual health, solutions can be proposed to increase the feeling of happiness in students, such as programs to promote spiritual health to improve the mental health of students during the COVID-19 pandemic.

In this regard, for better planning in various scientific fields, especially in the field of spiritual health and happiness of any society, happiness research is required (Duncan, 2010) to be aware of the current situation of that society in that field. Considering the importance of this issue and its role in student's lives and their academic success, this study aimed to investigate the levels of spiritual health and happiness, as well as the relationship between them among students in COVID-19 crisis.

Method

Study design and setting

This was a descriptive-analytical study. The research settings were Rafsanjan University of Medical Sciences (RUMS), located at south east of Iran. Presently, the university benefits from four schools admitting students in a wide and varied range of fields of medicine, dentistry, nursing and midwifery, health and allied medical sciences.

Sampling and sample size

The present descriptive study used the multistage random sampling method to evaluate the level of spiritual health and happiness and to determine the relationship between them.

Four faculties participated in the study. In the first stage, two class was randomly selected from the entrance of each field. Then, according to the list of students of each class, about half of the students were selected randomly and their consent to participate in the study was obtained. The inclusion criteria were students from all the semesters who had completed at least 6 months in medical college, students' consent to participate in the study and the absence of a history of unfortunate events such as the death of a loved one or a serious illness in themselves and family members in the previous month. Participants with a history of mental disorders (Self-reported) and incomplete questionnaires were excluded from the study. The sample size was estimated to be 347 individuals using $p = 0.5$ and $\alpha = 0.05$, $r = 0.15$ and the sample size formula, In order to increase the accuracy of the results and due to the possibility of dropping 20% of the samples, 415 people were included in the study, and the information of 409 people who were completely completed was evaluated.

$$N = [\frac{(Z\alpha + Z\beta)}{C}]2 + 3 = 347 \quad (1)$$

Measures

Data were collected with three questionnaires: A: demographic information, B: the Ellison Spiritual Health Questionnaire, and C: the standard OHQ.

Demographic information questionnaire

it includes gender, marital status, economic status of the family, the field of study, interest in the field, housing, and coronavirus symptoms.

Paloutzian and Ellison spiritual health questionnaire

The spiritual health scale of Paloutzian and Ellison (1991) consists of 20 items with three subscales: cognition, emotions, and action. The Paloutzian and Ellison Spiritual Health Questionnaire consists of 20 questions with response scales such as strongly agree, agree, neutral, disagree and strongly disagree on the Likert scale. Each option is assigned a score ranging from 1 to 5. The total score of spiritual health is the sum of the scores of the three dimensions of cognition, action, and emotions, which is between 20 and 100. Its validity and reliability have been confirmed (Alpha coefficient = 0.82) (Rahimi et al., 2014). This questionnaire has also been used by other Iranian researchers, and its reliability has been confirmed (Mozafarinia et al., 2014). In the present study, the Cronbach's alpha for this questionnaire was 0.92.

The Oxford happiness questionnaire

The OHQ with 29 questions was used to measure happiness. The OHQ was developed by Hills and Argyle (Hills and Argyle, 2002). The score range of this questionnaire is between 0 and 87 (each question with a 4-point Likert scale and a score between 0 and 3). The questionnaire is divided into five sections: life satisfaction, self-esteem, actual wellbeing, satisfaction, and positive moods. The reliability and validity of this questionnaire were measured by Alipour and Agah Heris (2007) and the results showed that it had good validity and reliability for measuring happiness in Iranian society. In the study of Jafarzadeh et al. (2015) the reliability coefficient of the scale was 0.84 using

Cronbach's alpha. In the present study, the Cronbach's alpha for this questionnaire was 0.94. According to the cultural diversity, there is no cut-off point for classification. However, according to the maximum score that can be obtained and the average score obtained in order to better understand the subject and according to some similar studies, the happiness score is divided into high, low and moderate.

Data collection

A computer expert assisted in the design of the electronic form of the demographic information questionnaire and other questionnaires. The research team tested and controlled this questionnaire in terms of efficiency and responsiveness. An online questionnaire was tested on 50 medical students to assess the involvement of individuals in completing the questionnaire. Due to the fact that the current research was conducted during the height of the COVID-19 crisis and the red state of COVID-19, it was not possible to complete the questionnaire in person. First, it was explained over the phone about the objectives of the project, the confidentiality of the information, and the questions and possible answers. Then, the students were asked to complete the questionnaires on the Internet within a period of about 10 min. During this period, classes were held virtually. Data were collected from 20 April to 20 June 2020.

Data analysis

Frequency, percentage, mean and standard deviation were used to describe the sample characteristics. Descriptive statistics and one-sample *t*-test, analysis of variance and Pearson correlation were used to measure students' spiritual health and its relationship with happiness. The normality of the data was checked and confirmed. The Kolmogorov-Smirnov test was used to ensure that the data were normal. Due to the quantitative nature of the variables, the Pearson correlation coefficient was used to check their relationship. The data were interpreted using SPSS 20 with a significance level of less than 0.05 was used to interpret the data.

Ethical considerations

The ethics committee of Rafsanjan University of Medical Sciences approved the study protocol (IR.RUMS.REC.1399.104). An informed consent form was placed at the

TABLE 1 Demographic variables of students and comparison of mean and standard deviation of happiness score and spiritual health in the study population (n = 409).

Variables	Frequency (valid percent)	Mean of spiritual health	*P*-value	Mean of happiness
Gender				
Man	116 (28.36)	72.98 ± 14.01	0.17	35.02 ± 17.39
Female	293 (71.63)	74.82 ± 11.85		33.82 ± 17.48
Marital status				
Married	58 (14.1)	81.87 ± 9.40	$P < 0001$*	43.86 ± 18.29
Single	351 (85.4)	73.05 ± 12.53		32.56 ± 16.79
Residence				
Native students	141 (34.8)	75.13 ± 12.78	0.32	36.81 ± 18.48
Non-native students	266 (64.7)	73.85 ± 12.37		32.73 ± 16.72
College				
Medicine	100 (24.3)	73.2 ± 13.2	0.14	38.32 ± 17
Paramedical	83 (20.2)	76.46 ± 12.9		35.20 ± 16.14
Nursing	73 (17.8)	72.8 ± 14.8		35.65 ± 18.24
Health	104 (25.3)	75.2 ± 11.57		34.08 ± 17.80
Dentistry	36 (8.8)	75.86 ± 12.04		33.00 ± 17.37
The economic situation				
Weak	27 (6.6)	67.96 ± 15.03	0.002*	26.55 ± 16.47
Medium	361 (87.8)	74.41 ± 12.14		34.16 ± 17.03
Good	21 (5.1)	80.52 ± 12.33		44.00 ± 21.25
Interest in the field of study (Medicine)				
Low	28 (6.8)	66.75 ± 13.40	$P < 0001$*	26.39 ± 15.52
Medium	176 (42.8)	71.73 ± 12.39		29.64 ± 14.65
High	205 (49.9)	77.54 ± 11.56		39.10 ± 18.49

* Significance level less than 0.05.

beginning of the electronic form. The objectives of the study, the confidentiality and anonymity of the information were explained in it.

Result

The study included 409 students aged between 18 and 31 years old, with the mean age of 21.6 ± 2.3. The majority of the students were female (n = 293, 71.3%). Most of the students were health students (n = 104, 25.3%) with a medium socioeconomic status (n = 361, 87.8%). Only 11 participants (2.7%) reported COVID-19 symptoms during the study, and 59 patients (13.9%) reported COVID-19 symptoms in their close relatives. Table 1 shows the demographic characteristics of the students.

The mean score of spiritual health among students was 74.30 ± 12.51. Table 2 shows spiritual health scores and its dimensions in terms of demographic factors. The mean score of happiness among students was 34.16 ± 17.44. Table 1 indicates the happiness score and its dimensions in terms of demographic characteristics. Although spiritual health (p = 0.17) and happiness were not significantly different between the two genders (p = 0.53), happiness scores were significantly different according to marital status (p < 0001), housing (p = 0.024), economic status (p = 0.003) and interest in the field of study (p < 0001). Spiritual health scores were significantly different according to marital status (p < 0001), economic status (p = 0.002) and interest in the field of study (p < 0001) (Table 1).

The results of the correlation coefficient test showed that there was a statistically significant and positive relationship between students' spiritual health score and happiness, as the score of spiritual health increases, so does the score of happiness. The results also showed a statistically significant relationship between all dimensions of spiritual health and happiness, although the strength of this relationship was variable (Table 3).

Multiple regression models were tested to explore how demographic variables, spiritual health, and happiness can all be used to predict spiritual health and happiness. As shown in Table 4, happiness, marital status, interest in the field and economic status of the family all predict 53% of the variance of spiritual health (R^2 = 53%), with happiness being the best predictor (p < 0.001). Spiritual health, gender, interest in the field and housing all predict 53% of the variance in happiness (R^2 = 53%), with spiritual health being the best predictor (p < 0.001).

TABLE 2 Mean and standard deviation of students' spiritual health and happiness dimensions (n = 409).

Dimensions	Mean and standard deviation	Range
Cognitive dimension (SH)	23.98 ± 4.14	6–30
Emotions domain (SH)	30.83 ± 6.36	9–45
Action dimension (SH)	19.48 ± 3.46	5–25
Spiritual Health	74.30 ± 12.51	27–100
Life satisfaction (H)	10.50 ± 5.27	0–32
Self-esteem (H)	7.74 ± 4.87	0–28
Subjective wellbeing (H)	4.06 ± 3.45	0–20
Self –Satisfaction (H)	5.50 ± 2.71	0–16
Positive mood (H)	6.37 ± 3.36	0–20
Happiness	34.16 ± 17.44	0–85

SH, spiritual health; H, happiness.

Discussion

This study aimed to evaluate the state of happiness and its determinants in students during the coronavirus epidemic. The results of the happiness study showed that the happiness score was low in this group. In different studies conducted on medical students in recent years to assess happiness, the mean happiness score ranged from 42.6 to 46.7 and was at a moderate level (Jouybari et al., 2017; Sadeghi et al., 2019). In this regard, the results of current study have been different from those of many other studies that have examined happiness in students, even though the mean score of happiness in medical students in the Sahraian study was higher than in the present study (Sahraian and Vakili, 2012). According to Kamthan et al. (2019), 60.8% of medical students were in the happiness group, and the happy population was made up of people who scored high on the happiness scale. To explain this difference, it should be noted that in the present study, happiness was measured during the coronavirus epidemic. Decreased emotional satisfaction and happiness can be expected because of the severity and scope of the coronavirus crisis. In this regard, studies conducted during the COVID-19 crisis revealed that the epidemic had a significant impact on emotional satisfaction and happiness. According to Yang and Ma (2020) the onset of coronavirus disease in China led to a 74% reduction in the feeling of living happily. Furthermore, Brodeur et al. (2020) showed that the COVID-19 epidemic had a negative effect on wellbeing and mental health and increased the feeling of sadness.

Therefore, it seems that students' happiness and mental health will suffer as a result of their fear of COVID-19. Numerous studies have suggested that the COVID-19 crisis is responsible for psychological disorders (Holmes et al., 2020; Hossini Rafsanjanipoor et al., 2021; Zakeri et al., 2021e). Some studies also showed that happiness, in addition to having a positive effect on physical and mental health, has a negative effect on students' academic achievement (Tabbodi et al., 2015). Therefore, strategies to raise the level of hope for the future and increase the feeling of happiness will be helpful in this situation. There are, of course, studies that show that some societies, even during COVID-19 crisis, cited high happiness, which could be due to the difference in the happiness level in different societies (Paz et al., 2022).

TABLE 3 Correlation coefficient of spiritual health and happiness dimensions in students (*n* = 409).

Variable	1	2	3	4	5	6	7	8	9
1–Cognition (SH)	1								
2–Emotions (SH)	0.69**	1							
3–Action (SH)	0.67**	0.70**	1						
4–Total spiritual health	0.87**	0.93**	0.85**	1					
5–Life Satisfaction (H)	0.60**	0.81**	0.60**	0.77**	1				
6–self- esteem (H)	0.45**	0.67**	0.49**	0.63**	0.79**	1			
7–Subjective wellbeing (H)	0.34**	0.55**	0.41**	0.51**	0.67**	0.78**	1		
8–Self-Satisfaction (H)	0.51**	0.62**	0.48**	0.62**	0.71**	0.72**	0.67**	1	
9–Positive mood (H)	0.45**	0.60**	0.48**	0.59**	0.72**	0.73**	0.68**	0.71**	1
10–Total happiness	0.54**	0.75**	0.57**	**0.72****	0.77**	0.63**	0.51**	0.62**	0.59**

SH, spiritual health; H, happiness. ** Significance level less than 0.001.

TABLE 4 Multiple regression analysis summary for underlying variables of spiritual health and happiness among students (*n* = 409).

Variable		β	P	95% CI Lower	95% CI Upper	R^2
Spiritual health	Constant	–	<0.001	42.43	54.36	53%
	Happiness	0.66	<0.001	0.42	0.53	
	Marital status	0.09	0.008	0.84	5.75	
	Interest in the field	0.08	0.017	0.30	3.10	
	Economic status of the family	0.06	0.049	0.00	4.96	
Happiness	Constant	–	<0.001	−56.56	−40.43	53%
	Spiritual health	0.70	<0.001	0.88	1.07	
	Gender	0.07	0.020	0.48	5.63	
	Interest in the field	0.07	0.030	0.21	4.11	
	Housing	0.07	0.028	0.29	5.16	

Data were presented as multiple regression analysis. Only significant results were shown. CI, Confidence intervals for B.

In the present study, the lowest score in the domain of happiness was related to the dimension of actual wellbeing and the highest score was related to satisfaction, which is consistent with the study of Mozafarinia et al. (2014). Daily activity restrictions seem to cause students to report low levels of vitality and happiness. Happiness was not significantly different between the two sexes in this study, but marriage, interest in the field of study, appropriate economic level and indigenousness were all positively associated with happiness. In line with the present study, some previous studies have shown no relationship between happiness and gender (Siamian et al., 2012).

Some studies have reported contradictory results. Calderon et al. (2019) showed that female students had higher happiness scores. This difference could be attributed to a variety of factors. Studies on students show the effect of social and economic factors on happiness. Furthermore, some studies show the effects of cultural diversity on happiness (Tuntiwarodom and Potipiti, 2008). Therefore, these differences may affect the difference in happiness between the two sexes in different studies.

In the present study, the level of spiritual health was moderate, which is consistent with many studies conducted on students (Dastgheib et al., 2015). In the present study, there was no difference in spiritual health scores between the sexes, while married students had better spiritual health. Although some studies, such as the Abbasi study, found no significant relationship between demographic variables and spiritual health (Abbasi et al., 2014), other studies have found that spiritual health is higher in female students (Tavan et al., 2015; Hasanshahi et al., 2016), which contradicts with the results of the present study. Although the score of spiritual health was higher in females, there was no statistically significant difference. Perhaps, the different conditions of the study and the existence of the COVID-19 disease crisis can be mentioned in justifying this difference, and more studies on spiritual health in crisis in both sexes are suggested. In the present study, the emotional domain of spiritual health received a higher score, which is consistent with the study of Ebadi et al. (2017).

The main purpose of this study was to investigate the relationship between spiritual health and happiness. The results of this study showed a relationship between all dimensions of spiritual health and happiness. Some research shows a positive relationship between religiosity and spirituality and various

aspects of wellbeing, including physical health, mental health, life satisfaction and happiness (VanderWeele, 2017).

The results of this study are consistent with the results of other studies in this field (Mozafarinia et al., 2014; Arani and Hamzeei, 2018). However, the correlation between spiritual health and happiness scores was higher in current study. Perhaps the higher coefficient can be justified by pointing out that the level of happiness is lower in the conditions of COVID-19 disease and according to Islamic culture, more emphasis is placed on spirituality to create calmness and cure in the conditions of COVID-19 disease. Numerous studies have emphasized the importance of promoting spiritual health during the crisis of COVID-19 disease in various ways (Koenig, 2020; Rathakrishnan et al., 2021). A study conducted in the faith community of United States during COVID-19 pandemic showed that the decline in religious activities was associated with a decrease in happiness in this group (Jacobi et al., 2022).

Spiritual health improves human mental health by providing social support and increasing self-efficacy and cohesion (George et al., 2002). Some studies have shown that promoting spiritual health can improve students' sense of pleasure, happiness and mental health (Ahmadi foroushani et al., 2013). On the other hand, Some studies show that in the pandemic crisis, some parts of spiritual health, including the participation in social religious activities, are faced with challenges (VanderWeele et al., 2016).

However, there are conflicting studies in this field, such as the study of Ahmadi Foroushani and Yazd khasti (2013) which found no significant relationship between religious beliefs, depression and mental health. To justify this difference, it is worth noting that both religious and spiritual dimensions of spiritual health were measured in our study, while Ahmadi's study only looked at religious beliefs and practices (Ahmadi Foroushani and Yazd khasti, 2013). However, according to the results of the present study and most studies conducted in this field, it seems that by emphasizing the promotion of spiritual health as one of the methods to improve peace, reduce frustration and increase happiness and joy in students, steps were taken in this stressful conditions for the community and medical students, who are responsible for promoting the community health. According to some studies, the strategy of spirituality was a practical and appropriate solution to resolve students' anxiety (Chaves et al., 2015).

As mentioned, during the COVID-19 epidemic, students' happiness has decreased and spiritual health was related to happiness. Meanwhile, happiness and spiritual health can affect mental health. Numerous studies show that spirituality and religiosity are correlated through behavioral, psychological, physiological and social factors that can affect people's mental health. From a behavioral perspective, people with higher spirituality and religiosity are often committed to a healthier physical and mental lifestyle. All of them are directly related to happiness through controlling your mind (Amirian and Fazilat-Pour, 2016; Zimmer et al., 2016; Dehghan et al., 2021a). People in cultural and religious fields are happy and hope for a heavenly life. Because spirituality and religiosity help them to overcome adversities and tensions throughout life (Dehghan et al., 2021b). Participating in religious practices and paying attention to spirituality can be a means to relax people, which can promote mental health outcomes such as happiness (Leung and Pong, 2021). From a social perspective, frequent attendance at religious services positively affects happiness. Because it can lead to more social support by increasing intimacy and communication with others (Childs, 2010; Amirian and Fazilat-Pour, 2016), and make people happy and improve people's mental health. Finally, more studies are needed to better understand the mechanisms that link happiness and spirituality to people's mental health.

As this is one of the first studies to examine happiness in the COVID-19 disease, these results can be used to help plan for better health in various dimensions. However, this study had some limitations, including the fact that due to lack of access to students, questionnaires were completed virtually, which may have affected the accuracy of completion. It also seems that designing a native tool based on Islamic beliefs to measure spiritual health can create more accurate results regarding students' spiritual health status. However, it is suggested that more reliable tools be used in future studies to evaluate happiness. In the present study, students participated from different disciplines. Although it was tried to avoid selection biases by random selection as much as possible, given that a number of disciplines were less participated, the results may not be generalized to all students.

Conclusion

The results of this study showed that during the COVID-19 epidemic, happiness scores of students were low in general and across all dimensions. The results of the correlation test showed a positive relationship between spiritual health score and happiness dimensions.

According to the results of the present study and some similar studies, it seems that steps can be taken to improve the level of happiness in students by strengthening the dimensions of spiritual health during crises such as COVID-19. Additional interventional studies are suggested in this field.

Data availability statement

The original contributions presented in this study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the Rafsanjan University of Medical Sciences. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MA, MM, and SL: concept and design. MM and SL: data collection. MA and MZ: drafting of the manuscript, critical revision of the manuscript, and statistical analysis. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Predictors of psychological and physiological measures of graduate student health during COVID-19

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Introduction: The COVID-19 pandemic brought on higher-than-normal levels of anxiety and depression, especially among graduate students whose academic trajectory was disrupted. However, not all graduate students were affected and therefore, it is important to identify potential protective factors.

Method: We recruited 61 graduate students whose research was directly impacted by the pandemic and examined their change in academic stressors since the onset of the pandemic. Hierarchical regression analyses were used to evaluate how perceived academic stressors brought on by the COVID-19 pandemic impacted anxiety, depression, and heart rate variability (HRV), and whether physical activity and trait resiliency independently buffered against the effects of stress.

Results: Graduate students who reported greater changes in academic stressors since the onset for the pandemic were more anxious and depressed. Moderate-intensity physical activity explained significant variance in anxiety whereas resiliency explained significant variance in both anxiety and depression. HRV was higher in males than females, aligning with sex differences in vulnerability to stress and mental illness.

Conclusion: Overall, the results suggest that resiliency and physical activity may offer unique protection against symptoms of anxiety and depression in graduate students experiencing increased academic stress during COVID-19. Institutions of higher education should consider investing in programs that encourage physical activity and promote resiliency by teaching mindfulness, stress management, and cognitive behavioral approaches.

KEYWORDS

mental health, COVID-19, graduate student, physical activity, resiliency, heart rate variability (HRV)

Introduction

Although globally, the pandemic caused rates of anxiety and depression to increase by over thirty percent (Xiong et al., 2020), graduate students and other young to middle aged adults may have been disproportionally affected (Varma et al., 2021). Under normal circumstances, young to middle aged adults are at a particularly high risk of experiencing onset of mental illness. The majority of mental disorders onset during early to middle adulthood, with a median range of 25 to 53 years old for anxiety disorders and 25 to 45 years old for other mood disorders (Kessler et al., 2007). Furthermore, onset of mental illness is often triggered by stressful life events (McLaughlin et al., 2010). Graduate students whose median age at graduation ranges from 28 to 32 years (Statistics Canada, 2019), have reported higher-than-normal levels of anxiety and depression during the pandemic because of the uncertainty surrounding their academic trajectory, environmental changes, and disruption to laboratory-based research (Chirikov et al., 2020; Suart et al., 2021). These stressors may be especially present among students in human and health sciences, where research often involves in-person data collection which was directly impacted by lockdown protocols (Suart et al., 2021). Canada's response to the pandemic included widespread closure of green spaces, national parks, recreational facilities, gyms, and dance studios, which negatively impacted physical activity participation and mental health (Marashi et al., 2021). It is important to understand how we can support the mental health of graduate students now and in the aftermath of the pandemic. The current study sought to examine the protective effects of physical activity and trait resiliency (Jacob et al., 2020; Rogowska et al., 2020; Kavčič et al., 2021; Marashi et al., 2021).

Regular engagement in moderate-to-vigorous physical activity (MVPA) has been shown to reduce the risk of stress-induced mental illness (Gerber and Pühse, 2009). Moderate intensity activity can be described as physical activity that is performed at 40-59% of heart rate reserve (HRR; max HR-rest HR) or at a rated perceived exertion (RPE) of five to six on a ten-point scale. Examples of moderate intensity activity include brisk walking, dancing, and raking the yard (MacIntosh et al., 2021). Vigorous intensity exercise can be described as physical activity that is performed at 60-84% of HRR or at a RPE of seven to eight on a ten-point scale. Examples of vigorous intensity exercise include jogging, running, carrying heavy loads upstairs, or participating in a strenuous fitness class (MacIntosh et al., 2021). A key physiological change induced by regular MVPA is increased cardiorespiratory fitness. Higher fit individuals tend to be less prone to anxiety and depression (Kandola et al., 2019), and the protective effects of cardiorespiratory fitness against depression seem to be stronger for groups experiencing higher perceived stress (Gerber et al., 2013). Cardiorespiratory fitness also correlates with heart rate variability (HRV), an index of autonomic nervous system functioning, and it may be through improved HRV that regular engagement in MVPA protects one against stress-induced mental illness (Levy et al., 1998; Sandercock et al., 2005; Hallman et al., 2017). HRV, defined as the beat-to-beat variability of the heart measured over time (McCraty and Shaffer, 2015), is influenced by the dynamic interaction between the two branches of the autonomic nervous system (McCorry, 2007). Resting HRV has been identified as an important biomarker of autonomic flexibility in response to environmental stressors (Mulcahy et al., 2019), and when higher fit individuals experience a stressor, they exhibit higher HRV than their untrained peers, indicating less stress reactivity (Klaperski et al., 2014; von Haaren et al., 2016).

Trait resiliency can be conceptualized as the ability to rebound from a stressful event (Luthar et al., 2000), and as with physical activity, is predictive of better mental health outcomes and less stress reactivity in response to stressful events (Souza et al., 2007). Perhaps, not surprising, people with higher cardiorespiratory fitness also tend to score higher on measures of trait resiliency (Silverman and Deuster, 2014), which begs the question: how uniquely related are physical activity and trait resiliency to a graduate student's stress response? Characterizing the unique contribution of physical activity and trait resiliency to graduate student well-being is critical for identifying intervention strategies during and post-pandemic.

Considering the paucity of research exploring the impact of COVID-19 on the mental and physical health of graduate students, the objective of the current study was to explore changes in perceived academic stressors brought on by the COVID-19 pandemic. We expected that increases in perceived stress would predict higher symptoms of anxiety and depression, and lower HRV. A second objective of the study was to test whether physical activity and trait resiliency buffered the effect of stress and to quantify the unique variance captured by each.

Materials and methods

The study followed a cross-sectional design. All participants were provided with an information sheet outlining the study protocol and were instructed to complete each step as follows. Participants filled out an online questionnaire using the platform LimeSurvey. Resting heart rate and HRV were measured each morning for one week using a mobile application. All steps were done asynchronously and unsupervised.

Participants

Based on prior research (Chalmers et al., 2014; Papasavvas et al., 2016), a small-to-moderate effect size was expected (Cohen's f = 0.20) and a total of approximately 67 participants

would be required, as estimated by G*Power (Faul et al., 2007) with β = 0.90; α = 0.05. Participants were recruited through social media advertisements (Twitter, Facebook, Instagram, Reddit) and by email to graduate student associations across Canada.

Participants were eligible if they were 18 years of age or older, currently enrolled in full-time studies in a thesis-based graduate degree program and could confirm that their research efforts had been affected by COVID-19 restrictions such that they experienced significant disruption and/or delay to their research program. To hone in on the unique experience of thesis-based graduate studies, professional and non-research based students were deemed ineligible. Participants were recruited and participated in the study between the period of November 2020 and April 2021 during which Canadian residents were facing the second and third waves of the COVID-19 pandemic, which included extensive closures. Additionally, to control for the effect of confounding variables, participants were required to confirm that they were free from diagnosis of diabetes type 1 or 2, cardiovascular or cerebrovascular disease, infectious disease, or acute illness; that they were non-smokers, had a BMI of 35 or less, were not taking prescription drugs to treat anxiety, depression, or blood pressure, and were not currently using illicit drugs. The fulfilment of these criteria was confirmed verbally over the phone. This study received ethics clearance from McMaster Research Ethics Board (MREB #5100). Written informed consent for participation was required for this study in accordance with the national legislation and the institutional requirements. Participants were compensated $25 CAD for their participation.

Materials

Questionnaires

The online survey collected demographic information on the participants including biological sex, gender, age, faculty of study, and income. The survey also included the following questionnaires.

Change in academic stress

Change in perceived stress related to academics since the onset of the COVID-19 pandemic was measured using an adapted version of the Graduate Stress Inventory-Revised (GSI-R) (Rocha-Singh, 1994). Its items are categorized into three domains of graduate student experience: (1) university environment, (2) academic and professional responsibilities, and (3) financial and familial responsibilities. Normally, the GSI-R is rated on a "not at all stressful" to "extremely stressful" 7-point Likert scale. Given the unprecedented circumstances, there were no existing psychometric tools designed to measure the impact of COVID-19 on graduate-school-related stress. Therefore, in the current study, we adapted the GSI-R to capture a *difference* in perceived stress from 6-months prior to COVID-19 to the onset of COVID-19. Specifically, participants were asked to rate how much stress they have perceived in "*. . .relation to the following events encountered in graduate school since the onset of COVID-19 relative to 6-months prior to COVID-19*". Responses included "much less" (−2), "less" (−1), "the same" (0), "more" (+ 1) and "much more" (+ 2). Item scores were summed for a maximum of 50 and minimum of −50. In the current study sample, Cronbach's α = 0.87, indicating good internal consistency (George and Mallery, 2019).

Anxiety

Anxiety was measured using the Generalized Anxiety Disorder 7-item (GAD-7) Scale (Spitzer et al., 2006). The GAD-7 is a validated tool used to measure anxiety symptoms associated with generalized anxiety disorder (GAD) and asks participants to score each of the seven DSM-IV criteria of GAD, on a scale from 0 to 3 (0 = *not at all*, 3 = *nearly every day*). Item scores were summed for a maximum score of 21 (none/minimal, 0-4; mild, 5-9; moderate, 10-14; severe, 15-21; Spitzer et al., 2006). In the current study sample, Cronbach's α = 0.91, indicating excellent internal consistency (George and Mallery, 2019).

Depression

Depression was measured using a modified version of the Patient Health Questionnaire-9 (PHQ-9) (Gilbody et al., 2007). The PHQ-9 is a validated tool used to monitor depressive symptoms and asks participants to score each of the nine DSM-IV criteria of Major Depressive Disorder (MDD), on a scale from 0 to 3 (0 = *not at all,* 3 = *nearly every day*; Gilbody et al., 2007). Due to concerns surrounding disclosure of sensitive information, the ninth item regarding suicidal thoughts and self-harm was omitted. Item scores were summed for a maximum score of 24 (none/minimal, 0-4; mild, 5-9; moderate, 10-14; moderately severe, 15-19; severe, 20-24). In the current study sample, Cronbach's α = 0.85, indicating good internal consistency (George and Mallery, 2019).

Resiliency

Resiliency was operationalized using the 14-item Resilience Scale (RS-14) (Wagnild, 2009). The RS-14 measures five characteristics of resiliency: (1) purpose, (2) perseverance, (3) equanimity, (4) self-reliance, and (5) existential aloneness (Wagnild, 2009). The RS–14 employs a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*). Item scores were summed for a maximal score of 98 (low, < 64; moderate, 65-81; moderately high, 82-90; high, > 90). In the current study sample, Cronbach's α = 0.88, indicating good internal consistency (George and Mallery, 2019).

Physical activity

Self-reported physical activity and sedentary behavior was measured using the International Physical Activity

Questionnaire (IPAQ) (Wanner et al., 2016). Specifically, participants were asked to denote the number of minutes per week that they typically engage in moderate physical activity (e.g., carrying light loads or bicycling at a regular pace) and vigorous physical activity (e.g., heavy lifting, digging, aerobics or fast bicycling). Minutes per week of total MVPA as well as moderate physical activity and vigorous physical activity were calculated.

Heart rate variability

HRV is typically measured using an electrocardiogram (ECG); however, readily accessible measurements using smartphone photoplethysmography (PPG) (Dobbs et al., 2019) show acceptable agreement with gold standard measures (Plews et al., 2017). In our study, HRV was measured using the mobile application, HRV4Training (HRV4T)[1]. HRV4T is a validated tool that utilizes photoplethysmography to detect volumetric changes in blood peripheral circulation by illuminating the skin and measuring changes in light absorption. The mobile application calculates the time difference between successive heart beats in milliseconds and automatically computes the root mean square of successive differences between R-R intervals (rMSSD) by squaring each data point, computing the average of those squared data points, and taking the square root of that average (Shaffer and Ginsberg, 2017). Although no measure of HRV is known to clearly indicate sympathetic activity, both rMSSD and high frequency (HF) HRV are shown to reflect parasympathetic activity (Thayer and Lane, 2000; Kleiger et al., 2005). We used rMSSD because it is relatively free of respiratory influences (Hill et al., 2009) and is shown to be the most accurate index in the context of short-term R-R interval readings (i.e., 5 min or less) (Munoz et al., 2015).

Participants used the HRV4T application to calculate rMSSD by placing their index finger over their smartphone's camera and LED flash for a five-minute reading. They did this upon waking, while lying in a supine position and breathing normally, for seven consecutive days and the average rMSSD reading across those seven days was used in the analysis. To mitigate issues related to accuracy of readings, participants were instructed to ensure that their daily HRV reading was deemed "Optimal" by the application before it was stored. An "Optimal" reading is defined by the application developers as being "...clean with either no ectopic beats or issues due to motion artifacts or a very limited amount of noise that could be dealt with by our artifact removal algorithms[1]". "Optimal" readings were confirmed by the researcher during data export. At the end of the week, participants forwarded their heart rate and HRV data directly from the HRV4T application to the researcher.

1 https://www.hrv4training.com/

Statistical analysis

Data were analyzed using IBM SPSS (Version 26). Descriptive statistics were computed for all study variables. Normality was assessed using visual inspection of histograms, and skewness and kurtosis based on recommendations by Kim (2013). Missing values were analyzed for pattern of missing data using Little's MCAR test. For all statistical analyses, a p value (2-tailed) < 0.05 was considered significant.

Sex differences in demographics were assessed with parametric and non-parametric t tests. Bivariate correlations were conducted for all study variables examined in the main analyses.

Separate hierarchical regression analyses were conducted for anxiety, depression, and HRV to first determine how changes in perceived academic stress affected mental health and to then determine the independent contribution of physical activity (moderate and vigorous) and trait resiliency. Age and biological sex were included as covariates.

Multicollinearity was assessed using tolerance and variance inflation factor (VIF). Homogeneity of variance and normality of residuals were assessed by plotting residuals against the predicted values. Independence of residuals was assessed using the Durbin-Watson test. In step 1, age and biological sex (coded: 0 = males; 1 = females) were entered to control for the age-related depletion of HRV as well as the established differences between males and females for anxiety and depression (Gater et al., 1998) and perceived stress (Brougham et al., 2009). In step 2, change in perceived academic stressors was entered, and in step 3, trait resiliency, moderate physical activity, and vigorous physical activity were entered stepwise.

Results

Data screening and assumptions

Sixty-eight participants were recruited for the study, five participants did not submit their data or follow up with emails, and therefore, 63 participants completed the entire protocol. Two participants were removed from analyses: one withdrew their data, and the other withdrew because of a family emergency. The final sample consisted of 61 participants.

Data were screened for missing data; 0.5% was missing (BMI, $n = 2$; Year of Study $n = 1$; Income Since COVID, $n = 2$; Income Pre COVID, $n = 2$). The pattern of missingness was missing completely at random (MCAR), according to Little's MCAR test. Therefore, no replacement strategy was employed, and listwise deletion was used for missing values. Dependent variables (anxiety and depression) had skewness and kurtosis within an acceptable range and all assumptions for linear regression were met (Field, 2013).

Demographics

The demographics are presented in Tables 1, 2, and bivariate Spearman correlations for main study variables are displayed in Table 3. Participants were graduate students between the ages of 22 and 46 years with a mean age of 28.2 years. All females identifying as women and all males identifying as men. Most participants were domestic students (92%) enrolled in a kinesiology (47.5%), Psychology (21.3%), or Health Science (11.5%) program and rated their current financial status as "*earning just enough*" (45.8%) or "*earning more than enough*" (45.8%). Therefore, it was a relatively homogenous sample.

TABLE 1 Means and frequencies of descriptive statistics in study sample.

Variable	
Age	28.2 (4.6)
Biological sex	
Female	43 (70%)
Male	18 (30%)
Domestic/International	
Domestic	55 (92%)
International outside United States	3 (5%)
International from United States	2 (3%)
Faculty	
Kinesiology	29 (47.4%)
Psychology	13 (21.3%)
Health Science	7 (11.5%)
Physical/Life Science	3 (4.9%)
Political Science	3 (4.9%)
Arts/Humanities	2 (3.3%)
Business	1 (1.6%)
Education	1 (1.6%)
Forestry	1 (1.6%)
Social Work	1 (1.6%)
Year of study	3.8 (2.3)
Income since COVID	
> Enough	27 (45.8%)
Just enough	27 (45.8%)
< Enough	5 (8.2%)

TABLE 2 Means and frequencies of sex differences in study sample.

Variable	Males	Females
Change in stress (−50 to 50)	7.39 (12.96)	14.21 (9.96)*
Anxiety (/21)	6.67 (5.43)	9.30 (6.03)
Depression (/24)	7.0 (6.29)	7.93 (4.73)
Resiliency (14 to 98)	76.78 (11.57)	79.23 (10.97)
MVPA (min/week)	281.39 (258.47)	197.79 (121.87)
Moderate PA (min/week)	130.56 (167.59)	85.35 (73.67)
Vigorous PA (min/week)	150.83 (118.31)	114.07 (126.92)
Meeting PA guidelines	12 (66%)	24 (55%)
Perceived PA level since COVID		
Lower	10 (59%)	24 (55%)
No Change	5 (29%)	10 (23%)
Higher	2 (11%)	9 (20%)
Resting heart rate (bpm)	57.67 (6.14)	66.09 (8.35)*
rMSSD (ms)	90.53 (52.33)	59.95 (26.19)*

Independent samples *t*-tests were run to test the difference between males and females for continuous and ordinal variables. Chi-square tests were run to test the difference between males and females for nominal variables. *$p < 0.05$.

Participants were experiencing more academic stress since the onset of the pandemic. Notably, females reported a greater increase academic stress than males. On average, anxiety and depressive symptoms were mild (Kroenke and Spitzer, 2002; Spitzer et al., 2006), resiliency was moderate (Wagnild, 2016), and there were no sex differences in anxiety, depression, or resiliency scores.

The sample was highly physically active with a mean moderate-to-vigorous physical activity (MVPA) of 223.6 min (> 3 h) per week, which exceeds that of the recommended 150 minutes (2.5 hours) per week (Ross et al., 2020). Just over half of respondents reported meeting the guidelines; however, nearly sixty percent reported that their physical activity level had dropped since the start of the pandemic. There were no sex differences in either measure of physical activity.

Resting heart rate was considered normal (Nanchen, 2018) and females exhibited higher resting heart rate than males. HRV indicated by rMSSD was in the ideal range and males exhibited a higher HRV than females (Heiss et al., 2021).

Anxiety

Hierarchical regression coefficients for anxiety are displayed in Table 4. Change in stress explained 31% of the variance ($b = 0.58$, $p < 0.001$, $f^2 = 0.30$) (step 2, $\Delta F(3, 57) = 27.56$, $p < 0.001$), indicating that participants who reported more academic stress since the onset of the pandemic were more anxious. An additional 15% of variance was explained by resiliency ($b = -0.32$, $p = 0.003$, $f^2 = 0.09$) and moderate physical activity ($b = -0.25$, $p = 0.03$, $f^2 = 0.04$), (step 3, $\Delta F(6, 54) = 5.81$, $p > 0.001$), indicating that higher resiliency and more moderate physical activity levels buffered against stress-induced anxiety.

Depression

Hierarchical regression coefficients for depression are displayed in Table 5. Change in stress explained 18% of the variance ($b = 0.21$, $p < 0.001$, $f^2 = 0.18$) (step 2, $\Delta F(3, 57) = 13.24$, $p < 0.001$), indicating that participants who reported more stress since the onset of the pandemic were more depressed. An additional 22% of variance was explained by resiliency ($b = -0.24$, $p < 0.001$, $f^2 = 0.20$) (step 3, $\Delta F(6, 54) = 6.79$, $p < 0.001$), indicating that participants with higher resiliency buffered against stress-induced depression.

HRV

Hierarchical regression coefficients for HRV are displayed in Table 6. Biological sex explained 14% of variance ($b = -0.37$,

TABLE 3 Bivariate correlations.

	1	2	3	4	5	6	7	8
1. ΔStress	–	–	–	–	–	–	–	–
2. Anxiety	0.68**	–	–	–	–	–	–	–
3. Depression	0.58**	0.62**	–	–	–	–	–	–
4. Resiliency	−0.42**	−0.46**	−0.63**	–	–	–	–	–
5. Moderate PA	−0.07	−0.34**	−0.14	0.16	–	–	–	–
6. Vigorous PA	−0.13	−0.14	−0.16	0.10	0.29*	–	–	–
7. HRV	−0.11	−0.17	−0.30*	0.18	0.15	−0.09	–	–
8. Sex	0.28*	0.19	0.14	0.09	−0.07	−0.20	−0.35**	–
9. Age	−0.05	−0.08	−0.07	0.08	−0.22	−0.01	0.11	0.01

Biological sex was coded as 0 = male, 1 = female, $^{**}p < 0.01$, $^{*}p < 0.0.5$.

TABLE 4 Hierarchical regression coefficients: Anxiety.

		Unstandardized coefficients		Standardized coefficients					
Step	Predictor	B	SE	β	p	R^2	ΔR^2	F	p
1						0.06	0.06	1.8	0.17
	Age	-0.17	0.16	−0.13	0.30				
	Sex	2.8	1.6	0.21	0.09				
2						0.31	0.30	10.94	**0.00**
	Age	−0.06	0.14	−0.05	0.64				
	Sex	0.60	1.4	0.05	0.67				
	Δ stress	0.31	0.06	0.59	**0.00**				
3						0.52	0.15	9.76	**0.00**
	Age	−0.08	0.12	−0.06	0.53				
	Sex	1.0	1.3	0.08	0.45				
	Δ stress	0.25	0.06	0.48	**0.00**				
	Resiliency	−0.17	0.05	−0.33	**0.003**				
	Moderate PA	−0.01	0.01	−0.24	**0.03**				
	Vigorous PA	0.005	0.005	0.11	0.33				

Biological sex was coded as 0 = male, 1 = female. Bolded values are significant at $p < 0.05$.

TABLE 5 Hierarchical regression coefficients: Depression.

		Unstandardized coefficients		Standardized coefficients					
Step	Predictor	B	SE	β	p	R^2	ΔR^2	F	p
1						0.033	0.033	0.98	0.38
	Age	−0.18	0.15	−0.16	0.22				
	Sex	1.1	1.5	0.09	0.75				
2						0.22	0.18	5.2	**0.00**
	Age	−0.11	0.13	−0.10	0.41				
	Sex	−0.38	1.4	−0.03	0.78				
	Δ stress	0.21	0.06	0.45	**0.00**				
3						0.43	0.215	6.79	**0.00**
	Age	−0.09	0.11	−0.09	0.42				
	Sex	0.88	1.3	0.08	0.68				
	Δ stress	0.12	0.05	0.25	**0.04**				
	Resiliency	−0.24	0.05	−0.51	**0.00**				
	Moderate PA	−0.002	0.006	−0.03	0.78				
	Vigorous PA	0.005	0.005	0.11	0.35				

Biological sex was coded as 0 = male, 1 = female. Bolded values are significant at $p < 0.05$.

TABLE 6 Hierarchical regression coefficients: HRV.

		Unstandardized coefficients		Standardized coefficients					
Step	**Predictor**	**B**	**SE**	**β**	**p**	**R^2**	**ΔR^2**	**F**	**p**
1						0.14	0.14	4.66	**0.01**
	Age	0.42	1.0	0.05	0.67				
	Sex	−30.6	10.0	−0.37	**0.003**				
2						0.15	0.01	3.30	**0.03**
	Age	0.54	1.0	0.06	0.60				
	Sex	−0.33	10.5	−0.40	**0.003**				
	Δ stress	0.35	0.43	0.10	0.43				
3						0.19	0.04	2.14	0.06
	Age	0.55	1.0	0.06	0.60				
	Sex	−0.36	11.1	−0.44	**0.002**				
	Δ stress	0.61	0.47	0.18	0.20				
	Resiliency	0.72	0.47	0.21	0.13				
	Moderate PA	0.02	0.05	0.07	0.67				
	Vigorous PA	-0.01	0.04	-0.03	0.85				

Biological sex was coded as 0 = male, 1 = female. Bolded values are significant at $p < 0.05$.

$p = 0.003$, $f^2 = 0.13$) (step 1, $\Delta F(2, 58) = 4.66$, $p = 0.01$), indicating higher (i.e., more favorable) HRV for males than females. No other associations were significant.

Discussion

The current study aimed to explore changes in perceived graduate school-related stressors brought on by the COVID-19 pandemic and to test whether physical activity and trait resiliency buffered the effect of stress. In a sample of Canadian research-based graduate students, those who experienced greater increases in academic stressors since the onset of the COVID pandemic were more anxious and depressed. However, those who engaged in more moderate physical activity were less anxious, and those with higher resiliency were less anxious and depressed, suggesting protective effects. Females had higher resting heart rate, lower HRV, and greater increases in stress than males, suggesting that females may be at greater risk of stress-induced mental illness. Furthermore, lower HRV was associated with higher depression scores (**Table 3**).

Moderate but not vigorous physical activity was associated with less anxiety. Although past research examining the effects of exercise on anxiety are mixed (Aylett et al., 2018; Henriksson et al., 2022), we have previously demonstrated that moderate exercise (and not vigorous exercise) may be more suitable for Lucibello et al. (2020) and offers better protection against stress-induced anxiety (Paolucci et al., 2018). Other studies suggest moderate exercise is better for individuals suffering with anxiety sensitivity who become more anxious when experiencing somatic symptoms of anxiety such as labored breathing and elevated heart rate which are both elicited by vigorous exercise (Zinbarg et al., 1999; Tabor et al., 2019). Institutional-level efforts to foster access to lower-to-moderate intensity physical activities may be met through the development of on-campus spaces such as Yoga and/or cycling studios, and green spaces. The use of physical activity as a tool to manage symptoms of mental health is well supported, however it is important to recognize the interaction between anxiety and exercise addiction. Specifically, it is suggested that higher levels of anxiety may be associated with an increased need for exercise as well as more frequent and intense sessions which may subsequently lead to over-training syndrome and exacerbated anxiety symptoms (Berczik et al., 2012). This is thought to be especially relevant during stressful situations (Berczik et al., 2012). Efforts to increase physical activity levels in at-risk populations (i.e., females) should take these potential reciprocal effects into account.

Although anxiety and depression tend to be comorbid, neither moderate nor vigorous physical activity were associated with depression. This finding contrasts with prior studies and may be due to the unprecedented circumstances surrounding the pandemic. Notably, the lack of social engagement that is typically part of a physical activity program but was missing during the pandemic is an important factor that may be impacting the effects of physical activity on depression (Harvey et al., 2010; Hallgren et al., 2017; Marashi et al., 2021).

Trait resiliency was associated with both anxiety and depression. This finding aligns with the neurovisceral integration model which describes self-regulatory processes as underpinning appropriate cognitive responses to stress (Thayer et al., 2009). The relationship between resiliency and mental health measures may be due to its association with self-regulation (Mestre et al., 2017). Indeed, several items on the RS-14 describe a capacity to self-regulate during difficult or threatening situations (Ex: "In an emergency, I'm someone people can generally rely on", "When I'm in a difficult situation, I can usually find my way out of it"). Students scoring high on resiliency may have adequate self-regulatory capacity, enabling them to respond more favorably to stress and preventing symptoms of anxiety and depression. Importantly, resiliency can be increased by intervention efforts that include mindfulness mediation (Kemper and Khirallah, 2015); stress management training that focuses on reframing stressful life experiences through principles such as gratitude, acceptance, and compassion (Magtibay et al., 2017); and cognitive behavioral approaches (Mache et al., 2015).

Although HRV was not associated with resiliency or physical activity (as predicted), it was influenced by biological sex, which is consistent with the literature (Koenig and Thayer, 2016). Females displayed significantly lower (i.e., unfavorable) resting HRV than males, and experienced greater increases in stress since the onset of the pandemic despite being exposed to similar environmental stressors. Given that HRV provides an index of one's stress reactivity (Souza et al., 2007) and one's stress reactivity predicts the development of mental illness (Charles et al., 2013), HRV may be an indicator of the biological disposition that predisposes females to experience higher rates of stress-induced mental illness than males. It is also important to acknowledge that our sample was predominately females who, under normal circumstances, are more susceptible to stress and mental illness (Gater et al., 1998; Brougham et al., 2009).

We expected resiliency and physical activity to be associated with HRV, but they were not. We believe this is a limitation of our cross-sectional design, and the multitude of factors that can influence HRV including cannabis use (Williams et al., 2021), sleep measures (da Estrela et al., 2021), nutrition (Young and Benton, 2018) and menstrual cycle phase (Brar et al., 2015) that were not controlled here. A longitudinal study design controlling for the above covariates is needed to examine the dynamic interrelationship between HRV, resiliency, physical activity, and mental health. One key advantage of using HRV is its relative accessibility and non-invasive nature. Therefore, developing sound transdiagnostic measures of mental health that are accessible and non-invasive provide a seamless way for health practitioners and researchers to diagnose, treat and monitor the health of patients or clients suffering from mental illness. It is important to note that we employed an unsupervised measure of HRV which may have impacted the accuracy of readings. However, although validated in research contexts (Plews et al., 2017), the mobile application used in our study was designed for commercial use which likely limited user-related errors. As well, participants were instructed to only store "Optimal" readings, which strengthens our confidence in the findings.

The negative relationship between depression and HRV noted in our correlational analyses is in line with literature exploring the link between HRV and general vulnerability to psychopathology. A wide range of psychiatric disorders (including depression) are characterized by low, and in some rare cases abnormally high (Heiss et al., 2021), resting HRV (Henje Blom et al., 2010; Kemp et al., 2012; Pittig et al., 2013; Chalmers et al., 2014; Beauchaine and Thayer, 2015). This finding may support the neurovisceral integration model suggesting that favorable responses to stress result partially from optimal inhibitory function of the prefrontal cortex over regions of the brain that govern emotional responses to stress (Thayer and Lane, 2000).

Limitations of our study include a convenience sample of graduate students predominately from kinesiology, psychology, and health science backgrounds, and who report high levels of physical activity, and thus, may not be representative of the Canadian graduate student population. It is also important to recognize that we did not collect demographic information pertaining to race or ethnicity which also limits our ability to generalize our findings. Our measure of change in stress is also a limitation as we asked participants to recall their stress levels prior to COVID-19. Longitudinal research is needed to explore changes in graduate-school related stress *over time* to explore its causal pathway with mental health measures, physical activity, and resiliency. Lastly, although we used a validated questionnaire, physical activity data was self-reported and is therefore subject to recall bias.

Conclusion

In summary, in a sample of graduate students, individuals experiencing more academic stressors since the onset of the COVID-19 pandemic were more anxious and depressed. However, students engaging in more moderate physical activity were less anxious, and those with higher resiliency were less anxious and depressed. Sex differences were also observed such that females had a lower resting HRV as well as larger increases in stress since the onset of the pandemic suggesting that HRV may be a potential biological mechanism for sex differences in susceptibility to stress-induced mental illness.

There is a dearth of literature examining efficacious tools to address mental health in graduate students even under normal circumstances. Results from our study provide groundwork for

future research interested in addressing mental health concerns in this population. Overall, the results suggest that resiliency and physical activity may offer unique protection against symptoms of anxiety and depression in graduate students experiencing stress during COVID-19 and institutions of higher education should consider investing in programs that encourage physical activity and promote trait resiliency by teaching mindfulness, stress management and cognitive behavioral approaches.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by McMaster University MREB. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MM and JH: conceptualization and writing (review and editing). MM: data collection, data analysis, and writing (first draft). Both authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Impact of the COVID-19 epidemic anxiety on college students' employment confidence and employment situation perception in China

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The psychological problems and employment problems of college students have always been the focus of attention of all sectors of society. The COVID-19 epidemic has a great impact on the mental health and employment of Chinese college students. Under this background, this study discusses how epidemic anxiety affects the employment confidence and perception of employment situation of Chinese college students. Through the online questionnaire survey of 1,132 college students nationwide, and the ordinal logistic regression analysis of the survey data using Stata 16.0 software, the results show that: (1) Epidemic anxiety negatively affects Chinese college students' employment confidence and employment situation perception, and has a significant impact on employment confidence. The three control variables of employment guidance, older age and higher education have a significant positive impact on college students' employment confidence and employment situation perception. College students in the eastern region have stronger employment confidence and more optimistic employment situation perception. But the expected monthly salary is negatively correlated with employment confidence. (2) Male college students and Science and Engineering students' epidemic anxiety have a stronger negative impact on employment confidence and employment situation perception. (3) Employment guidance has a moderating effect on the relationship between epidemic anxiety, employment confidence and employment situation perception. Employment guidance can enhance college students' employment confidence and reduce their sense of employment crisis by alleviating epidemic anxiety. Combined with the research conclusions, it is proposed that the state and schools should pay attention to the psychological counseling of college students, strengthen the employment guidance of colleges and universities, vigorously support the development of small, medium-sized and micro enterprises, and improve the employment and entrepreneurship service system of college students, so as to promote the employment of college students.

KEYWORDS

COVID-19, epidemic anxiety, college student, employment, employment confidence, employment situation, employment guidance

Introduction

The outbreak of COVID-19 pneumonia has had a strong impact on the global economic and social development. Up to now, COVID-19 is still sporadic throughout the country. Under the background of normalization of epidemic prevention and control, China's economy has gradually recovered, but the negative impact of the epidemic on college students' mental health and employment continues (Li et al., 2022). In 2022, the number of college graduates in China reached 10.76 million[1], affected by multiple factors such as the COVID-19 epidemic and the economic downturn, the employment situation is severe and complex, and the uncertainty of job hunting for college graduates continues to increase (Wang and Li, 2022). On November 16, 2021, the Ministry of Education issued the notice on doing a good job in the employment and entrepreneurship of 2022 national college graduates[2], aiming to improve the employment and entrepreneurship promotion mechanism, promote the quality and efficiency of employment and entrepreneurship, and promote the fuller and higher quality employment of college graduates.

The COVID-19 has affected large, medium and small enterprises in China to varying degrees, causing a large number of enterprises to face difficulties in survival and development (especially small, medium-sized, and micro enterprises). The phenomenon of layoffs, salary cuts and closures of enterprises occurs frequently, which directly leads to the contraction of market jobs. The surge in the number of returned overseas talents has also led to increased domestic employment competition and a worse employment environment (Li et al., 2020). In addition, domestic colleges and universities often take more strict epidemic prevention and control measures, which brings many inconveniences to college students' lives and job interviews. In this case, college students are prone to anxiety, worry and fear, which also affects the employment of college graduates (Wang Y. J. et al., 2021). Therefore, an in-depth study of college students' psychological problems and employment issues has important theoretical and practical significance.

This paper takes the COVID-19 as the background, takes Chinese college students as the research object, conducts an online questionnaire survey on college students in 36 colleges and universities across the country, and discusses the impact of COVID-19 anxiety on Chinese college students' employment confidence and employment situation perception through the combination of theory and data regression analysis. This study is expected to provide ideas or references for the state and colleges in carrying out college students' mental health education and improving college students' employment rate.

Literature review

The COVID-19 has lasted for more than 2 years since its outbreak. The epidemic has not only caused heavy losses to the global economy and society, but also brought a huge negative impact on the mental health and employment of college students (Song et al., 2021). Looking at the existing research results, this paper combs the literature from the following three levels: (1) Research on the anxiety psychology of college students under the COVID-19. (2) Research on the impact of the COVID-19 on China's economy and employment. (3) Research on the employment of college graduates under the COVID-19.

From the research progress of the anxiety psychology of college students under the COVID-19, most studies have indicated that stress is the main factor causing anxiety (Aslam et al., 2021; Niu et al., 2021). As public health emergencies with strong infectivity and rapid spread, COVID-19 has caused a certain psychological burden on the public. As a special social group, As a special social group, college students' physical and mental development is not yet fully mature, and they are in a period of high incidence of psychological problems. Therefore, academic research on epidemic anxiety tend to focus on the mental health problems of college students during the epidemic (Wang J. et al., 2021). The research shows that the positive detection rates of anxiety and depression among college students are 10.2 and 19.33%, respectively. The COVID-19 epidemic has caused certain psychological disorders to college students at home, among which depression is more serious (Shader, 2020). The research indicates that the anxiety and depression levels of Chinese college students during the COVID-19 pandemic are higher than the national norm. The fear of the epidemic is a risk factor for anxiety. There are statistical differences between college students of different genders in the anxiety and panic of risk exposure. In the face of major stressful events, female's psychological coping ability is lower than male, moreover, female show more fear and tension than male and pay more attention to the epidemic situation, which may be related to female's more sensitive character (Liu et al., 2020). In addition, graduates are faced with issues such as graduation defense, employment, postgraduate entrance examination, and emotions, and they are under certain psychological pressure. However, due to COVID-19, various arrangements have been postponed repeatedly, which has affected graduation defense and employment of graduates. Therefore, graduates under COVID-19 are at higher risk of anxiety. In questioning how to alleviate anxiety during the epidemic, the study suggests that the online class mode, family relations and social epidemic prevention and control in colleges and universities have a significant impact on the level of epidemic anxiety (Tan et al.,

1 Source: Ministry of Education News. http://www.moe.gov.cn/fbh/live/2021/53931/mtbd/202112/t20211229_591299.html.

2 Source: Website of the Ministry of Education. http://www.moe.gov.cn/srcsite/A15/s3265/202111/t20211119_581056.html.

2021). Schools should pay close attention to the physical and mental health of students, organize open classes of psychological counseling and convey positive information, and encourage college students to carry out more extracurricular activities to reduce the occurrence of mental health problems of college students during the epidemic (Liu, 2020; Rogowska et al., 2020).

From the research progress of the impact of the COVID-19 on China's economy and employment. The epidemic has had a devastating impact on human health and life. It has caused unprecedented disruptions in production, consumption, investment, supply chains, tourism, and trade, and it has had a profound effect on the economy of China and the world (Dewi and Melati, 2021; Ferreira et al., 2021; Karn, 2021). In terms of the impact of COVID-19 on labor demand and supply, market wage level and employment rate, some scholars found that COVID-19 had a dual impact on labor demand and supply. On the one hand, under the epidemic, the economic growth rate decreased, the demand for labor decreased, and the employment rate decreased. On the other hand, the decline of market wages has affected the labor participation rate and aggravated the reduction of the number of employed people (Zhang and Wu, 2020). Most studies have shown that although the impact of COVID-19 on employment is short-term, it is more serious than the impact of SARS in 2003 (Wang, 2020a). The short-term performance is employment reduction. The state should focus on migrant workers, college graduates, unemployed people and workers fighting the epidemic, and provide them with accurate and effective employment assistance services (Mo et al., 2020).

From the research progress of the employment of college graduates under the COVID-19. College graduates, as a special group in the employment, bear the double pressure of graduation and employment. COVID-19 undoubtedly further increases their psychological pressure on employment. The slowdown of labor mobility in the market, the decline of new jobs (Jin, 2020; Zhang and Zhao, 2020), and the increased uncertainty of employment have made college graduates worried, resulting in anxiety among college students (Cao, 2020). Generally, under the background of the COVID-19 outbreak, external environment factors, the psychological quality of college graduates, gap between high employment expectation and actual situation make employment difficult for college graduates. In addition, the epidemic has changed the career orientation of graduates. The security and stability of employment has become the first factor of employment. Graduates' confidence has also been affected to some extent. College graduates are anxious about employment prospects. Therefore, the government should establish a large employment database to accurately formulate employment policies (Ren, 2021). Colleges and universities should innovate employment work from the aspects of employment guidance ideas, employment network services, employment security, employment psychological counseling, employment assistance for special groups, play an intermediary role (Wang, 2020b), optimize the employment coping mechanism of graduates, improve the scientific cognition of the COVID-19, and promote the employment of graduates (Chen and Zhang, 2020).

To sum up, there are a lot of research results at home and abroad on the impact of COVID-19 on college students' mental health and employment, but most of them focus on one of the variables, such as COVID-19 and college students' psychological problems, or COVID-19 and employment relations. Few articles carry out in-depth research on the relationship between college students' psychological anxiety and employment psychological problems during the epidemic period, and the literature using large sample size data statistical analysis method is even rare. Therefore, this study supplements and expands the previous research topics and contents to explore the impact of epidemic anxiety on Chinese college students' employment confidence and employment situation perception.

Theories and hypotheses

Rational choice theory

Coleman first proposed the rational choice theory in 1990s. This theory mainly integrates the theories of micro and macro sociology, advocates using different components of the system, such as individuals, groups, organizations, institution, to explain the behavior of the system, which is called "internal analysis of system behavior" (Krstic and Krstic, 2015). The theory develops further based on the hypothesis of "economic man" in classical economics, and it extends the premise of economic man to "rational man" in neoclassical economics. The "rational man" hypothesis holds that in the process of participating in society, people will calculate and analyze rationally according to all aspects of information they have obtained, and make decisions that are most conducive to their own interests in order to obtain the maximum utility. Therefore, using this theory to construct the analytical framework of this paper can overcome the stereotype of economic man (Gao, 2012). Incorporating the research subject into the subjective perception of the epidemic environment can effectively analyze the obstacles faced by college students in the employment process under the epidemic environment. College students will rationally examine all types of resource, including material, spiritual, social needs and preferences, to find a job during the epidemic. If the available resources are uncontrollable, then the anxiety of employment will increase (Li et al., 2021).

Theory of unsynchronization between economic and employment growth

Economic development is the result of the joint action of many production factors, such as capital, technology,

land and labor. In the process of economic development, the higher the substitutability of other production factors to labor factors, the greater the contribution to economic development, and the lower the dependence of economic growth on labor. Therefore, economic and employment growth are not synchronized in real time. To solve this problem, researchers of this theory have focused on institutional factors and reduce the differences between individuals and society through institutions (Liu, 2010). After the institutional elements were put forward, China's economy and society have developed continuously and rapidly since the reform and opening up. It has continuously lowered the barriers of industrial structure transformation and upgrading from the institutional level, gradually transforming from the development of labor-intensive industries to the development of high-tech industries. It has also paid more attention to the investment and research on technological elements in economic development. Technological factors gradually replace labor factors to become the leading factor of economic development, and technological crowding out labor, making the employment situation of college students more and more severe (Zhang and Zhang, 2019). The sudden outbreak of the COVID-19 has led to a temporary slow development or even stagnation of China's economic development, forced many enterprises to speed up technological innovation, improve the core competitiveness of enterprises, reduce the impact of uncontrollable labor factors during the epidemic, avoid excessive dependence on labor, and expand the investment in technical factors again (Wu et al., 2022), which exacerbates the deterioration of the employment situation of college students and increases their employment anxiety.

Career construction theory

Savickas, an occupational psychologist, observed that under the volatility, uncertainty, complexity, ambiguity (VUCA) scenario, people's career development produces obvious differentiation. Individuals who show strong adaptability in the face of major changes or crises related to their careers eventually achieve career success, whereas those who do not adapt well become victims of career crises. On this basis, Savickas proposed the theory of career construction, adaptation is defined and systematically classified, and the internal relations of adaptation are sorted out. It is proposed that occupational adaptation is a causal chain composed of adaptation preparation, adaptability, adaptive behavior and adaptive result. A high level of adaptation preparation, adaptability and adaptive behavior is conducive to obtaining the adaptive result (Savickas, 2013). The suddenness and unpredictability of COVID-19 fits the concept of VUCA scenarios. As the social, economic, and psychological changes caused by the pandemic will continue for some time, college students who have not yet been employed this year will still have to overcome the effects of the pandemic, whereas future graduates will continue to face uncertainties in the post-pandemic period (Pan et al., 2021). Therefore, the differences of college students' adaptation preparation, adaptability and adaptive behavior will directly affect the adaptive result and employment mentality.

Based on the above analysis, this study constructs the theoretical framework of epidemic anxiety on college students' employment confidence and employment situation perception (Figure 1), and puts forward the following theoretical research assumptions (Table 1).

Methods

Data collection and sample

The subjects are Chinese college students. Online questionnaires are distributed and collected through various mobile terminals (such as wechat, QQ, etc.), and participants fill in the questionnaire information online (platform: questionnaire star https://www.wjx.cn/). Random sampling, each IP address can only be filled in once, the survey time is set from September 2020 to October 2021, and 1132 valid samples are finally recovered. Participants are mostly concentrated in the eastern region of China, where the economy is relatively developed and many colleges and universities are gathered. A total of 36 colleges and universities are sampled, including 4 key colleges and universities, 6 sub key colleges and universities and 26 ordinary colleges and universities.

Study content and measurements

The content of the questionnaire consists of three parts. The first part is the personal information of college students (not involving private information such as names), including "gender, age, major, region, employment status" and other information. The second part is the mental health status during the epidemic (evaluation contents: Kessler10 scale[3]), including "whether there is unexplained fatigue; whether there is often a sense of tension; whether it is difficult to calm down when

3 Kessler10 scale is a short scale that can be used to investigate the mental health status of people. It was first compiled by Kessler and Mroczek of the University of Michigan in the early 1990s. The scale contains 10 items, which are the frequency of nonspecific mental health-related symptoms such as anxiety and stress levels experienced in the past 4 weeks. Kessler10 scale has good reliability and validity, and is suitable for large-scale mental health surveys.

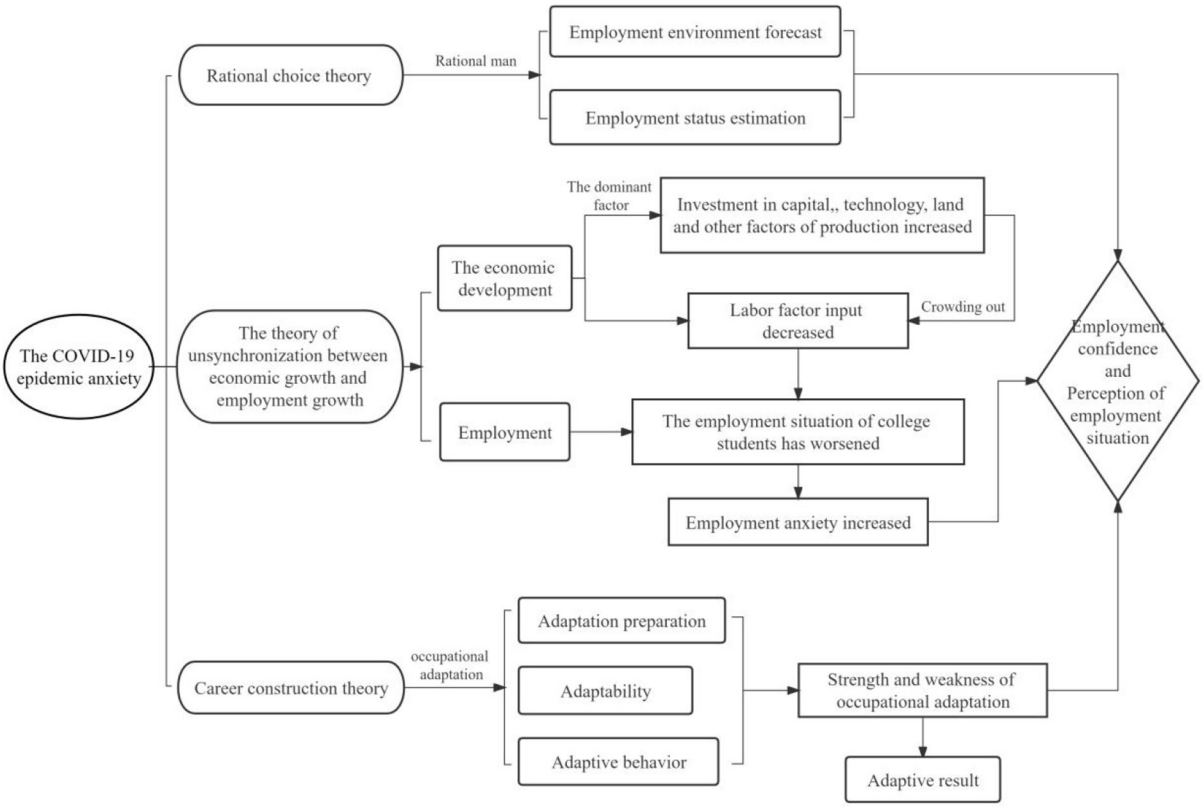

FIGURE 1
Theoretical framework diagram.

TABLE 1 Theoretical research assumptions.

Hypothesis 1	Epidemic anxiety negatively affects college students' employment confidence.
Hypothesis 2	The higher the epidemic anxiety, the stronger the sense of crisis of the employment situation of college graduates.
Hypothesis 3	Employment guidance can effectively help college students enhance employment confidence and reduce the sense of employment crisis.

there is tension; whether there is a sense of helplessness; whether there is a good rest; whether there is a sense of anxiety; whether there is often a sense of depression; whether there is a fear of difficulties in anything; whether there is no interest in anything; whether I feel worthless" a total of 10 evaluation contents. The third part is employment information, including "employment choices, employment plans, whether they have received employment guidance, perception of the employment situation during the epidemic and confidence in finding a satisfactory job". The dependent variables, explanatory variables and control variables were measured according to the content of the questionnaire.

The measurement indicators of dependent variables are employment confidence and employment situation perception, which correspond to question 1 "do you think it is possible to find a satisfactory job under the epidemic?" and question 2 "how do you think the employment situation under the epidemic?". Assign values to the options, and assign the options of employment confidence "very no confidence", "relatively no confidence", "general", "relatively confident" and "very confident" to the ordered classification variables of 1–5, respectively. The higher the value, the stronger the confidence in employment and the confidence to find a satisfactory job. Similarly, the options of employment situation perception "very not optimistic", "relatively not optimistic", "general", "relatively optimistic" and "very optimistic" are assigned to ordered classification variables of 1–5, respectively. The higher the value, the more optimistic the perception of employment situation and the weaker the sense of employment crisis.

TABLE 2 Demographic characteristics of participants.

Variable	Sample size ($N = 1,132$)	Proportion (%)
Epidemic anxiety		
Normal (10–15 points)	294	25.97
Mild (16–21 points)	206	18.20
Moderate (22–29 points)	290	25.62
Serious (30–50 points)	342	30.21
Gender		
Female	716	63.25
Male	416	36.75
Age		
Under 18	17	1.50
18–25	862	76.15
26–30	197	17.40
Over 30	56	4.95
Education		
Junior college	595	52.56
Undergraduate college	417	36.84
Postgraduate	109	9.63
Doctoral candidate	11	0.97
Major		
Science and engineering	524	46.29
Liberal arts and history	608	53.71
Employment status		
Unemployed	822	72.61
Employed	310	27.39
Employment confidence		
Very no confidence	23	2.03
Relatively no confidence	82	7.24
General	444	39.22
Relatively confident	309	27.30
Very confident	274	24.20
Employment situation perception		
Very not optimistic	99	8.75
Relatively not optimistic	359	31.71
General	372	32.86
Relatively optimistic	160	14.13
Very optimistic	142	12.54
Employment guidance		
No	245	21.64
Yes	887	78.36
Employment location preference		
Small towns	96	8.48
Small and medium-sized cities	485	42.84
Big city	551	48.67
Expected monthly salary (RMB)		
Under 3,000	21	1.86
3,000–5,000	145	12.81
5,000–8,000	434	38.34
8,000–12,000	299	26.41
Over 12,000	233	20.58
Region		
Western	282	24.91
Central	81	7.16
Eastern	769	67.93

The measurement index of the explanatory variable is epidemic anxiety, and the corresponding questions are the mental health evaluation contents of 10 items about anxiety and stress level in the second part of the questionnaire. The five options of each question are "Almost none", "Occasionally", "Sometimes", "Most of the time" and "All the time". The scores of each option are 1–5 points in turn, and the scores of the options of 10 questions are summed up. The higher the score, the stronger the anxiety level of college students. According to the total score, the epidemic anxiety level is further divided into four levels: Normal (10–15 points); Mild (16–21 points); Moderate (22–29 points); Serious (30–50 points).

The measurement indicators of control variables include employment guidance, age, education, major, expected monthly salary, region, etc. These variables may also affect college students' employment confidence and employment situation perception.

Estimation

Because employment confidence and employment situation perception are ordered multi classification variables, this paper uses the ordinal multiple logistic regression model to estimate, and the model is constructed as follows:

$$employment = \beta_0 + \beta_1 \, anxiety_i + X_i\delta + \mu_i \quad (1)$$

Among them, "employment" represents the dependent variable: employment confidence or employment situation perception. Subscript "i" represents each college student sample. "anxiety" represents epidemic anxiety. "X" is the control variable. "μ" is the random error term. "β_0" is the constant term. "β_1" is the regression coefficient of the explanatory variable. And "δ" is the vector composed of the regression coefficient corresponding to the control variable.

Statistical analysis

The data were statistically analyzed by Stata 16.0 software. First, descriptive statistical analysis of demographic characteristics and college students' mental health and employment status. Secondly, the ordinal multiple logistic regression method was used to analyze the impact of epidemic anxiety on Chinese college students' employment confidence and employment situation perception. Thirdly, according to the gender and major differences of Chinese college students, the explanatory variables and dependent variables are grouped and regressed to explore the impact of epidemic anxiety level of different groups on employment confidence and employment situation perception. Finally, through the following three-step regression method, the moderating effect of employment guidance on employment confidence and employment situation perception is analyzed: (1) College students are divided into two groups: those who have received employment guidance and those who have not received employment guidance. (2) Regression between employment guidance and epidemic anxiety separately, and analyze the impact of employment guidance on epidemic anxiety. (3) Interact epidemic anxiety with employment guidance to form an interactive item (epidemic anxiety * employment guidance), and then regression with employment confidence and employment situation perception, respectively.

Results

demographic characteristics and selected characteristics of the study population are shown in Table 2. Among 1,132 college students, nearly 70% (67.93%) are from eastern China, and nearly two-thirds are female, of which 72.61% are unemployed. Most college students (74.03%) have mild or above epidemic anxiety, and their employment confidence is not too high. Most of them are in a general state (39.22%). 40.46% of college students believe that the current employment situation of the epidemic is not optimistic, and they have a strong sense of employment crisis. In terms of employment options, nearly half (48.67%) of college students choose to work in big cities, and the proportion of college students who expect a monthly salary of 5,000–8,000 yuan is relatively high (38.34%).

Impact of epidemic anxiety on employment confidence and employment situation perception

Table 3 shows the relationship between epidemic anxiety and Chinese college students' employment confidence and employment situation perception. Epidemic anxiety significantly weakened college students' employment confidence ($p < 0.01$), hypothesis 1 was verified. At the same time, epidemic anxiety has a negative impact on college students' employment situation perception, but not significant, hypothesis 2 was verified. In addition, employment guidance and age increase significantly improved ($p < 0.01$) college students' employment confidence and employment situation perception. Higher education has a positive effect on employment confidence and employment situation perception, and has a significant promoting effect on employment confidence ($p < 0.01$). The higher the expected monthly salary, the lower the employment confidence. College students in eastern China have stronger confidence in employment and more optimistic employment situation perception.

Impact of gender and major differences on employment confidence and employment situation perception

The relationship between gender and major differences and employment confidence and employment situation perception is shown in Table 4. Male college students' epidemic anxiety has a greater negative impact on employment confidence ($p < 0.01$) and employment situation perception ($p < 0.1$) than female college students. Compared with college students of Liberal Arts and History, the epidemic anxiety of college students of Science and Engineering is more likely to lead to lower confidence in employment ($p < 0.01$) and enhanced sense of crisis in employment situation ($p < 0.05$).

The moderating effect of employment guidance on employment confidence and employment situation perception

The results of three-step regression analysis in Table 5 show that employment guidance has a moderating effect on the relationship between epidemic anxiety, employment confidence and employment situation perception. First, the negative impact of epidemic anxiety on employment confidence and employment situation perception of college students who have received employment guidance is lower than that of college students who have not received employment guidance, Second, employment guidance can significantly reduce the epidemic anxiety of college students ($p < 0.01$), further alleviate their sense of employment crisis, and enhance their employment confidence. Third, the interaction between epidemic anxiety and employment guidance (epidemic anxiety * employment guidance) has a positive impact on college students' employment confidence and employment situation perception, hypothesis 3 was verified.

TABLE 3 Impact of epidemic anxiety on employment confidence and employment situation perception.

Variable name		Dependent variable	
		Employment confidence	Employment situation perception
Explanatory variables	Epidemic anxiety	−0.407*** (−8.053)	−0.017 (−0.357)
Control variable	Employment guidance	0.977*** (6.990)	0.791*** (5.965)
	Age	1.112*** (9.505)	0.993*** (9.237)
	Education	0.331*** (3.836)	0.036 (0.446)
	Major	0.024 (0.216)	−0.229** (−2.092)
	Expected monthly salary	−0.042 (−0.748)	0.006 (0.114)
	Region	0.085 (1.298)	0.006 (0.098)
N	1,132	1,132	

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; Standard error of robustness in brackets.

Discussion

Research shows that the impact of COVID-19 on college students' mental health is multifaceted, mainly manifested in fear, anxiety, worry, etc. College students' mental health problems will also have a certain impact on their employment (Chen et al., 2020). The main purpose of this study is to analyze the impact of college students' epidemic anxiety on their employment confidence and employment situation perception. The survey shows that 74.03% of college students feel anxious about the COVID-19, of which 30.21% have serious anxiety, 25.62% are moderate anxiety, and mild anxiety accounts for 18.20%. The anxiety of college students may be related to the influence of COVID-19 on their study, life, interpersonal communication and employment (Sun et al., 2021). In addition, nearly 50% of college students felt general or no confidence in employment, and 73.32% of college students believed that the current employment situation of the COVID-19 was not optimistic or general. College students' low confidence in employment and a strong sense of crisis in the employment situation are also closely related to the heavy damage COVID-19 has brought to the global economy. The economic downturn has caused the depression of the employment market, the normal employment interview is often blocked, college students have difficulties in going abroad to study, the internal employment competition is intensifying, and there is a serious "Involution" phenomenon[4] in China (Wang and Zhang, 2022), which leads college students to face the employment problem with a more pessimistic attitude.

Previous studies have shown that college students' anxiety during the epidemic has a certain negative impact on employment. This study also confirmed this conclusion through the results of the ordinal multiple logistic regression, and expanded and supplemented it. The results show that COVID-19 anxiety has a negative impact on Chinese college students' employment confidence and employment situation perception. In recent years, the global economic downturn, domestic economic downward pressure and COVID-19 have made the employment situation of college graduates more severe. The increasing anxiety about the epidemic has caused psychological burden on college students, making it more difficult for college students to obtain the desired jobs when looking for a job (Gao et al., 2021). Therefore, college students' employment confidence is also more vulnerable to attack, their perception of the employment situation is more pessimistic, and their sense of employment crisis is enhanced. In addition, from the statistical analysis results of the control variables, employment guidance helps college students build employment confidence and judge the employment situation with an optimistic attitude. College students who have received employment guidance will have a clearer plan for their career, a clearer employment goal when choosing a job (Ma et al., 2021), and have stronger employment confidence. At the same time, with the growth of college students' age and the improvement of their educational background, college students' psychological quality is gradually mature and their ability to work and interpersonal communication is continuously improved, their employment confidence is enhanced, and their sense of crisis in the employment situation is reduced. From a regional perspective, the overall economic level and employment situation in the eastern region are far better than those in the central and western

4 The original meaning of the word "Involution" refers to the phenomenon that human society stagnates or cannot be transformed into another advanced mode after reaching a certain form in a development stage. In short, it means "growth without development", "ineffective efforts", "excessive competition", etc. During the epidemic period, after spreading on the Internet, many college students used it to refer to irrational internal competition or "forced voluntary" competition. Now it also refers to the phenomenon that the same industry competes to pay more efforts to compete for limited resources, resulting in the decline of individual "income effort ratio". It can be seen as "hard inflation".

regions (Yuan et al., 2018). College students are more likely to find a satisfactory job in the eastern region, so they have stronger confidence in employment. However, when the salary level of employment cannot meet expectations, the higher the expectation of monthly salary, it will reduce the employment confidence of college students.

From the perspective of gender and major differences, compared with female college students, male college students' epidemic anxiety can weaken their employment confidence to a greater extent and have a higher sense of crisis in the employment situation. On the one hand, this may be related to the Chinese thought of "Male in Charge of The Outside, Female in Charge of The Inside". Male are given the responsibility of "supporting the family" in society, and there is great pressure on employment. On the other hand, male pay more attention to the money and power that work can bring , for example, male are more eager to seek higher paid jobs and male are longing for higher positions (Yang and Zhao, 2020). From these two levels, male have higher requirements for employment. The destruction of the employment environment caused by the epidemic has led to the increase of employment uncertainties and the lack of a large number of high-quality jobs (Phyllis et al., 2020), which has made male college students increasingly anxious about the epidemic and have a stronger sense of crisis in the employment situation, affecting their confidence in finding a satisfactory job. Compared with college students majoring in Liberal Arts and History, college students majoring in Science and Engineering have higher requirements for salary level. College students majoring in Science and Engineering have strong professional skills and believe that their professional value is high, such as electronic information technology, urban planning, construction engineering, chemical engineering, etc., and do not consider employment positions whose salary is lower than expected. However, affected by the epidemic, the wage level in the employment market has declined, the supply of high paying jobs has decreased, and the employment competition has intensified (Wang et al., 2022), leading to the epidemic anxiety, which has a greater negative impact on the employment confidence and employment situation perception of Science and Engineering college students.

Active employment guidance can effectively reduce college students' anxiety about the epidemic, and has a moderating effect on college students' employment confidence and employment situation perception. The opening of employment guidance work and guidance courses in colleges and universities is an important window for college students to learn workplace skills, obtain employment market information, build career planning, and form a positive outlook on employment. College students who have received employment guidance are not only trained to obtain reliable employment information, grasp the changes of employment situation and job selection skills (Mahir et al., 2021). Moreover, it can also get the help of

TABLE 4 Impact of gender and major differences on employment confidence and employment situation perception.

Variable name	Employment confidence (gender)		Employment situation perception (gender)		Employment confidence (major)		Employment situation perception (major)	
	Female	Male	Female	Male	Science and Engineering	Liberal Arts and History	Science and Engineering	Liberal Arts and History
Epidemic anxiety	−0.325*** (−4.974)	−0.564*** (−6.674)	−0.063 (1.001)	−0.126* (−1.655)	−0.429*** (−5.858)	−0.363*** (−5.140)	−0.156** (−2.241)	−0.143** (2.169)
Control variable	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
N	716	416	716	416	524	608	524	608

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; Standard error of robustness in brackets.

TABLE 5 The moderating effect of employment guidance on employment confidence and employment situation perception.

Variable name	Step 1				Step 2		Step 3
	Employment confidence (employment guidance)		Employment situation perception (employment guidance)		Epidemic anxiety	Employment confidence	Employment situation perception
	Yes	No	Yes	No			
Epidemic anxiety	−0.413*** (−7.328)	−0.436*** (−3.564)	−0.027 (−0.524)	−0.153 (1.299)		−0.486*** (−4.183)	−0.002 (−0.126)
Employment guidance					−0.436*** (−3.385)	0.711* (1.892)	0.539 (1.349)
Epidemic anxiety*employment guidance						0.097 (0.761)	0.011 (0.718)
Control variable	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
N	887	245	887	245	1,132	1,132	1,132

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; Standard error of robustness in brackets.

instructors on psychological counseling, alleviate the anxiety of college students caused by the impact of the epidemic, develop a positive attitude toward employment, and be able to methodically look for employment opportunities and actively face employment difficulties in COVID-19 (Falcón-Linares et al., 2021). Compared with college students who have not received employment guidance, they have a more optimistic attitude toward employment, a sense of crisis in the employment situation has been alleviated, and their employment confidence has been enhanced. The results show that active employment guidance is very necessary for college students.

Conclusion

74.03% of college students were anxious about the COVID-19, of which 73.32% were not optimistic about the employment situation. Nearly 50% of college students have low confidence in employment. There is a significant negative correlation between epidemic anxiety and Chinese college students' employment confidence, and there is a negative correlation between epidemic anxiety and employment situation perception, but it is not significant. The stronger the epidemic anxiety, the stronger the sense of crisis in the employment situation, and the weaker the employment confidence. Employment guidance, older age and higher education have a significant positive impact on college students' employment confidence and employment situation perception. College students in the eastern region have higher employment confidence and more optimistic perception of the employment situation, but the higher the monthly salary, the lower the employment confidence. Compared with female college students and Liberal Arts and History students, male college students and Science and Engineering students' epidemic anxiety have a stronger negative impact on employment confidence and employment situation perception. Employment guidance for college students can help alleviate the anxiety of college students, enhance their confidence in employment and reduce their sense of crisis in the employment situation. Employment guidance plays an important role in moderating the relationship between epidemic anxiety and employment confidence and employment situation perception.

College Students' epidemic anxiety has an important impact on their employment. Combined with the research results, the enlightenment to us is that the state and universities should start from the following aspects to promote the employment of college students. First, colleges and universities should pay attention to psychological counseling of college students. College student counselors, tutors and psychological counseling departments in colleges and universities should timely find and eliminate college students' anxiety or depression, encourage college students to maintain good work and rest habits, strengthen outdoor exercise, and reduce the anxiety caused by the epidemic (Li and Chen, 2022). Second, strengthen employment guidance in colleges and universities. Deliver the latest employment information, urge college students to build career plans, change their employment concepts, reasonably position employment goals, and adjust employment expectations. Pay special attention to the employment guidance for male college students and Science and Engineering

students, and combine the employment guidance with mental health education, and always pay attention to the mental health problems of college students (Wang et al., 2019). Third, vigorously support the development of small, medium-sized and micro enterprises. Small, medium-sized and micro enterprises are the main force to accommodate the employment of a large number of college graduates, ensure sufficient employment positions, guide college students to work in private enterprises, and avoid excessive pursuit of employment positions in state-owned enterprises and government agencies[5] (Zhang and Gao, 2022). Fourth, improve the employment and entrepreneurship service system for college students. Strengthen the employment assistance for fresh graduates, such as employment subsidies, employment position recommendation, etc. Build an employment and entrepreneurship service system for college students based on big data technology, dynamically monitor the employment situation of college students, and use big data to link enterprises and colleges (Li, 2022), so as to solve the employment problem of college students faster and better.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

SZ supervised and directed. SZ and JZ conceived and designed the experiments. GW and JZ wrote the original draft and performed data analysis and interpretation. GW reviewed and edited the manuscript. GW and WC performed data collection and collation. All authors contributed to the article and approved the submitted version.

5 The survey shows that 70.84% of college students intend to work in party and government organs, state-owned institutions and state-owned enterprises, while the proportion of college students who intend to work in collective enterprises, private enterprises, foreign-funded enterprises and other types of enterprises is only 7.16, 8.04, 6.18, and 7.77%, respectively.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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What can we learn from the COVID-19 pandemic? Resilience for the future and neuropsychopedagogical insights

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Introduction

The psychological effects of COVID-19 pandemic

The COVID-19 pandemic caused a spike in the prevalence of stress and anxiety (Yao et al., 2020). Globally, between January 2020 and January 2021, depressive disorders increased by 27% while anxiety disorders increased by 25% (Santomauro et al., 2021). Despite attempts to promote mental health practices through digital resources (Arenliu et al., 2020), the pandemic massively impacted adolescents and young adults as it doubled the prevalence of depressive and anxiety symptoms among youths (Racine et al., 2021).

A "new normality" has changed our everyday life (Bozkurt and Sharma, 2020) and social norms (Andriani, 2020). Previous research on natural disaster preparedness (Kostouros and Warthe, 2020; Warthe et al., 2022; Di Giuseppe et al., 2023 (In Press)) does not suggest how to deal with a long-term phenomenon such as a pandemic that has caught global communities unprepared. COVID-19 and its effects have highlighted the urgency for individuals and societies to fortify themselves at a psychosocial level.

A key construct to address this need is resilience, defined as the ability to adaptively cope with adversity (Luthar et al., 2000), resulting from the dynamic interaction among genetic, biological, and environmental factors (Herrman et al., 2011). In this paper, we refer to resilience as the process that allows the individual, group, and community to cope with, overcome, and emerge strengthened from negative experiences (Grotberg, 1995; Hamby et al., 2018). To date, most studies on the effects of the pandemic primarily examine the risk factors for individuals' health, while studies that

explore resources and assets that promote positive coping with the adverse effects of the pandemic are still scarce.

Starting from this premise, the following paper is the result of a collective reflection shared by resilience researchers across the globe (Fondazione Patrizio Paoletti, 2022), inquiring about how the pandemic can be considered a catalyst for change for building more resilient communities and social structures. As a contribution to facing the current emergency, resilience researchers share four interdisciplinary insights that are presented in the current paper.

Discussion

What can we learn from COVID-19?

Insight 1: Being more aware of brain functioning and its potential can help us face the global increase in anxiety and depression

Every individual, community, and institution should access theoretical and practical knowledge about the human brain and mental functioning to become more resilient. Adults can become more resilient by reprogramming their brains to counteract the effects of stress by enhancing the activity of the prefrontal cortex and coping circuits (Fredrickson, 1998; Davidson, 2000; Korb, 2015; Tabibnia and Radecki, 2018). Stressors negatively impact the prefrontal cortex, which is the seat of higher functions (Diamond, 2016), and the synthesis of brain-derived neurotrophic factor (BDNF), which is critical for neuronal plasticity (Fritsch et al., 2010). Tabibnia (2020) highlights three neuroscience-based strategies that are key for building resilience: (1) reducing the negative impact of experience (e.g., *via* cognitive reappraisal) and therefore the distress responses of the amygdala, hypothalamic-pituitary-adrenal axis, and autonomic nervous system; (2) increasing positive experience (e.g., optimism and social cohesion) and associated activation of mesostriatal reward circuits, which can counteract stress responses; (3) cultivating self-transcendence (with techniques such as meditation, mindfulness), thereby reducing the activation of the default mode network (DMN) and associated rumination, self-reflection, and mind-wandering. Different meditation techniques, such as Quadrato Motor Training (QMT), can indirectly incentivize resilience by increasing prefrontal activation and decreasing the DMN (Dotan Ben-Soussan et al., 2013; Paoletti and Ben-Soussan, 2021; Paoletti et al., 2022a).

Insight 2: It is necessary to develop an awareness of human interconnectedness to overcome adversity

Our wellbeing is not only dependent on our actions toward ourselves and toward others but is also influenced by the actions of others (White and McCallum, 2021). We can be more resilient when we are focused on other individuals and their needs through empathy, compassion, and tolerance (Jordan, 2004; Slavich et al., 2021). Additionally, the support of family, friends, and community is considered another source of strengths crucial to developing resilience and overcoming adversity in diverse cultural contexts and populations (Hamby et al., 2018; Kelmendi and Hamby, 2022). Conversely, "self-centered" resilience reinforces social alienation, hindering the development of a sense of brotherhood and responsibility to others (Mahdiani and Ungar, 2021). Individuals' sense of community is not yet sufficiently developed to cope with a global emergency (Hirsch, 2010; Turcotte and Caron, 2017), as indicated by the social tensions about biopower (Arminjon and Marion-Veyron, 2021) and the difficulties in complying with anti-contagion measures (Hills and Eraso, 2021). Noticeably, activities such as artistic engagement can improve the level of resilience of individuals and communities (Reed et al., 2020). The creative process (e.g., drawing) allows the expression and processing of emotions within group interventions as well as with COVID-19 patients (Bhattacharya et al., 2022). Plus, it has been demonstrated that the creative potential represents a protective factor against COVID-19 lockdown stress (D'Anselmo et al., 2022).

Insight 3: School-programs should educate next generations in resilience

To face the global spread of anxiety and depression among youth as a consequence of the pandemic (Racine et al., 2021), resilience must be promoted and integrated in educational settings. The educational landscape should create personalized and collective support strategies and integrate resilience in educational curricula around the world (Mwangi et al., 2017; Kelmendi and Hamby, 2022). Educational systems must develop new strategies to survive the long-term crisis sustainably, ensuring that no one is left behind (Bozkurt, 2022) in light of socioeconomic disparities between countries. Fundamental to this is the digitalization of educational systems, possibly facilitated by preparatory interventions to support students, teachers and parents (Hyseni- Duraku and Hoxha, 2020).

Insight 4: Self-training resilience tools can allow individuals, groups, and communities to access neuro-psycho-pedagogical knowledge to face adversities, uncertainty, and changes in everyday life

Self-educational programs can help people to understand the links between neuro-psycho-physiological states, emotions, and behaviors to re-interpret events and emergencies and create a resilient community. In this sense, Patrizio Paoletti Foundation designed a self-administered resilience-training program entitled "Ten Keys (i.e., suggestions) for Resilience" (Table 1; Paoletti et al., 2022a). The program was born in the framework of the Sphere Model of Consciousness (Paoletti,

TABLE 1 Ten-Keys for resilience by Patrizio Paoletti Foundation. Revised version from (Di Giuseppe et al., 2022a).

Key	Content	Neuropsychopedagogical principle
(1) Focus on what you can control and make small decisions.	Bringing attention to the *here and now* and making small decisions to overcome uncertainty.	Observation and Self-observation (Paoletti and Selvaggio, 2011a)
(2) Identify an attainable, exciting, measurable goal.	Setting goals, foreseeing obstacles, and cultivating positive beliefs.	Observation and Self-observation (Paoletti and Selvaggio, 2011a).
(3) Several times a day become aware of your posture.	Setting body posture for physical activation, raising attention and self-confidence.	Observation and Self-observation (Paoletti and Selvaggio, 2011a).
(4) Be inspired by stories.	Following resilience role-models.	Mediation (Paoletti and Selvaggio, 2011b).
(5) Ask yourself what is really important.	Training in self-motivation, listening to your most intimate preferences.	Mediation (Paoletti and Selvaggio, 2011b).
(6) Cultivate gratitude.	Learning to cultivate positive emotions (e.g., gratitude) and to manage negative emotions.	Mediation (Paoletti and Selvaggio, 2011b).
(7) Appreciate the other as a resource, cultivate and expand your social network.	Listening, sharing experiences, enhancing social and interpersonal resources.	Translation (Paoletti and Selvaggio, 2012).
(8) Cultivate curiosity.	Learning from everything and from every experience.	Translation (Paoletti and Selvaggio, 2012).
(9) Practice a few minutes of silence.	Practicing multiple times a day intentional silence, envisioning the best version of yourself.	Normalization (Paoletti and Selvaggio, 2013)
(10) Embrace and transform: before bedtime, generate your tomorrow today.	Self-programming and foreshadowing of the future through proactive storytelling of daily life.	Normalization (Paoletti and Selvaggio, 2013)

2002a,b; Paoletti et al., 2022c; Paoletti and Ben Soussan, 2019), and was inspired by interdisciplinary literature (Fredrickson, 1998; Davidson, 2000; Korb, 2015; Paoletti, 2018; Tabibnia and Radecki, 2018). The 10 Keys for resilience are theoretical-practical indications describing how a resilient brain works. These indications support the process of awareness through the proactive re-signification of experience at a cognitive level, improving emotional regulation and the physical wellbeing of the individual. Taken collectively, the 10 Keys create an expanded conceptualization of resilience, where the individual trains to overcome adversity to transform the adversity into an opportunity for personal and collective growth (Paoletti et al., 2022a). The 10-Keys are organized according to the four neuro—psycho-pedagogical principles of the Pedagogy for the Third Millennium (PTM; Paoletti, 2008, 2018): Observation, Mediation, Translation, Normalization Paoletti and Selvaggio, 2011a,b, 2012, 2013; Paoletti et al., 2022a. The Ten-Keys were applied in emergency and challenging context (e.g., earthquake survivors, inmates, and juvenile penal justice educators) even during COVID-19 pandemic (Di Giuseppe et al., 2022c; Di Giuseppe, 2022; Di Giuseppe et al., 2022a,b, 2023 (In Press); Maculan et al., 2022; Paoletti et al., 2022b).

Conclusion

The four insights, resulting from the encounter among resilience researchers (Fondazione Patrizio Paoletti, 2022), offer an interpretation of the experiences lived during the pandemic. Taken collectively, these insights integrate neuroscience, psychology, and pedagogy to face the post-pandemic world with an interdisciplinary knowledge. The insights aim at helping us to face the current emergency and preparing us for the future, overcoming the global spread of anxiety and stress highlighted by scientific literature. Next generations could benefit from re-analyzing the concept of resilience as a set of strengths of the individual and community to promote wellbeing and mental health. It is also crucial, in the future of the educational systems, to integrate resilience in school programmes, and to promote self-training in resilience across the life cycle. These neuro-psycho-pedagogical insights eventually can be translated to a wide range of emerging future challenging situations which we are currently facing, such as financial instability, war, and climate change.

Author contributions

PP conceived and supervised the realization of the manuscript in the structure. TD, CL, GP, PP, AB, GT, KK, GW, VB, RL, TB-S, AI, CM, and NB contributed in the writing of the insights presented in the article. All authors contributed to the revision of the article and approved the final version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Association between fear of COVID-19 and hoarding behavior during the outbreak of the COVID-19 pandemic: The mediating role of mental health status

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Hoarding behavior can effectively improve people's ability to resist risks, so as to reduce the negative effects of risks. However, excessive hoarding behavior will seriously reduce people's quality of life. The COVID-19 pandemic can cause excessive hoarding in a large number of people in a short period of time, and also cause a series of economic problems such as social material shortage. It is unclear how hoarding levels are linked to fear and negative emotions caused by COVID-19 among people of different educational backgrounds and social status. The purpose of this study was to explore the relationship between fear of COVID-19 and hoarding behavior in different populations in school and social contexts, as well as the mediating role of negative emotions and the moderating role of subjective/objective social status and education level in this process. An online cross-sectional survey was conducted in various provinces in China in January 2022. Demographic information, the MacArthur Scale of Subjective Social Status, the Fear of COVID-19 scale, the Depression Anxiety Stress-21, and the Saving Inventory-Revised were used to evaluate the severity of individual hoarding symptoms, the frequency of hoarding, the degree of fear, and the negative emotions (depression, anxiety, stress) caused by COVID-19. Research data showed that fear of COVID-19 was significantly correlated with hoarding behavior ($p<0.05$). Fear of COVID-19 was significantly lower in the student sample than in the nonstudent sample ($p<0.05$). Negative emotions played a mediating role in the relationship between fear of COVID-19 and hoarding behavior ($p<0.05$). Educational and economic levels moderated this process, but social status did not. Compared with the student sample, educational background and income had less of a moderating effect on the depression, anxiety, and stress caused by fear of COVID-19 in the nonstudent sample. However, these factors had a more regulative effect on the clutter and excessive

acquisition behavior caused by depression, anxiety, and stress, although not on difficulty discarding. These findings suggest that reduce negative emotions in the population, improve cognitive levels, and provide financial support from governments may be effective ways to reduce hoarding symptoms.

KEYWORDS

COVID-19, hoarding behavior, obsessive-compulsive disorder, educational background, economic level, mental health

Introduction

Hoarding is typical of many animals. Excessive hoarding is called hoarding disorder (Davidson et al., 2019). According to theory, hoarding disorder arises from unusual beliefs regarding and strong emotional attachment to items as well as executive functioning deficits, behavioral avoidance, and early developmental factors (Frost and Hartl, 1996; Mataix-Cols et al., 2010). Recently, the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders officially classified hoarding disorder as a disease, which is associated with trichotillomania and body dysmorphic disorder. Hoarding disorder refers to "unrestrained accumulation behavior," which is characterized by individuals' tendency to constantly acquire and accumulate new items in their living quarters and to experience difficulty discarding useless hoarded items or even excessive demand or other behaviors. This behavior makes it impossible for such people to live a normal life (Battle, 2013). Worryingly, an assessment of hoarding behaviors among Asian adults found a lifetime prevalence of 2% and a general prevalence of 22.6% (Subramaniam et al., 2014). Hoarding disorder has seriously reduced the quality of life of this segment of the population and significantly affected the average emotional level of patients.

Some cities in China continued to report higher numbers of COVID-19 cases in January. In response, China has adopted a unique and efficient dynamic clearing strategy for the domestic pandemic. China's stringent zero-COVID strategy will face its toughest test when millions of people travel around the country for Chinese New Year and the Winter Olympics begin in Beijing. The government's dynamic clearing of COVID-19 has inevitably led to blockades of some areas (Xiong et al., 2020; Mallapaty, 2022). Similar to the situation of the SARS epidemic in China in 2003 (Maunder et al., 2003; Chan et al., 2006; Cheung et al., 2008). Our study was conducted in this epidemic environment, the intermittent shortages of living materials and individual social isolation caused by COVID-19 may have negative impacts on individual mental health that cannot be ignored. COVID-19 significantly impacts people's risk perceptions, stress levels, and fear. In terms of risk perceptions, one study used the 8-item COVID-19 Risk Perception Scale to assess individual risk associated with COVID-19 (Yıldırım and Güler, 2020). The results showed that people's levels of risk perception are significantly positively correlated with the severity of COVID-19 and self-efficacy. This assessment was conducted by using a scale related to exposure to stressors (Tambling et al., 2021), which showed that people's stress increased significantly during the COVID-19 pandemic. In terms of fear, Chung-Ying Lin et al. developed the Fear of COVID-19 Scale (FCV-19S) to assess the population's fear of COVID-19 during the pandemic, which has been associated with satisfactory psychological measurement results in 10 countries (Lin et al., 2021). In addition, experimental data have shown that during the COVID-19 pandemic, fear of the pandemic has increased significantly. Recently, studies have used the Obsessive Compulsive Inventory-Revised, the Cognitive and Affective Mindfulness Scale-Revised, and the Depression Anxiety Stress Scales-21 (DASS-21) to evaluated the general population (Marazziti et al., 2021) and found that the prevalence of obsessive-compulsive hoarding disorder increased by approximately 4% following the onset of the pandemic.

Recent studies have reported a significant increase in the hoarding of daily necessities such as food, drinking water, and toilet paper during the pandemic (Benatti et al., 2020; Sim et al., 2020). The frequency of this phenomenon and the increasing number of people with hoarding disorder have drawn attention from academic circles. Since the end of 2019, studies have mainly focused on the relationship between the dissemination of information by news media, social distancing, personality traits, stress levels, negative emotion levels and hoarding behavior during the COVID-19 pandemic. A study of 770 adolescents in the United States (Oosterhoff and Palmer, 2020) showed that the more frequently they were exposed to COVID-19-related media and disinfection practices, the higher their degree of hoarding behavior. In addition, 530 Japanese adults (Yoshino et al., 2021) and the German population (Fink et al., 2021) were evaluated in terms of hoarding behavior and personality traits. Multivariate regression analysis showed that individuals with high levels of agreeableness, neuroticism, openness, and cupidity tended to hoard more items during the pandemic. Individuals experience higher levels of depression, anxiety and distress in response to stressful events related to COVID-19 and may exhibit greater degrees of hoarding disorder (Fontenelle and Miguel, 2020; Ouellette et al., 2021). Importantly, some research data have shown that obsessive-compulsive hoarding places a tremendous burden on an individual's economic level (Tolin et al., 2010).

Groups of different social classes and economic levels have different susceptibility to stress and different tolerance to risk (Cheng and Chan, 2008). However, the question of whether there is a correlation between the hoarding levels of people from different educational backgrounds and the fear and anxiety caused by COVID-19 remains under investigation, and the influence of social status and economic level on this process remains unclear. Therefore, this paper used a scale to evaluate the relationship between negative emotions and hoarding behavior during the COVID-19 pandemic as well as the mediating and moderating roles played by educational background and economic level in this process, with the aim of providing a reference concerning the impact of COVID-19 on individual psychological emotions and hoarding behavior.

Materials and methods

Participants

Over the course of nearly one month (10 January 2022 to 10 February 2022), offline survey activities and personal freedoms were restricted due to the requirements of the relevant governments (for example, large-scale events were banned, public facilities were closed, and people were urged to reduce social contact). In addition, policies related to pandemic prevention and control prevented offline survey activities from being carried out normally. Therefore, we distributed a questionnaire aimed at evaluating hoarding behavior to the subjects via online and social media channels. An a priori sample size calculation for *t*-test design with an anticipated medium effect size of 0.5, power level of 0.95, and $p < 0.05$ for two groups and seven measurement times (Faul et al., 2007), suggested a minimum sample size of 210 participants (G*Power 3.1.9.6 software; Faul et al., 2007). And an a priori sample size calculation for correlation analysis design with an anticipated medium effect size of 0.3, power level of 0.9, and $p < 0.05$ for two groups and seven measurement times, suggested a minimum sample size of 109 participants. (Bäuerle et al., 2020a,b; Teufel et al., 2020; Weismüller et al., 2020). In the analysis, we included only individuals aged 18–65, excluding younger and older respondents as well as respondents whose answer times were too short or too long. All participants provided written informed consent prior to participating in the online survey. The survey was completely anonymous and was approved by the relevant ethics committee.

Assessment

We use an online software named "Questionnaire Star" to design the questionnaire content and publish the questionnaire online. This study used qualitative methods to collect data, and the entire evaluation process took about 180–600 s. The estimated time is based on the fastest time for 15 undergraduate volunteers to fill out the questionnaire effectively. In addition, considering that a long answer time may affect the questionnaire quality, we invited mental health experts from Hebei Medical University to conduct an evaluation. Finally, we set the upper limit of the answer time as 600 s. During this assessment, participants were able to save their responses and double-check their responses upon submission. The assessment asked respondents to report demographic information such as their age, gender, living area and place of birth, educational background, subject type, whether or not they were an only child, whether or not they were a student, their objective economic condition and social status level. The MacArthur Scale of Subjective Social Status (Goodman et al., 2007), the Saving Inventory-Revised (SI-R) (Frost et al., 2004, 2011; Tolin et al., 2010; Kellman-McFarlane et al., 2019), the Depression Anxiety Stress Scale-21 (DASS-21) (Henry and Crawford, 2005; Bäuerle et al., 2020a,b; Hetkamp et al., 2020; Musche et al., 2020; Weismüller et al., 2020; Schweda et al., 2021; Skoda et al., 2021a,b) the Fear of COVID-19 Scale (FCV-19S) (Bäuerle et al., 2020a,b; Hetkamp et al., 2020; Musche et al., 2020; Weismüller et al., 2020; Schweda et al., 2021; Skoda et al., 2021a,b), and the Hoarding Frequency Scale were also included. The collected data were analyzed by using Pearson correlation analysis, a confidence test, an independent sample *t*-test, a regression analysis, and mediating and moderating effect analyses. To ensure the accuracy of the analysis, all scales in this study refer to authoritative journal literature, and mature scales with high reliability and efficiency are selected. All scales were developed by foreign scholars and the original scale language was English. The Fear of COVID-19 scale, the Saving Inventory-Revised etc. were translated and backtranslated according to the procedure proposed by Brislin (Davidson et al., 2019). Our team invited 3 bilingual doctors to translate and reverse translate the scale, and invited 2 experts in the field of psychology to investigate the scale and adjust it according to the situation.

Demographic information

In terms of demographic information, the questionnaire assessed the participants' age, gender, place of living and place of birth, educational background (the educational background of the subjects was evaluated on a 3-point scale; 1 = junior college, 2 = undergraduate, 3 = master's degree or above), major, whether or not the participants was an only child, whether or not the participant was a student, participants' objective economic condition and social status level, namely, the occupation of the participant's father/mother (subjects' parents' occupation was evaluated on a 5-point scale; 1 = temporary worker, unemployed, farmer or unskilled worker, etc., 2 = manual worker, such as construction worker, technician, self-employed and related personnel, 3 = general management personnel, technicians, commercial service personnel such as a driver, salesperson, etc., 4 = middle management personnel, personnel of state organs, party and government organizations, personnel of public

institutions, scientific and technical personnel such as a teacher, doctor, etc. 5 = senior management personnel, party and government organs of leading cadres, private owners such as a civil servant, manager, etc.), level of education (father/mother divided in accordance with scores concerning standard assessment subjects with 6 levels of education for parents; 1 = elementary school or primary school, 2 = junior high school degree, 3 = high school or technical secondary school degree, 4 = college degree, 5 = bachelor's degree, 6 = graduate degree or above), and annual family income (RMB was used as the economic standard to evaluate the economic conditions of the subjects on a 10-point scale, 1 = no income, 2 = 2,000 RMB or less, 3 = 2,000–5,000 RMB, 4 = 5,000–10,000 RMB, 5 = 10,000–30,000 RMB, 6 = 30,000–50,000 RMB, 7 = 50,000–100,000 RMB, 8 = 100,000–150,000 RMB, 9 = 150,000–200,000 RMB, 10 = 200,000 RMB and above).

MacArthur scale of subjective social status

This scale is a self-report tool. The scale features a single dimension and includes only one item. It is used as a subjective evaluation of the social status, social status, and economic level of both students and nonstudents as well as the degrees of visibility and respect, reputation and prestige associated with those individuals (Goodman et al., 2007). The scale is scored on a 10-point scale. The higher the corresponding score selected by the subject is, the higher the subject's level social status according to his or her subjective evaluation.

Saving inventory-revised

This inventory is a self-report tool used to assess the severity of hoarding disorder in subjects (Frost et al., 2004). The scale includes 21 items, which are divided into three dimensions: clutter, difficulty discarding, and excessive acquisition. The original SI-R has been proven to exhibit good psychometric characteristics in terms of internal consistency, confidence, convergence and divergence (Tolin et al., 2010; Frost et al., 2011). The total score of the scale ranges from 0 to 92, with a 5-point scale ranging from 0 (never) to 4 (extremely) for each item. The higher the subject's assessment score is, the more likely he or she is to engage in the behavior in question. Recently, Kellman-McFarlane et al. proposed 39 points as the optimal threshold to distinguish hoarders from nonhoarders by reference to the receiver operating characteristic curve (Kellman-McFarlane et al., 2019).

Depression anxiety stress scale-21

This scale is a self-report tool used to assess participants' levels of negative emotions such as depression, anxiety and stress. The scale consists of 21 items divided into 3 dimensions in accordance with Clark and Watson's tripartite model (Henry and Crawford, 2005), namely, depression (sadness, anhedonia, lack of initiative, low self-esteem, etc.), anxiety (panic, fear, etc.) and stress (irritability, impatience, tension, etc.). Experience has proven that DASS-21 exhibits good psychometric characteristics in various environments (Henry and Crawford, 2005). The total score of the scale is 0–63 points (0–21 points for each dimension), and the score for each item is 0–3 points (always matched). The higher the evaluation score of the subject is, the higher the corresponding levels of depression, anxiety and stress.

Fear of COVID-19 scale

This scale is a self-report tool used to assess subjects' level of fear during the COVID-19 pandemic. Following a revision, the scale consists of 7 items and a single dimension. The original FCV-19S has been shown to exhibit good psychometric characteristics in various situations (Bäuerle et al., 2020a,b; Hetkamp et al., 2020; Musche et al., 2020; Weismüller et al., 2020; Schweda et al., 2021; Skoda et al., 2021a,b). Each item is scored on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). The higher the subject's assessment score is, the stronger that subject's level of fear of the novel coronavirus.

Hoarding frequency scale (from store)

This scale is a self-report tool used to assess hoarding frequency via a single item that asked respondents how often they hoarded supplies from a grocery store or department store over the past 7 days. The Hoarding Frequency Scale features a single dimension and only one item, and it has been shown to exhibit good psychometric characteristics in various environments (Oosterhoff and Palmer, 2020). The total score of the scale ranged from 1 to 5, and each item is scored from 1 (never) to 5 (very frequently). The higher the evaluation score of the subject is, the more frequently that subject exhibits hoarding behavior.

Statistical analysis

After entering the data into the computer, we used SPSS 21.0 software for data analysis. The steps are as follows: First, the deviation analysis of common methods; Secondly, descriptive statistics and Pearson correlation analysis were carried out for the main variables. Third, the *t*-test was used to determine the differences in relevant indicators between student samples and nonstudent samples, and between hoarders and nonhoarders. Fourthly, the process plug-in developed by Hayes is used to select models 7, 8, 14, 15, 58, 59 to test the mediation model and moderation model regulation model respectively. Descriptive statistics are reported as mean +/− standard deviation. Independent sample *t*-test is to divide the samples into student samples and nonstudent samples, as well as into hoarder samples and nonhoarder samples for analysis. We planned a mediation and moderation analysis with bootstrapping techniques using the PROCESS macro for SPSS (version 3.0; Hayes, 2015). Overall, we performed six models, using consistently the total FCV-19S score as an independent variable. SI-R (Clutter, Difficulty Discarding and Excessive Acquisition) and Hoarding Frequency Scale scores served as dependent variables in separately calculated models. DASS-21 (Anxiety, Depression, and Stress) total score and subscale score were used as mediating variables. We performed 10,000 bootstrap samples to generate a 95% bias-corrected confidence interval of the indirect effect a*b. In our mediation analysis, the a path represented the path from FCV-19S to

DASS-21, and the b path represented the path from DASS-21 to SI-R and Hoarding Frequency Scale. The output from our model also included path c, the path from FCV-19S to SI-R and Hoarding Frequency Scale. Additionally, we conducted a moderation model with total FCV-19S score serving as an independent variable, while SI-R and Hoarding Frequency Scale total scores were used again as dependent variables in separately calculated models. In this model, educational background, economic level and social status are moderating variables.

Results

Description of the sample

Statistics are described in terms of percentages, the mean and standard deviation for a normal distribution curve, and median and range (Min–Max) for a nonnormal distribution curve. All the subjects were from China ($n = 643$, 100%), and the average age of participants was 25.28 (8.03) years old. In terms of education, at least 545 participants (84.76%) had a bachelor's degree or higher level of education, with the average score being 1.94 (0.49). In terms of age, the mean age of subjects who were assessed as hoarders ($n = 187$) was 25.37 (7.21) years. Among the samples, the mean total score of the evaluated SI-R was 33.14 (11.89), the mean total score on DASS-21 was 12.15 (11.39), and the mean total score on FCV-19S was 17.56 (6.15). The average score on the Hoarding Frequency Scale was 2.39 (0.89). In addition, participants' average economic level was 6.45 (1.95). The specific clinical data of the subjects are summarized in Table 1.

Common method bias test of variables

The results of the principal component factor analysis showed that 12 factors in the total samples featured a characteristic grounding greater than 1 and that the variation explained by the first factor was only 23.51%, i.e., less than 40% of the critical standard, there is no evidence of a common method bias.

Correlation analysis among scales

Pearson correlation analysis of each scale and the demographic information showed that educational background was significantly correlated with scores on the DASS-21 total scale and subscale, FCV-19S and Hoarding Frequency Scale. The McArthur subjective social status scale was only correlated significantly with economic level and educational background. The DASS-21 total scale and subscale were significantly correlated with the SI-R total scale and subscale. In addition, the FCV-19S and Hoarding Frequency Scale were significantly correlated with the other scales. The correlation analysis among the specific scales is shown in Table 2.

Comparison of scores on various scales between students and nonstudents

An independent samples *t*-test analysis was conducted on the scale data for both students and nonstudents. Statistical data showed that MacArthur Scale of Subjective Social Status scores, total FCV-19S scores and economic level of school students were significantly lower than those of nonstudents, educational background scores were significantly higher for students than nonstudents, and Fear of COVID-19 Scale scores were significantly lower for students than nonstudents. No significant differences were found with respect to the other demographic data or scale and subscale scores. The comparison data of the scores on all the scales are summarized in Table 3.

Comparison of scale scores for hoarders and nonhoarders

According to the scoring criteria suggested by Frost et al., we divided all samples into hoarders and nonhoarders by reference to the SI-R scale with a critical value of 41. Independent sample *t*-test analysis was conducted on the data of each scale for both hoarders and nonhoarders. The statistical results showed that the scores of DASS-21, its subscale and FCV-19S were significantly higher for hoarders than for nonhoarders ($p < 0.01$) and that the difference in these scores was statistically significant. No significant differences were found for the demographic data or

TABLE 1 Summary of participants' clinical features.

	Means (SD)	Cut-off scores	% of individuals at the clinical level
Saving inventory-revised	33.14 (11.89)	≥41 (Frost et al., 2004; Tolin et al., 2011)	29.08%
Clutter	12.15 (5.64)	≥17 (Frost et al., 2004; Tolin et al., 2011)	22.40%
Difficulty discarding	10.59 (3.80)	≥14 (Frost et al., 2004; Tolin et al., 2011)	22.86%
Excessive acquisition	10.40 (3.94)	≥9 (Frost et al., 2004; Tolin et al., 2011)	67.81%
Depression anxiety stress scale-21	12.15 (11.39)	–	–
Depression	3.69 (4.09)	>9 (Frost et al., 2011)	9.18%
Anxiety	3.70 (3.83)	>7 (Frost et al., 2011)	14.62%
Stress	4.76 (4.12)	>14 (Frost et al., 2011)	2.02%
Fear of COVID-19 scale	17.55 (6.15)	–	–
Hoarding frequency scale	2.39 (0.89)	–	–
Educational background	1.94 (0.49)	–	–
Economic level	6.45 (1.95)	–	–

TABLE 2 Summary of the analysis of correlations among the scales (*r*).

	1	2	3	4	5	6	7	8	9	10	11	12
Educational background (1)												
Economic level (2)	<0.01**											
Clutter (3)	0.29	0.06										
Difficulty discarding (4)	0.44	0.05	<0.01**									
Excessive acquisition (5)	0.05	0.07	<0.01**	<0.01**								
Saving inventory-revised (6)	0.17	0.03*	<0.01**	<0.01**	<0.01**							
Depression (7)	<0.01**	0.01*	<0.01**	<0.01**	<0.01**	<0.01**						
Anxiety (8)	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**					
Stress (9)	0.01*	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**				
Depression anxiety stress scale-21 (10)	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**			
Fear of COVID-19 scale (11)	<0.01**	0.5	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**		
Hoarding frequency scale (12)	0.02*	0.09	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	<0.01**	
MacArthur scale of subjective social status (13)	0.04*	<0.01**	0.83	0.77	0.35	0.61	0.13	0.95	0.12	0.26	0.28	0.12

*$p < 0.05$, calculated using 2-tailed bivariate correlations; **$p < 0.01$, calculated using 2-tailed bivariate correlations.

scale and subscale scores. The comparison of scores between DASS-21 and FCV-19S is shown in Figure 1.

Hierarchical linear regression analysis of SI-R, DASS-21 and FCV-19S

As shown in Tables 4, 5, SI-R is strongly correlated with DASS-21 and FCV-19S scores. With respect to fear of the COVID-19 pandemic in the context of the magnitude and frequency of hoarding behavior during this process, we further investigate whether DASS-21 scores play a mediating role in this process for all participants. Statistical analysis of the available data for all the samples demonstrates that DASS-21 scores regarding clutter and excessive acquisition constitute a significant portion of the mediating effect. The specific multiple linear regression analysis is summarized in Tables 4, 5.

An analysis of the moderating effect of level of education and income in on increasing hoarding behavior induced by fear of COVID-19 as mediated by DASS-21

Based on the results of the correlation analysis and multiple linear regression analysis of this study (as shown above), we selected the overall sample, student sample and nonstudent sample to explore the mediating and moderating effects of other scales and variables on the SI-R, DASS-21, FCV-19S and Hoarding Frequency Scale in further detail. According to the analysis of the mediating and moderating effects of level of education and income, the statistical results show that these factors have a significant moderating effect on multiple models of the Hoarding Frequency Scale as a dependent variable among both the student and overall samples, but not among the nonstudent sample (Figures 2A,B). Compared with the student sample, the educational background and income of the nonstudent sample had less of a moderating effect on the depression, anxiety and stress caused by fear of COVID-19. However, this variable has a more regulative effect on the clutter and excessive acquisition behavior caused by depression, anxiety and stress, but not on difficulty discarding (Supplementary Tables S1–S6). In this context, fear of COVID-19 may have a particular effect on the nonstudent sample via anxiety (Figures 2C–F). The analysis of the important mediating and moderating effects of level of education income among the entire sample, the student sample and the nonstudent sample is shown in Figure 2.

Discussion

In this study, an online questionnaire was used to explore the impact of COVID-19 on the mood and hoarding behavior of individuals from different educational backgrounds. In addition, the method of manual intervention was used to review the quality of individuals' answers to facilitate the selection of answers and improve efficiency. Ultimately, a total of 643 valid samples were obtained (after eliminating questionnaires that took less than 180 s to complete). To the best of our knowledge, this was the first study to use the DASS-21 mediation model and educational, economic, and subjective social status to investigate whether the association between FCV-19S and SI-R can be partially explained by the psychological effects of the COVID-19 pandemic. Two main assessment findings are reported. First, the level of education of the population sample, college student sample and professional sample, using the Hoarding Behavior Scale or SI-R as the dependent variable, has a significant moderating effect on the various models, but the sample's level of social status does not. Second, DASS-21 significantly mediates the effect of FCV-19S on SI-R and

TABLE 3 Summary of data for each scale score comparison ($x \pm s$).

Parameter	Students ($N = 438$)	Nonstudents ($N = 205$)	t	p
MacArthur scale of subjective social status	4.30 ± 1.56	5.36 ± 1.97	−6.753	<0.01**
Clutter	12.16 ± 5.50	12.12 ± 5.92	0.099	0.92
Difficulty discarding	10.73 ± 3.65	10.30 ± 4.10	1.326	0.19
Excessive acquisition	10.45 ± 3.74	10.30 ± 4.32	0.421	0.67
Saving inventory-revised	33.34 ± 11.27	32.72 ± 13.14	0.584	0.56
Depression	3.78 ± 4.12	3.50 ± 4.05	0.811	0.42
Anxiety	3.86 ± 3.91	3.35 ± 3.64	1.580	0.11
Stress	4.78 ± 4.21	4.72 ± 3.94	0.183	0.86
Depression anxiety stress scale-21	12.42 ± 11.59	11.57 ± 10.97	0.888	0.38
Fear of COVID-19 scale	17.15 ± 5.76	18.41 ± 6.84	−2.28	0.02*
Hoarding frequency scale	2.35 ± 0.91	2.47 ± 0.84	−1.52	0.13
Educational background	1.99 ± 0.43	1.84 ± 0.60	3.11	<0.01**
Economic level	6.29 ± 1.95	6.77 ± 1.92	−2.869	<0.01**

*$p < 0.05$, calculated using 2-tailed bivariate correlations; **$p < 0.01$, calculated using 2-tailed bivariate correlations.

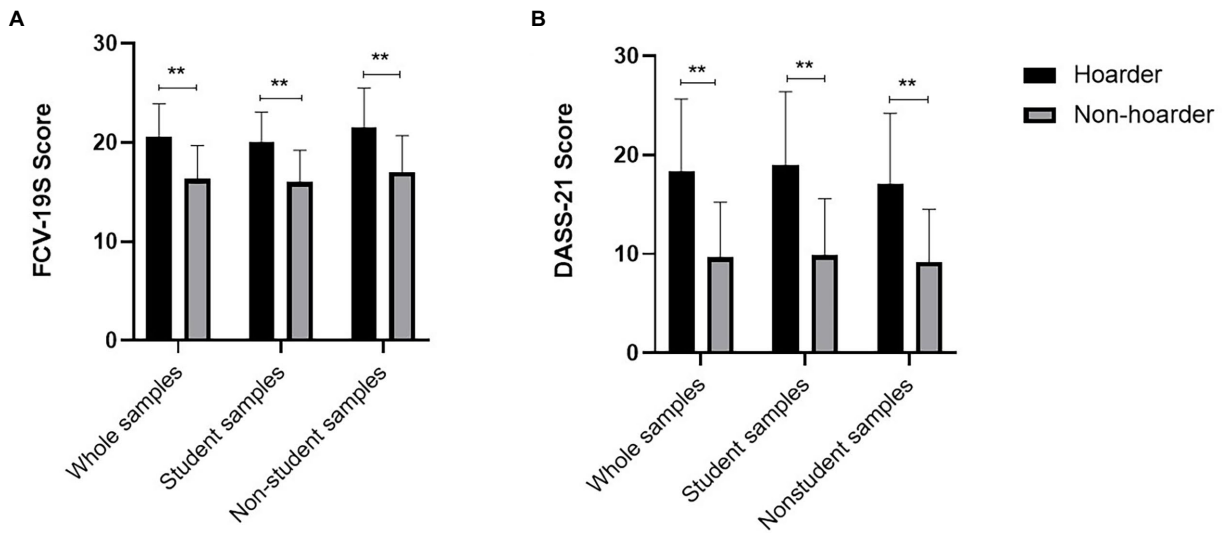

FIGURE 1
(A) Histogram model of the comparison of FCV-19S scores between hoarders and nonhoarders. **(B)** Histogram model of the comparison of DASS-21 scores between hoarders and nonhoarders. The difference between the two scores was statistically significant (**p <0.01).

Hoarding Behavior Scale scores. Our research can facilitate the development of targeted knowledge publicity and psychotherapy programs for individuals from different social strata, with different incomes and from different educational backgrounds. This approach can reduce the mass panic caused by COVID-19 and the shortage of supplies caused by excessive hoarding, thereby reducing the delivery pressure faced by the material transportation system during the pandemic.

The impact of fear of the COVID-19 pandemic on physical and psychological stress responses has received a great deal of attention. Studies have shown that COVID-19 has increased people's anxiety, depression, insomnia, hoarding and other behaviors and has even aggravated these characteristics into mental diseases, thereby seriously harming people's physical and mental health (Fontenelle and Miguel, 2020; Fontenelle et al., 2021; Kim et al., 2021; Franklin et al., 2022).

Our questionnaire design was the first to quantify the correlations among people's fear of COVID-19, negative emotions (depression, anxiety and stress), educational background, income, social status and hoarding behavior. Our analysis of the entire sample showed that people's fear of COVID-19 was positively correlated with negative emotions (depression, anxiety and stress), which is similar to the conclusions of previous studies. Our study was the first to discover that academic degree is negatively correlated with fear of COVID-19, negative emotions (depression, anxiety and stress), and hoarding frequency. This result may be related to the higher cognitive level of highly educated individuals, such as certain knowledge related to disease prevention and control and health

TABLE 4 Results of mediation analysis (clutter).

	Clutter					DASS-21					Clutter				
	B	SE	t	*p*	β	B	SE	t	*p*	β	B	SE	t	*p*	β
Constant	7.166**	0.64	11.194	<0.01	–	0.185	1.266	0.146	0.884	–	7.139**	0.613	11.641	<0.01	–
FCV-19S	0.284**	0.034	8.249	<0.01	0.31	0.682**	0.068	10.017	<0.01	0.368	0.184**	0.035	5.195	<0.01	0.201
DASS-21											0.146**	0.019	7.643	<0.01	0.296
R^2	0.096					0.135					0.172				
Adjust R^2	0.095					0.134					0.169				
F	F(1,641) = 68.042					*F*(1,641) = 100.336					*F*(2,640) = 66.274				
Value	$p < 0.01$					$p < 0.01$					$p < 0.01$				

*$p < 0.05$, calculated using 2-tailed bivariate correlations; **$p < 0.01$, calculated using 2-tailed bivariate correlations.

TABLE 5 Results of mediation analysis (excessive acquisition).

	Excessive acquisition					DASS-21					Excessive acquisition				
	B	SE	t	*p*	β	B	SE	t	*p*	β	B	SE	t	*p*	β
Constant	6.626**	0.443	14.962	<0.01	–	0.185	1.266	0.146	0.884	–	6.604**	0.415	15.9	<0.01	–
FCV-19S	0.215**	0.024	9.024	<0.01	0.336	0.682**	0.068	10.017	<0.01	0.368	0.132**	0.024	5.479	<0.01	0.206
DASS-21											0.122**	0.013	9.428	<0.01	0.354
R^2	0.113					0.135					0.221				
Adjust R^2	0.111					0.134					0.218				
F	*F* (1,641) = 81.432					*F* (1,641) = 100.336					*F* (2,640) = 90.738				
Value	$p < 0.01$					$p < 0.01$					$p < 0.01$				

*$p < 0.05$, calculated using 2-tailed bivariate correlations; **$p < 0.01$, calculated using 2-tailed bivariate correlations.

literacy (Li and Liu, 2020). This knowledge enables highly educated individuals to react to the negative news caused by the novel coronavirus in a more rational manner and to exhibit greater ability to engage in information screening (Kim et al., 2021), which can effectively reduce the possibility of individuals blindly hoarding daily necessities. Simultaneously, highly educated individuals may have a high degree of understanding of the transmission vectors of COVID-19 and can better comply with personal protective measures (Bazaid et al., 2020). In addition, highly educated individuals can continue to maintain a high frequency of exercise during the closures caused by the pandemic (de Boer et al., 2021), and such a high frequency of exercise may make it easier for these individuals to release and relieve negative emotions, thereby allowing them to exhibit fewer symptoms such as depression and anxiety (Wolf et al., 2021). There are negative correlations among family income, hoarding behavior and negative emotions (depression, anxiety and stress). That is, high family income may offer individuals more material security and a stronger ability to withstand the risks caused by the blockade, such that high-income individuals do not need to worry about the decline in quality of life caused by economic problems (Bierman et al., 2021). Furthermore, such a level of income mitigates the influence of life pressure caused by insufficient income that can lead to individual depression, anxiety and other symptoms (Ettman et al., 2020). Interestingly, subjective social status is not associated with hoarding behavior or negative emotions, and higher income does not reduce COVID-19 fear to the same degree as higher education. Therefore, it can be speculated that increasing residents' income can reduce individual hoarding behavior, but reducing people's psychological fear of COVID-19 nevertheless requires the improvement of the overall cognitive level nationwide.

Subsequently, we further split the overall sample into student samples and nonstudent samples. Following a comparative analysis of the scale data between the two samples, it can be concluded that the economic level and subjective social status of the student sample are significantly higher than those of the nonstudent sample during the COVID-19 period. Our analysis suggests that this finding may be due to the different environments faced by students and nonstudents. People who are not on campus are frequently employed and live off campus and can move freely within a certain area, while the activity areas of on-campus students are usually limited to the campus (Mallapaty, 2022). In addition, these groups face different risks from COVID-19, since people who are not in school are frequently quarantined, unable to work and lose income after contracting or coming into close contact with COVID-19. In-school students who become infected or experience close contact with COVID-19 are also treated in isolation. Unlike those who are not in school, in-school students do not face pressure regarding income, and they can continue to study for their specialized courses normally via the internet. In this study, the subjective social rank and fear of COVID-19 of nonstudents were significantly higher than those reported by

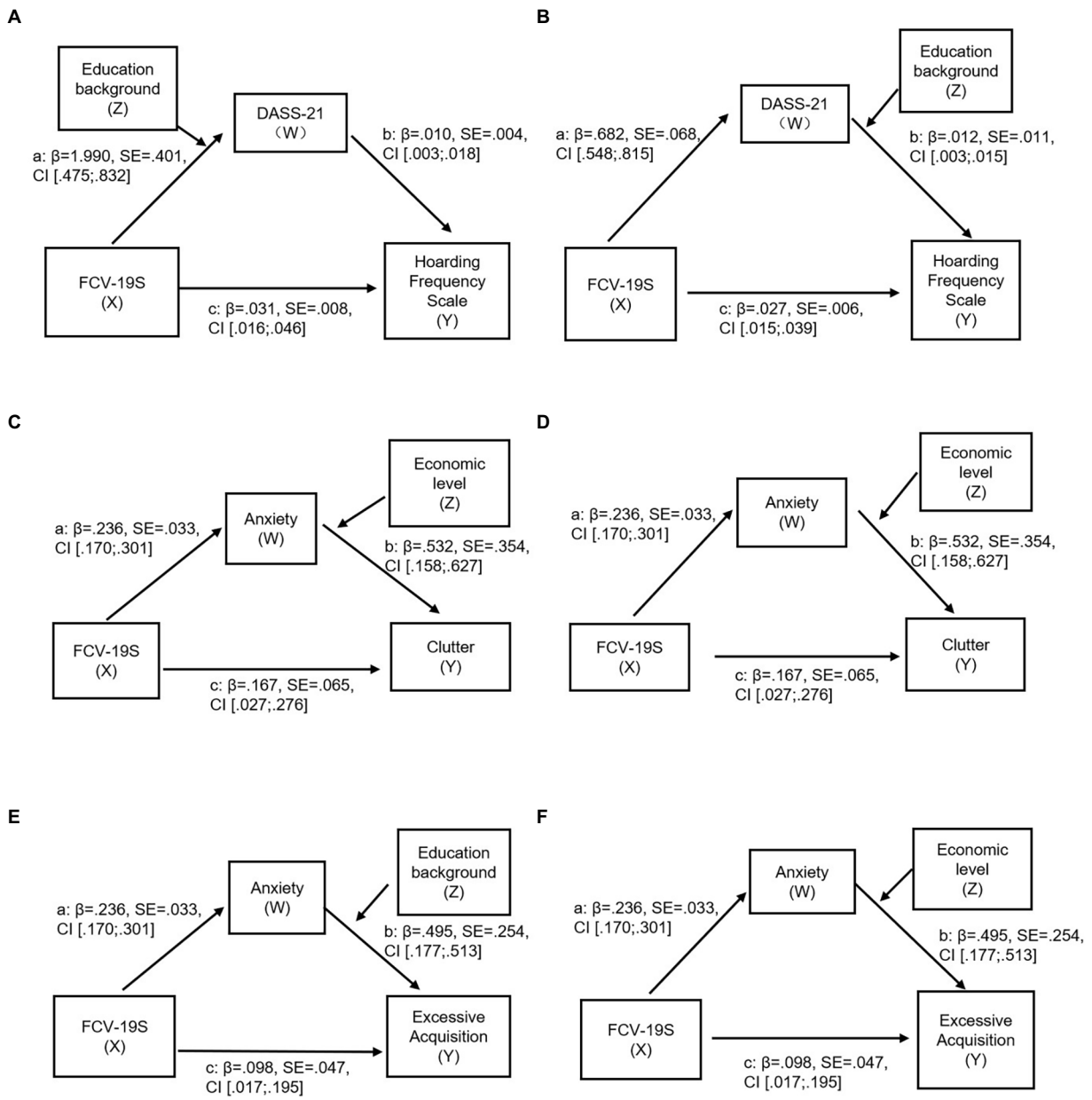

FIGURE 2
(A) DASS-21 mediating and moderating model of the correlation between FCV-19S scores and Hoarding Frequency Scale scores. c is the direct effect of FCV-19S scores and Hoarding Frequency Scale scores; a and b are the fully normalized indirect effects of DASS-21 (student sample). **(B)** DASS-21 mediating and moderating model of the correlation between FCV-19S scores and Hoarding Frequency Scale scores. c is the direct effect of FCV-19S scores and Hoarding Frequency Scale scores; a and b are the fully normalized indirect effects of DASS-21 scores (overall sample). **(C,D)** Anxiety mediating and moderating model of the correlation between FCV-19S scores and clutter. c is the direct effect of FCV-19S scores and clutter; a and b are the fully normalized indirect effects of anxiety (nonstudent sample). **(E,F)** Anxiety mediating and moderating model of the correlation between FCV-19S scores and excessive acquisition. c is the direct effect of FCV-19S scores and excessive acquisition; a and b are the fully normalized indirect effects of anxiety (nonstudent sample).

current students, which is consistent with the expected results. In the sample of students, educational background, family income and subjective social status were not correlated with hoarding behavior. Among these factors, level of education only had an impact on fear of COVID-19 and negative emotions, and among nonstudents, level of education was only negatively correlated with fear of COVID-19 fear, while family income was more closely correlated with hoarding behavior and negative emotions (depression, anxiety and pressure). A degree may entail a higher level of knowledge and ability, indicating that for students in school, attainment of a degree can reduce their fear of COVID-19.

Studies have shown that fear of COVID-19 can cause anxiety, depression and other mental diseases (Fitzpatrick et al., 2020; Nicomedes and Avila, 2020; Stein, 2020; Millroth and Frey, 2021;

Ypsilanti et al., 2021). Reducing people's fear of COVID-19 is important not only to improve their ability to cope but also to reduce rates of depression and anxiety.

Our study used analyses of mediating and moderating effects to explore the relationships among COVID-19 fear, severity of psychological distress (anxiety, depression, and stress), and hoarding severity. Mediation analysis refers to a series of methods aimed at extracting causal mechanism information concerning the influence of predictors on results (Mokhayeri and Mansournia, 2019). We also took into account individuals' subjective social status and educational backgrounds and found that the severity of psychological distress has a partial mediating effect on the hoarding behavior caused by fear of COVID-19 in the whole sample. To our knowledge, no prior studies have explored the mediating patterns operative among individual fear of COVID-19, severity of psychological distress, and hoarding severity. This research can facilitate a better understanding of the relationship between negative emotions in communities and abnormal hoarding behavior in the context of the COVID-19 pandemic, which can be reduced by decreasing people's fear of COVID-19 and their levels of depression and anxiety. Interestingly, after we analyzed the mediating and moderating effects in the context of the subscale on the nonstudent sample, we found that depression, anxiety and stress played a mediating role in the excessive acquisition behavior and accumulation behavior caused by fear of COVID-19. In addition, fear of COVID-19 in particular may have a specific effect on nonstudent samples via anxiety. Among these mediating effects, educational background and income play a moderating role in the process by which depression, anxiety and stress promote an increase in excessive seeking and accumulation behavior, respectively (Supplementary Tables S1–S6). In this context, depression, anxiety, and stress do not, for the most part, mediate the process of COVID-19 fear-induced difficulty discarding. This result could be due to people's focus on buying large quantities of necessities due to the quarantines and lockdowns instituted in response to the-COVID-19 pandemic. Such anxious and panic-related buying behavior is the main driving factor of the accumulation of items and excessive demand (Teufel et al., 2020), but it is unrelated to difficulty discarding. In other words, during the pandemic, people tend to focus on buying behaviors to alleviate the anxiety and stress resulting from the COVID-19 pandemic (Tse et al., 2022), while less attention is given to the discarding of everyday items. The moderating effect of educational background and income may be due to the fact that individuals with superior educational backgrounds generally have higher levels of awareness of measures related to pandemic prevention and control (Bazaid et al., 2020; Li and Liu, 2020; Li et al., 2021), which can prevent the blind buying and hoarding behaviors caused by anxiety, pressure and other emotional factors. High income can greatly reduce the impact of the pandemic on daily life, allowing individuals to maintain a high level of quality of life without anxiety that can promote an increase in hoarding behavior (Xiong et al., 2020; Huang et al., 2022). It is worth noting that compared with the student sample, educational background and income in the nonstudent sample have lesser moderating effects on the depression, anxiety and stress resulting from fear of COVID-19 and greater moderating effects on the excessive acquisition behavior and clutter behavior caused by depression, anxiety and stress.

Although the findings are interesting, some limitations still exist in the present study. During the survey period, the COVID-19 epidemic situation and related prevention and control policies are changing rapidly, and the epidemic trend and policy change are easy to affect the public's emotional level, thus reducing the accuracy of the survey results. Therefore, we choose to shorten the survey time to 3 days to minimize the instability of the psychological and emotional level and hoarding level of the survey population. In addition, the sample size will be further reduced after the sample is divided into student samples and nonstudent samples. However, according to the data analyzed, the sample size of N = 643 is also sufficient to reflect and express the correlation between COVID-19 fear and hoarding behavior among the current domestic population. Our findings therefore suggest a new strategy: governments could raise awareness of COVID-19 by encouraging media campaigns, or by targeting subsidies to those disproportionately affected by the pandemic. These measures have a positive moderating effect on improving hoarding behavior indirectly caused by fear of contracting COVID-19. However, the depression, anxiety and stress caused by fear of COVID-19 must also be managed in other ways, such as counseling by a professional counselor or taking medication for mental illness.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Medical Ethics Committee of Hebei Medical University. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

HS: conceptualization, methodology, supervision, resources, and review and editing. YZ: conceptualization, methodology, data curation, supervision, and review and editing. YY: conceptualization, methodology, data curation, writing-original draft, formal analysis, and writing-review and editing. RZ: conceptualization, methodology, data curation, and formal analysis. YC, SG, YLiu, SW, HZ, HC, and YLi: conceptualization, methodology, and data curation. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.996486/full#supplementary-material

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Depression, anxiety, stress, and physical activity of Australian adults during COVID-19: A combined longitudinal and repeated cross-sectional study

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Background: The COVID-19 pandemic has led to a worsening of mental health and health behaviors. While physical activity is positively associated mental health, there is limited understanding of how mental health and physical activity evolve throughout the COVID-19 pandemic. This study aimed to examine changes in depression, anxiety and stress and physical activity, and associations between depression, anxiety, and stress with physical activity in Australian adults across three-time points during the COVID-19 pandemic.

Materials and methods: This study collected both longitudinal and cross-sectional data at three-time points during the COVID-19 pandemic in Australia (i.e., April, July/August, and December 2020). Australians aged 18 years and over were invited to complete online surveys hosted on Qualtrics survey platform. Linear mixed models with random subject effect and general linear models were used to analyze the longitudinal and repeated cross-sectional data respectively.

Results: The number of participants in cross-sectional surveys and longitudinal surveys was 1,877 and 849, respectively. There was an overall reduction between time 2 vs. time 3 in depression (d = 1.03, 95% CI = 0.20, 1.85), anxiety (d = 0.57, 95% CI = 0.02, 1.12), and stress (d = 1.13, 95% CI = 0.21, 2.04) scores but no significant differences in physical activity across three-time points. On average, participants who met the physical activity guidelines had lower depression (d = −2.08, 95% CI = −2.90, −1.26), anxiety (d = −0.88, 95% CI = −1.41, −0.34), and stress (d = −1.35, 95% CI = −2.13, −0.56) scores compared to those not meeting the guidelines.

Conclusion: In the context of the ongoing COVID-19 pandemic, both governments and service providers should continue to provide the public with timely mental health support and promote the benefits of physical activity, as a cost-effective strategy to improve mental health and wellbeing.

KEYWORDS

mental health, DASS-21, exercise, COVID-19 pandemic, depressive symptoms, anxiety, distress

Introduction

On March 11, 2020, the World Health Organization (WHO) declared the novel coronavirus (COVID-19) a pandemic, due to its rapid global spread and high mortality (World Health Organisation, 2021). Since then, restrictive measures to contain the virus including lockdowns, self-isolation, and quarantine have brought significant social and economic impact to people's lives (Bonaccorsi et al., 2020; Dong and Bouey, 2020; Wells et al., 2020). As a consequence of these measures, mental health outcomes and health behaviors have declined (Xiong et al., 2020).

Studies exploring the impact of the COVID-19 pandemic on mental health have reported an increased prevalence of mental health problems and psychological distress in both clinical and general populations across the world, including depression, anxiety, stress, and post-traumatic disorder (Ahmed et al., 2020; Brooks et al., 2020; Chandola et al., 2020; Salari et al., 2020; Serafini et al., 2020; Torales et al., 2020; Violant-Holz et al., 2020; Xiong et al., 2020; Passavanti et al., 2021). Systematic reviews and meta-analyses on the impact of COVID-19 on mental health in the general population have reported a two-to-eight-fold increase in the prevalence of depression, anxiety, stress, and sleep disorders (Luo et al., 2020; Salari et al., 2020; Nochaiwong et al., 2021; Wu et al., 2021). This is concerning given that mental health is integral for good physical health, psychosocial functioning, and quality of life (World health Organisation, 2018).

Longitudinal studies were also examined changes in mental health over time during the pandemic. Specifically, a UK longitudinal study reported an almost threefold increase in mental health problems in the general population between the pre-pandemic period (2017–2019) and April 2020, with only a slight reduction in the elevated prevalence rate and severity by May/June 2020 (Daly et al., 2020). Similarly, an Austrian longitudinal study reported elevated levels of depression, anxiety and stress found in the general population in April 2020, largely unchanged by September 2020 (Pieh et al., 2021). In contrast, a USA longitudinal study found a significant increase in psychological distress in the general population at the beginning of the pandemic (March/April 2020), but by June 2020 psychological distress had reduced to be close to pre-pandemic levels (Daly and Robinson, 2021). As changes in mental health are generally attributed to governments' pandemic response policies, population resilience, and infection and mortality rates which were different worldwide (Daly et al., 2020; Daly and Robinson, 2021; Pieh et al., 2021), it is important to have local data to better understand the pandemic impact on mental health in Australia. To our knowledge there are no longitudinal studies examining change in mental health during the pandemic in Australia.

Previous studies have also reported significant declines in physical activity following implementation of lockdown measures, as people have been unable to access recreational and gym facilities and engage in incidental physical activities (Violant-Holz et al., 2020; Faulkner et al., 2021; Karageorghis et al., 2021). One of the few longitudinal studies in this area tracked a sample of 35,915 adults in England from March 2020 to August 2020 and reported that the majority of participants either stayed physically inactive or reduced physical activity from pre-lockdown to lockdown, and then to post lockdown (Bu et al., 2021). An Australian longitudinal study also reported a significant reduction albeit small in steps logged by participants of the Australian 10,000 steps program after the national lockdown in April 2020, but with a gradual recovery leading up to June 2020, as social restrictions eased (To et al., 2021).

There is evidence demonstrating that an increase of physical activity is associated with lower levels of depression, anxiety, and stress (Rebar et al., 2015; Chekroud et al., 2018; Schuch et al., 2019; Jacob et al., 2020; Kandola et al., 2020; Stanton et al., 2020; Violant-Holz et al., 2020; Puccinelli et al., 2021). However, the mechanism for mental health benefits of physical activity is not well-established. The effects are likely resulted from a combination of several mechanisms at psychological (e.g., mood, feelings of mastery, self-efficacy) and neurophysiological (e.g., hippocampal neurogenesis, hypothalamic-pituitary adrenal axis regulation) levels (Rebar et al., 2015). As the extraordinary circumstances caused by COVID-19 had a profound impact on people's physical and mental health, it is possible that the mechanism that normally drive the association between physical activity and mental health were altered. To date, there have been fewer studies examining the association

between changes in physical activity with depression, anxiety, and stress during the COVID-19 pandemic, hence more work is needed in this space. For example, a Canadian study found that those who reported engaging in more physical activity during lockdown periods experienced lower anxiety than those who reported being less physically active during lockdown (Lesser and Nienhuis, 2020).

Given the ongoing threats of the pandemic and the importance of mental health and physical activity for our overall health, the present study aimed to examine changes in depression, anxiety and stress, and physical activity, as well as the associations between depression, anxiety and stress with physical activity in Australian adults across three-time points throughout the pandemic. The findings from this study can assist governments and service providers making the decision regarding providing mental health and physical activity support for the public during the COVID-19 pandemic.

Materials and methods

Study design

This study made use of both longitudinal (i.e., the same participants completing at least two surveys) and repeated cross-sectional (i.e., different participants completing the survey at different time points) data collected at three-time points during COVID-19 pandemic in Australia. During the first survey, which was conducted from 9th to 19th April 2020, Australian governments had implemented nationwide lockdown measures to reduce the spread of infection including social distancing, stay at home orders, and domestic and international incoming and outgoing travel restrictions. During the second survey, which was conducted from 30th July to 16th August 2020, Victoria was the only Australian state in which a second wave of the COVID-19 pandemic had occurred, and a Victorian state-wide lockdown measure was enforced to protect people and control the rate of infection. In contrast, all other Australian states had reduced their preventive measures due to the low number of infected cases. During the third survey (conducted from 1st to 25th of December 2020), there were no hard lockdowns in place anywhere in Australia.

Participants and recruitment methods

Participants were recruited *via* paid advertisements on Facebook and through social media (the account was "CQUni COVID-19 Community Study" which is not connected to the official CQUni page). Advertisements included a direct link to the surveys hosted on Qualtrics survey platform. A range of images to separately target males and females were used. Central Queensland University internal emails including academic and professional staff were also used for recruitment. Australians aged 18 years and over were invited to complete the surveys. Online informed consent was obtained from all participants after they were provided with the information on the nature of the study and participation. The survey responses were anonymous. Participants were not paid for participation and no information about whether participants were participating in other studies was collected. Participants who completed the first or second survey were invited to participate in subsequent surveys. Those consenting to being re-contacted, provided their e-mail address so they could be advised of subsequent survey rounds. The total number of participants in three cross-sectional surveys were 1887 and in longitudinal surveys (including new participants recruited in survey 2) were 849. The study was approved by the Human Research Ethics Committee of Central Queensland University, Australia (Approval number 22332).

Measures

Depression, anxiety, and stress were assessed using the 21-item Depression, Anxiety and Stress Scale (DASS-21) (Lovibond and Lovibond, 1995). The DASS-21 has good construct validity in measuring the dimensions of depression, anxiety, and stress, as well as a high reliability with Cronbach's alpha α of 0.88, 0.82, and 0.90 for depression, anxiety, and stress respectively for general adult population (Henry and Crawford, 2005). Each scale comprises seven items scored on a 4-point Likert scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time). The score for each scale was calculated by adding the scores of the relevant seven items and multiplying the total by two. For clinical purpose, the following cut-off scores have been developed for defining (1) normal, (2) mild, (3) moderate, (4) severe, and (5) extremely severe scores respectively for each DASS scale: depression (0–9, 10–13, 14–20, 21–27, 28+), anxiety (0–7, 8–9, 10–14, 15–19, 20+), and stress (0–14, 15–18, 19–25, 26–33, 34+).

Physical activity was measured using the 8-item Active Australia Survey (AAS) (Australian Institute of Health and Welfare, 2003), which asks participants to report frequency and duration of their physical activity over the past 7 days, including gardening, walking, moderate, and vigorous physical activities. The total time in physical activity was calculated by adding the minutes for walking and moderate activity and double the time spent in vigorous activity (not including gardening). The AAS has an acceptable criterion validity with correlations between self-report physical activity and accelerometer data and pedometer steps 0.52 and 0.43, respectively (Brown et al., 2004). Physical activity level was coded to: meet (total physical activity $\geq$ 150 min per week); or not meet (total physical activity $<$ 150 min per week) the national physical activity guidelines (Australian Institute of Health and Welfare, 2003).

Sociodemographic characteristics included in this study were age, gender, educational attainment, household income, Body Mass Index (BMI), and chronic disease status. Participants'

weekly household income was categorized as: (1) less than AUD $1,000; (2) between AUD $1,000 and 2,000; (3) more than AUD $2,000. BMI was calculated as weight in kilograms divided by height in meters squared and interpreted based on the standard weight status categories: Normal (24.9 kg/m^2 or lower), Overweight (BMI of 25.0–29.9 kg/m^2), and Obese (BMI of 30.0 kg/m^{2}and above). When assessing for the presence of chronic disease, participants were asked the question "Have you ever been told by a doctor that you have any chronic health problems?" with a "yes" or "no" response.

Statistical analysis

Statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS) version 27. Descriptive statistics (mean ± standard deviation [M ± SD] and percentages [n, %]) were used to describe mental health and physical activity status, and sociodemographic characteristics of the sample at each of the three-time points.

To examine changes in depression, anxiety, stress and physical activity, and associations between depression, anxiety, and stress with physical activity across three-time points, linear mixed models with random subject effect were employed for the longitudinal data and general linear models were employed for the repeated cross-sectional data. Robust variance estimator was also used.

Sociodemographic characteristics were accounted for in multivariable analysis. There were less than 1% missing values for sociodemographic characteristics factors, except for household income which was 16.9% for repeated cross-sectional data, and 12.9% for longitudinal data across three-time points. Therefore, two multivariable models were run with and without household income. As the result between the two models were similar, only the multivariable model with household income is presented here. Given there were three-time points, Bonferroni adjustment method was used to correct inflated p-values. Crude estimates and those adjusted for potential confounders were reported with 95% confidence interval. Significance level was set at 0.05 and all p-values were two-tailed.

Results

Participants characteristics

Sociodemographic characteristics of the longitudinal sample are shown in Table 1. At baseline, two-thirds of participants (68.7%) were female and reported being overweight or obese (67.6%). Close to half of the participants reported a weekly household income of more than $2,000 Australian dollars per week and having at least one chronic condition. Average age was 52.3 years (SD = 14.2). For all time points, most participants were in the normal to mild ranges for depression, anxiety, and stress and close to half of the participants were meeting the physical activity guidelines. The characteristics of the repeated cross-sectional samples were similar to the longitudinal (Table 2).

Changes in depression, anxiety, stress, and physical activity

In longitudinal sample, Model 2 shows there was a significant decrease in depression score between time 1 and time 3 (d = 1.30, p = 0.003, CI = 0.36, 2.24) and between time 2 and time 3 (d = 1.03, p = 0.009, CI = 0.20, 1.85) (Table 3). There was a significant decrease in anxiety score between time 2 and time 3 (d = 0.57, p = 0.041, CI = 0.02, 1.12). There was a significant decrease in stress score between time 1 and time 3 (d = 1.13, p = 0.010, CI = 0.21, 2.04) as well as between time 2 and time 3 (d = 0.90, p = 0.024, CI = 0.09, 1.70). There were no significant differences in physical activity between the three-time points.

In the cross-sectional sample, Model 2 shows a significant increase in depression score between time 1 and time 2 (d = −2.25, p = 0.001, CI = −3.72, −0.77) and a significant decrease between time 2 and time 3 (d = 2.78, p = 0.001, CI = 0.93, 4.64) was found (Table 4). There was also a significant increase in anxiety score between time 1 and time 2 (d = −1.03, p = 0.032, CI = −2.00, −0.06). There was a significant increase in stress score between time 1 and time 2 (d = −1.56, p = 0.013, CI = −2.87, −0.25) and significant decrease in stress score between time 2 and time 3 (d = 2.18, p = 0.006, CI = 0.50, 3.86). There were no significant differences in the physical activity level found between the three-time points. The changes in the outcomes were also visualized in Figure 1.

Associations between mental health and physical activity

Table 5 shows there were significant associations between depression, anxiety, and stress with physical activity in both longitudinal and cross-sectional samples. Particularly, Model 2 shows that compared to those who reported not meeting the physical activity guidelines, those who reported meeting the physical activity guidelines were found to have significantly lower depression (d = −2.08, p = 0.001, CI = −2.90, −1.26), anxiety (d = −0.88, p = 0.001, CI = −1.41, −0.34) and stress scores (d = −1.35, p = 0.001, CI = −2.13, −0.56) in the longitudinal sample, and also significant lower depression (d = −2.32, p = 0.001, CI = −3.41, −1.23), anxiety (d = −1.45, p = 0.001, CI = −2.21, −0.70) and stress (d = −1.44, p = 0.005, CI = −2.44, −0.44) scores in the cross-sectional sample.

Discussion

The present study examined changes in depression, anxiety, stress and physical activity, as well as associations between depression, anxiety and stress with physical activity in Australian adults across three-time points during the COVID-19 pandemic. The findings showed that depression, anxiety, and stress scores were generally lower at time 3 for both longitudinal and cross-sectional samples. There was, however, one exception to this, the cross-sectional data indicated that from time 1 to time 2, depression, anxiety and stress scores significantly increased and the proportion of participants

TABLE 1 Sociodemographic characteristics of the longitudinal sample.

	Survey 1		Survey 2		Survey 3	
	n	% or mean (SD)	n	% or mean (SD)	n	% or mean (SD)
Gender						
Male	199	31.3%	270	31.8%	162	29.6%
Female	436	68.7%	579	68.2%	386	70.4%
Age (years)	635	52.29 (14.18)	849	53.22 (14.13)	548	53.81 (13.88)
Years of education	635	16.53 (4.68)	849	16.62 (4.69)	548	16.52 (4.62)
Household income/week						
<1,000AUD	147	26.5%	212	28.7%	141	29.7%
1,000–<2,000AUD	175	31.5%	217	29.4%	136	28.6%
≥2,000AUD	233	42.0%	310	41.9%	198	41.7%
Chronic disease						
Yes	300	47.2%	418	49.2%	281	51.3%
No	335	52.8%	431	50.8%	267	48.7%
Weight status						
Normal	197	31.2%	262	31.0%	149	27.3%
Overweight	214	33.9%	275	32.5%	198	36.3%
Obese	213	33.7%	293	34.7%	186	34.1%
Depression level						
Normal	408	64.3%	539	63.5%	368	67.2%
Mild	68	10.7%	82	9.7%	66	12.0%
Moderate	78	12.3%	109	12.8%	49	8.9%
Severe	34	5.4%	50	5.9%	23	4.2%
Extremely severe	47	7.4%	69	8.1%	42	7.7%
Anxiety level						
Normal	514	80.9%	652	76.8%	434	79.2%
Mild	29	4.6%	54	6.4%	27	4.9%
Moderate	50	7.9%	71	8.4%	58	10.6%
Severe	14	2.2%	30	3.5%	13	2.4%
Extremely severe	28	4.4%	42	4.9%	16	2.9%
Stress level						
Normal	464	73.1%	642	75.6%	432	78.8%
Mild	65	10.2%	63	7.4%	35	6.4%
Moderate	46	7.2%	62	7.3%	36	6.6%
Severe	45	7.1%	49	5.8%	29	5.3%
Extremely severe	15	2.4%	33	3.9%	16	2.9%
Meeting physical activity guidelines						
No	276	43.5%	376	44.9%	226	41.7%
Yes	359	56.5%	461	55.1%	316	58.3%
Depression score	635	8.68 (9.82)	849	8.98 (10.44)	548	7.93 (10.31)
Anxiety score	635	4.10 (6.27)	849	4.60 (6.76)	548	4.00 (5.96)
Stress score	635	9.88 (9.45)	849	9.92 (9.89)	548	8.89 (9.52)
Total physical activity minutes/week	635	322.60 (366.56)	837	312.89 (361.53)	542	330.35 (359.94)

TABLE 2 Sociodemographic characteristics of the cross-sectional sample.

	Survey 1		Survey 2		Survey 3	
	n	% or mean (SD)	n	% or mean (SD)	n	% or mean (SD)
Gender						
Male	325	34.1%	222	38.1%	166	47.0%
Female	627	65.9%	360	61.9%	187	53.0%
Age (years)	951	49.47 (15.32)	581	54.12 (15.04)	353	55.01 (14.39)
Years of Education	952	16.04 (5.32)	582	15.84 (5.29)	353	14.73 (5.36)
Household income/week						
<1,000AUD	216	26.7%	174	36.3%	106	38.1%
1,000–<2,000AUD	234	28.9%	130	27.1%	78	28.1%
≥2,000AUD	360	44.4%	176	36.7%	94	33.8%
Chronic disease						
Yes	440	46.2%	287	49.3%	150	42.5%
No	512	53.8%	295	50.7%	203	57.5%
Weight status						
Normal	268	28.4%	163	28.3%	69	19.7%
Overweight	312	33.1%	189	32.9%	126	36.0%
Obese	343	36.3%	209	36.3%	150	42.9%
Depression level						
Normal	573	60.2%	311	53.4%	227	64.3%
Mild	115	12.1%	73	12.5%	39	11.0%
Moderate	143	15.0%	87	14.9%	41	11.6%
Severe	48	5.0%	35	6.0%	19	5.4%
Extremely severe	73	7.7%	76	13.1%	27	7.6%
Anxiety level						
Normal	730	76.7%	425	73.0%	278	78.8%
Mild	55	5.8%	16	2.7%	17	4.8%
Moderate	82	8.6%	63	10.8%	27	7.6%
Severe	27	2.8%	33	5.7%	10	2.8%
Extremely severe	58	6.1%	45	7.7%	21	5.9%
Stress level						
Normal	683	71.7%	414	71.1%	273	77.3%
Mild	89	9.3%	46	7.9%	25	7.1%
Moderate	85	8.9%	56	9.6%	26	7.4%
Severe	63	6.6%	36	6.2%	19	5.4%
Extremely severe	32	3.4%	30	5.2%	10	2.8%
Meeting physical activity guidelines						
No	404	45.4%	261	47.5%	167	50.9%
Yes	485	54.6%	289	52.5%	161	49.1%
Depression score	952	9.57 (10.17)	582	11.36 (11.44)	353	8.41 (10.36)
Anxiety score	952	4.84 (7.23)	582	5.67 (7.51)	353	4.49 (7.24)
Stress score	952	10.57 (9.76)	582	11.24 (10.29)	353	8.96 (9.83)
Total physical activity minutes/week	889	303.67 (364.71)	550	335.93 (414.27)	328	315.91 (392.45)

reporting symptoms of extremely severe depression and severity anxiety, were doubled. This may in part be due to the negative impact of two consecutive lockdowns in Victoria, as there was an increase in the number of participants from Victoria joining the cross-sectional sample from 16.7 to 36.6% at time 2. The negative impact of strict lockdown measures on mental health have been reported in previous studies (Brooks et al., 2020; Chandola et al., 2020; Rossi et al., 2020). Similarly, our results shows that depression, anxiety and stress improved as the lockdown measures were relaxed.

TABLE 3 Changes in mental health and physical activity in the longitudinal sample.

	Model 1			Model 2		
	Difference	95% CI	*P*-value	Difference	95% CI	*P*-value
Depression score						
Time 1 vs. Time 3	1.28	0.43, 2.13	0.001	1.30	0.36, 2.24	0.003
Time 1 vs. Time 2	0.17	−0.55, 0.89	1.000	0.27	−0.53, 1.07	1.000
Time 2 vs. Time 3	1.11	0.37, 1.85	0.001	1.03	0.20, 1.85	0.009
Anxiety score						
Time 1 vs. Time 3	0.29	−0.28, 0.87	0.671	0.31	−0.31, 0.94	0.689
Time 1 vs. Time 2	−0.30	−0.79, 0.19	0.418	−0.25	−0.79, 0.28	0.759
Time 2 vs. Time 3	0.60	0.09, 1.10	0.015	0.57	0.02, 1.12	0.041
Stress score						
Time 1 vs. Time 3	1.10	0.27, 1.94	0.005	1.13	0.21, 2.04	0.010
Time 1 vs. Time 2	0.09	−0.62, 0.80	1.000	0.23	−0.55, 1.01	1.000
Time 2 vs. Time 3	1.01	0.28, 1.75	0.003	0.90	0.09, 1.70	0.024
Total PA minutes						
Time 1 vs. Time 3	−9.47	−45.10, 26.16	1.000	−9.75	−47.95, 28.45	1.000
Time 1 vs. Time 2	−10.26	−20.14, 40.66	1.000	15.47	−17.17, 48.11	0.768
Time 2 vs. Time 3	−19.73	−51.24, 11.78	0.401	−25.22	−59.16, 8.72	0.225

Model 1 is bivariate. Model 2 accounts for age, gender, educational attainment, income, body mass index, and chronic disease status.

TABLE 4 Changes in mental health and physical activity outcomes in cross-sectional sample.

	Model 1			Model 2		
	Difference	95% CI	*P*-value	Difference	95% CI	*P*-value
Depression score						
Time 1 vs. Time 3	1.16	−0.37, 2.70	0.211	0.54	−1.10, 2.18	1.000
Time 1 vs. Time 2	−1.79	−3.17, −0.41	0.006	−2.25	−3.72, −0.77	0.001
Time 2 vs. Time 3	2.95	1.21, 4.69	0.000	2.78	0.93, 4.64	0.001
Anxiety score						
Time 1 vs. Time 3	0.35	−0.73, 1.43	1.000	0.02	−1.15, 1.20	1.000
Time 1 vs. Time 2	−0.83	−1.76, 0.11	0.102	−1.03	−2.00, −0.06	0.032
Time 2 vs. Time 3	1.18	−0.01, 2.36	0.052	1.05	−0.22, 2.33	0.142
Stress score						
Time 1 vs. Time 3	1.61	0.14, 3.07	0.026	0.62	−0.89, 2.13	0.980
Time 1 vs. Time 2	−0.67	−1.94, 0.60	0.611	−1.56	−2.87, −0.25	0.013
Time 2 vs. Time 3	2.28	0.67, 3.90	0.002	2.18	0.50, 3.86	0.006
Total PA minutes						
Time 1 vs. Time 3	−12.24	−71.73, 47.25	1.000	12.65	−48.57, 73.87	1.000
Time 1 vs. Time 2	−32.25	−83.65, 19.14	0.399	−14.43	−68.25, 39.39	1.000
Time 2 vs. Time 3	20.01	−46.83, 86.86	1.000	27.08	−38.46, 92.63	0.968

Model 1 is bivariate. Model 2 accounts for age, gender, educational attainment, income, body mass index, and chronic disease status.

Our findings are also in line with the cross-sectional research outcomes reported by the Australian Bureau of Statistics, where in December 2020, the number of Australian adults feeling negatively impacted by the COVID-19 pandemic in relation to mental health, reduced to its lowest level since the initial peak in April 2020 (Australian Institute of Health and Welfare, 2021a). Our findings, however, are in contrast with reviews suggesting a worsening of mental health during the COVID-19 pandemic (Salari et al., 2020; Violant-Holz et al., 2020; Xiong et al., 2020). These differences may be accounted for by a combination of factors related to differences in both pandemic management and study sample. Since the onset of the COVID-19 pandemic, the Australian government has significantly invested in mental

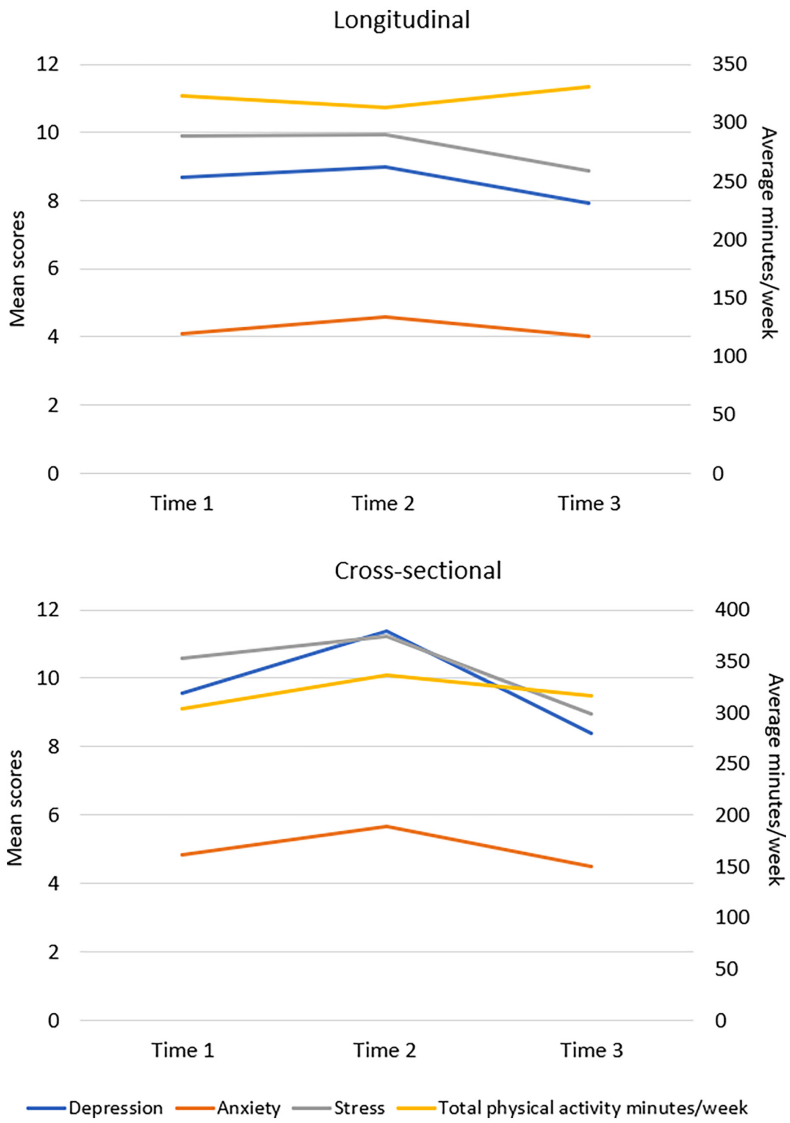

FIGURE 1
Changes in depression, anxiety, stress, and physical activity over time.

health care and unprecedented fiscal measures to support the nation's wellbeing and psychosocial functioning (Australian Institute of Health and Welfare, 2021b; Chen and Langwasser, 2021). Furthermore, when compared to most countries being affected by the COVID-19 pandemic, Australia had lower infection and mortality rates, and implemented less rounds of lockdown, which helped to minimize disruptions to usual living conditions to the greatest extent possible (Lowly Institute, 2020; Australian Institute of Health and Welfare, 2021a). In addition, a large proportion of our participants reported having a higher household income, being older and having more years of education than the Australian general population. Previous studies suggest these sociodemographic factors may be protective for mental health and wellbeing during the COVID-19 pandemic (Coulombe et al., 2020; Newby et al., 2020; Kunzler et al., 2021).

In contrast with studies reporting significant reductions in physical activity during the COVID-19 pandemic (Violant-Holz et al., 2020; Faulkner et al., 2021; Karageorghis et al., 2021; Stockwell et al., 2021), our findings indicated no significant changes in physical activity for both longitudinal and cross-sectional samples across the three-time points. The total average weekly physical activity reported by our participants was also marginally higher than the pre-pandemic general population average of 294 min of weekly physical activity for Australians aged 15 and over (Australian Bureau of Statistics, 2018). More than 55% of the longitudinal sample and 49% of the repeated cross-sectional sample reported meeting the physical

TABLE 5 Associations between mental health scores and meeting physical activity guidelines.

	Model 1			Model 2		
	Difference	95% CI	*P*-values	Difference	95% CI	*P*-values
Longitudinal sample						
Depression score	−2.03	−2.78, −1.28	<0.001	−2.08	−2.90, −1.26	<0.001
Anxiety score	−0.93	−1.43, −0.42	<0.001	−0.88	−1.41, −0.34	0.001
Stress score	−1.19	−1.92, −0.46	0.002	−1.35	−2.13, −0.56	<0.001
Cross-sectional sample						
Depression score	−2.82	−3.81, −1.84	<0.001	−2.32	−3.41, −1.23	<0.001
Anxiety score	−1.94	−2.61, −1.26	<0.001	−1.45	−2.21, −0.70	<0.001
Stress score	−1.76	−2.69, −0.83	<0.001	−1.44	−2.44, −0.44	0.005

Model 1 includes meeting physical activity (yes vs. no) and time. Model 2 includes meeting physical activity (yes vs. no), time, age, gender, educational attainment, income, body mass index, and chronic disease status.

activity guidelines of accumulating at least 150 min of moderate intensity physical activity per week, which were slightly higher than the pre-pandemic Australian general population average of 45% of adults meeting the physical activity guidelines (Vandelanotte et al., 2010; Alley et al., 2017; Australian Bureau of Statistics, 2018). Nevertheless, this is still a concerning low level of physical activity considering the significant health risks and related economic cost associated with physical inactivity (Ding et al., 2016; Hall et al., 2021).

The consistent levels of physical activity found in our samples may be due to several protective factors. Australian governments have actively promoted benefits and practical access to physical activity during the pandemic, including permitting outdoor exercise and recreational activities to be essential reasons for leaving home even during lockdown periods (Fitzpatrick et al., 2020). This was also reflected in the uptake and engagement of the 10,000 Steps program which quadrupled during the pandemic, with thousands of new people registering with the program (To et al., 2021). The lower infection rate and effective containment of the COVID-19 have also provided the public with a safer outdoor environment to be physically active (Lowly Institute, 2020; Australian Institute of Health and Welfare, 2021a). In addition, previous research has identified people being older in age, mentally well and having a higher household income and education level, tended to be more physically active during the COVID-19 pandemic, and most of our participants also shared these sociodemographic characteristics (Bu et al., 2021).

Consistent with previous evidence, the present study also demonstrated that regular participation in physical activity is associated with lower scores for depression, anxiety, and stress (Stubbs et al., 2017; Chekroud et al., 2018; Callow et al., 2020; Gianfredi et al., 2020; Lesser and Nienhuis, 2020; Stanton et al., 2020; Puccinelli et al., 2021). The positive influence of physical activity on mental health holds significant importance and implications for people's wellbeing and health preventative measures during the COVID-19 pandemic. Governments and health service providers should continue to promote the benefits and access to physical activity during this unprecedented health crisis and beyond. In particular, US and many European countries have already taken the initiative to invest and reconfigure streets into walking and cycling infrastructures during the pandemic to promote physical activity within a dedicated space (Doubleday et al., 2021; Kraus and Koch, 2021).

The present study has several strengths, including large sample sizes, broad national inclusion of participants from metropolitan, regional, and remote areas of Australia and application of both longitudinal and cross-sectional study designs. However, it also has limitations, which should be considered when interpreting and generalizing the results to other populations. Firstly, this study does not include pre-pandemic data and it is therefore unknown how mental health and physical activity outcomes changed from before the pandemic to the first time point. Secondly, a large proportion of participants were female, older in age, had higher household incomes, and more years of education than the Australian adult population. Thirdly, this study also relied on voluntary participation and there may have been an over-representation of participants joining in the study who perceived themselves to be affected by the current pandemic. Fourthly, this is an observational study and therefore, it is not possible to control for unknown confounders. Finally, the use of self-reported measures could result in recall bias and further research should consider using objective measures to strengthen the findings.

In conclusion, our findings show an improvement in depression, anxiety, and stress and no significant changes in physical activity in Australian adults across three-time points during the COVID-19 pandemic. The significant benefits of engaging in sufficient physical activity on mental health were also demonstrated. These findings have practical implications for physical activity to be utilized as a cost-effective coping method to support people's mental health, and the need for governments and service providers to continue implement initiatives to promote mental wellbeing and physical activity

as the COVID-19 pandemic continues to evolve. The findings from this study may also be applied in similar contexts in which other extraordinary negative events cause large scale psychological distress and changed social conditions (e.g., war, new pandemic). Further research is needed to monitor the long-term impact of the COVID-19 pandemic on mental health and physical activity to inform and guide appropriate public health promotion and intervention in a timely manner.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Human Research Ethics Committee of Central Queensland University, Australia (Approval number: 22332). The patients/participants provided their written informed consent to participate in this study.

Author contributions

QT, RS, SK, SW, SA, TT, AF, and CV: conceptualization, methodology, and review and editing. TT: data curation. WZ and QT: data analysis. WZ: manuscript drafting. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Relationship between alcohol consumption and adverse childhood experiences in college students–A cross-sectional study

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Background: Alcohol consumption is an important issue. Adverse childhood experiences (ACEs) can affect alcohol consumption later in life. Therefore, the main objective of this study was to test the association between ACE and the alcohol consumption in college students.

Materials and methods: A cross-sectional study on college students was conducted during December 2021 and January 2022, Through the school web system, students received a standard questionnaire on alcohol consumption (AUDIT) and ACEs. The study involved 4,044 participants from three universities in Slovakia.

Result: Compared to men, the incidence of emotional abuse by a parent, physical abuse by a parent, and sexual abuse was significantly higher in women ($p<0.001$). Furthermore, women reported greater emotional and physical neglect ($p<0.001$). The incidence of a high or very high AUDIT score in college students with ACE-0, ACE-1, ACE-2, ACE-3, and ACE-4+ was 3.8, 4.7, 4.1, 6.4, and 9.3%, respectively.

Conclusion: More adverse childhood experiences were associated with increased alcohol consumption in both male and female university students. Baseline drinking was higher in male students, but increased drinking in relation to an increase in ACEs was higher in female students. These results point to gender-specific driving forces and targets for intervention.

KEYWORDS

adverse childhood experience, alcohol consumption, COVID-19 pandemic, negative impact pandemic, audit

Introduction

Adverse childhood experiences, including several types of abuse (physical, sexual, and emotional abuse, neglect, being the witness of domestic violence, and other serious household dysfunctions), indicate potentially established traumatic sources of stress (Heim et al., 2002; DeLisi and Beauregard, 2018). Adverse Childhood Experiences (ACEs) can have lasting negative effects on health, wellbeing, education, and job potential (Herzog and Schmahl, 2018). Adverse childhood experiences are associated with poorer mental health and a higher risk of psychological and psychiatric problems (Kalmakis and Chandler, 2014; Reiser et al., 2014; Serafini et al., 2014). Several studies have suggested that ACEs are associated with a negative perception of physical health (Suliman et al., 2009; Duke et al., 2010; Putnam et al., 2013; Marackova et al., 2016; Scott and Semple, 2017; Lackova Rebicova et al., 2020). Furthermore, higher ACE scores increase the risk of developing several diseases in adulthood, increased alcohol consumption, and many types of addictions (Felitti, 2002; Chartier et al., 2010; Mouton et al., 2016).

With a lifetime prevalence of up to 14%, alcohol use disorder (AUD) is one of the main public health problems (Anda et al., 2002). In Slovakia, three out of four adults drink alcohol on occasion or regularly. Additionally, alcohol in Slovakia is more socially acceptable than other psychoactive substances, and the general societal environment can be considered alcogenic. Children who grew up in families with parental alcohol abuse are at increased risk of developing AUD with a wide range of psychological, physical, and socioeconomic health consequences (Koppes et al., 2006; Strine et al., 2012; Rehm and Shield, 2014; Shield et al., 2014; Frankenberger et al., 2015; Lee and Chen, 2017; Seitz et al., 2018). Identifying factors in all domains that are known to increase the risk of AUD is important for the development of more effective prevention and treatment strategies (Thompson et al., 2008). The prevalence of liver cirrhosis is highest in Slovakia, with alcohol-associated liver disease (ALD) being the most common aetiology (Sepanlou et al., 2020).

To better understand alcohol-related behaviour during, the Alcohol Use Disorder Identification Test (AUDIT) was administered to detect alcohol consumption in college students. Therefore, the main objective of this study was to test the association between adverse childhood experiences and the alcohol consumption of college students.

Therefore, our hypothesis is as the following:

> $H0: \mu_1 = \mu_2$ (there is no difference in the mean of ACE among alcohol non-users and users).
>
> $H1: \mu_1 \neq \mu_2$ (there is a difference in the mean of ACE among alcohol non-users and users).

Materials and methods

This analytical cross-sectional study was conducted between December 2021 and January 2022. Three Slovak universities were included in the study: (1) Matej Bel University in Banská Bystrica, (2) the Technical University of Košice, and (and attendance at boarding schools increased the odds of alcohol 3) Slovak Medical University Bratislava, Faculty of Health Care in Banska Bystrica. After obtaining their informed consent, the students completed structured questionnaires. The main outcomes were ACEs and alcohol consumption by Alcohol Use Disorder Identification Test (AUDIT) (Ballester et al., 2021). The questionnaire was compiled using Google Forms and distributed through the universities' online systems, and data were extracted into an Excel spreadsheet. College students self-reported responses. Demographic variables were obtained from students at the beginning of the questionnaire. The inclusion criteria were satisfied if the participants were college students at a Slovak university. The minimum required age was 18. Students with visual impairment were not included in the study. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants involved in the study. The study was approved by the Ethics Committee of Matej Bel University under the number 2200/2021.

Adverse childhood experience

The ACE questionnaire is an assessment tool that measures various types of abuse and other kinds of adverse experiences in childhood (Hardt and Rutter, 2004; Haaris Sheikh et al., 2017; Choi et al., 2020; McLennan et al., 2020). The ACE questionnaire includes 10 domains, each assigned zero (particular ACE not experienced) or one (ACE experienced) point and summarized as a final score on a scale of 0–10. The domains are physical, psychological, and sexual abuse, emotional and physical neglect, and domestic dysfunction, such as alcohol abuse, drug use at home, loss of a parent, mental illness, violent treatment of the mother, and imprisonment of the parent. Scores are expressed as the sum of points with a higher score representing more ACEs (Anda et al., 1999).

Alcohol use disorder identification test

The AUDIT is a simple and effective method of detecting unhealthy alcohol use, defined as risky or dangerous consumption or any alcohol use disorder (Daeppen et al., 2000; Kuitunen-Paul and Roerecke, 2018; Verhoog et al., 2020; Ballester et al., 2021). AUDIT can also help identify alcohol dependence and the specific consequences of harmful drinking. The Slovak standardized version was used. The final AUDIT score is divided into low

TABLE 1 Participants' characteristics.

		Total (N = 4,044)
Age (years)	Mean	22.33 (SD = 4.8)
Gender	Women	1,850 (45.7%)
	Men	2,194 (54.3%)
School year	First year	1,342 (33.2%)
	Second year	951 (23.5%)
	Third year	745 (18.4%)
	Fourth year	530 (13.1%)
	Fifth year	421 (10.4%)
	Sixth year	55 (1.4%)
Type of study	Full-time	3,697 (91.4%)
	Remote	347 (8.6%)
University	Technical University	2,769 (68.5%)
	Matej Bel University	1,066 (26.4%)
	Slovak Medical University	209 (5.2%)

(scores between 0 and 7), medium (scores between 8 and 15), high (scores between 16 and 19), and very high (scores 20 and above). The questions addressed: (1) frequency of drinking, (2) amount of alcohol ingested, (3) symptoms of addiction (impaired control of drinking, increased importance of drinking, and early morning drinking), and (4) surrogates of harmful alcohol use (guilt after drinking and alcohol-related injuries).

Participants

The study involved 4,044 students from the three universities in Slovakia: Technical University of Košice, Matej Bel University in Banská Bystrica, and the Slovak Medical University Bratislava, Faculty of Healthcare in Banská Bystrica. The characteristics of the cohort are shown in Table 1. The questionnaires were collected using Google Forms.

Statistical analysis

The results were uploaded in an Excel spreadsheet and subsequently subjected to a statistical analysis using the IBM SPSS Statistics 19 software. A two-proportion z-test, pooled for H0: $p1 = p2$, was used to test the equality of proportion between the groups of men and women. The absolute risk calculation was used to express the relationship between the final ACE score and the AUDIT score (absolute risk = the number of events in the treated group divided by the number of people in that group). As the distribution of ACE scores is not normal, the nonparametric Mann–Whitney U test was used to test the difference in mean score of ACE between group of alcohol users and group of alcohol non-users.

The sample size for this study was calculated using the following formula:

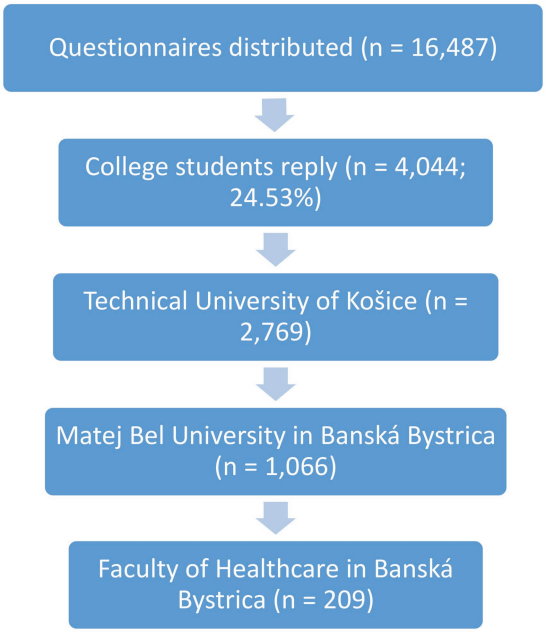

FIGURE 1
Flow diagram of the study.

$$n = \frac{\frac{Z^2 * p * q}{e^2}}{1 + \frac{Z^2 * p * q}{e^2 * N}}$$

where n = sample size, N = population size, Z = Z score, p = probability of success, q = probability of failure, and e = margin of error. The confidence level was set at 95%, the margin of error at 5%, the probability of success at 50%, and the population of Slovak university students at 133,558. Therefore, a sample of 196 subjects was required.

The internal consistency of the AUDIT and ACE scores was measured separately by the Cronbach's alpha coefficient of reliability. The AUDIT had a Cronbach's alpha of 0.79, and the ACE questionnaire had a Cronbach's alpha of 0.71.

Results

A total of 16,487 students received the questionnaire link. The total number of students who answered the questionnaire and were enrolled in the study was 4,044 (24.53%), which included 1,850 women (45.7%) and 2,194 men (54.3%) (see Figure 1).

The AUDIT was completed by a total of 3,647 students. Low AUDIT scores (0–7 points) were detected in 2,573 student participants (1,318 men, 1,258 women), medium scores (8–15 points) in 893 student participants (583 men, 310 women), high scores (16–19 points) in 92 student participants (68 men, 24 women), and very high scores (20–40 points) in 86 student participants (61 men, 25 women). The results are summarized in Table 2.

TABLE 2 Summary results of the AUDIT questionnaire according to the particular scores, domains, and genders.

Domains	Item of the AUDIT	Gender	Particular AUDIT score				
			(0)	(1)	(2)	(3)	(4)
Hazardous alcohol use	Q1. How often do you have a drink containing alcohol?	Women	4.5%	43.4%	24%	23.4%	4.8%
		Men	6.5%	34.5%	23%	24%	12%
		All	*5.6%*	*38.6%*	*23%*	*24%*	*8.8%*
	Q2. How many drinks containing alcohol do you have on a typical day when you are drinking?	Women	43.2%	40.6%	12.2%	3.4%	0.5%
		Men	23.6%	42.5%	22.4%	9.6%	1.8%
		All	*32.6%*	*41.6%*	*17.7%*	*6.8%*	*1.2%*
	Q3. How often do you have six or more drinks on one occasion?	Women	52.3%	30.9%	10.2%	4.3%	2.2%
		Men	33.7%	27.3%	16.1%	10.5%	12.5%
		All	*42.2%*	*29.0%*	*13.4%*	*7.7%*	*7.8%*
Dependence symptoms	Q4. How often during the last year have you found that you were not able to stop drinking once you had started?	Women	87.8%	8.2%	2.4%	0.7%	1.0%
		Men	86.9%	6.9%	3.6%	1.2%	1.4%
		All	*87.3%*	*7.5%*	*3.0%*	*1.0%*	*1.2%*
	Q5. How often during the last year have you failed to do what was normally expected from you because of drinking?	Women	82.4%	14.1%	2.3%	0.9%	0.4%
		Men	79.2%	14.5%	4.3%	1.3%	0.7%
		All	*80.7%*	*14.3%*	*3.4%*	*1.1%*	*0.5%*
	Q6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	Women	97.2%	1.7%	0.5%	0.2%	0.3%
		Men	93.0%	4.7%	1.0%	0.6%	0.7%
		All	*95.0%*	*3.3%*	*0.8%*	*0.4%*	*0.5%*
Harmful alcohol use	Q7. How often during the last year have you had a feeling of guilt or remorse after drinking?	Women	72.4%	20.9%	5.0%	0.9%	0.8%
		Men	72.2%	21.5%	4.5%	1.1%	0.8%
		All	*72.3%*	*21.2%*	*4.7%*	*1.0%*	*0.8%*
	Q8. How often during the last year have you been unable to remember what happened the night before because you had been drinking?	Women	75.7%	19.4%	3.6%	0.7%	0.6%
		Men	67.2%	24.1%	6.5%	1.6%	0.6%
		All	*71.1%*	*21.9%*	*5.2%*	*1.2%*	*0.6%*
	Q9. Have you or someone else been injured as a result of your drinking?	Women	82.6%		11.4%		6.0%
		Men	78.0%		15.1%		6.9%
		All	*80.1%*		*13.4%*		*6.5%*
	Q10. Has a relative or friend or a doctor or another health worker been concerned about your drinking or suggested you cut down?	Women	95.8%		2.0%		2.2%
		Men	92.3%		3.2%		4.5%
		All	*93.9%*		*2.7%*		*3.5%*

Particular score explanation: item Q1: 0 (never), 1 (monthly or less), 2 (2–4 times a month), 3 (2–3 times a week), or 4 (4 or more times a week); item Q2: 0 (1–2), 1 (3–4), 2 (5–6), 3 (7–9), or 4 (10 or more); items Q3–Q8: 0 (never), 1 (less than monthly), 2 (monthly), 3 (weekly), or 4 (daily or almost daily); items Q9–Q10: 0 (no), 2 (yes, but not in the last year), or 4 (yes, during the last year).

Compared to men, the incidence of emotional abuse by a parent, physical abuse by a parent, and sexual abuse by anyone was significantly higher in women ($p < 0.001$). Similarly, women reported greater emotional and physical neglect, growing up with

TABLE 3 ACE results according to the type and gender.

Domain of the ACE	Gender	Proportion of ´YES´	*p*-value*	Frequencies	
				´YES´	´NO´
1. Emotional abuse by a parent	Women	19.8%	<0.001	367	1,483
	Men	11.5%		252	1,942
	All	**15.3%**		*619*	*3,425*
2. Physical abuse by a parent	Women	12.2%	<0.001	225	1,625
	Men	8.2%		181	2,013
	All	**10.0%**		*406*	*3,638*
3. Sexual abuse by anyone	Women	16.2%	<0.001	300	1,550
	Men	2.9%		63	2,131
	All	**8.9%**		*363*	*3,681*
4. Emotional neglect	Women	21.9%	<0.001	406	1,444
	Men	10.5%		230	1,964
	All	**15.7%**		*636*	*3,408*
5. Physical neglect	Women	9.9%	<0.001	184	1,666
	Men	5.8%		128	2,066
	All	**7.7%**		*312*	*3,732*
6. Parental separation/ divorce	Women	23.2%	<0.001	429	1,421
	Men	18.2%		399	1,795
	All	**20.5%**		*828*	*3,216*
7. Battered mother	Women	17.0%	<0.001	*315*	*1,535*
	Men	13.5%		*297*	*1,897*
	All	**15.1%**		*612*	*3,432*
8. Growing up with an alcohol and/or drug abuser in the household	Women	20.1%	<0.001	372	1,478
	Men	12.9%		284	1,910
	All	**16.2%**		*656*	*3,388*
9. Living with a family member experiencing mental illness	Women	20.1%	<0.001	372	1,478
	Men	12.5%		274	1,920
	All	**15.9%**		*646*	*3,398*
10. Experiencing the incarceration of a household member	Women	7.2%	0.0348	134	1,716
	Men	5.8%		128	2,066
	All	**6.5%**		*262*	*3,782*

*According to two-proportion *z*-test, pooled for H0: $p1 = p2$.

an alcohol and/or drug abuser at home, and living with a family member experiencing mental illness ($p < 0.001$). The results are summarized in Table 3.

The incidence of a high or very high AUDIT score in college students with ACE-0, ACE-1, ACE-2, ACE-3, and ACE-4+ was 3.8, 4.7, 4.1, 6.4, and 9.3%, respectively ($p < 0.001$ for ACE-0 vs. ACE-4+). Students who scored an AUDIT score suggesting an increased risk of developing AUD (16–40 score) also scored higher in ACE. These associations are seen in Figure 2.

Of the men who had high or very high AUDIT scores, 5.5% reported no ACE and 10.2% reported an ACE score of 4 or more ($Z = 2.14$; $p = 0.016$). Of women who had high or very high AUDIT scores, 0.9% reported having no ACEs and 8.9% reported an ACE score of 4 or more ($Z = 6.19$; $p < 0.001$) (see Table 4).

For students who had an ACE of 0–3 and a final AUDIT score in the high range, a statistically significant difference was found between men and women, with men being more prone to association between ACE and AUDIT than women ($Z = 6.41$; $p < 0.001$). For students with ACE scores of at least 4 and a high AUDIT final score, no statistically significant differences were found between men and women ($Z = 0.44$; $p = 0.663$; Figure 2).

Comparison of the mean score between the group of alcohol users and the group of non-alcoholics showed that there was a statistically significant difference between these groups ($Z = 4.559$, $p < 0.001$) (Table 5).

Discussion

Slovakia belongs to countries with high alcohol consumption (Chapman et al., 2004; Ford et al., 2011). In our study, an association was observed between a higher incidence of ACEs and alcohol consumption among college students. More ACEs were associated with increased alcohol consumption in both male and female university students. The higher incidence of ACEs may represent one of the main aspects of the development of

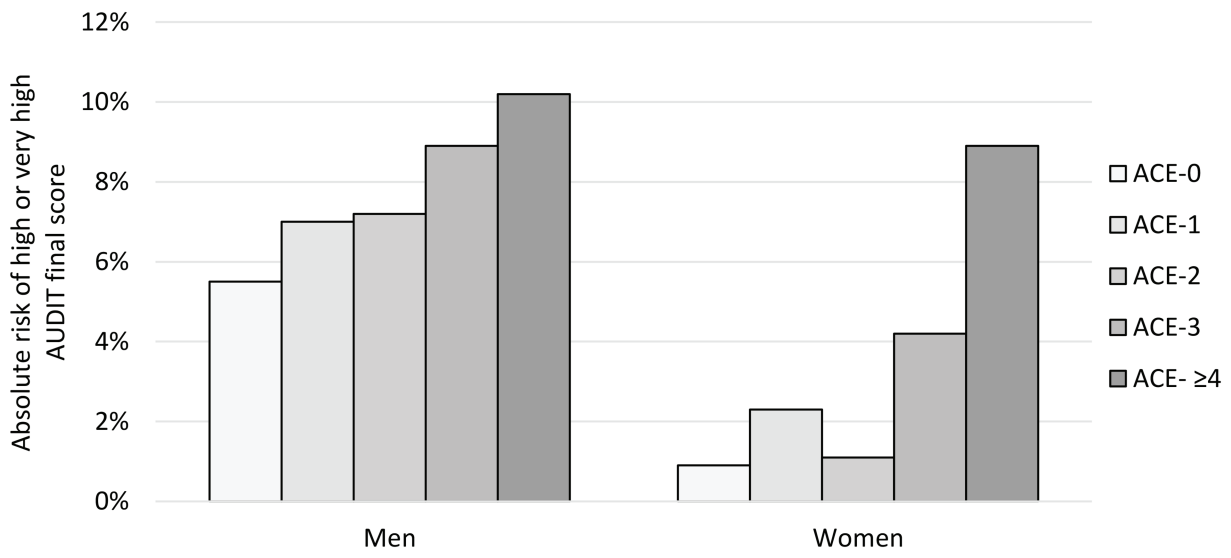

FIGURE 2
Absolute risk of high or very high AUDIT score in relation to ACE score, separately for men and women.

TABLE 4 Distribution of participants according to ACE score and AUDIT final score.

ACE score	AUDIT final score			Total
	Low	Medium	High or very high	
0	73.6%	22.6%	3.8%	100%
1	71.3%	23.9%	4.7%	100%
2	67.7%	28.1%	4.1%	100%
3	67.0%	26.7%	6.3%	100%
≥4	63.2%	27.6%	9.3%	100%
Total	70.6%	24.5%	4.9%	100%

TABLE 5 Groups of alcohol users and non-users - descriptive statistics of ACE score.

Group	*N*	Mean ACE score	*SD*	*Z**	*p*-value
Alcohol users	1,071 (29.4%)	1.53	1.9	4.559	< 0.001
Alcohol non-users	2,576 (70.6%)	1.23	1.7		

*According to Mann–Whitney *U* test.

excessive alcohol consumption in later life. In our study, a high prevalence of ACEs was found; ACEs were not rare and were more common in women than in men. In college students, a low proportion of abstinent students was found. College students in their twenties are less than 6% absolute abstainers (together with the alarming 8.8% of frequent and binge drinkers). Slovakia ranks first in the world in the prevalence of liver cirrhosis, and the mortality of AUD is 1.5 times higher than in the rest of Europe (Sepanlou et al., 2020). These results are very likely reflections of a permissive national alcohol policy. The relationship between increased alcohol consumption was found in both men and women; however, in female students, the incidence of ACEs and their relative impact on the increase in AUDIT was higher compared to male students. It is common knowledge that girls are more likely to be exposed to sexual violence than boys, which is correlated with the results of our study (Finkelhor, 1994). On the other hand, a higher baseline alcohol consumption was found (higher AUDIT scores in students without ACEs) in male students compared to female students. The relative increase in AUDIT scores based on the increase in ACE scores was more pronounced in female students (approximately tenfold increase between ACE-0 and ACE-4+) compared to male students (approximately twofold increase); however, the cumulative proportion of drinkers in any ACE category was higher in male students. Our results show that in male students, additional driving forces behind alcohol consumption, in addition to ACEs, are important.

The links between gender, early ACEs, and self-reported binge drinking and heavy drinking were studied by Crouch et al. (2018). Almost all ACE categories were associated with an increased probability of reporting binge drinking and heavy drinking. Mental illness had the highest odds for men, and emotional abuse had the highest odds for women. Men and women with four or more ACEs had a higher chance of reporting binge and heavy drinking compared to their counterparts. In addition to these findings, our results point to the difference in the strength of impact ACEs can exert on drinking of women compared to men (10-fold increase compared to a 2-fold increase).

ACEs are associated with a higher risk of anxiety and depression in old age (Chapman et al., 2004; Ford et al., 2011; Hovens et al., 2015). A better understanding of the factors underlying the risk of problem drinking and dependence on alcohol is important for the development of better prevention and early intervention measures. Depression among adult children of alcoholics appears to be largely, if not exclusively, associated with an unfavourable family experience with their parents (Anda et al., 2002). ACEs are common and strongly associated with subsequent alcohol abuse and are likely to account for a high proportion of alcohol abuse (Leung et al., 2016). Children in alcoholic families have more frequent adverse experiences (Wolock and Magura, 1996); however, the risk of alcoholism and depression in adulthood increases with the increasing number of ACEs, regardless of parental alcohol abuse (Wolock and Magura, 1996). The effects of parental substance use (including alcohol) on abuse outcome of their children's appear to be partly mediated by their neglectful parenting (Rothman et al., 2008; Pilowsky et al., 2009). Loudermilk et al. (2018) studied the association between binge drinking and ACEs. Adults who experienced household abuse were 30% more likely to drink. As in our study, men were at increased risk of becoming alcoholics. The association between alcohol consumption and ACEs was also studied by Koss et al. (2003). There were significant sex differences in alcohol dependence and several ACEs. High prevalence rates for one or more types of ACEs were documented (men: 74–100%; women: 83–93%). For men, combined physical and sexual abuse significantly increased the likelihood of subsequent alcohol dependence; for women, sexual abuse, and attendance at boarding schools increased the odds of alcohol dependence. In a study by Batty et al. (2008), 8,170 individuals born in 1970 were tested for alcohol drinking. Higher childhood mental ability scores had an increased prevalence of problem drinking in adulthood. Unlike our study, this association was stronger in women. Childhood mental ability was also associated with a higher average intake of alcohol and a higher frequency of drinking.

Our study has several limitations. The main limitation of our study is the retrospective nature of the study, which is associated with several risks of bias. It is difficult to determine a direct association according to cross-sectional analysis. Therefore, it is difficult to make clear recommendations. Study was done during the pandemic COVID-19 which may have influenced the outcome of alcohol consumption.

The questionnaires were distributed through the schools' online communication systems, and their completion was voluntary. This could have led to a selection bias. The veracity of obtained data on the ACE test and the AUDIT cannot be proved, and therefore, some answers may be underestimated or overestimated. Finally, since the level of education also depends on the ACE score, the results of our study may not reflect other segments of the population. On the other hand, the strengths of the study are its size of several 1000's and the rarity of alcohol consumption that is analysed against ACE in the regional and social environment of college students.

Conclusion

Among university students, ACEs were not rare and were more frequent in women than in men. Higher ACE scores were associated with higher AUDIT scores in both men and women. Men without ACEs have higher AUDIT scores than women without ACEs. An association between ACE and AUDIT scores was stronger in female students compared to male students. This points to the gender-specific pathogenesis of alcohol use and AUD, with the underlying driving forces being therapeutic targets.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethical statement

The studies involving human participants were reviewed and approved by Ethical Committee of Matej Bel University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

KŠ, ĽS, EL, and MM: conceptualization. ĽS, DL, TK, and KŠ: methodology. ĽS: validation and supervision. ĽS, KŠ, MS, and MM: formal analysis. DL, EL, and KŠ: investigation. KŠ, DL, ĽS, MP, and MM: writing. KŠ, DL, and EL: original draft preparation. KŠ, DL, EL, MS, MP, TK, LB, MM, and ĽS: writing—review and editing. EL and MS: project administration. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.1004651/full#supplementary-material

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Impacts of university lockdown during the coronavirus pandemic on college students' academic achievement and critical thinking: A longitudinal study

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The outbreak of the coronavirus disease 2019 (COVID-19) has resulted in widespread university lockdown. However, impacts of the university lockdown on the learning and academic development of university students have not been thoroughly investigated. The current study examined college students' changes of learning outcomes during the COVID-19 lockdown period and clarified what might explain individual differences in students' learning outcomes after they had learned from home for a whole semester when universities were physically closed due to the COVID-19 pandemic. Data were derived from a longitudinal study examining the development of college students including students' academic achievement and critical thinking (including both skills and dispositions) before and after the university lockdown. We observed significant decreases in critical thinking skills and dispositions from pre- to post-lockdown. Both perceived academic achievement and critical thinking exhibited greater variability after the lockdown. In addition, students' readiness for online learning, especially their self-management skills, consistently predicted post-lockdown learning outcomes after controlling for pre-lockdown outcomes and family socioeconomic status (SES). Those who have assumed more responsibilities at home, or who were more vulnerable to emotional distress during the pandemic, performed less well in post-lockdown learning outcomes. These findings call for better management of student learning and development when major changes are required in higher education practices for responding to the ongoing COVID-19 crisis as well as other potential situations.

KEYWORDS

academic achievement, critical thinking skills, critical thinking dispositions, COVID-19, distant learning, learning performance, self-management skills

Introduction

The outbreak of the coronavirus disease 2019 (COVID-19) has resulted in widespread school shutdowns. More than 180 countries around the world have mandated school closures, leaving, at its peak in April 2020, approximately 1.5 billion children and youth out of school (UNESCO, 2020). Just within higher education in China, all colleges and universities shut down and adopted distance education during the spring semester of 2020, affecting more than 17 million college students (Yao, 2020). The university closures discontinued the classic style of higher education, forcing students to adjust to learning at home, as well as to adopt new learning methods (Gonzalez et al., 2020). These dramatic changes are likely to pose significant disruptions to students' conventional learning and created several uncertainties which may affect students' learning outcomes. Concerns have been raised with respect to students' learning losses and greater variability in their academic skills due to school closures or the temporary lockdown of universities (Kaffenberger, 2021). The current paper, by means of a longitudinal study, evaluated impacts of a university lockdown on students' learning outcomes represented by academic achievement and critical thinking (including both skills and dispositions), and clarified how and to what extent learning from home during the COVID-19 pandemic affected college students' learning outcomes.

Potential effects of university lockdowns on students' learning outcomes

While school and university lockdowns are deemed necessary to mitigate the spread of the coronavirus, they may carry important consequences for students' academic development. Many studies have examined effects of school lockdowns or home confinements on K-12 students, suggesting that school lockdowns have produced substantial losses in students' learning outcomes (Azevedo et al., 2021; Clark et al., 2021; Maldonado and De Witte, 2021; Parolin and Lee, 2021). Modeling estimates suggest that these learning losses continue to accumulate even after children return to schools (Kuhfeld et al., 2020). However, at the moment it remains unclear whether the university lockdown affects college students learning performance. Young adults are assumed to experience less difficulty when adapting to distant learning than children, given that most young adults have some online learning experiences while K-12 students rely heavily on classroom learning. Moreover, compared to school-aged children, young adults have acquired some amount of self-management skills to facilitate learning beyond classrooms (Anthonysamy et al., 2020). For example, Gonzalez et al. (2020) found that college students changed their learning strategies to a more continuous habit during COVID-19 home confinements, which contributed to improved academic scores. Though that study focused only on changes of college students' academic scores, the finding contrasted with the widely assumed learning loss concerns due to university lockdowns.

It needs to note that previous studies mostly investigated students' changes of academic achievement due to the pandemic, impacts of university lockdowns on students' other important learning outcomes have not been reported. One crucial learning outcome is critical thinking that is described as the acquisition of deep and meaningful understanding as well as critical inquiry skills and dispositions (Garrison et al., 2001). Critical thinking has been recognized as one of the most important learning outcomes expected of college students (Halpern, 1998; Shaw et al., 2020). Apparently, a comprehensive examination of students' learning outcomes before and after the university lockdown is required to evaluate effects of the university lockdown upon both their academic achievement, as well as critical thinking skills and dispositions.

Factors related to students' learning during the lockdown period

In addition to possible changes in students' learning outcomes, a more crucial issue is to clarify what might have shaped students' post-lockdown learning outcomes given that the COVID-19 pandemic is an undeniably unique event with many new factors that may affect students' learning. Though a thorough examination of all impacting factors is not possible, several of them are particularly notable in characterizing students' at-home learning during the lockdown period due to COVID-19.

First, the outbreak of the coronavirus pandemic has pushed most universities toward distance education, which was probably the only option to mitigate the adverse influence of the disruption to classroom learning. Though few were ready for this abrupt transition, students' skills and attitudes toward online learning are important factors to keep them actively engaged online (Bolliger, 2004; Hsu et al., 2019). Research shows that online learning successes rely heavily on students' self-management skills (Wang, 2011; Broadbent, 2017; Panadero et al., 2019). Self-management skills include students' ability to evaluate, monitor, and regulate themselves and assume responsibility for their own performance (Frayne, 1991; Gerhardt, 2007). These skills are especially valuable qualities for online learning at home given that many students may not have had practical guidelines they could follow during the pandemic.

Second, high rates of the transmission and mortality of COVID-19, combined with a lack of prevention and treatment measures, have left many people with cognitive uncertainty as well as negative emotions (Shanahan et al., 2020;

Wang et al., 2020; Rodriguez et al., 2021). High rates of psychological distress have been reported among young adults in response to the pandemic (Xiong et al., 2020). Stressors such as fears of infection, frustration, and anger would likely have enduring effects on college students and their learning performance (Hasan and Bao, 2020). Thus, it is assumed students' cognitive and emotional responses to the pandemic might affect their learning outcomes.

Third, research shows that the detrimental effects of school lockdown on K-12 students' academic performance are particularly evident for students from disadvantaged family backgrounds (Kuhfeld et al., 2020; Parolin and Lee, 2021). Unlike typical learning activities conducted at universities, most college students learned from home during the pandemic. This means that college students' learning is likely to be at least partially dependent upon their home environments and their daily family interactions. For example, college students are already adults and are expected to share domestic responsibilities with their parents when they stay at home. Thus, students' family and home issues (e.g., taking care of family issues, dealing with housework chores) during the pandemic are likely to influence their time and effort put into learning, which may eventually affect their learning outcomes. Consequently, it is reasonable to assume that students' time put into family or home responsibilities when they stayed at home might be another important type of factor influencing their post-lockdown learning outcomes.

The present study

In this study, we examined impacts of COVID-19 university lockdown on college students' learning outcomes including academic achievement and critical thinking, and further identified factors affecting their learning outcomes when students learned at home during the pandemic. The data used for analyses were drawn from a longitudinal study collecting data before and after the university lockdown from students at a public university in Zhengzhou, China, which is located approximately 3 h by train from Wuhan, the first epicenter of the global COVID-19 pandemic. The university, like most other universities in China, started the Lunar New Year vacation from the middle of January 2020, and shifted to distance education from February 2020 following China's national school closure policy due to the outbreak of COVID-19 in late January 2020.[1] Students were asked to study online and were not allowed to return to campus until September 2020. This meant that these students had stayed home for approximately 9 months (including a 2-month summer vacation). Our data were composed of pre- and post-lockdown assessments (with an interval of 12 months) of learning outcomes and several issues related to students' learning performance. The unique feature of the data allowed us to evaluate changes (both performance average and variability) of students' learning outcomes and to clarify factors influencing their post-lockdown outcomes when pre-pandemic levels were accounted for.

In addition, to examine changes of academic achievement and critical thinking, we evaluated a variety of learning-related factors including students' readiness for online learning, their cognitive and emotional responses to the pandemic, time devoted to learning at home, and responsibilities at home to examine their potential effects on learning outcomes. Since family socioeconomic status (SES) has been shown to influence students' educational outcomes (Sirin, 2005), we also measured students' family SES as background variables. It was hypothesized that the learning-related factors would account for variations in students' post-lockdown learning outcomes when their pre-lockdown outcomes and family SES were controlled for.

Eventually, this study aimed to clarify not only what has happened to college students' learning during the COVID-19 lockdown period pandemic but also what might have shaped their academic achievement and critical thinking. Addressing both of these goals is crucial for higher education providers to deal with consequences of university closures during the COVID-19 pandemic and similar situations in the future.

Materials and methods

Sample and procedures

As stated earlier, data came from a longitudinal, ongoing research project on college students' academic development. The project was initiated in October 2018, when 648 first-year college students were recruited via the university subject pool. Participants were informed that they would be contacted and tested again in October 2019, and October 2020. A new cohort of first-year students ($N = 364$) was recruited and added to the sample pool in October 2019, and was retested in October 2020. Students' learning-related skills and dispositions were measured each year with scales and questionnaires varied slightly from year-to-year. This paper used the data collected in October 2019 as the pre-lockdown data (except for the critical thinking skill test, which was collected in October 2018), and used those collected in October 2020 as the post-lockdown data. This

1 In late January 2020, China postponed all educational activities and the Chinese Ministry of Education urged higher education institutions to use online delivery as an alternative to face-to-face teaching. In response to the call, higher education institutions in mainland China transitioned to online teaching for the spring semester of 2020. College students in most universities were not allowed to return to campus until the start of the autumn semester of 2020.

provided us with 1,004[2] effective participants (635 women, *M* age = 21.67, *SD* age = 1.01 at October 2020). Approximately 80% of the sample majored in social science, with 20% in natural sciences and mathematics. In addition, 38% of the sample grew up in urban areas, 56% in rural areas, and 6% did not indicate the rural/urban information. The study protocol was approved by the Human Subjects Review Committee of the Huazhong University of Science and Technology. Each participant signed a written informed consent describing the study purpose, procedure and right of withdrawal during the study.

All measures were administered in a computer room at the university. Participants were tested in groups of 35–55 by two research assistants. Each participant completed the measures on a computer. The pre-lockdown testing included measures of socioeconomic status, perceived academic achievement, and critical thinking skills and dispositions. Besides the pre-lockdown measures, the post-lockdown testing additionally included questionnaires assessing students' readiness for online learning, students' cognitive and emotional responses to the pandemic, their time devoted to learning, and responsibilities at home when they stayed at home during the pandemic.

Measures of learning outcomes

Grade point average

College grade point average (GPA) was gathered from student records. The GPA for the autumn semester of 2019 and the spring semester of 2020 were used as academic scores before and after the university lockdown. However, we learned from the university's academic affairs division that exam difficulty in the spring semester of 2020 was set by many teachers at a relatively low level given that students had experienced a disruption to normal schooling by the pandemic. Therefore, GPA scores after the university lockdown ($M = 3.42$, $SD = 0.51$) were relatively high compared to those before the lockdown ($M = 2.65$, $SD = 0.82$). We thus employed a standard test to assess students' self-perceived academic achievement (see below) as a supplement.

Perceived academic achievement

Perceived academic achievement was assessed by a subscale from the Student Learning and Development Scale (Wei et al., 2015), which was developed to assess Chinese undergraduate students' academic, social, and practical development. The academic subscale was especially suitable for assessing perceived academic achievement of Chinese college students (Ren et al., 2020). The subscale has five items measuring multiple dimensions of students' academic performance: students' level of professional knowledge, students' level of research methods in the subjects they have learned, students' comprehensive applied ability, students' level of reading and comprehension, and students' ability of using information technology for learning and research. Participants were asked to indicate how much progress they had made in each of the academic dimensions over the past year. The subscale used a 4-point scale (1 = *no improvement*; 4 = *greatly improved*). Scores of this subscale ranged from 5 to 20. Higher scores reflected larger achievement. The subscale showed good reliabilities and construct validities among Chinese college students (Wei et al., 2015). The internal consistency reliability in the current study was 0.86.

Critical thinking skills

The Chinese Critical Thinking Test was used to tap students' critical thinking skills (Luo and Yang, 2002). This test was designed based on the California Critical Thinking Skills Test (Facione et al., 2002). For the Chinese version, Luo and Yang generated test items according to lifestyles of Chinese students. The test includes 34 multiple-choice items, each of which has four response options, with only one being correct. The items assess five critical thinking skills: evaluation, inference, analysis, inductive reasoning, and deductive reasoning. The score was the total number of correctly answered items. As reported by Luo and Yang (2002), the test-retest correlation (1 month between time 1 and time 2) was 0.63, and the split-half reliability was 0.80. In addition, there were moderate to strong correlations between scores of the subscales and the total score (>0.50, Lin, 2018), supporting the construct validity of the test. The internal consistency reliability of this scale was 0.64 in the current study.

Critical thinking dispositions

The Chinese Critical Thinking Dispositions Inventory (Ren et al., 2020) was developed according to the conceptual framework of the California Critical Thinking Disposition Inventory (Facione et al., 2001). In this study, we used three subscales of the inventory to shorten testing time and reduce students' fatigue. The three subscales assessed critical thinking dispositions (truth-seeking, analyticity and systematicity) that have been frequently studied in the critical thinking literature. Truth-seeking reflects one's objectivity with findings even if the findings do not support one's preconceived opinions. Analyticity refers to the disposition of applying reasoning and the use of evidence to solve problems. Systematicity reflects one's disposition of being organized and orderly in inquiry. Each disposition dimension was measured by five items. Since the current research treats critical thinking dispositions as a component of critical thinking, the total score of the test was used. Participants rated items using a 6-point scale (1 = *strongly disagree*; 6 = *strongly agree*). The internal consistency reliability of this inventory was 0.82 based on data of our study.

2 Eight participants were omitted from the post-lockdown survey and their data were not included.

Measures of potential factors related to students' learning

Readiness for online learning

This questionnaire was adapted from the online learning instrument developed by Smith et al. (2003) to assess students' readiness for online learning. The **Supplementary material** presents all items of this measure, as well as items of other measures of potential factors associated with learning. The online readiness questionnaire assesses two important factors: the readiness for online learning skills, reflecting student's comfort with basic online learning skills (e.g., computing, communication, and keyboarding), and the readiness for self-management learning, reflecting the readiness for organization, time-management, and independence necessary for online learning. The readiness for online learning skills factor included six items (e.g., "I was able to easily access the Internet as needed for my studies"). The readiness for self-management of learning factor included four items (e.g., "I was able to manage my study time effectively and easily completed assignments on time"). Students indicated their agreement using a 5-point scale (1 = *strongly disagree*; 5 = *strongly agree*). Separate scores were computed for the two subscales of online learning. Higher scores reflected better preparation for online learning. The questionnaire showed a good reliability (with a Cronbach alpha of 0.83), and yielded a two-factor structure that was readily interpretable in the framework of existing theory (Smith et al., 2003). Reliabilities of these subscales ranged from 0.77 to 0.83 in the current study.

Cognitive and emotional responses to COVID-19

This questionnaire was adapted from the psychological response questionnaire from the severe acute respiratory syndrome pandemic (Qian et al., 2005). The revised questionnaire included two subscales evaluating students' cognitive and emotional responses toward COVID-19. The cognitive subscale included four items measuring the level of one's awareness and control of the pandemic (e.g., "I thought that I should take all actions to avoid being infected by the virus"). The emotional subscale included four items assessing one's levels of nervousness, anger, pessimism, and helplessness during the pandemic (e.g., "When I learned that a case was found in our city, I felt helpless"). Participants responded to each item using a 5-point scale (1 = *not at all typical of me*; 5 = *very typical of me*). Separate scores were computed for each subscale. Higher scores on the cognitive subscale reflected more reasonable responses to the pandemic, while higher scores on the emotional subscale reflected more negative responses. Internal consistency reliabilities of these subscales were both 0.74 in the current study.

Students' time devoted to learning at home

This questionnaire evaluated students' time devoted to learning at home during the pandemic. Prior to formal testing, we piloted the questionnaire with a small number of students to check for general understandability, and we made minor revisions based on their feedback. The questionnaire included three items covering the following aspects: students' time spent on online learning, time used for completing the study plan; and time that was not interrupted for learning (see all the items in the **Supplementary material**). Students rated each item using a 5-point scale (1 = *strongly disagree*; 5 = strongly agree). We computed a total score by summing scores of the items. Higher scores reflected more time students were able to devote to learning at home during the lockdown period. The internal consistency reliability of this questionnaire was 0.63 in the current study.

Students' responsibilities at home during the lockdown

This questionnaire was developed to evaluate the degree of students' responsibilities when they stayed at home during the lockdown. There were three items each covering the following responsibilities: taking care of family members, doing housework, and dealing with home affairs. Each item was rated using a 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*). The higher the score, the higher level of responsibilities at home. In the current study, the internal consistency reliability of this questionnaire was 0.80.

Measures of socioeconomic status

Data of students' family SES were collected and used as controlling variables in examining associations of the learning-related factors with the learning outcomes. We used monthly household income, parents' occupation, and parents' level of education to estimate SES. Family household income was measured with a 10-point scale (1 = less than 2,000, 2 = 2,001–3,000, 3 = 3,001–4,000, 4 = 4,001–5,000, 5 = 5,001–6,000, 6 = 6,001–7,000, 7 = 7,001–8,000, 8 = 8,001–9,000, 9 = 9,001–10,000, and 10 = more than 10,000 Chinese Yuan per month). Both parents' occupations were measured using the Occupational Prestige Scale (Lu, 2003), in which contemporary Chinese occupations were rated according to the status of ownership of organizational, economic and cultural resources (1 = unemployed, 2 = agricultural laborer, 3 = industrial workers, 4 = business service employees, 5 = industrial and commercial households, 6 = clerks, 7 = professional and technical personnel, 8 = private businessman, 9 = managers, and 10 = state and social managers). Higher scores represented higher prestige of an occupation. Each parent's educational level was assigned a value from 1 to 6 (1 = elementary school and below, 2 = junior high school, 3 = high school or

technical secondary school, 4 = junior college, 5 = bachelor, and 6 = master and above).

Data cleaning

First, we checked the datasets for the number of participants for each variable. The valid number of participants was 1,004 except for GPA, perceived academic achievement, and critical thinking skills. GPA scores were available for 853 students in the pre-lockdown testing, and 868 in the post-lockdown testing. Data of perceived academic achievement were available for 642 students (because only the 2018 cohort completed this test, and the 2019 cohort did not shorten the overall survey). Data of critical thinking skills were available for 642 students (only the 2018 cohort completed this test). Second, we performed analyses to detect outliers. Any observation exceeding three standard deviations from the means was replaced with a value that was three standard deviations. This procedure affected no more than 5% of observations.

Analytic strategy

First, we performed tests of measurement invariance for the learning outcome measures (perceived academic performance, critical thinking skills, and critical thinking dispositions) across the time points before and after the university lockdown. Following established procedures (Putnick and Bornstein, 2016), we compared the configural invariance model (i.e., models had the same pattern of factor structure, but factor loadings between models were allowed to vary across times), the metric invariance model in which factor loadings were constrained to be the same across times, and the scalar invariance model in both factor loadings and intercepts were constrained to be the same across times). Each model was evaluated using the χ^2, comparative fit index (CFI), the root-mean-square error of approximation (RMSEA) by means of LISREL 8.7. Metric invariance was supported if the metric model did not result in significant changes in model fit compared to the configural model (ΔCFI $\leq$ 0.01, and ΔRMSEA $\leq$ 0.015 suggest no substantial change according to Chen, 2007). Likewise, scalar invariance was supported if the scalar model did not significantly degrade relative to the metric model.

Paired sample *t*-tests were first performed to compare the average performance of the learning outcomes (except GPA) before and after the university lockdown. To evaluate changes of the variability of the learning outcomes, we computed the coefficient of variation (CV = SD/mean) for each learning outcome. The CV is a statistical measure of the variability of a distribution of repeated measurements or a data set. As a relative difference quantity, the CV can be used not only for comparing variability across repeated measurements, but also for comparing variability across sets of measurements on different scales (Shechtman, 2013). A larger CV value reflects greater variability.

Next, following the procedure described by Shanahan et al. (2020), regression analyses were performed in separate steps to examine relationships between the pre-lockdown learning outcomes and the proposed learning-related factors with the post-lockdown learning outcomes. First, we examined the association between each of the learning-related factors and each of the post-lockdown learning outcomes by controlling for SES and the corresponding prior learning outcome. This was achieved by performing a hierarchical linear regression with SES and the prior learning outcome in the first step, and a learning-related factor in the second step. This step was repeated for each post-lockdown learning outcome and each learning-related factor. By doing this, we obtained the association between each learning-related factor and each learning outcome after adjusting for SES and the prior learning outcome. Second, all the significant learning-related factors from the first step were entered into one regression model for predicting each post-lockdown learning outcome. SES and the prior learning outcome served as control variables. This step was repeated for all learning outcomes. The second step resulted in trimmed models with final SES factors, the prior learning outcomes, and learning-related factors related as predictors of post-lockdown outcomes.

Results

Table 1 presents the samples, means, and standard deviations for each of the variables. The intercorrelations among the variables at both time points were presented in **Supplementary Table 2**. Results indicated longitudinal metric invariance (ΔCFI = $-0.001 \leq 0.01$, and ΔRMSEA = $-0.002 \leq 0.015$, for details of the model fit see **Supplementary Table 3**), and scaler invariance (ΔCFI = $0.002 \leq 0.01$, and ΔRMSEA = $-0.005 \leq 0.015$) across the time points before and after the lockdown. The establishment of the measurement invariance allowed us to directly compare scores of the learning outcomes across the two times and examine relations of the study variables.

Figure 1 illustrates changes of the average performance for each learning outcome before and after the university lockdown (the GPA scores were not compared since, as mentioned earlier, the exam difficulty in 2020 was set at a relatively low level). Average scores of the learning outcomes showed an overall decreasing trend from pre- to post-lockdown. Paired sample *t*-tests revealed that critical thinking skills ($t = 4.02$, $p < 0.01$, Cohen's $d = 0.16$), and critical thinking dispositions ($t = 5.33$, $p < 0.01$, Cohen's $d = 0.17$) were lower after the university lockdown compared to their pre-lockdown assessments. No significant difference was found between the pre- and post-

TABLE 1 Descriptive statistics for all variables of the study.

Variables	*N*	*M*	*SD*
Socioeconomic status			
Household income level	1,004	5.04	2.71
Father's occupation level	1,004	4.71	2.71
Mother's occupation level	1,004	3.89	2.64
Father's educational level	1,004	2.76	1.21
Mother's educational level	1,004	2.57	1.25
Pre-lockdown learning outcomes			
Grade point average	853	2.65	0.82
Perceived academic achievement	642	12.30	2.67
Critical thinking skills	642	20.47	3.26
Critical thinking dispositions	1,004	64.70	8.71
Post-lockdown learning outcomes			
Grade point average	868	3.42	0.51
Perceived academic achievement	642	12.21	2.78
Critical thinking skills	642	18.80	4.78
Critical thinking dispositions	1,004	63.14	9.05
Potential learning-related factors			
Time devoted to learning at home	1,004	10.86	2.16
Responsibilities at home	1,004	6.80	2.49
Cognitive response to the pandemic	1,004	12.68	3.53
Emotional response to the pandemic	1,004	10.45	3.23
Readiness for online learning skills	1,004	22.57	3.58
Readiness for self-management learning	1,004	14.00	2.92

lockdown perceived academic achievement ($t = 0.71$, $p > 0.05$, Cohen's $d = 0.03$). Figure 2 illustrates changes of the CVs for each learning outcome. It is evident that variability for each learning outcome showed an overall increasing trend from pre- to post-lockdown. Variability of the critical thinking skills showed a particularly large increase.

Figure 3 presents the associations between each learning-related factor and post-lockdown learning outcome produced by regression analyses, after controlling for SES variables and pre-lockdown learning outcomes (for exact coefficients and *p*-values, see the Supplementary Table 4). As expected, prior outcome variables showed the largest associations with their corresponding post-lockdown outcomes. With respect to the proposed learning-related factors, students' time devoted to learning was positively associated with GPA, perceived academic achievement and critical thinking dispositions, whereas students' responsibilities at home were negatively associated with all outcome variables except GPA. Students' cognitive response to the pandemic was positively related to critical thinking skills, while the emotional response was negatively associated with perceived academic achievement and critical thinking dispositions. Readiness for online learning skills and self-management learning were positively associated with all outcome variables except critical thinking skills.

Table 2 presents associations from the final trimmed models aiming to understand which factors explained unique variance of the post-lockdown outcomes after controlling for pre-lockdown learning outcomes and SES factors. The upper part of Table 2 includes all significant prior outcome variables and SES factors, and the lower part presents all the significant learning-related factors. Results of factors with $p > 0.10$ were not presented. The significant predictors are ordered by the size of the standardized regression coefficients. As shown in Table 2, readiness for self-management learning showed the largest effects on perceived academic achievement and critical thinking dispositions. Readiness for online learning skills showed consistently positive effects on all outcome variables except critical thinking skills. While students' cognitive responses to the pandemic were positively related to critical thinking skills, their emotional responses were negatively associated with critical thinking dispositions. In addition, responsibilities at home were consistently associated with all outcome variables except GPA.

Discussion

After the onset of the COVID-19 pandemic, many universities turned to distance education to limit viral transmission of infection, which influenced millions of college students, forcing them to adapt to new learning environments as well as ways of learning they may have been unaccustomed to. Such unexpected changes led to significant uncertainty in the learning and academic development of students (Conceição and Howles, 2020). Concerns have been raised regarding the consequences of school lockdowns on students' academic development (e.g., Kuhfeld et al., 2020; Kaffenberger, 2021), and the consequences are not likely to fade as things return to "normal." Unfortunately, empirical evidence has been limited in evaluating how university lockdowns during the pandemic impact students' learning outcomes. In addition, the transition to online learning at home may lead to important factors radically different from those related to students' learning during typical academic years. Clarifying these factors and their associations with students' learning outcomes is crucial for higher education to develop learning-centered programs, and to validate non-standard or alternative learning formats for managing the ongoing pandemic crisis.

This study leveraged a longitudinal design to describe the average performance and variability of college students' learning outcomes after they participated in online learning from home for an extended period Comparisons of students' learning outcomes showed that while students' perceived academic achievement showed no improvement, their critical thinking (both skills and dispositions) decreased significantly from pre- to post-lockdown. In addition, outcome variables after the lockdown exhibited overall greater variability relative to those prior to the pandemic, with critical thinking skills showing

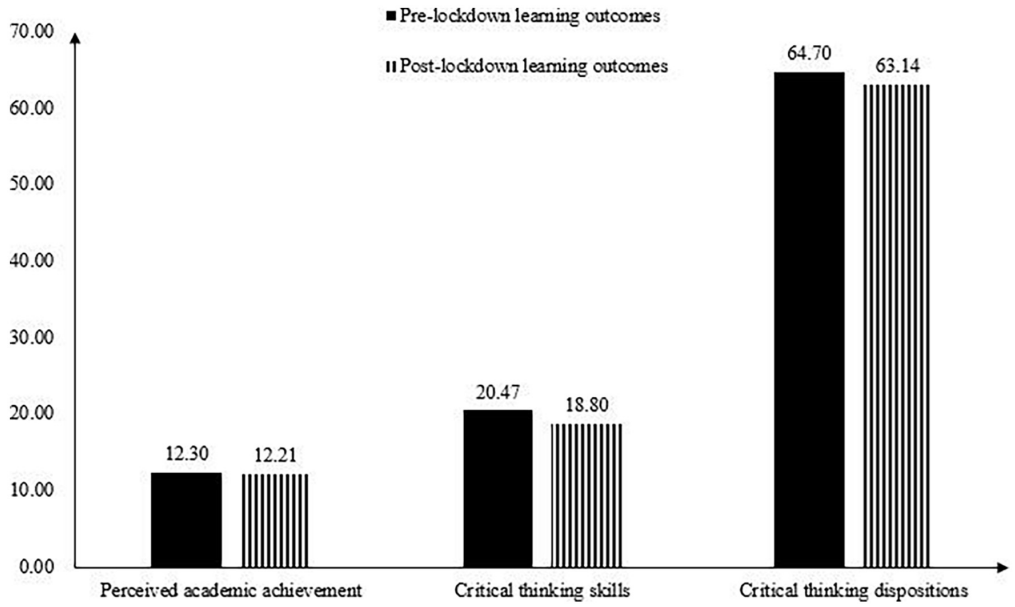

FIGURE 1
Illustration the average performance for each learning outcome before and after the university lockdown.

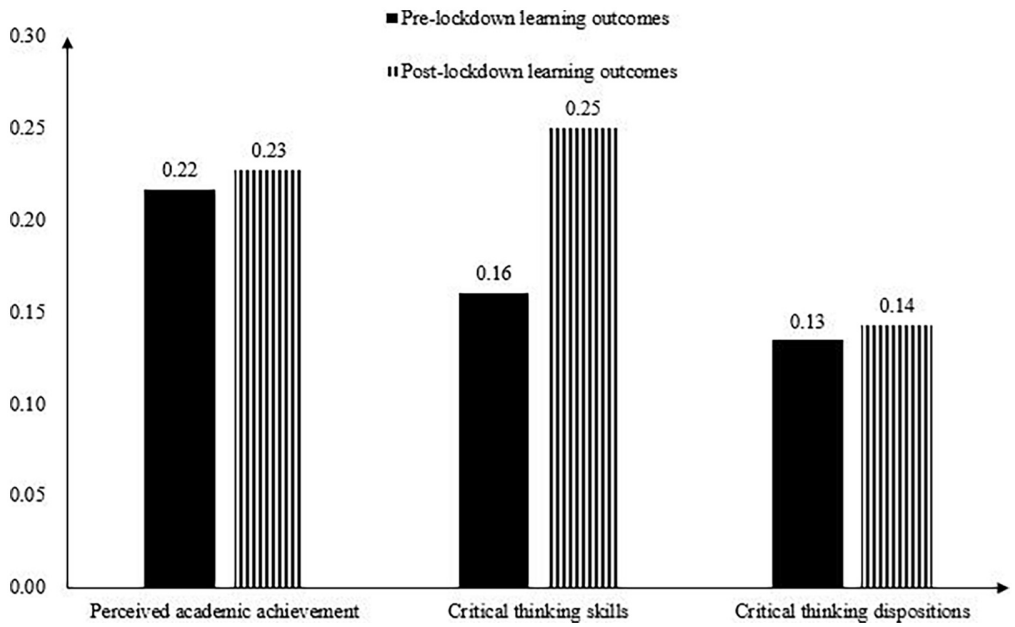

FIGURE 2
Illustrations of variability of each learning outcome before and after the university lockdown.

a particularly large increase. These results concur with the learning loss concerns identified by other education researchers (e.g., Kaffenberger, 2021), conveying worrying messages that college students learned less due to the disruption of traditional instruction. Moreover, the result that variability for each learning outcome showed an increasing trend suggests that the university lockdown was likely to widen variations in students' learning outcomes.

Among the factors proposed to influence students' learning, readiness for online learning was consistently associated with post-lockdown learning outcomes including academic achievement and critical thinking dispositions, even after

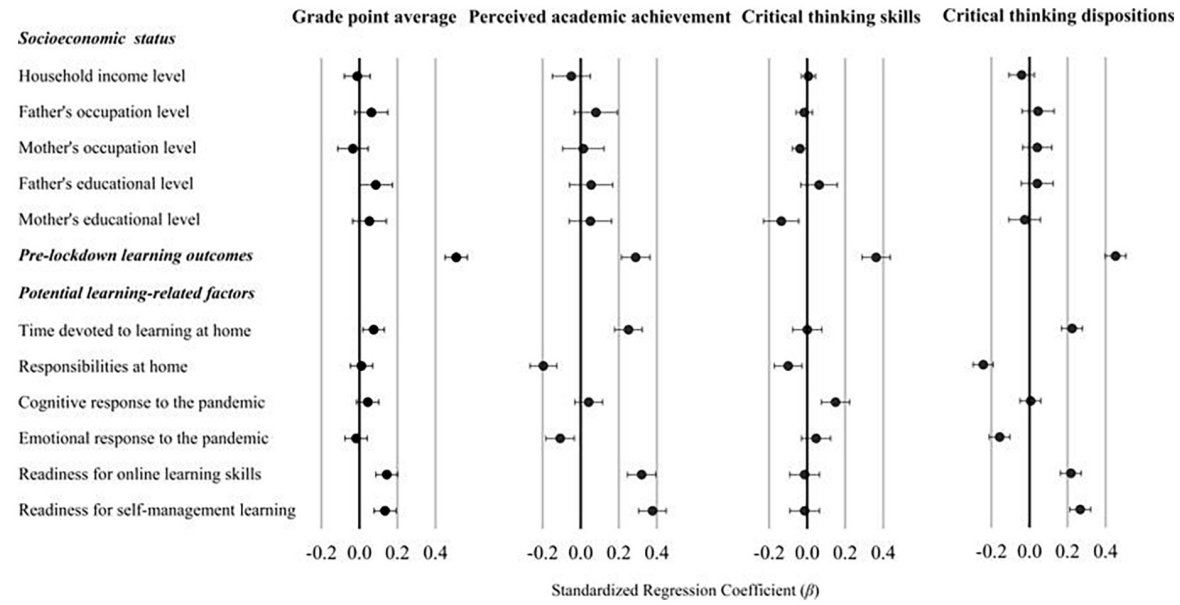

FIGURE 3
Associations of socioeconomic status (SES) and pre-lockdown learning outcomes with post-lockdown outcomes. Separated hierarchical linear regressions were conducted with SES factors and pre-lockdown learning outcomes in the first step, and each learning-related factor in the second step (i.e., a separate model for each learning-related factor). Standardized regression coefficients (β) and 95% CIs were applied.

TABLE 2 Standardized regression coefficients from the final trimmed hierarchical linear regression models with socioeconomic status (SES) factors and pre-lockdown learning outcomes in the first step, and the potential learning-related factors that were significantly identified by the separated models as the second step.

Grade point average	Perceived academic achievement	Critical thinking skills	Critical thinking dispositions
SES factors and pre-lockdown learning outcomes	SES factors and pre-lockdown learning outcomes	SES factors and pre-lockdown learning outcomes	SES factors and pre-lockdown learning outcomes
• Grade point average ($\beta = 0.52, p < 0.01$)	• Perceived academic achievement ($\beta = 0.18, p < 0.01$)	• Critical thinking skills ($\beta = 0.35, p < 0.01$)	• Critical thinking dispositions ($\beta = 0.37, p < 0.01$)
		• Mother's educational level ($\beta = -0.14, p < 0.05$)	
Factors related to learning during the pandemic	Factors related to learning during the pandemic	Factors related to learning during the pandemic	Factors related to learning during the pandemic
• Readiness for online learning skills ($\beta = 0.10, p < 0.01$)	• Readiness for self-management learning ($\beta = 0.26, p < 0.01$)	• Cognitive response to the pandemic ($\beta = 0.15, p < 0.01$)	• Readiness for self-management learning ($\beta = 0.16, p < 0.01$)
• Readiness for self-management learning ($\beta = 0.08, p < 0.05$)	• Readiness for online learning skills ($\beta = 0.13, p < 0.01$)	• Responsibilities at home ($\beta = -0.11, p < 0.01$)	• Responsibilities at home ($\beta = -0.16, p < 0.01$)
	• Responsibilities at home ($\beta = -0.11, p < 0.01$)		• Emotional response to the pandemic ($\beta = -0.12, p < 0.01$)
	• Emotional response to the pandemic ($\beta = -0.08, p < 0.05$)		• Time devoted to learning at home ($\beta = 0.08, p < 0.05$)
			• Readiness for online learning skills ($\beta = 0.06, p = 0.10$)

controlling for pre-lockdown learning outcomes. The role of self-management learning was particularly evident in students' self-perceived academic achievement and critical thinking dispositions. These results are consistent with previous work indicating that self-management learning affects students' academic achievement and e-learning performance (Wang, 2011; Broadbent, 2017; Panadero et al., 2019). Self-management involves self-assessment, goal setting, time

management, and regulating goal progress and attainment by using reinforcement and punishment (Frayne, 1991), which is recognized as a prerequisite for effective learning in distance education (Evans, 2000). Indeed, the need for self-management learning runs clearly throughout the distant learning literature, and in most online learning delivery formats (Bernard et al., 2004).

Compared with students' time devoted to learning at home, their responsibilities at home exhibited relatively large effects on learning outcomes: those who assumed more responsibilities at home during the pandemic reported lower scores on perceived academic achievement, critical thinking skills and dispositions. As stated earlier, college students are already adults who are expected to share household responsibilities with their parents when they stay at home. Greater responsibilities at home may put considerable pressure on students' learning behaviors especially given that they were experiencing disruptions to the location and format of their schooling prior to the lockdown. It is possible that students' added responsibilities at home, coupled with the sudden shift to online learning, created a challenging learning environment making them feel "out of control" or at least less in control than normal.

Interestingly, whereas students' cognitive responses to the pandemic were positively related to critical thinking skills, their emotional responses were negatively related to critical thinking dispositions. Note that these findings were observed even after adjusting for students' pre-pandemic critical thinking skills/dispositions. Though the reported associations were only weak to moderate, they did reveal the possibility that students' psychological responses to the pandemic may alter their higher-order learning outcomes. A reasonable perception of and response to the pandemic may serve as a conductive buffer layer for one to analyze and understand new knowledge. In contrast, negative emotional responses experienced due to an awareness of the possible consequences of the pandemic may to some extent affect one's willingness or ability to apply critical thinking.

Limitations

Our study has the strength of including both pre- and post-lockdown assessments of both students' academic achievement and critical thinking. However, it also faces a few limitations. First, the sample is potentially not representative of students from other kinds of institutions (e.g., those from other countries, of different sizes, or private compared to public). While the lockdown policy in China was virtually identical across higher educational institutions, the homogeneity of the sample may also affect the generalizability of our results to nations or regions with different lockdown strategies, different rates of the pandemic, and different social or educational systems.

Second, though the pre-pandemic learning outcomes were controlled in examining associations between the proposed learning-related issues during the pandemic and post-lockdown learning outcomes, the reported associations are correlational in nature, and cannot be given direct causal interpretations.

A third limitation is that our assessment of the learning-related factors took place immediately after the lockdown ended. Students' responses to some factors (e.g., emotional responses during the pandemic) might to some extent be distorted by the prolonged lockdown. Fourth, the pre-lockdown assessment occurred approximately 3 months before the outbreak of COVID-19 (the critical thinking skills were measured around 15 months before the outbreak). It is possible that some of the observed changes in learning outcomes may partly result from factors preceding the pandemic.

Implications

Despite the limitations, our findings have important implications for college students' educational development as well as for educational practices when lockdown measures are imposed during a severe pandemic like COVID-19. First, decreases in critical thinking are especially disquieting since it plays a crucial role in students' later academic achievement and even their future professional development (Shaw et al., 2020). This calls for a consideration of corrective measures to maximize the recovery of learning losses. For example, instructions that have been demonstrated effective for improving college students' critical thinking (e.g., Heijltjes et al., 2014) might be referenced to develop special programs for promoting their critical thinking skills.

Second, given the significant roles of self-management in students' learning outcomes, higher education institutions might prepare students with necessary and important skills (e.g., evaluating, monitoring, and regulating oneself) for online learning via tutorials of self-management training. Third, during times of unexpected disruption to normal schooling, universities and departments should provide supportive measures such as providing attractive learning materials or secure internet access (Hasan and Bao, 2020), and educate students about coping strategies such as engaging in physical exercise, or positive reappraisal (Shanahan et al., 2020) to alleviate their emotional distress and counteract the adverse effects on students' learning performance.

Conclusion

Our study assessed college students' academic achievement and critical thinking before and after the COVID-19 university lockdown. We also assessed several factors hypothesized to influence students' learning from home during the lockdown period. We observed significant decreases in critical thinking skills and dispositions among students from the pre- to post-lockdown, and both achievement and critical thinking

exhibited overall greater variability after the lockdown. In addition, students' readiness for online learning, especially their self-management skills, consistently predicted post-lockdown academic achievement and critical thinking after pre-lockdown outcomes and family SES were controlled for. Those who assumed more responsibilities at home, or who were more vulnerable to emotional distress during the pandemic, performed less well in post-lockdown learning outcomes. These findings call for better management of student learning and development when major changes are required in higher education practices for responding to the ongoing COVID-19 crisis as well as other potential situations.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Human Subjects Review Committee of the Huazhong University of Science and Technology. The participants provided their written informed consent to participate in this study.

Author contributions

XL and JM collected the data and wrote the manuscript. SZ assisted in data collection. TB assisted in re-drafting and editing the manuscript. XR designed the study and wrote the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.995784/full#supplementary-material

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Alexithymia and post-traumatic stress disorder symptoms in Chinese undergraduate students during the COVID-19 national lockdown: The mediating role of sleep problems and the moderating role of self-esteem

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Objective: This study examined whether sleep disturbance was a mediator between alexithymic traits and post-traumatic stress disorder (PTSD) COVID-19 pandemic-related stress symptoms, and explored whether self-esteem moderated the alexithymic contribution to poor sleep and PTSD symptoms.

Method: A representative sample of young adults (N=2,485) from six universities in Southwest China completed online self-report surveys on alexithymia, sleep, PTSD, self-esteem, sociodemographic information, and health-related behaviors.

Results: High alexithymic young adults were found to be more likely to have higher sleep problems and higher PTSD symptoms. The moderated mediation model showed that sleep problems mediated the associations between alexithymia and PTSD symptoms. Alexithymic people with lower self-esteem were more likely to have elevated PTSD symptoms and sleep problems than those with higher self-esteem.

Conclusion: Targeted psychological interventions for young people who have difficulty expressing and identifying emotions are recommended as these could assist in reducing their post-traumatic psychophysical and psychological problems. Improving self-esteem could also offer some protection for trauma-exposed individuals.

KEYWORDS

COVID-19, post-traumatic stress disorder, alexithymia, sleep disturbance, self-esteem

Introduction

Posttraumatic stress disorder (PTSD) symptoms are common psychological problems in people exposed to life-threatening traumatic events (Kessler et al., 2017; Tang et al., 2018; Ding et al., 2022). The COVID-19 pandemic, which was first identified in late 2019, had caused more than 6.48 million global deaths by 29th August 2022. This deadly global pandemic has also resulted in significant public worry and psychological stress (Ji et al., 2021; Liao and Wang, 2021; Tang et al., 2022), such as PTSD symptoms (Johnson et al., 2020; Cénat et al., 2021; Jian et al., 2022). To determine the psychopathological PTSD mechanisms, many studies have sought to identify the psychosomatic symptoms and diathesis factors that contribute to PTSD symptoms, two of which are alexithymia (Badura, 2003; Frewen et al., 2008a; Osimo et al., 2021) and sleep problems (Leskin et al., 2002; Germain, 2013). However, these factors have not been explored in a COVID-19 pandemic context.

Alexithymia, which was originally described as a personality trait and often manifests as an absence of a verbal ability to express emotions (Sifneos, 1973), has many psychological consequences (Scimeca et al., 2014). People with high alexithymia often have externally orientated thinking and an inability to express or recognize their own or others' emotions. Whether alexithymia is a trait or a state is still being debated; however, many longitudinal studies have found that alexithymia remains relatively stable over time (Salminen et al., 2006; Tolmunen et al., 2011). For instance, in an 11-year follow-up study, alexithymia was found to be a stable personality trait (Tolmunen et al., 2011). As alexithymia is often conceptualized as a lack of emotional self-regulation and competency and an inability to adaptively regulate emotions when under stress, it could be a risk factor for several other mental health problems, such as post-traumatic stress disorder (PTSD). A recent meta-analysis found that people with PTSD tended to have a greater number of alexithymic traits than the general population (Edwards, 2019), and a recent study found that highly alexithymic people were more vulnerable to mental health problems during the COVID-19 pandemic (Osimo et al., 2021).

Litz's influential PTSD network model (Litz, 1992; Litz et al., 2002) claims that people with PTSD may have some predominant emotional processing schemas that block the expression of emotions, which indicated that the presence of alexithymia may indicate a vulnerability to the development of PTSD (Zlotnick et al., 2001). Frewen et al. (2008b) argued that alexithymic symptoms could predict brain activation in trauma-associated memory areas. Therefore, it is possible that people with alexithymia could be more vulnerable to the development of traumatic stress-related PTSD symptoms.

As there has been little research into the associations between alexithymia and PTSD symptoms in the COVID-19 pandemic context, this study examined the relationship between alexithymia and PTSD symptoms in young adults. While a positive relationship between alexithymia and PTSD symptoms has been assumed, the association mechanism is unclear; therefore, this research also explored the potential relationship mechanism between alexithymia and pandemic stress-related PTSD symptoms.

Sleep problems as a mediator

Research has shown that sleep problems, such as poor sleep quality and nightmares, tend to occur after trauma exposure and can predict PTSD onset and progression (Ross et al., 1989; Germain, 2013). Previous adolescent and adult studies (Belleville et al., 2009; Brown et al., 2011) have consistently found that sleep problems are strongly correlated with PTSD symptom severity. Prospective and treatment studies have also provided robust evidence for the relationship between sleep problems and PTSD symptoms (Pigeon et al., 2013; van Liempt et al., 2013; Colvonen et al., 2018). Experimental studies that examined the relationship between sleep and PTSD also support the hypothesis that sleep plays an important role in PTSD-relevant processes (Vanderheyden et al., 2015). Therefore, previous studies have strongly indicated that sleep problems may contribute to maladaptive stress and trauma responses and could be a pivotal risk factor for PTSD pathogenesis.

Connections between alexithymia and sleep problems have been found in previous research. For example, independent of mental health problems, alexithymic traits were found to be associated with reduced sleep quality in an adult sample (Murphy et al., 2018), and an alexithymic group scored significantly higher than a non-alexithymic group in a representative undergraduate student sample for a variety of sleep problems, such as insomnia, excessive sleepiness, sleepwalking, and nightmares (Bauermann et al., 2008). When depression and other psychiatric symptoms were controlled for in an outpatient sample, sleep disorders were found to be independently associated with alexithymia (Honkalampi et al., 1999). Several recent studies in adult samples have also found that alexithymic traits were associated with poor sleep quality (Yaşar and Gündoğmuş, 2021; Pojatić et al., 2022).

Although past studies have suggested that sleep problems could be a mediating variable between alexithymia and trauma-related PTSD, few studies had explored the link between sleep problems and pandemic-related PTSD or the underlying psychosocial mechanism of this relationship. For instance, only one study at follow-up found that baseline sleep quality was highly correlated with COVID-19-related PTSD symptoms (Straus et al., 2022). Therefore, to the best of our knowledge, there have been no studies that have explored the underlying psychosocial mechanism between sleep problems and COVID-19-related PTSD symptoms.

Therefore, it is possible that people with high alexithymic traits could be more prone to sleep problems from pandemic stress, which in turn could make them more prone to PTSD symptoms. In other words, sleep disturbances could be a mediator between alexithymia and pandemic-related PTSD symptoms.

Self-esteem as a moderator

Although alexithymia may be associated with poor sleep quality and PTSD symptoms, different personality traits may result in different reactions. Therefore, it is important to consider the personality moderators that could buffer the relationship between alexithymia and the possible negative outcomes of COVID-19 pandemic stress. As self-esteem, which is a personal construct related to the overall affective evaluation of one's worth, value, or importance (Blascovich et al., 1991), has been linked to several positive behaviors and psychological manifestations (Rehman et al., 2021; Yan et al., 2021; Iqbal and Dar, 2022; Lee et al., 2022), it could act as a buffer between these adverse effects.

Recent studies have found that self-esteem buffered the mental health symptoms triggered by COVID-19 (Rossi et al., 2020; Lin and Chen, 2021). For example, in a sample of college students, self-esteem was found to increase social support and reduce COVID-19 pandemic stress and related psychological problems (Chen et al., 2021). The anxiety buffering hypothesis theory (Greenberg et al., 1992) primarily sees self-esteem as insulating the self from deep-rooted fears and that this feeling of personal value reduces the susceptibility to mental health problems. Many studies have also found an inverse relationship between self-esteem and psychological distress (Kucharska, 2017; Justo et al., 2018; Zhou et al., 2018), which indicated that self-esteem was possibly protecting against the detrimental psychological effects of the life-threatening pandemic and its associated stressors.

Therefore, this study sought to determine the potential mediating roles of sleep disturbance and self-esteem on the relationship between alexithymia and PTSD symptoms during the COVID-19 pandemic, for which the following hypotheses were tested and a mediation model was constructed (see Figure 1).

> *Hypothesis 1*: Alexithymia is positively associated with pandemic-related PTSD symptoms.
>
> *Hypothesis 2*: Sleep disturbance mediates the relationship between alexithymia and pandemic-related PTSD symptoms.

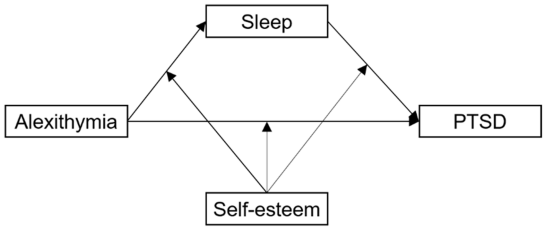

FIGURE 1
Hypothetical moderated mediation model. PTSD, posttraumatic stress disorder.

> *Hypothesis 3*: Self-esteem moderates the direct and indirect effects of alexithymia and pandemic-related PTSD symptoms *via* sleep disturbance.

Materials and methods

Study design and procedure

To provide better targeted psychological services for students and increase the understanding of the mental health conditions of university students during the COVID-19 pandemic lockdown, the mental health service departments of six universities in Southwest China agreed to participate in this survey. Undergraduate students from these universities were then invited to participate in an online psychological health survey between 20 February and 27 February 2020, which was during the first COVID-19 wave in China. China went into nationwide lockdown from 23 January to 13 April 2020. Convenience sampling was used in this study, which was approved by the Research Ethics Committee of the Sichuan Psychological Association (2020_12). A random monetary reward (RMB 1–10) was given to motivate student participation in this survey. This study was a secondary analysis, with the recruitment and data collection process detailed in prior work (Tang et al., 2020).

While the students participated anonymously in the survey, they had the option to provide their student numbers so that data could be matched in any following surveys. Students were told that all data would be kept confidential, they should complete the survey based on their first response, and that they could withdraw from the survey at any time if they felt uncomfortable. Because there were 100,000 undergraduates across the six universities, a 95% confidence interval and a 2% error rate margin were taken, which meant 2,345 or more measurements/surveys were needed to have confidence levels of 95% and ensure the real value was within ±2% of the measured/surveyed value. Therefore, using convenience sampling, 120 classes (20 from each university) were selected to participate in the survey. The number of students in each class ranged from 20 to 60; therefore, 3,610 people were invited to participate. The online survey was conducted using the Questionnaire Star Website. First, the survey purpose and informed consent were sent to the students through WeChat groups, after which the students who had signed the online informed consent were forwarded the link and survey QR code through the WeChat group by their coordinator. Participants were required to answer all questionnaire items before moving on to the next item to ensure there were no missing values.

Instruments and measures

Alexithymia

The Chinese version of the Toronto Alexithymia Scales (TAS-20; Taylor et al., 2003; Zhu et al., 2007) was used to

measure the alexithymic symptoms, which comprises 20 items across three dimensions; (1) difficulty in identifying feelings, (2) difficulty in describing feelings, and (3) externally oriented thinking; with each item rated on a 5-point scale from 1 = strongly disagree to 5 = strongly agree, with higher scores indicating higher degrees of alexithymia, with the TAS-20 scale cut-off being 61 (Franz et al., 2008). This questionnaire has been proven to have excellent reliability and validity in Chinese populations (Jinyao et al., 2003; Zhu et al., 2007). The McDonald's ω in the current study was 0.86.

Post-traumatic stress disorder

The PTSD symptom severity in the previous 4 weeks was measured using the Chinese version of the PTSD Check List-Civilian Version (PCL-C), which has had good reliability and validity in Chinese populations (Weathers et al., 1999; Xiaoyun et al., 2007), with a total score of 38 or higher being considered probable PTSD (Dobie et al., 2002). This scale comprises 17 items rated on a 5-point Likert scale from 1 = not at all to 5 = extremely, with higher scores indicating higher PTSD symptoms. The McDonald's ω was 0.92 in the current study.

Self-esteem

Self-esteem was measured using the Rosenberg Self-Esteem Scale (Rosenberg, 1965; Du et al., 2016), which comprises 10 items rated on a 5-point Likert scale from 1 (not very true) to 5 (very true), with higher scores indicating higher self-esteem. This scale has been validated in Chinese populations (Du et al., 2012). The McDonald's ω for the scale in this study was 0.78.

Sleep disturbance

Sleep disturbance in the previous 4 weeks was measured using the Chinese version of the Pittsburgh Sleep Quality Index (PSQI), which comprises (Buysse et al., 1989) 18 items across seven dimensions: subjective sleep quality; sleep latency; sleep duration; habitual sleep efficiency; sleep problems; sleep medication use; and daytime dysfunction. Each dimension is scored on a 4-point Likert ranging from 0 to 3, with the total score being the sum of the scores from the seven dimensions and the cutoff score being eight (Liu et al., 1996; Kaufmann et al., 2019). This scale has shown satisfactory reliability and validity in Chinese populations (Tsai et al., 2005). The McDonald's ω in the present study was 0.83.

Sociodemographic variables and pandemic exposure variables

Demographics such as gender, age, and whether participants were only children were also collected. Pandemic-related exposure variables were measured based on three main questions: someone in the community had been infected; family, friends, and neighbors had been infected; and family, friends, and neighbors had died from COVID-19.

Data analysis

All statistical analyses were performed using SPSS 22.0. Pearson's correlation analysis was employed to analyze the correlations between all variables; sleep disturbance, alexithymia, self-esteem, and PTSD symptoms; and mediation analyses were conducted using multiple regression and Hayes's PROCESS macro for SPSS (Hayes, 2017) in Model 4, with the moderated mediation model being constructed using Hayes's (2017) PROCESS macro (Model 59).

Results

Sample characteristics

While 3,610 undergraduate students were initially invited to participate, only 2,501 completed the surveys, a response rate of 69.3%. Of these, 16 were excluded because of obvious illogical answers, such as all survey choices being the same; therefore, the final sample comprised 2,485 participants, 1,525 of which were female (61.4%), and with the mean age being 19.8 years (SD, 1.55 years; range, 16–27 years; see Table 1).

TABLE 1 Demographic and exposure variables (*N*=2,485).

Variables	*n*	%
Total	2,485	100
Gender		
Male	960	38.6
Female	1,525	61.4
Age (year)		
16–18	518	20.8
19	648	26.1
20	574	23.1
21	384	15.5
22–27	361	14.5
Only-child status		
Yes	1,061	42.7
No	1,424	57.3
Type of pandemic exposure		
Someone in the community infected		
Yes	105	4.2
No	2,380	95.8
Family, friends, and neighbors infected		
Yes	22	0.9
No	2,463	99.1
Family, friends, and neighbors died from COVID-19		
Yes	2	<0.01
No	2,483	>99.99

Correlations between the key variables

The correlation analyses revealed that PTSD, sleep disturbance, and alexithymia were all significantly and positively correlated (Table 2) and that self-esteem was negatively associated with PTSD, sleep disturbance, and alexithymia. Age, gender, only-child status, and COVID-19-related exposure were not found to have any significant or minor associations with the four main study variables; PTSD, alexithymia, self-esteem, and sleep.

Mediation effects

In the first step, the multiple regression analyses indicated that alexithymia was significantly associated with PTSD ($b = 0.52$, $p < 0.001$; Table 3). In the second step, the multiple regression analyses indicated that alexithymia was significantly associated with sleep disturbance ($b = 0.42$, $p < 0.001$), and in the third step, when sleep disturbance was controlled for, the multiple regression analyses indicated that alexithymia was still significantly associated with PTSD ($b = 0.32$, $p < 0.001$). Finally, the bias-corrected percentile bootstrap method indicated that the indirect effect of alexithymia on PTSD through sleep disturbance was significant ($b = 0.20$, SE = 0.02 $p < 0.001$; 95%CI, 0.17–0.23).

Moderated mediation model

As hypothesized, moderated mediation models were established (Table 4). In model 1, the R^2 change was 0.32 and a main effect for alexithymia was found on PTSD, $b = 0.42$, $p < 0.001$, with this effect being moderated by self-esteem, $b = -0.20$, $p < 0.001$(Figure 2).

In model 2, the R^2 change was 0.21, alexithymia had a main effect on sleep disturbance, $b = 0.33$, $p < 0.001$, with this effect being found to be moderated by self-esteem, $b = -0.15$, $p < 0.001$(Figure 3).

In model 3, the R^2 change was 0.47, and sleep disturbance had a main effect on PTSD, $b = 0.42$, $p < 0.001$, with this effect being moderated by self-esteem, $b = -0.05$, $p < 0.001$(Figure 4).

Discussion

To the best of our knowledge, this was the first study to explore the relationships between alexithymia, sleep disturbance, self-esteem, and PTSD symptoms during the COVID-19 pandemic. This study proposed and tested a moderated mediation model to analyze the mechanisms underlying the associations between alexithymic traits and pandemic-related PTSD symptoms in a sample of young adults. The findings supported the hypotheses and suggested that alexithymic traits were highly positively correlated with pandemic-related PTSD symptoms and that sleep disturbance played a mediating role. The direct and indirect associations between alexithymic traits and pandemic-related PTSD symptoms through sleep problems were found to be moderated by self-esteem.

As expected, a significant relationship was found between alexithymia and PTSD symptoms during the COVID-19 pandemic, which was a similar finding to a previous meta-analysis study that found that alexithymic symptomatology was particularly characteristic of individuals with PTSD (Frewen et al., 2008a). The results also aligned with a prospective study that indicated that the alexithymic level was significantly correlated with PTSD symptom severity (McCaslin et al., 2006). The finding that alexithymia was significantly related to PTSD supported the notion that alexithymia is a preexisting personality trait that facilitates trauma-related PTSD symptoms. Litz's information processing model (Litz, 1992) claims that PTSD symptoms are caused by some defects in the individual information processing schema, which results in emotional obstruction. Therefore, alexithymia, which is difficulties with emotional recognition and a lack of expression, can be explained, that is, young people who

TABLE 2 Correlation coefficients between the main variables (N=2,485).

Variables	1	2	3	4	5	6	7	8	9	10
1. Gender	1									
2. Age	0.46**	1								
3. Only-child	−0.05	−0.08**	1							
4. Exposure 1[a]	−0.03	−0.02	−0.03	1						
5. Exposure 2[b]	0.01	−0.01	0.03	0.14**	1					
6. Exposure 3[c]	−0.01	0.03	0.01	−0.01	0.16**	1				
7. PTSD	0.04	0.05	−0.06	0.03	0.03	−0.01	1			
8. Alexithymia	−0.02	−0.03	−0.05	0.04	0.03	−0.01	0.52**	1		
9. Self-esteem	0.01	−0.02	0.09**	−0.05	−0.02	−0.01	0.33**	−0.43**	1	
10. Sleep	0.05	0.07**	0.01	0.05	0.03	0.01	0.61**	0.42**	−0.29**	1

[a]"Exposure 1" referred to "Someone in the community infected".
[b]"Exposure 2" referred to "Family, friends, and neighbors infected".
[c]"Exposure 3" referred to "Family, friends, and neighbors who died from COVID-19."
*$p < 0.05$, **$p < 0.01$. PTSD, post-traumatic stress disorder.

experience COVID-19-related stress and who are unable to express their emotions, accumulated fears, and negative emotions may be more likely to develop PTSD symptoms (Velotti et al., 2021). Alexithymic neuroscience studies have also found that as alexithymia symptoms activate the brain areas associated with trauma-related memories, people with alexithymia may be more susceptible to pandemic stress-related PTSD symptoms (Frewen et al., 2008b). This result also supported another neuroscience study that found trait alexithymic symptoms significantly predicted state neural responses to PTSD symptom provocation (Frewen et al., 2006). A recent study also provided evidence that targeted psychotherapy could enhance the ability to identify and express emotions in alexithymic individuals and reduce PTSD symptoms (Zorzella et al., 2020). Therefore, combined with the results in this study, it is possible that early alexithymia identification and early intervention could decrease the effects of the COVID-19 pandemic or other traumatic stresses and the development of more serious PTSD symptoms in young adults.

This study was one of the first to examine the mechanisms underlying the relationships between alexithymia and PTSD symptoms, and therefore, extends existing knowledge by finding that sleep problems partly mediate the association between alexithymic traits and PTSD symptoms. The finding that alexithymic traits are significantly associated with sleep problems supports earlier findings that alexithymia has an independent effect on sleep quality (Kronholm et al., 2008). These findings were also consistent with a recent study that independent of depression and anxiety, heightened alexithymia is associated with poor sleep (Murphy et al., 2018). Parker et al. (1998), concluded that people with high alexithymia and deficits in their reappraisal of negative emotions had poorer maladaptive emotional regulation and immature self-defense styles. An experimental study also found that highly alexithymic individuals with emotion regulation deficits had a greater propensity to elevate their subjective negative affect (i.e., tension and anger) when confronted with stress (Connelly and Denney, 2007), which appeared to raise their vulnerability to sleep problems (Gruber and Cassoff, 2014; Palmer and Alfano, 2017). This study also found that alexithymic traits increased the risk of sleep problems, which in turn elevated the likelihood of developing pandemic-related PTSD symptoms, which was in line with previous studies that found that sleep problems were significantly associated with PTSD symptoms (van Liempt et al., 2013; Fan et al., 2017; Hu et al., 2021). This could explain why people with high alexithymia are more likely to have pandemic stress-related sleep problems and more likely to have PTSD symptoms.

Another significant contribution of this study was that the moderating role of self-esteem was tested in the mediation model, from which it was found that alexithymic people with high self-esteem had fewer sleep problems and lower PTSD symptoms than alexithymic people with low self-esteem. This finding suggested that high self-esteem could to some extent, offset pandemic stress-related sleep problems and PTSD symptom frequencies in people with high alexithymia. High self-esteem was also found to mitigate the negative sleep disturbance effect on PTSD symptoms, which was partly in line with previous studies (Arima et al., 2020; Rossi et al., 2020) that found that self-esteem was a protective factor against adverse psychological consequences in the general population response to the COVID-19 pandemic. The results in this study also supported the stress-buffering effects of the

TABLE 3 Mediation effect of alexithymia on PTSD (N=2,485).

Predictors	Model 1 (PTSD)		Model 2 (Sleep)		Model 3 (PTSD)	
	β	t	β	t	β	t
Alexithymia	0.52	30.18***	0.42	23.30***	0.32	19.40***
Sleep					0.47	28.54***
R^2	0.27		0.18		0.45	
F	910.54***		543.25***		1001.53***	

***$p < 0.001$. PTSD, posttraumatic stress disorder.

TABLE 4 Moderated mediation effect of alexithymia on PTSD (N=2,485).

Predictors	Model 1 (PTSD)				Model 2 (Sleep)				Model 3 (PTSD)			
	β	SE	t	%95CI	β	SE	t	%95CI	β	SE	t	%95CI
Alexithymia	0.42	0.019	22.44***	0.38–0.46	0.33	0.020	16.65***	0.30–0.37	0.27	0.017	15.78***	0.24–0.31
SE	−0.13	0.018	−7.28***	−0.17 to −0.10	−0.14	0.020	−6.92***	−0.18 to −0.10	−0.07	0.016	−4.39***	−0.10 to −0.04
Alexithymia * SE	−0.20	0.016	−12.34***	−0.23 to −0.16	−0.14	0.017	−8.38***	−0.18 to −0.11	−0.11	0.016	−6.64***	−0.14 to −0.08
Sleep									0.42	0.017	24.78***	0.39–0.45
Sleep * SE									−0.05	0.015	−3.43***	−0.08 to −0.02
R^2	0.32				0.22				0.47			
F	393.44***				226.95***				446.19***			

***$p < 0.001$. PTSD, posttraumatic stress disorder; SE, self-esteem.

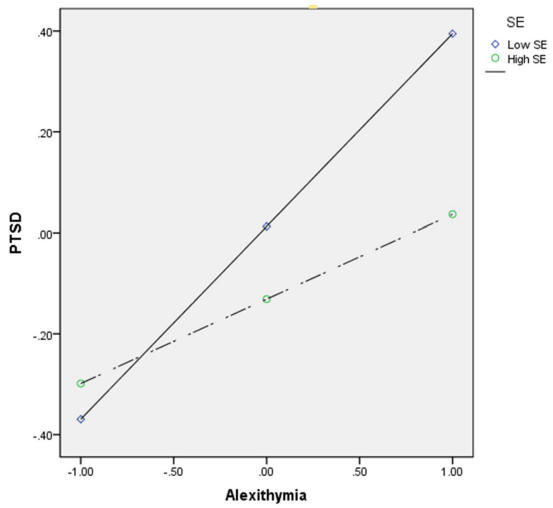

FIGURE 2
Moderation effect of self-esteem between alexithymia and PTSD. High and low levels of self-esteem represent one standard deviation above and below the mean. SE, self-esteem; PTSD, posttraumatic stress disorder.

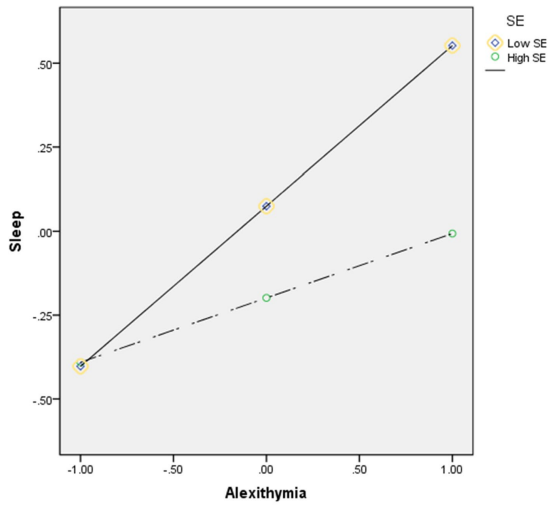

FIGURE 3
Moderation effect of self-esteem between alexithymia and sleep disturbance. High and low levels of self-esteem represent one standard deviation above and below the mean. SE, self-esteem.

self-esteem model (Rector and Roger, 1997), and offered additional evidence that self-esteem could assist people with strong internal resources to mitigate the negative effects of pandemic stress even when high-alexithymia inflates sleep problems and PTSD symptoms. Therefore, this study's results highlighted the important role of self-esteem in protecting trauma-exposed individuals from negative consequences and mitigating the effects of personality predisposition on negative mood disorders.

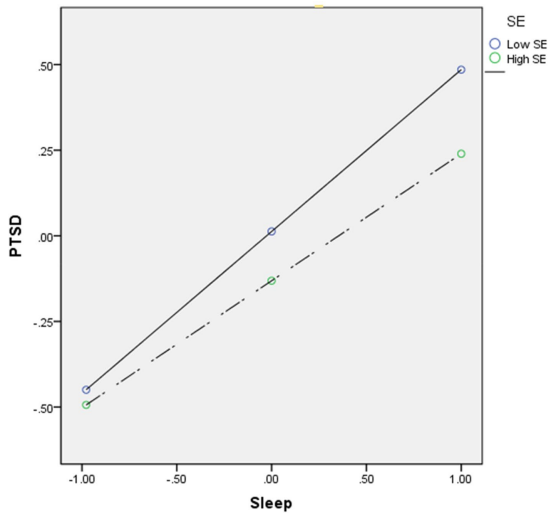

FIGURE 4
Moderation effect of self-esteem between sleep disturbance and PTSD. High and low levels of self-esteem represent one standard deviation above and below the mean. SE, self-esteem; PTSD, posttraumatic stress disorder.

Overall, this study has important implications for preventative mental health interventions in general responses to COVID-19 pandemic stress. As heightened alexithymia may increase the risk of disrupted sleep and PTSD symptoms when suffering from trauma-related stress, the greater a person's capability to identify, understand, and verbalize emotions and affection, the less likely they are to be overwhelmed by posttraumatic psychophysiological symptoms. Therefore, to reduce the development of these post-traumatic psychophysiological and psychological problems, education and intervention programs are needed that improve people's abilities to identify and express feelings. Most importantly, this study's data indicated that sleep problems were a mediator between alexithymia and PTSD symptoms, and elucidated the possible mechanism underlying the effect of alexithymia on mental health problems, that is, improving sleep problems could partially mitigate the possibility of developing pandemic stress-related PTSD symptoms. Finally, because self-esteem was found to act as an alexithymic impact buffer against sleep problems or PTSD symptoms, targeted post-trauma psychological interventions should be focused on promoting self-esteem in the general population.

Regardless of these important findings, this study had several limitations. First, although a mediation moderation model was used in this cross-sectional study, the causality between the psychological alexithymic constructs and PTSD symptoms could not be concluded. Therefore, future longitudinal studies could explore these causal relationships. Second, the use of self-assessment and online surveys as the single psychological measurement method could be seen to be inadequate; therefore, objective measurements and face-to-face interviews could further advance the understanding of these psychological variables and

improve reliability and validity. Finally, although the representative sample was recruited from six universities, the unity of the college student population could have affected the applicability and generalization of these results to other groups.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Research Ethics Committee of Sichuan Psychological Association (2020_12). The patients/participants provided their written informed consent to participate in this study.

Author contributions

YZ, YijZ, JC, and WT wrote the main manuscript text. TN prepared the tables. YijZ prepared the figures. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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COVID-19 pandemic and adolescent mental health in China: Micro evidence and socioeconomic mechanisms

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Although the impact of the COVID-19 pandemic on adolescent mental health has received sufficient attention in the medical and public health fields, analysis from the social science perspective is still lacking. By regarding the shock of COVID-19 pandemic as a quasi-natural experiment, this study adopts the Difference-in-Differences (DID) model and large microdata from Shandong Province, China, to identify the causal effect of the COVID-19 pandemic on the mental health of senior high school students. We find that the COVID-19 pandemic results in an increase of 2.5677 points in adolescent psychological problem scores, equivalent to an average decrease of 29.93% in mental health. Furthermore, results of mechanism tests show that this negative impact of the COVID-19 pandemic on adolescent mental health can be explained by a reduction in social trust, as well as widening inequalities caused by the digital divide and family income gap. Moreover, the estimates suggest that the COVID-19 pandemic has a greater negative influence on the mental health of boys and urban adolescents. Our study complements the research field on the impact of the COVID-19 pandemic on adolescent mental health and the potential socioeconomic mechanisms from a new perspective. These findings provide insights into how to safeguard adolescent mental health in China and other countries in the pandemic prevention and post-pandemic era.

KEYWORDS

COVID-19 pandemic, adolescents, mental health, socioeconomic mechanisms, Difference-in-Differences model, China

Introduction

The COVID-19 pandemic has led to more than 605 million infections and nearly 6.5 million deaths worldwide. As one of the major global public health crises, the impact of the COVID-19 pandemic on people's physical and mental health has received widespread attention from a large number of scholars. In addition to the direct effect of the COVID-19

pandemic on the mental health of patients (Pfefferbaum and North, 2020; Vindegaard and Benros, 2020; Kumar and Nayar, 2021), it may also indirectly impact people's mental health through multiple channels. On the one hand, the economic recession and unemployment caused by the COVID-19 pandemic may undermine people's mental health (Van Dorn et al., 2020; Ginsburgh et al., 2021; Wildman, 2021). On the other hand, during the pandemic prevention and control period, the risk perceptions of public health crises, the spread of negative information, family isolation measures and the maintenance of social distance may also bring negative emotions such as anxiety and worry (Chen et al., 2020; Commodari et al., 2020; Ding et al., 2020; Huang and Zhao, 2020; Zhou et al., 2020; Tian et al., 2022).

For immature adolescents, the COVID-19 breakout is also making a profound difference in their learning, lives and health. Not surprisingly, the impact of the COVID-19 pandemic on adolescent mental health has received ample attention in the medical and public health fields (e.g., Racine et al., 2020; Xiang et al., 2020; Hu and Qian, 2021; Shek et al., 2021; Wright et al., 2021; Kim et al., 2022). Most studies have observed a trend of deterioration in the overall mental health of adolescents following the COVID-19 pandemic and a significant increase in the number of reported symptoms of depression and anxiety (Adibelli and Sümen, 2020; Shek et al., 2021; Wu et al., 2021; Cao et al., 2022). For example, Duan et al. (2020) surveyed 3,613 Chinese students through online recruitment and found that 22.28% of them experienced anxiety and depression during the COVID-19 pandemic. Liang et al. (2020) also revealed that nearly 40.4% adolescents in the sample were found to be prone to psychological problems and 14.4% the sampled youth with Post-traumatic stress disorder (PTSD) symptoms after the occurrence of COVID-19. Worse, for some adolescents with prior mental illness or chronic disease, they experienced higher levels of psychological distress, depression, and behavioral problems (Jefsen et al., 2021). Some studies even found that the COVID-19 pandemic led to an increased incidence of suicidal ideation, suicide, and non-suicidal self-harm in adolescents (Banati et al., 2020; Durante and Lau, 2022).

China is one of the countries in the world with the most stringent prevention and control of the COVID-19 pandemic. Similarly, existing studies, through some local or online survey data, supported the conclusion that the COVID-19 pandemic worsened Chinese adolescent mental health (e.g., Chen et al., 2020; Duan et al., 2020; Qi et al., 2020; Zhang et al., 2020; Chi et al., 2021; Qu et al., 2021; Cao et al., 2022). First, in the context of COVID-19 prevention and control, the epidemic prevention department requires to keep social distance, reduce social interaction, and shorten the time of outdoor interaction, which is detrimental to the mental health of adolescents (Duan et al., 2020; Li Y. et al., 2021; Samji et al., 2022; Tang et al., 2020). Second, the epidemic has caused most schools to move traditional classes online, increasing students' access to electronic devices, which has a negative impact on their physical and mental health (Dong et al., 2020; Hu and Qian, 2021). Third, for some families without electronic devices or with low income, the inequality brought by the epidemic may further hurt the mental health of adolescents (Hu and Qian, 2021; Cheshmehzangi et al., 2022; Samji et al., 2022).

Although the potential impact of the COVID-19 pandemic on adolescent mental health has attracted considerable scholarly interest, these studies have mainly stayed in the medical and public health fields. Few studies explored the effect of the COVID-19 pandemic on adolescent mental health from social science perspectives (Banati et al., 2020; Brodeur et al., 2021; Jaspal and Breakwell, 2022). More importantly, little is still known about the potential socioeconomic mechanisms of the COVID-19 pandemic breaking adolescent mental health. In addition, most of these studies in China relied on small-scale questionnaires or online surveys (e.g., Chen et al., 2020; Duan et al., 2020; Cao et al., 2022), lacking the support of large-scale micro-data. Therefore, unlike these previous studies, we use a large micro-database, the Database of Youth Health (DYH), which consisted of a multi-wave survey conducted annually in the academic year 2015/2016, 2016/2017, 2017/2018, and 2020/2021, and contained nearly 100,000 sampled students from 186 middle schools in 17 cities of Shandong Province, China (Zhang et al., 2022). This database is conducted by Shandong University and National Population Health Data Center in China, and contains a large number of variables on students' mental health, basic information, and socio-economic status, providing the feasibility of our study (Yi et al., 2019; Dong et al., 2020, 2021). Moreover, the shock of the COVID-19 pandemic provides a perfect quasi-natural experiment, which creates conditions for us to use the Difference-in-Differences (DID) model, a widely used approach in the field of social sciences (e.g., O'Connell et al., 2022; Zhao et al., 2022; Zhao and Yan, 2022), to identify the impact of the COVID-19 pandemic on adolescent mental health in China. In terms of the measurement of mental health, we used the Strengths and Difficulties Questionnaire (SDQ), which is widely used in research related to adolescent mental health (e.g., Goodman et al., 2000; Rotheray et al., 2014; Kersten et al., 2017; Hu and Qian, 2021; Ravens-Sieberer et al., 2022), and measured adolescents' mental health in five dimensions: Emotional symptoms, Conduct problems, Inattention, Peer relationship problems, and Prosocial problems.

The contributions of this study are reflected in the following three aspects. First, our study enriches the literature on the impact of the COVID-19 pandemic on adolescent mental health. In particular, using an identification method commonly used in the social sciences, we confirm the causal relationship between the COVID-19 pandemic and adolescent mental health loss in China (Adibelli and Sümen, 2020; Banati et al., 2020; Xiao et al., 2020). Furthermore, because of the importance of mental health as a component of human capital (Goldsmith et al., 1997; Graff and Neidell, 2013), our findings suggest a negative impact of the COVID-19 pandemic on human capital (O'Connell et al., 2022).

Second, this study further supplements the potential socioeconomic mechanisms that the COVID-19 pandemic affects adolescent mental health. Previous studies mainly analyzed the negative impact of the COVID-19 pandemic on adolescent mental health from three aspects: society, family, and media (Duan et al., 2020; Evans et al., 2020; Qu et al., 2021; Rogers et al., 2021; Shek et al., 2021; Samji et al., 2022). In this paper, we innovatively increase the investigation on channels in terms of social trust, digital divide, and family income gap. In particular, previous research rarely analyzed the negative impact of the COVID-19 pandemic on mental health in terms of economic factors (Wildman, 2021).

Third, in terms of theoretical contributions, from the perspective of adolescent mental health loss, our research implies that the shock of the COVID-19 pandemic may exacerbate social inequalities. Specifically, we analyze the possible mechanistic roles of social trust, digital divide and family income gap from the theoretical level. Thus, by adopting the case from China, this study further supplements to rapidly growing literature that focused on social inequalities caused by critical public health incidents, like the COVID-19 pandemic (Van Dorn et al., 2020; Fisher and Ryan, 2021; Ginsburgh et al., 2021; Wildman, 2021). Additionally, our findings provide insights into how to develop more rational public policies to enhance the welfare and utility of these vulnerable groups during the pandemic and post-pandemic era.

Theoretical mechanisms and research hypotheses

In this section, based on a socioeconomic perspective, we theoretically analyzed the mechanisms through which the COVID-19 pandemic affects adolescent mental health from both subjective adolescent factors (psychological and behavioral factors) and objective family factors. More specifically, based on the data available in the questionnaire, we focused on the mediating effect of adolescent social trust in the above-mentioned effects at the level of subjective factors. In terms of objective family factors, we explored the moderating effects of digital divide (family Internet accessibility) and family income, and also discussed the association between the digital divide, family income gap and adolescent mental health during the COVID-19 pandemic. The details of mechanisms are shown in Figure 1.

Social trust

Negative public health events such as epidemics often pose a huge challenge to social trust (Kye and Hwang, 2020; Woelfert and Kunst, 2020; Aassve et al., 2021). When the epidemic breaks out, people instinctively become fearful of the risks, illnesses, and deaths caused by epidemics (Jefsen et al., 2021; Kumar and Nayar, 2021; Li W. et al., 2021), reducing social interactions and communications. Meanwhile, it is important to note that individual risk perceptions of the COVID-19 pandemic may also have a differential impact on social trust and related social behaviors, which includes distance perception, affective risk perception and cognitive risk perception, and thus on the mental health (Commodari et al., 2020; Ding et al., 2020).

Additionally, the inconvenience associated with epidemic prevention and control may allow people to transmit negative emotions about the virus or disease to patients and grassroots organizations (Kye and Hwang, 2020; Woelfert and Kunst, 2020), resulting in a social phenomenon of "generalized stigmatization" (Lin et al., 2022), which further exacerbates attitudes of social mistrust. Worse, during the epidemic, a series of factors, such as value conflicts and resource competitions, also combine to exacerbate the transfer and spread of this mistrust (Siegrist et al., 2000). Furthermore, epidemics are often accompanied by the spread of various rumors, making a higher opportunity cost of acquiring true information. In theory, adopting heuristic decision-making strategies or rules of thumb becomes the optimal choice (Nunn and Wantchekon, 2011). In the situation of the outbreak and spread of COVID-19, the costs for individuals to know if others are carrying the virus can be very high, as rigorous medical testing is required to determine (Kye and Hwang, 2020). Therefore, as a low-cost optimal strategy, people are more willing to choose to trust their acquaintances based on a rule of thumb (Brodeur et al., 2021). In contrast, for strangers, the level of trust naturally decreases due to the excessive transaction costs of information acquisition and screening.

Adolescents are in a vulnerable position both in terms of access to authentic information and screening of information. With the advice of their parents, schools, and local governments, they tend to comply with the COVID-19 pandemic prevention and control measures more strictly (Dong et al., 2020; Qu et al., 2021). Thus, adolescents' outdoor activities and communications are further reduced, which may decrease their social trust (Qi et al., 2020; Samji et al., 2022). Even in public, they are also likely to be more highly worried and fearful, especially in crowded places or by public transportation, and have significantly less social trust in strangers and deliberately stay away from them (Kye and Hwang, 2020; Woelfert and Kunst, 2020; Aassve et al., 2021). More importantly, adolescents are still immature and are more likely to take relatively conservative measures to resist risk in the face of negative events such as the COVID-19 pandemic (Zhao and Li, 2022). In cases where information on the illness of others is difficult to obtain, they tend to lower their social trust to avoid exposing themselves to risky events (Aassve et al., 2021).

In terms of the situation in China, as the Chinese government has implemented strict COVID-19 pandemic control measures, the itineraries of infected individuals are published, which makes it less difficult for people to obtain information about this disease (Xiao et al., 2020; Cao et al., 2022). Despite this, there are still strict requirements for vaccinations, nucleic acid testing, masks and social distancing, making adolescents aware that the risk of infection still exists (Shek et al., 2021). At this point, reducing trust in strangers remains a good option. Given that the positive impact of social trust on individual mental health is widely recognized

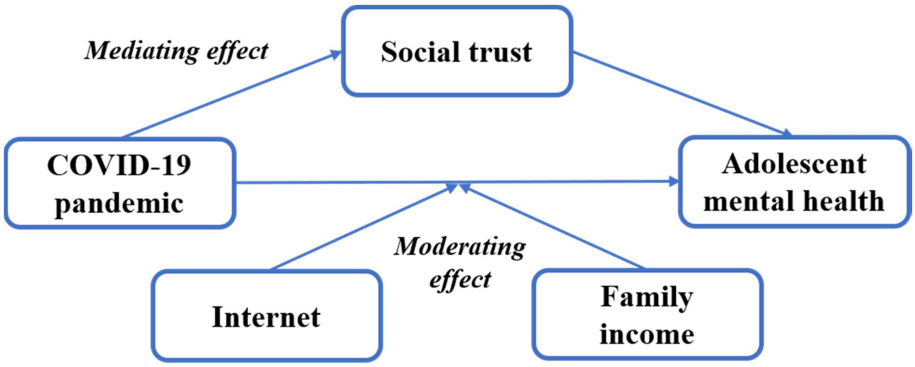

FIGURE 1
The mechanisms of the COVID-19 pandemic on adolescent mental health.

(e.g., Fahmi et al., 2019; Roychowdhury, 2021), we propose our first hypothesis:

> *Hypothesis 1*: The COVID-19 pandemic is likely to reduce adolescents' social trust, especially with strangers in public, which is detrimental to their mental health.

Digital divide

With the popularity of the Internet, digital tools have played an important role in the prevention and control of the COVID-19 pandemic (Shah et al., 2020). For example, in China, relying on support from the Internet and big data technology, people scan health codes, trip codes, and nucleic acid codes to cooperate with various epidemic prevention and control measures (Guo et al., 2022). In the event of infections, digital technology can accurately identify their activity trajectory and analyze the source of viral infection, contributing to epidemic control and special medical care for patients (Zhu et al., 2022). Nonetheless, the phenomenon of the digital divide in epidemic prevention and control has increasingly drawn the attention of scholars (e.g., Dong et al., 2020; Duan et al., 2020; Qi et al., 2020; Hu and Qian, 2021; Samji et al., 2022). In particular, COVID-19 has led to the need for students to study online. For some students in rural or remote areas, they face a large digital divide in online education.

First, there is a large gap between households in rural areas and urban households in terms of Internet access, Internet speed, and flexibility of electronic equipment and software use, especially in developing countries like China (Li and Ranieri, 2013). Epidemic-induced online teaching and learning may lead to difficulties for rural students to keep up and greatly reduce their learning effectiveness (Samji et al., 2022). Second, at the level of the skills divide, many teachers in rural schools do not have the flexibility to use digital technology to present three-dimensional and diverse knowledge content due to limitations (Warf, 2019). Also, students are also not able to make more innovative connections or expand their horizons (Looker and Thiessen, 2003). Third, in terms of the empowerment gap, online education technology can provide students with a channel for self-empowerment and access to more social capital (Hess and Leal, 2001). However, most rural schools are unable to provide sufficient and excellent online education resources, further widening the urban–rural education gap.

Previous studies confirmed that the digital divide further evolved into inequalities in human capital, increasing rural–urban differences in physical and mental health (e.g., Ennis et al., 2012; Shah et al., 2020). Therefore, we put forward our second hypothesis:

> *Hypothesis 2*: The COVID-19 pandemic widens the digital divide, leading to impaired adolescent mental health.

Family income gap

We consider that the third mechanism by which the COVID-19 pandemic influences adolescent mental health is the family income gap. As one of the "black swan" incidents, the COVID-19 pandemic has hit people's income in several ways, causing a further widening of the social income gap. On the one hand, the COVID-19 pandemic has resulted in an economic recession, a contraction in foreign trade and international investment, and a reduction in fiscal sources (Crossley et al., 2021; Ginsburgh et al., 2021; Wildman, 2021), which brings about the decrease in the guaranteed social benefits available to socially vulnerable groups, especially for developing countries (Qian and Fan, 2020; Brodeur et al., 2021). On the other hand, the COVID-19 pandemic has caused higher unemployment rates and lower income. Evidence from the United States, Sweden, India, and Korea show that COVID-19 negatively affected the labor force participation rate, working hours, and residents' income, bringing about a significant increase in unemployment (Aum et al., 2021; Desai et al., 2021; Hensvik et al., 2021). However, wealthy groups are adept at using emergencies such as epidemics to protect their property and even make a profit (Leach et al., 2021), such as entering the related industries for epidemic prevention and control. Also, this income gap may be exacerbated by a series of economic stimulus policies adopted because of the epidemic (Ginsburgh et al., 2021).

There is no doubt that family income is closely related to adolescent mental health. Studies from psychology show that adolescents from families in higher socioeconomic classes have significantly higher levels of positive affect, life satisfaction, and mental health than those in lower economic classes (McLaughlin et al., 2012; Coley et al., 2018). In addition, adolescents from low-income families generate perceptions of their own class economic backwardness and higher levels of low self-esteem and depression through upward social comparisons (Baird et al., 2013). They are more likely to have psychological problems such as obsessive–compulsive symptoms, depression, and psychoticism, impairing their personality development and long-term psychological health (McLaughlin et al., 2012; Reiss, 2013). Therefore, the widening family income gap caused by the COVID-19 pandemic may lead to mental health loss among adolescents from relatively low-income families due to a range of negative issues, such as lack of socioeconomic resources, less emotional care, and inferior position in social comparison (Coley et al., 2018; Hu and Qian, 2021; Lu et al., 2021). More specifically, the outbreak of the COVID-19 pandemic caused a shortage of livelihood resources in the short term. Short-term supply shocks may result in price increases for some essential goods, which are obviously very detrimental to low-income households, while high-income households are less affected. Increased inequality in access to necessities is likely to exacerbate some psychological problems of adolescents in low-income households, such as excessive worries about the future and panic due to the lack of food and medical supplies. Therefore, we develop the third hypothesis:

> *Hypothesis 3*: Widening family income gap from the shock of the COVID-19 pandemic further worsens the mental health of adolescents.

It has to be noted that some mechanisms are not independent of each other and it is very difficult to really pin down each mechanism. For example, adolescents from low-income families face a higher probability of counting the digital divide (Ennis et al., 2012). However, there are also different meanings of the moderating effects of the digital divide and the income gap. The different focus of these two mechanisms implies that the COVID-19 pandemic has led to different aspects of social inequality, both of which deserve the attention of government, the public, and academia.

Data and methods

Data

The data used in this study is from two databases. First, the data on the COVID-19 pandemic of cities in China comes from the COVID-19 Timely Dynamic Tracking Database released by SINA.[1] SINA is an online media company serving China and the global Chinese community. According to the official data released by local governments, COVID-19 Timely Dynamic Tracking Database from SINA has continuously collected and released real-time data on COVID-19 in various cities in China since January 20, 2020, mainly including the cumulative (or new) number of confirmed cases, deaths, cured cases, and so on.

Second, the data on students' mental health and basic characteristics come from the DYH, which is conducted by Shandong University and National Population Health Data Center in China. The DYH program consisted of a multi-wave survey conducted annually in the academic year 2015/2016, 2016/2017, 2017/2018, and 2020/2021, and investigated 99,327 junior or senior high school students from 186 secondary schools in 17 cities of Shandong province in China (Zhang et al., 2022). This database is the first open shared dataset about Chinese adolescents' health, and contains rich variables about students' basic information, mental health, social-economic status, social interaction, nutrition and diet, and so forth (Yi et al., 2019; Dong et al., 2020, 2021). More importantly, to our knowledge, the DYH is one of the few large micro databases that can provide information before and after the spread of COVID-19 in China. Therefore, the DYH provide a good data basis for exploring the impact of the COVID-19 pandemic on adolescent mental health.

In our research, considering the adaptability of the data, we used the data from the DYH in the academic year 2017/2018 and 2020/2021 for analysis, and excluded samples with missing values for the explanatory variable, explained variables, and control variables. In addition, it is important to note that since the DYH program only investigated the mental health status of senior high school students, the study ultimately included a sample of 12,096 senior high school students from 10 cities in Shandong Province in China.

Variables

Measures of adolescent mental health

Our study refers to the Strengths and Difficulties Questionnaire (SDQ) to evaluate adolescent mental health, which is a widely used method to capture adolescents' self-reported mental health (e.g., Goodman et al., 2000; Rotheray et al., 2014; Kersten et al., 2017; Hu and Qian, 2021; Ravens-Sieberer et al., 2022). The SDQ contains 5 subscales: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, prosocial behavior, and 5 items are set for each subscale.[2] Each item contains three options: not true (0), somewhat true (1), and certainly true (2), and then the score of each subscale can be obtained by adding up the scores for its 5 constituent items. A higher score indicates more serious psychological problems for the first four subscales, that

1 Data source: https://news.sina.cn/zt_d/yiqing0121?vt=4.

2 For more information on the Strengths and Difficulties Questionnaire (SDQ), see www.sdqinfo.org.

is, the worse status of mental health. Differently, a higher score indicates the better mental health for the prosocial behavior subscale.

The DYH contains a lot of questions about student mental health, which are also self-reported by students. Therefore, referring to the subscales of the SDQ, we constructed an indicator system to measure adolescent mental health according to the relevant questions and information available in the DYH, as shown in Table A1 in the Appendix. Specifically, we set three relevant items in the DYH for each subscale, and each item contains four options: never (0), not serious (1), moderate (2), relatively serious (3), and very serious (4). The score for each subscale, ranging from 0–12, were calculated by summing the corresponding 3 items. Different from the original SDQ, in our indicator system, the higher the scores of these five subscales, the more serious the corresponding psychological problems.[3] Furthermore, we can obtain a comprehensive indicator *Psychological problems* by adding up the scores of each subscale to measure the overall status of adolescent mental health.

The shock of the COVID-19 pandemic

In terms of the core explanatory variable, we referred to the DID method, and divided the samples into treatment group and control group by the cumulative number of confirmed cases of COVID-19 in each city in the first half of 2020. First of all, it is important to note that COVID-19 mainly spread intensively in China in the first half of 2020, and the situation has gradually recovered in the second half of the year. Meanwhile, the data of the DYH in 2020/2021 was also investigated in the second half of 2020. Therefore, we used the cumulative number of confirmed cases in each city in the first half of 2020 to examine the impact of COVID-19, which is also more reasonable. According to the COVID-19 Timely Dynamic Tracking Database, from January 20 to June 30 in 2020, among the cities in the sample, Jinan, Weifang, Jining, Weihai, Dezhou, Liaocheng, Linyi, and Heze all had confirmed cases, but there were no confirmed cases in Dongying and Laiwu (see Table A2 in the Appendix). Therefore, we construct the binary shock variable *COVID19*. Specifically, as shown in Table A2, when the observation is affected by the COVID-19 pandemic, the core explanatory variable, *COVID-19*Post*, is equal to 1, including students in Jinan, Weifang, Jining, Weihai, Dezhou, Liaocheng, Linyi, Heze in 2020. If the observations were not or barely affected by the COVID-19 pandemic, it is assigned to 0, including students in Dongying and Laiwu in 2020, and samples in 2017.

Control variables

As shown in Table 1, we control a series of characteristic variables about students and their families, including students' gender, age, *Hukou*,[4] migrant, elite class, health, schooling of father and mother, family wealth, etc. Adolescent mental health may be associated with some characteristics at the individual and family levels, so controlling for student and family-level characteristics as much as possible can help minimize potential endogeneity problems. The definitions and summary statistics of variables in our research are reported in Table 1.

Methodology

Unlike previous related studies that relied on small-scale questionnaires, our study is based on large-scale micro-survey data and is based on a socio-economic perspective. Therefore, we examine the outbreak of the COVID-19 pandemic as a quasi-natural experiment and used the DID model to identify the causal effects of the COVID-19 pandemic on adolescent mental health, which is a widely employed approach to evaluate the impact of a shock caused by epidemic disease or natural disasters (Domino et al., 2003; Mu and Chen, 2016). In addition, there is certain rationality and validity in using the DID method in our research. Specifically, firstly, the intensive spread of COVID-19 in China was in the first half of 2020, and DYH included both the mental health data of students in the 2017/2018 and 2020/2021 academic years,[5] that is, the period before and after the occurrence of the COVID-19 pandemic. Secondly, among the cities investigated, there were no confirmed cases of COVID-19 in Dongying and Laiwu in the first half of 2020, while other cities all had confirmed cases, which provides a good control group for the DID model. Therefore, based on the principles of the DID method, we can identify the causal effect of the COVID-19 pandemic on adolescent mental health by comparing the changes in mental health status of sampled students from the treatment group and control group, before and after the outbreak of the COVID-19 pandemic.

The DID model is one of the classic methods to evaluate the effect of exogenous shocks, events, or policies, which is widely employed in social science (e.g., O'Connell et al., 2022; Zhao et al., 2022; Zhao and Yan, 2022). When evaluating the effects of a shock, such as the COVID-19 pandemic, if we just simply compare the difference of the dependent variable before and after the shock, the short-term trend changes may interfere with the estimation results and lead to the causality effects being

3 In the original SDQ, a higher score indicates the better mental health for the prosocial behavior subscale, while it indicates worse mental health for the prosocial behavior in our measurement. The advantage of this approach is that it is easier for us obtain a comprehensive indicator of mental health (*Psychological problems*) by adding up the scores of 5 subscales.

4 The household registration (*Hukou*) system of China is a household-based population management policy implemented in China. In the *Hukou* system, the Hukou status of the population is divided according to their location and family members, and can be mainly divided into two categories: rural *Hukou* and urban *Hukou*.

5 The 2020/2021 academic year starts in the second half of 2020.

TABLE 1 Variable definition and summary statistics.

Variable	Definition	*N*	Mean	S.D.
Panel A. Indicators of psychological problems (SDQ method)				
Psychological problems	Degree of student psychological problems as measured by SDQ method (0–60 points)	12,096	8.579	10.270
Emotional symptoms	Subscale of SDQ (0–12 points)	12,096	2.058	2.647
Conduct problems	Subscale of SDQ (0–12 points)	12,096	1.590	2.069
Inattention	Subscale of SDQ (0–12 points)	12,096	1.835	2.366
Peer relationship problems	Subscale of SDQ (0–12 points)	12,096	1.529	2.135
Prosocial problems	Subscale of SDQ (0–12 points)	12,096	1.567	2.173
Panel B. COVID-19 shock				
COVID19*Post	Shock variable of DID. 1 = adolescent in cities hit by COVID-19 in 2020; 0 = surveying in 2017 or adolescent in cities barely affected by the COVID-19 in 2020	12,096	0.608	0.488
Panel C. Control variables				
Gender	Girls = 0; boys = 1	12,096	0.481	0.500
Age	Adolescent age (years old)	12,096	16.21	1.099
Hukou	Rural = 0; Urban = 1	12,096	0.454	0.498
Migrant	Whether the student is a migrant child (no = 0; yes = 1)	12,096	0.083	0.276
Elite class	Whether the student is in an elite class (no = 0; yes = 1)	12,096	0.193	0.394
Health	Adolescent physical health status through self-assessment (1 = poor; 2 = general; 3 = good; 4 = very good; 5 = excellent)	12,096	3.546	1.043
Only child	Whether the student is an only child (no = 0; yes = 1) 1 = unschooled;	12,096	0.323	0.468
Schooling of father	2 = primary school; 3 = junior middle school; 4 = specialized secondary school; 5 = vocational high school; 6 = senior high school; 7 = junior college; 8 = bachelor degree; 9 = master's or Ph.D. degree	12,096	4.338	1.988
Schooling of mother	1 = unschooled; 2 = primary school; 3 = junior middle school; 4 = specialized secondary school; 5 = vocational high school; 6 = senior high school; 7 = junior college; 8 = bachelor degree; 9 = master's or Ph.D. degree	12,096	3.949	1.999
Father's occupation	1 = the adolescent father is a national civil servant; enterprise manager; teachers, engineers, doctors, lawyers and other high-tech occupations; 0 = other occupations	12,096	0.168	0.374
Wealth	Relatively household wealth (1–5 from low to high)	12,096	2.891	0.618
Internet	whether there is a computer at home with Internet access (no = 0; yes = 1)	12,096	0.859	0.348
Board	Boarding at the school from Monday to Thursday (no = 0; yes = 1)	12,096	0.715	0.451

uncertain. However, in the DID identification strategy, the before-and-after change of the dependent variables in the control group is used as an approximation for the short-term trend changes. Specifically, we regarded those students who were barely affected by COVID-19 in 2020 as the control group, and estimate this short-term trend changes. Then, the DID estimate can be obtained by subtracting the short-term trend changes from the before-and-after change of the dependent variables in the treatment group, which consists of students who were already affected by COVID-19 in 2020. The empirical model is set up as follows:

$$\mathrm{MH}_{\mathrm{ict}} = \beta_0 + \beta_1 \mathrm{COVID19}_c * \mathrm{Post}_t + \beta_2 X_{\mathrm{ict}} + \gamma_c + \theta_t + \varepsilon_{\mathrm{ict}} \quad (1)$$

In the equation (1), the subscript i accounts for student, c denotes city, and t refers to year. $\mathrm{MH}_{\mathrm{ict}}$ indicates the mental health status (psychological problems) of the student i in the city c in the year t. $\mathrm{COVID19}_{\mathrm{c}}$ represents whether the city c was affected by the spread of COVID-19. $\mathrm{Post}_{\mathrm{t}}$ is a dummy that equals to 1 indicating that the survey year t is after the COVID-19 shock, and 0 otherwise. β_1 is the DID estimate, representing the effect of the COVID-19 pandemic on adolescent mental health, which is the key coefficient we are interested in. If β_1 is significantly positive, it means that the COVID-19 pandemic leads to an increase in psychological problems among adolescents and worsens their mental health. X_{ict} denotes a series of control variables, as

mentioned above. Furthermore, we control the city fixed effect γ_c and year fixed effect θ_t, which are used to control for city characteristics and time trends in the framework of DID methods.[6] ε_{ict} is the random error term.

Results

The impact of the COVID-19 pandemic on adolescent mental health

Table 2 reports the baseline results of the COVID-19 pandemic on adolescent psychological problems. In column (1), we find that the shock of COVID-19 significantly increased the scores of adolescents' psychological problems by an average of 2.5677 points, which is about 29.93% of the mean value of this explained variable, *Psychological problems*. Thus, similar to the literature in medicine and public health (e.g., Duan et al., 2020; Qi et al., 2020; Chi et al., 2021; Qu et al., 2021; Cao et al., 2022), by using the DID method, we also confirm that the COVID-19 pandemic significantly increased adolescent psychological problems, and had a significant negative impact on their overall mental health.

Further, in columns (2) to (6), we examined the impacts of the COVID-19 pandemic on each subscale of mental health, including *Emotional symptoms*, *Conduct problems*, *Inattention*, *Peer relationship problems*, and *Prosocial problems*. As mentioned earlier, these 5 subscales are scored on a scale of 0–12, and the higher the score, the more serious the corresponding psychological problem. According to these results in Table 2, we find that all coefficients on *COVID19*Post* are significantly positive at the 1% level, suggesting that the COVID-19 pandemic also significantly increased the scores of the 5 subscales. Therefore, the negative impacts of the COVID-19 on adolescent mental health may be comprehensive, and manifested in various aspects.

More specifically, as shown in columns (2), (4), and (5), the COVID-19 pandemic greatly increased the severity of adolescent negative emotions and directly hindered their prosocial tendencies and peer relationships. Moreover, the results of columns (3) and (4) tell us that the COVID-19 had a negative impact on adolescent behaviors, such as making teenagers more easily to be angry, accusing others, and being easily distracted. Meanwhile, it is worth noting that many studies have reached similar conclusions using data from other countries (Patra and Patro, 2020; Hu and Qian, 2021; Idele and Banati, 2021; Meyers et al., 2021). Our evidence indicates that the negative impact of the COVID-19 pandemic on adolescent mental health is widespread globally, and this issue needs more attention, especially in developing countries.

Mechanism tests

In "Theoretical mechanisms and research hypotheses," we theoretically identify three mechanisms by which the COVID-19 pandemic affects adolescent mental health, namely social trust, digital divide, and family income gap. We now further test these mechanisms and examine the hypotheses.

Social trust

The COVID-19 pandemic may negatively impact adolescent mental health by reducing their social trust, especially with strangers in public. As mentioned in Hypothesis 1, negative public health events such as the COVID-19 pandemic have posed a huge challenge to social trust (Kye and Hwang, 2020; Woelfert and Kunst, 2020; Aassve et al., 2021), especially for adolescents. Based on the relevant questions in the questionnaire, we examined the impact of the COVID-19 pandemic on adolescents' social trust from three aspects: taking public transportation, appearing in crowded places, and eating in public places. The reason we construct social trust indicators from these three dimensions is that in these scenarios, adolescents have to come into contact with strangers. During the COVID-19 pandemic, these variables can partially reflect adolescent social trust.

In Table 3, we find that the coefficients on *COVID19*Post* are all significantly positive in three columns. These results suggest that the shock of the COVID-19 pandemic not only significantly increased adolescents' fear of taking public transportation, but also increased their discomfort in crowded public places and eating in public places. Thus, our estimates imply that the COVID-19 pandemic further worsens adolescent mental health by reducing their social trust, which supports Hypothesis 1.

Digital divide

In "Theoretical mechanisms and research hypotheses," we have highlighted the COVID-19 pandemic may further widen the digital divide between different households, adversely affecting the mental health of some adolescents. To test Hypothesis 2, we construct the interaction term of the COVID-19 pandemic and Internet accessibility (*COVID19*Post*Internet*), and estimate this marginal effect on adolescent mental health.

By using the DID model, the results are represented in column (1) of Table 4, we find that the coefficient on this interaction is −1.0688, with significance statistical significance at the 10% level. These results suggest that during the COVID-19 pandemic, the Internet can further alleviate adolescent psychological problems compared with adolescents without the Internet, as Internet access can reduce the psychological problems in adolescents in Tables 2, 4. Therefore, our estimates provide positive evidence for

6 Controlling for city and year fixed effects allows us to use a reduce d form of the DID model, eliminating the need for additional controls for COVID-19 and Post.

TABLE 2 The impact of COVID-19 on student mental health.

	(1)	(2)	(3)	(4)	(5)	(6)
	Psychological Problems	**Emotional symptoms**	**Conduct problems**	**Inattention**	**Peer relationship problems**	**Prosocial problems**
COVID19*Post	2.5677***	0.5733***	0.4655***	0.5028***	0.4406***	0.5854***
	(0.6453)	(0.1539)	(0.1300)	(0.1424)	(0.1357)	(0.1341)
	[1.30, 3.83]	[0.27, 0.87]	[0.21, 0.72]	[0.22, 0.78]	[0.17, 0.71]	[0.32, 0.85]
Gender	0.1343	−0.1241***	−0.0269	0.0036	0.1426***	0.1392***
	(0.1817)	(0.0471)	(0.0371)	(0.0424)	(0.0385)	(0.0389)
Age	−0.0541	−0.0068	−0.0144	0.0071	−0.0192	−0.0207
	(0.0820)	(0.0211)	(0.0168)	(0.0191)	(0.0173)	(0.0175)
Hukou	−0.3490	−0.0707	−0.1141**	−0.0415	−0.0463	−0.0763
	(0.2320)	(0.0626)	(0.0471)	(0.0540)	(0.0490)	(0.0500)
Migrant	−0.0930	0.0253	0.0168	−0.0689	−0.0148	−0.0514
	(0.3073)	(0.0827)	(0.0616)	(0.0718)	(0.0662)	(0.0662)
Elite class	0.2026	0.0053	0.0522	0.0292	0.0726	0.0434
	(0.2354)	(0.0597)	(0.0489)	(0.0547)	(0.0502)	(0.0509)
Health	−2.6853***	−0.6871***	−0.4575***	−0.5992***	−0.4634***	−0.4781***
	(0.0976)	(0.0257)	(0.0197)	(0.0226)	(0.0206)	(0.0209)
Only child	0.5045**	0.0917	0.1356***	0.0484	0.1152**	0.1136**
	(0.2215)	(0.0572)	(0.0452)	(0.0506)	(0.0475)	(0.0474)
Schooling of father	−0.2886***	−0.0666***	−0.0492***	−0.0604***	−0.0526***	−0.0598***
	(0.0653)	(0.0168)	(0.0137)	(0.0149)	(0.0139)	(0.0142)
Schooling of mother	−0.1183*	−0.0316*	−0.0184	−0.0187	−0.0245*	−0.0251*
	(0.0625)	(0.0163)	(0.0132)	(0.0143)	(0.0133)	(0.0136)
Father's occupation	0.8980***	0.1119	0.2452***	0.1479**	0.1855***	0.2075***
	(0.2885)	(0.0717)	(0.0617)	(0.0663)	(0.0611)	(0.0617)
Wealth	−0.8606***	−0.2120***	−0.1564***	−0.2007***	−0.1378***	−0.1536***
	(0.1845)	(0.0455)	(0.0388)	(0.0427)	(0.0387)	(0.0392)
Internet	−1.7229***	−0.2833***	−0.3733***	−0.3619***	−0.3354***	−0.3690***
	(0.2993)	(0.0740)	(0.0614)	(0.0686)	(0.0642)	(0.0643)
Board	0.0413	−0.0483	0.0060	−0.0083	0.0499	0.0419
	(0.2125)	(0.0557)	(0.0438)	(0.0493)	(0.0447)	(0.0456)
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Constant	23.8722***	5.7789***	4.3896***	4.9493***	4.3345***	4.4198***
	(1.5650)	(0.4033)	(0.3206)	(0.3613)	(0.3297)	(0.3354)
R-squared	0.1151	0.1030	0.0965	0.1038	0.0832	0.0886
N	12,096	12,096	12,096	12,096	12,096	12,096

***, **, * indicate significance at the levels of 1, 5, and 10%, respectively. Robust standard errors are presented in parentheses. 95% confidence intervals for COVID19*Post are reported in brackets. Only the confidence intervals for the key explanatory variable COVID19*Post are reported in the table, while confidence intervals for the remaining variables can be calculated from the estimated coefficients and standard errors.

Hypothesis 2 that the shock of the COVID-19 pandemic has clearly widened the inequality created by the digital divide, with a stronger negative impact on the mental health of some adolescents with fewer digital resources.

Family income gap

In Hypothesis 3, we point out that the widening family income gap due to the COVID-19 pandemic may further worsen the mental health of some adolescents. We divided the full sample into three groups: low-income, middle-income, and high-income families,[7] and constructed the interaction term of the COVID-19 pandemic and low-income family (*COVID19*Post*Low-income family*) for the DID estimations. In addition, it is important to highlight that even though there is some correlation between the digital divide and the family income gap, *Low-income family* in the

7 The DHY surveyed the self-rated household economic situation. The relevant variable ranges from 1–5, where 1 and 2 indicate low income, 3 denotes middle income, and 4 and 5 mean high income.

TABLE 3 Mechanisms: COVID-19 and social trust.

	(1)	(2)	(3)
	Fear of taking public transport	**Feeling uncomfortable in crowded public places**	**Feeling uncomfortable eating in public**
COVID19*Post	0.2731***	0.1416***	0.0957*
	(0.0474)	(0.0523)	(0.0537)
	[0.18, 0.37]	[0.04, 0.24]	[−0.01, 0.20]
Control variables	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Constant	2.0757***	2.5691***	2.4143***
	(0.1211)	(0.1393)	(0.1419)
R-squared	0.0441	0.0622	0.0506
N	12,096	12,096	12,096

***, **, * indicate significance at the levels of 1, 5, and 10%, respectively. Robust standard errors are presented in parentheses. The above three mechanistic variables Fear of taking public transport, Feeling uncomfortable in crowded public places, and Feeling uncomfortable eating in public are all scored from 1 to 5. The higher the score, the higher the degree of panic or discomfort. 95% confidence intervals for COVID19*Post are reported in brackets.

TABLE 4 Mechanisms: COVID-19 and digital divide and income gap.

	(1)	(2)	(3)	(4)
	Digital divide	**Income gap**	**Considering both digital divide and income gap**	**Only low-income families**
COVID19*Post	3.5115***	2.2944***	2.9047***	4.2020**
	(0.8323)	(0.6458)	(0.8367)	(1.7612)
	[1.88, 5.14]	[1.03, 3.56]	[1.26, 4.54]	[0.75, 7.66]
Internet	−1.1234**		−1.1685**	0.4345
	(0.4629)		(0.4680)	(0.8875)
	[−2.03, −0.22]		[−2.09, −0.25]	[−1.31, 2.17]
COVID19*Post*Internet	−1.0688*		−0.6667	−2.2448*
	(0.6004)		(0.6043)	(1.1714)
	[−2.25, 0.11]		[−1.85, 0.52]	[−4.54, 0.05]
Low-income family		0.9547*	1.0265*	
		(0.5315)	(0.5338)	
		[−0.09, 2.00]	[−0.02, 2.07]	
COVID19*Post*Low-income family		1.7213***	1.5824***	
		(0.5542)	(0.5585)	
		[0.64, 2.81]	[0.49, 2.68]	
Control variables	Yes	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
R-squared	0.1153	0.1176	0.1196	0.1130
N	12,096	12,096	12,096	2017

***, **, * indicate significance at the levels of 1, 5, and 10%, respectively. Robust standard errors are presented in parentheses. Low-income family is a dummy variable, if the value is 1, it means that the family is relatively poor or very poor in the self-assessment. COVID-19* Internet and COVID-19* Low-income family represent the interaction terms of COVID-19 and Internet and Low-income family, respectively. 95% confidence intervals are reported in brackets.

study specifically refers to relatively low-income family, not poor family, and thus not all relatively low-income families in the sample do not have access to the Internet. Also, the digital divide focuses on the prevention of the epidemic through digital technology and the online education for students, while the family income gap focuses more on the increase of inequality in family income and access to necessities during the COVID-19 pandemic. The two mechanisms have distinct differences in perspective and therefore need to be discussed separately.

In column (2) of Table 4, not surprisingly, the coefficient of the variable *Low-income family* is significantly positive, implying that teenagers from low-income families are more likely to have psychological problems than those from middle-income and high-income families. Moreover, the coefficient of *COVID19*Post*Low-income family* keeps significantly positive, indicating that the COVID-19 pandemic has further increased the occurrence and severity of psychological problems among adolescents from low-income families, confirming the accuracy of our previous research Hypothesis 3.

Considering both digital divide and family income gap

As shown in Table A3 in the Appendix, there are 671 adolescents in the sample who are both from low-income families and also do not have Internet access at home, which means that about 30.59% of the low-income families (2017) do not have Internet. Therefore, we need to further test whether there is a potential link between the two mechanisms of digital divide and family income gap. In column (3) of Table 4, we consider both digital divide and family income gap in a model, and find that the coefficient of *COVID19*Post*Low-income family* remains significant at the 1% statistical level, but the coefficient of *COVID19*Post*Internet* is not significant.

The main reason for this coefficient change may be that in the model of column (1), some families without Internet are also low-income, and when only the moderating effect of Internet is considered (i.e., when *Low-income family* and *COVID19*Post*Low-income family* are not controlled), the deterioration of mental health due to lower income in this part of the sample is ignored, thus overestimating the moderating effect of Internet. In addition, since the coefficient of *COVID19*Post*Internet* is only statistically significant at the 10% level in column (1), its significance is not strong, and thus tends to be weakened when controlling for both moderating effects of digital divide and family income gap.

Furthermore, in column (4) of Table 4, we retain only the low-income families, which completely exclude the difference between low-income and middle or high-income families, to verify the moderating effect of the Internet access more clearly. The results show that among the low-income families, the coefficient of *COVID19*Post*Internet* is −2.2448 and statistically significant at the 10% level, which indicates that even in low-income families, Internet access still significantly weakens the negative impact of the COVID-19 pandemic on adolescent mental health. Therefore, based on the results in columns (1) to (4) of Table 4, we can confirm that although there is some association between the two moderating effects of digital divide and family income gap, the effects are not exactly parallel.

Heterogeneity analysis

We explore the heterogeneity of the COVID-19 pandemic on adolescent mental health from three perspectives: gender, only children, and *hukou*.

First, we analyze the heterogeneity effect by gender. In columns (1) and (2) of Table 5, we find that the COVID-19 pandemic intensifies psychological problems for both boys and girls, with a slightly higher significance for boys. This subtle difference may be due to boys being more prone to social relationship problems and prosocial problems (Gore et al., 1993; Fisher and Ryan, 2021). Specifically, as reported in columns (5) and (6) in Table 2, although gender did not significantly influence the occurrence or aggravation of psychological problems, boys were more likely to have peer relationship problems and prosocial problems than girls. In the mechanistic analysis, the shock of COVID-19 pandemic negatively affected the adolescent social distance and social trust, and the above factors may have more influence on the 2 subscales of peer relationship and prosocial tendency, with boys already performing worse. Therefore, we believe that the depressing effects of COVID-19 on mental health may be more pronounced for boys.

Second, the results in columns (3) and (4) of Table 5 show that the adverse effects of the COVID-19 pandemic on the mental health of both non-only and non-only children are significant. However, this difference is not obvious from the estimated results. Thus, in terms of the impact of COVID-19 on adolescent mental health, the heterogeneous effects of the negative impact are not known for either only children who may enjoy more family resources or non-only children who have more siblings with them.

Third, we consider urban–rural heterogeneity. In this paper, urban areas mainly include the city center and counties, while rural areas contain the towns and villages. According to the results of columns (5) and (6) in Table 5, the mental health of adolescents living in both urban and rural areas was negatively affected by the COVID-19 pandemic. In contrast, the mental health of urban adolescents was more affected by the pandemic, probably because the COVID-19 pandemic spread more widely in urban China and the corresponding prevention and control measures were more stringent in urban areas. Taken together, based on the heterogeneity analysis, it is clear that the adverse impact of the COVID-19 pandemic on the mental health of Chinese adolescents is widespread.

Robustness checks

To ensure the robustness of the estimated results, we conducted a series of robustness checks, including placebo test, excluding some extreme samples, and adding control variables.

First, in column (1) of Table 6, we perform a placebo test by advancing the COVID-19 shock, which is widely used in robustness checks of DID estimations (Chen and Zhao, 2022; Zhao and Yan, 2022). Specifically, we simulate the COVID-19 shock forward by one period, which is the 2017/2018 academic year based on our data feasibility. Then we construct the variable *COVID19*Post_1*. The results show that the coefficient on this pseudo-variable changes greatly compared with the baseline results in Table 2. Thus, the placebo test indicates that the pseudo

TABLE 5 Heterogeneity due to student and family characteristics.

	(1)	(2)	(3)	(4)	(5)	(6)
	Girls	**Boys**	**Only child**	**Non-only child**	**Urban**	**Rural**
COVID-19*Post	2.0653**	3.3648***	2.6753**	2.5001***	2.4463**	1.9624**
	(0.8397)	(0.9960)	(1.1000)	(0.7934)	(1.0190)	(0.8369)
	[0.42, 3.71]	[1.41, 5.32]	[0.52, 4.83]	[0.95, 4.06]	[0.45, 4.44]	[0.32, 3.60]
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.0989	0.1368	0.1148	0.1189	0.1407	0.1055
N	6,274	5,822	3,907	8,189	6,160	5,936

***, **, * indicate significance at the levels of 1, 5, and 10%, respectively. Robust standard errors are presented in parentheses. 95% confidence intervals for COVID-19*Post are reported in brackets.

TABLE 6 Robustness checks.

	(1)	(2)	(3)	(4)	(5)	(6)
	Placebo test of advancing the shock by one period	**Excluding very poor and very wealthy households**	**Excluding students with poor physical health**	**Excluding students whose father or mother (or both) received tertiary education**	**Excluding students whose father or mother (or both) is a teacher, doctor, or other professional technician**	**Additional control variables**
COVID-19*Post		2.4017***	2.3981***	2.2440***	2.5326***	2.1030***
		(0.6517)	(0.6401)	(0.7224)	(0.6838)	(0.6430)
		[1.12, 3.68]	[1.14, 3.65]	[0.83, 3.66]	[1.19, 3.87]	[0.84, 3.36]
COVID-19*Post_1	−0.8067*					
	(0.4145)					
	[−1.62, 0.01]					
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Additional control variables	No	No	No	No	No	Yes
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.1135	0.1145	0.1008	0.1104	0.1127	0.1331
N	12,096	11,487	11,865	9,541	10,909	12,096

***, **, * indicate significance at the levels of 1, 5, and 10%, respectively. The explained variable in all columns is Psychological problems. Robust standard errors are presented in parentheses. Post_1 represents that the variable Post advances one period. 95% confidence intervals are reported in brackets.

effect we construct does not exist, which indirectly verifies the reliability of the baseline results.

Second, we adopt the method of eliminating extreme observations to ensure the generality of the samples. Socioeconomic status is an important factor affecting adolescent mental health (Wildman, 2003; Reiss, 2013), and adolescents from relatively poor and wealthy families may have differences in their own mental health from most samples. Thus, we eliminate adolescents from very poor and very wealthy households in column (2) in Table 6. In addition, given the strong association between physical and mental health (Feiss and Pangelinan, 2021), we exclude adolescents who self-rated poor physical health in column (3). Moreover, parents' education and occupation are likely to affect students' mental health. Thus, we remove adolescents whose parents are highly educated, or engaged in highly skilled occupations[8] in columns (4) and (5), respectively. Clearly, the results are also basically consistent with the baseline results in Table 2.

Third, we add some additional control variables to further mitigate potential endogeneity issues in column (6) of Table 6, including student-parent relationship, parental education expectations, parents' attitudes towards their children's education, students' participation in extracurricular education, and awards in school. Table A4 in the Appendix reports the definitions and summary statistics of these variables. We find that the coefficient and significance of *COVID19*Post* are virtually unchanged.

8 Here, one of the parents is a teacher, a doctor or other technical jobs, which are regarded as special samples.

Discussion and conclusion

The potential impacts of the COVID-19 pandemic on adolescent mental health have attracted considerable interest mainly in the fields of medical and public health (e.g., Racine et al., 2020; Xiang et al., 2020; Hu and Qian, 2021; Shek et al., 2021; Wright et al., 2021; Kim et al., 2022). Most of these studies were mainly based on online questionnaires and small-scale survey data, and analyzed through psychological and medical perspectives (Guessoum et al., 2020), while few studies used large-scale social survey data to explore this issue from a socioeconomic perspective (Banati et al., 2020; Brodeur et al., 2021; Jaspal and Breakwell, 2022). In addition, by using data from adolescents in different countries, such as China (e.g., Chen et al., 2020; Cao et al., 2022), Germany (Ravens-Sieberer et al., 2022), India (e.g., Patra and Patro, 2020), Italy (e.g., Commodari and La Rosa, 2020), the United Kingdom (e.g., Hu and Qian, 2021; Wright et al., 2021), the United States (e.g., Rogers et al., 2021) etc., scholars have observed a trend of deterioration in adolescent mental health and an increase in the frequency of psychological problems during the COVID-19 period (Adibelli and Sümen, 2020; Shek et al., 2021; Wu et al., 2021; Cao et al., 2022). Based on a large-scale

social survey, the DYH in China, we adopt the DID model to identify the impact of the COVID-19 pandemic on adolescent mental health and explore the socioeconomic mechanisms. Unlike previous studies that have focused specifically on psychological and behavioral changes in adolescents, our study places greater emphasis on social trust among adolescents and the exacerbation of inequalities during the COVID-19 pandemic, which adds to the existing literature and provides new insights.

We draw several conclusions from our findings. First, we find that the COVID-19 pandemic has significantly increased adolescent psychological problems in China. Worse, the negative impact of the COVID-19 pandemic on adolescent mental health is very comprehensive in terms of each subscale, including emotional symptoms, conduct problems, inattention, peer relationship problems, and prosocial problems. Specifically, COVID-19 pandemic significantly increased the scores of adolescents' psychological problems by an average of 2.5677 points, which corresponds to an average decrease of 29.93% in mental health. Second, we explore several socioeconomic mechanisms, indicating that the negative impact of the COVID-19 pandemic on adolescent mental health can be explained by a reduction in adolescents' social trust, and widening inequalities caused by the digital divide and income gap. Third, the results of heterogeneity analysis suggest that the COVID-19 pandemic has a greater negative influence on the mental health of boys and urban adolescents.

Our findings offer some insights into preventing adolescent psychological problems in China and other countries during the COVID-19 pandemic. The Chinese government has adopted strict pandemic prevention and control measures, such as the dynamic zero-COVID policy, to minimize the negative socioeconomic impacts of the COVID-19 pandemic as soon as possible. However, even so, adolescent mental health is inevitably negatively impacted by the pandemic (Zhang et al., 2020; Qu et al., 2021; Cao et al., 2022). According to the findings of our research, the decline in social trust of adolescents caused by the COVID-19 pandemic is one of the important mechanisms for the deterioration of their mental health. Therefore, it is recommended that the government continue to take active pandemic prevention measures to avoid the spread of the epidemic as much as possible, thereby enhancing adolescent social trust and making them feel safer in public.

In addition, we provide evidence that the shock of the COVID-19 pandemic has exacerbated the inequalities caused by the digital divide and income gap in China, and the mental health of adolescents from families with low income and fewer digital resources has further deteriorated during the pandemic. Thus, to enhance the mental health of disadvantaged adolescents and promote human capital enhancement, it is suggested that the government, schools, public welfare funds and other relevant institutions provide them with more economic support and social care.

There are some limitations of this paper and recommendations for further research. First, the data used in this study only covers cities in Shandong Province, China; thus, there are certain limitations in the scope of the sample. Second, limited by the database, we only discuss and test the socioeconomic mechanisms from three aspects: social trust, digital divide, and income gap, and more potential mechanisms cannot be further confirmed. Third, the database used in this study only investigated the mental health of senior high school students, so the impact of the COVID-19 pandemic on adolescents at other educational phases remains to be explored.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

BC: data curation, conceptualization, software, methodology, writing-original draft, writing—reviewing and editing, and funding acquisition. CZ: conceptualization, methodology, validation, writing—original draft, and funding acquisition. XL: validation, formal analysis, and writing—reviewing and editing. JL: conceptualization and writing—reviewing and editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships

that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.1041376/full#supplementary-material

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Exploring the roles of fear and powerlessness in the relationship between perceived risk of the COVID-19 pandemic and information-avoidance behavior

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The COVID-19 has seriously impacted various aspects of the society on a global scale. However, it is still unclear how perceived risk influences epidemic information-avoidance behavior which generally helps us understand public information avoidance. This study aimed to assess the relationship between the perceived epidemic risk and information-avoidance behavior and the mediating role of fear and powerlessness during the COVID-19 pandemic in China. A total of 557 Chinese respondents with COVID-19 treated in modular hospitals ranging from 16 to 72 years old were recruited and completed questionnaires in the face-to-face manner containing scales of the perceived epidemic risk of COVID-19, fear, powerlessness, and information-avoidance behavior. To test the conceptual model, we adopted structural equation modeling (SEM) with the perceived risk of the COVID-19 pandemic as a predictor, fear and powerlessness as mediating variables, and information-avoidance behavior as the outcome. The results indicated a significant and positive association between the perceived epidemic risk of COVID-19 and information-avoidance behavior. Powerlessness acted as the mediator between the perceived epidemic risk of COVID-19 and information-avoidance behavior. The perceived epidemic risk of COVID-19 influenced information-avoidance behavior through fear and powerlessness in turn. Findings from this study implied that public health managers should consider the mediating roles of negative emotions such as fear and powerlessness for coping with behaviors in public health emergencies, especially the information avoidance behaviors related to risk perception.

KEYWORDS

fear, powerlessness, perceived epidemic risk, information-avoidance behavior, COVID-19

Introduction

The new coronavirus disease named coronavirus disease 2019 (COVID-19) by the World Health Organization has spread around the world and become a public health concern due to its high level of contagion (Guan et al., 2020). The vulnerability of COVID-19 has made many people become aware that they are at constant risk of infection, which influences their coping behavior and decisions (Rana et al., 2021). When facing a perceived epidemic risk, the first thing that most people think about is how to avoid risk-related outcomes, which further motivates mental and behavioral responses to the looming risk. Seeking and avoiding additional information related to this risk are two specific behavioral reactions to risky situations (Gutteling and De Vries, 2017).

Information-seeking behavior related to the perceived risk of COVID-19 can be defined as an active or purposeful behavior undertaken by an individual to find information about COVID-19 (Zimmerman and Shaw, 2020). The protection motivation theory regarded information behavior as a response to fear caused by potential threats, and posited that messages related to a certain risk or threat stimulated people to assess the severity of a risky situation and the capability of their response to the situation to protect themselves (Rogers, 1975). Previous studies have also demonstrated a positive relationship between individuals' risk perception and information-seeking behavior (Gutteling and De Vries, 2017; Huang and Yang, 2020; Wen, 2020).

Although information related to a risk is very important and valuable to protect against threats, people do not always seek it and sometimes spare no effort to avoid it (Sweeny and Miller, 2012; Emanuel et al., 2015). Namely, information-avoidance behavior can be defined as any behavior that intended to prevent or delay the acquisition of available but potentially unwanted information to cope with perceived risk during a pandemic (Sweeny et al., 2010; Demetriades and Walter, 2016). Information-avoidance behavior also plays an important role in information management when coping with perceived risk in a health context (Liu et al., 2021). On the one hand, information-avoidance behavior can serve as a strategy to control negative emotions and maintain optimism and hope (Barbour et al., 2012). On the other hand, information-avoidance behavior can also make individuals being unable to obtain epidemic-related information from a disease control standpoint, thus increased the unmitigated spread of disease. However, information avoidance has received less attention than information seeking, and the relationship between information-avoidance behavior and risk perception is still controversial (Yang et al., 2021). Some researchers have revealed that risk perception positively predicted information-avoidance behaviors (Witte, 1996; Taber et al., 2015). Other researchers have found that risk perception negatively predicted information avoidance (Yang and Kahlor, 2013). This literature suggested that the relationship between risk perception and information avoidance was more complex. Therefore, it is necessary to further explore the relationship between these factors and related psychological paths in the middle of the COVID-19 pandemic. Hence, the Hypothesis 1 in the present study was proposed as follows.

> *Hypothesis 1*: Individuals' perceived risk during COVID-19 was correlated with information-avoidance behaviors.

When discussing the relationship between risk perception and information avoidance, it is hard to discuss it alone without considering affect or emotion, because they often rely on and influence each other in empirical research (Griffin et al., 1999). The Planned Risk Information Avoidance (PRIA) Model proposed by Deline and Kahlor (2019) also believed that affective components (such as emotional valence) were important predictors of an individual's information-avoidance behavior. Previous research on the relationship between risk perception and information avoidance reported that the risk perception's impact on information avoidance was mediated by affective responses such as concern, worry, and anxiety (Yang and Kahlor, 2013; Kahlor et al., 2020). As a major psychological reaction to health crises, fear has also often been discussed in previous studies (Dunwoody and Griffin, 2015; Emanuel et al., 2015; Petzold et al., 2020). In general, fear has been regarded as a negative emotion derived from perceived threats to an individual's well-being, and was characterized by increased arousal, behavioral tendencies, and negative apprehensions (Dillard et al., 2021; Mertens et al., 2021). When individuals recognized that their environment contained a risk to which they were susceptible and that risk worked against their goal of maintaining their well-being, they tended to experience fear (Lazarus, 1991). Moreover, people have been affected by stressful experiences during the COVID-19 pandemic, and their most common response to the outbreak of COVID-19 was fear (Porcelli, 2020). For example, in a recent study recruiting 6,509 participants in Germany, Petzold et al. (2020) found that approximately 45% of the participants reported fear of being infected with COVID-19. Assuming that people were aware of the pandemic and the elevated risk during the crisis of the COVID-19, individuals with higher risk perception may perceive the pandemic to be a more significant threat to their well-being, which may cause stronger fear. Consistent with this inference, empirical evidence has revealed a positive relationship between the perceived epidemic risk and their fear during COVID-19 (Harper et al., 2021). Regarding the correlation between perceived epidemic risk or fear and information-avoidance behavior, Dunwoody and Griffin (2015) assumed that perceived epidemic risk triggered information avoidance when this risk made an individual too fearful. However, Emanuel et al. (2015) found that information avoidance behavior was unrelated to perceived epidemic risk. Therefore, it remains unclear whether perceived epidemic risk triggers information-avoidance behavior through fear in the middle of the COVID-19 pandemic. Hence, the Hypothesis 2 in the present study was proposed as follows.

> *Hypothesis 2*: Fear mediated the relationship between the individuals' perceived risk during COVID-19 and information-avoidance behaviors.

In addition to fear as a discrete emotion, we supplemented the model with feelings of powerlessness in the face of epidemic risk. Powerlessness has been regarded as the psychological experience in which an individual felt out of control and unable to cope with current or future events (Braga and Cruz, 2009). It was also a common psychological response to the outbreak of COVID-19 in China (Guo et al., 2020; Liu et al., 2021). For example, Liu et al. (2021) conducted a survey on the mental health of Wuhan citizens during the COVID-19 pandemic, and further demonstrated that the residents of Wuhan experienced various levels of powerlessness. Recent studies reported that individuals in a lasting crisis event who felt higher level of perceived epidemic risk during COVID-19 tended to use less social media, and showed more information-avoidance behavior (Ravindran et al., 2014; Chen et al., 2021). Importantly, a more recent cross-sectional survey on the psychosocial impact of COVID-19 revealed that fear was a predictor of powerlessness (Jin and Ryu, 2022). Based on these findings, powerlessness may play an important role in the perceived epidemic risk of COVID-19-triggered information-avoidance behavior. Hence, the Hypothesis 3 and Hypothesis 4 in the present study were proposed as follows.

> *Hypothesis 3*: Powerlessness mediated the relationship between the individuals' perceived risk during COVID-19 and information-avoidance behaviors.
>
> *Hypothesis 4*: Fear and powerlessness serially mediated the relationship between the individuals' perceived risk during COVID-19 and information-avoidance behaviors.

Overall, previous studies have found that individuals exhibited emotional reactions such as powerlessness and fear during the COVID-19 pandemic, and have also revealed that the perceived epidemic risk of COVID-19 was associated with information-avoidance behavior. However, whether the perceived epidemic risk of COVID-19 predicts information-avoidance behavior is still controversial. Importantly, the psychological path of perceived epidemic risk of COVID-19 on information-avoidance behavior remains unclear. To fill this gap, the present study was performed to investigate the complex associations among those variables using a structural equation modeling (SEM) approach.

Materials and methods

Participants and procedures

Given that convenience sampling has been considered as a specific type of random sampling method and provided the highest response level while saving resources and time (Jager et al., 2017), Chinese respondents with COVID-19 treated in modular hospitals in Shanghai were randomly recruited and completed the survey in the face-to-face manner. The total sample size was 557, and all were included in the analysis. As shown in Table 1, the sample was predominantly male (75.8%). Approximately 28% of respondents were 40–49 years old, 23.5% were 30–39 years old, 21% were 20–29 years old, and 19.7% were 50–59 years old. The education level of respondents ranged from "less than high school" to "graduate degree." This survey was approved by the Local Ethics Committee and conformed to the principles of the Declaration of Helsinki, and included items concerning risk perception, feelings of fear and powerlessness, and information avoidance. The respondents filled out the informed consent document and were told that the purpose of this survey was only for research and their participation was voluntary and completely anonymous, apart from certain demographic data.

The data-gathering phase started from April 12, 2022, to May 5, 2022. Anderson and Gerbing (1988) advised that a small sample size from 100 to 150 was adequate for a simple structural model, and a more complex structural model requires a larger sample size. The sample sizes of 366, and 374 have been employed in previous studies for testing study models of 4–6 hypotheses (Sumarliah et al., 2021a, b). According to Fugard and Potts (2015), the present study adopted the formula ($n = \frac{z^2 \times p \times q}{e^2}$) with identical parameters to determine the adequate sample size (Fugard and Potts, 2015; Wang et al., 2022). Based on this equation, it can be determined that the adequate sample size for this study is 384. Thus, the sample size of 577 in this study is adequate to test our hypothesis of the framework.

Measures

The present study followed a cross-sectional design and used a face-to-face questionnaire as the data collection method. To

TABLE 1 Descriptive statistics analysis of demographic information.

Demographics		Percentage (%)
Gender	Male	75.8
	Female	24.2
Age	<20 years	3.2
	20–29 years	21
	30–39 years	23.5
	40–49 years	28
	50–59 years	19.7
	60–69 years	4.3
	≥70 years	0.3
Education	Less than high school	48.7
	High school graduate	32.1
	Undergraduate	9.5
	Graduate and above	9.7

assess the perceived epidemic risk of COVID-19, fear, powerlessness, and information-avoidance behavior of those infected with COVID-19, we adopted the scales used in the previous literature. See Table 2 for complete item details.

The perceived epidemic risk for the respondents infected with COVID-19 was measured using six items adapted from previous research (Deng and Feng, 2022). The items were scored using a Likert-type response scale ranging from 1 "strongly disagree" to 5 "strongly agree." McDonald's Omega value of the perceived epidemic risk scale was 0.886 in the current study.

Fear of COVID-19 was measured using five items adapted from previous studies (Doshi et al., 2021; Ahorsu et al., 2022). Respondents were asked to rate the extent to which they agreed with statements regarding the fear of COVID-19 on a Likert-type response scale ranging from 1 "strongly disagree" to 5 "strongly agree." McDonald's Omega value of the fear scale was 0.916 in the current study.

Powerlessness was measured using two items adapted from Braga and Cruz (2009) and Deng and Feng (2022). Respondents were asked to rate the extent to which they agreed with statements regarding their powerlessness to COVID-19 on a Likert-type response scale ranging from 1 "strongly disagree" to 5 "strongly agree." McDonald's Omega value of the powerlessness scale was 0.762 in the current study.

Information-avoidance behavior was measured using two items adapted from previous studies (Howell and Shepperd, 2016; Kim et al., 2020). Respondents were asked to rate the extent to which they agreed with statements regarding whether to take evasive action against information about COVID-19 on a Likert-type response scale ranging from 1 "strongly disagree" to 5 "strongly agree." McDonald's Omega value of the information-avoidance behavior scale was 0.791 in the current study.

Data analysis

Data were analyzed *via* SPSS 16.0 and IBM SPSS AMOS 26. First, correlations among the study variables were determined, and the reliability of constructs was conducted in SPSS. To analyze the conceptual model, SEM was performed using AMOS 26; the perceived epidemic risk of COVID-19 was identified as a predictor, fear and powerlessness as mediators, and information-avoidance behavior as the outcome. The fitness of the model was good [χ^2 (84) = 338.20; $p < 0.001$, RMSEA = 0.07 90% CI = (0.065, 0.082), SRMR = 0.05, NFI = 0.93, and CFI = 0.94]. A non-parametric bootstrap method (5,000 samples) was used to test the significance of the mediating effects, with a 95% CI failing to contain zero, indicating a significant mediation effect (Hu and Bentler, 1999).

Results

Common method biases

After data collection completion, we used Harman's single factor test to examine possible common method bias of all variables in this study. Exploratory factor analysis was run for all items of variables with rotated principal component and four factors with eigenvalues greater than one. The first factor accounted for 32.17% of the total variance, which was below the

TABLE 2 Summary of the dependent, independent, and mediating variables.

Variable	Wording	*M*	SD
Perceived epidemic risk scale	Average index	3.04	0.76
(ω = 0.886)	I think COVID-19 is very contagious	2.87	1.00
	I think that even with proper protection, there is still a risk of infection with COVID-19	2.76	0.90
	I am still not very clear about the government's measures to control COVID-19	2.89	0.97
	I do not know what caused COVID-19	3.06	0.93
	I think there is still a risk of infection after COVID-19 is cured	3.24	0.95
	After COVID-19 is cured, I think it may still have an impact on the body	3.40	0.94
Fear scale		3.03	0.80
(ω = 0.916)	I am most afraid of COVID-19	3.15	0.93
	It makes me uncomfortable to think about COVID-19	3.06	0.87
	I worry a lot about COVID-19	2.89	0.93
	I am afraid of losing my life because of COVID-19	2.96	0.92
	My hands become clammy when I think about COVID-19	3.10	0.97
Powerlessness scale		2.97	0.75
(ω = 0.762)	I felt incapable of looking after myself after I was infected with COVID-19	2.83	0.82
	I felt I could do nothing after I was infected with COVID-19	3.11	0.85
Information-avoidance scale		2.34	0.77
(ω = 0.791)	I did not want any more information about COVID-19 after I was infected	2.42	0.87
	I intentionally ignored some information related to COVID-19 after I was infected	2.26	0.81

threshold of 40%, suggesting no significant common method bias in the measurements (Podsakoff et al., 2003; Zhou and Long, 2004).

Correlation analyses

The Pearson correlation analysis results shown in Table 3 indicated that all the scales were significantly correlated except for the correlation between the fear and information-avoidance behavior ($r = 0.05$, $p = 0.960$). The perceived epidemic risk of COVID-19 was positively and sufficiently associated with fear ($r = 0.15$, $p < 0.001$) as well as powerlessness ($r = 0.26$, $p < 0.001$) and information-avoidance behavior ($r = 0.28$, $p < 0.001$). Fear was positively and significantly associated with powerlessness ($r = 0.30$, $p < 0.001$), and powerlessness was positively and significantly associated with information-avoidance behavior ($r = 0.26$, $p < 0.001$).

Relationships between the perceived epidemic risk of COVID-19 and information-avoidance behavior: Mediating effects of fear and powerlessness

Based on the results of the correlation analysis and our hypothesis that fear and powerlessness mediate the relationship between the perceived epidemic risk of COVID-19 and information-avoidance behavior, we used AMOS 26.0 to test the mediating model. The results of the regression analyses are shown in Figure 1. The perceived epidemic risk of COVID-19 positively predicted information-avoidance behavior ($\beta = 0.24$, $p < 0.001$) as well as fear ($\beta = 0.15$, $p = 0.013$) and powerlessness ($\beta = 0.21$, $p < 0.001$). Fear significantly predicted powerlessness ($\beta = 0.27$, $p < 0.001$); however, fear did not predict information-avoidance behavior ($\beta = -0.05$, $p = 0.321$). A strong regression path was found between powerlessness and information-avoidance behavior ($\beta = 0.22$, $p < 0.001$).

To test the intermediary roles of fear and powerlessness in the relationship between the perceived epidemic risk of COVID-19 and information-avoidance behavior, the bootstrap method was used to sample 5,000 times and build a 95% unbiased correction CI. The results showed that the intermediary chain effect of fear and powerlessness was significant [$\beta = 0.009$, 95% CI (0.002, 0.020)], indicating significant mediation by fear and powerlessness. In addition, the perceived epidemic risk of COVID-19 had an indirect effect on information-avoidance behavior through powerlessness [$\beta = 0.047$, 95% CI (0.025, 0.079)].

TABLE 3 Pearson correlations for all study variables (n=557).

Variable	1	2	3	4
1. Perceived risk	1			
2. Fear	0.15***	1		
3. Powerlessness	0.26***	0.30***	1	
4. Information-avoidance behavior	0.28***	0.05	0.26***	1

***$p < 0.001$.

Discussion

In the present study, we first examined whether the perceived epidemic risk of COVID-19 was associated with information-avoidance behavior in patients with COVID-19. Importantly, we also aimed to establish the mediating effect of feelings of fear and powerlessness in the association between the perceived epidemic risk of COVID-19 and information-avoidance behavior.

Consistent with the Hypothesis 1, this study confirmed that the perceived epidemic risk of COVID-19 positively predicted information-avoidance behavior. This confirmed the results of previous studies (Witte, 1996; Dunwoody and Griffin, 2015; Taber et al., 2015), but was also inconsistent with a previous study suggesting that risk perception negatively predicted information-avoidance behavior (Yang and Kahlor, 2013). This contradiction may arise from different respondents and risk issues. Yang and Kahlor (2013) research was mainly concerned with the

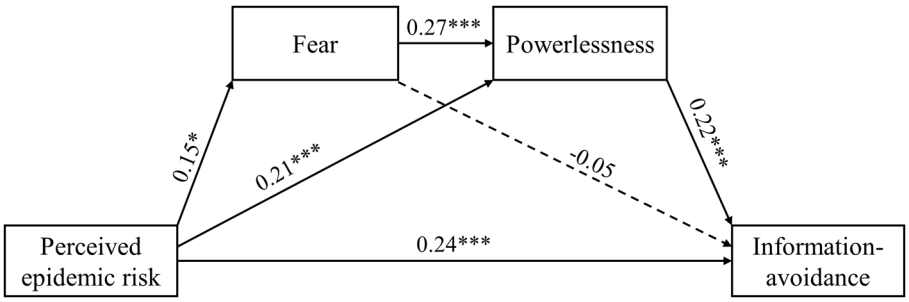

FIGURE 1
Structural equation model of the direct effect of perceived epidemic risk on other variables and the mediating effects of fear and powerlessness. The dotted lines indicate non-significant relationships. *p<0.05, ***p<0.001.

relationship between college students' risk perception related to ecological hazards from climate change and information-avoidance behavior. Inconsistent with the previous study, this study mainly focused on the relationship between the perceived epidemic risk of COVID-19 and information-avoidance behavior in patients with COVID-19. Considering that the COVID-19 pandemic was a global public crisis and had posed a great threat to individuals, the results indicated that higher risk perception could motivate an individual to avoid information if the information was perceived as too threatening (Deline and Kahlor, 2019). This argument was consistent with the assumption that individuals avoid information to mitigate emotional burdens (van 't Riet and Ruiter, 2013).

In addition, we found that risk perception was directly related to negative emotions such as anger, anxiety, and stress (Griffin et al., 1999; Oh et al., 2021). This result confirmed and extended the findings in the previous studies, and demonstrated that the higher the perceived epidemic risk of COVID-19 by respondents, the more intense the experience of fear and powerlessness would be. According to the Extended Parallel Process Model, affective response to events depended on whether individuals felt that they could control the risk (Witte, 1994). Negative emotions were aroused when individuals took the risk seriously and believed that the threat would affect them personally. This means that respondents in this study felt fear and powerlessness, perhaps because they had been infected with COVID-19 and believed that their actions would not significantly affect an outcome, and lost control of the current situation during the crisis (Braga and Cruz, 2009).

Another aim of this study was to investigate the mediating effects of fear and powerlessness on the relationship between the perceived epidemic risk of COVID-19 and information-avoidance behavior. According to the protection motivation theory proposed by Rogers (1975), individuals usually used threat and coping appraisal to protect themselves in the face of threats. This view regarded information-avoidance behavior as a response to fear aroused by perceived epidemic risk. Consistent with this claim, previous studies of risk-related information behavior have demonstrated a positive relationship between perceived epidemic risk and information-avoidance behavior through feelings of fear (Jepson and Chaiken, 1990; Witte, 1994; Chiang and Tang, 2022). Notably, these studies mainly focused on the context of chronic risks for which people may not perceive a strong sense of urgency or prioritize acting immediately (Zhao and Liu, 2021). For example, Chiang and Tang (2022) mainly focused on internet security compliance behavior in a public Wi-Fi usage condition, and demonstrated that fear was an important determinant of the user's avoidance behavior. Inconsistent with the claim of the protection motivation theory and the Hypothesis 2, feelings of fear did not mediate the association between the perceived epidemic risk of COVID-19 and information-avoidance behavior in the current study. These findings suggested that whether perceived risk affected information-avoidance behavior through fear may depend on the level of fear.

Notably, although no mediating effect of fear was observed in this sample, the SEM results corroborated the Hypothesis 3, and revealed that powerlessness mediated the relationship between the perceived epidemic risk of COVID-19 and information-avoidance behavior. In addition, the perceived epidemic risk of COVID-19 influenced information-avoidance behavior through feelings of fear and powerlessness in turn which also aligned with the Hypothesis 4. These findings confirmed and enriched one school of thought that individuals resorted to defensive avoidance to reduce their negative emotions when they felt chronic fear or when their fear has reached a certain level (Jepson and Chaiken, 1990; Witte, 1994). Namely, in the acute risk situation, individuals infected with COVID-19 exhibited a sense of powerlessness to reduce or diminish their fear of COVID-19, which stimulated information-avoidance behavior. In this case, a sense of powerlessness in coping with the perceived epidemic risk of COVID-19 could serve as a buffer to resist the negative effects of fear related to the specific threat or risk from COVID-19. Consistent with this inference, correlational evidence in the previous studies also indicated that the levels of fear were positively associated with a sense of powerlessness in the middle of the COVID-19 pandemic (Lifshin et al., 2020). In the context of COVID-19, individuals with powerlessness tended to avoid information regarding the risks when they felt a greater likelihood of being personally affected (Chen et al., 2021; Zhao and Liu, 2021).

With a view to theoretical application, this study confirmed the positive association between the perceived epidemic risk of COVID-19 and information-avoidance behaviors, and further deepened the PRIA by analyzing its mediating effect in the path of information avoidance. Compared with the PRIA in which the "affective risk response" was used as a mediating variable for risk perception to positively predict information-avoidance behavior, this study further explained the mechanism of this effect from the perspective of mediating influence. That is, when we considered the impact of specific emotional variables such as fear and powerlessness, the perceived epidemic risk of COVID-19 could not only directly affect information-avoidance behavior, but also indirectly affected the information-avoidance mechanism through fear and powerlessness in turn.

With a view to practical application and influencing of policy, the epidemic risk of COVID-19 perceived by citizens impacted their negative and information-avoidance behavior in turn. In this regard, individuals were more likely to avoid information when they felt the huge threat posed by the risk of COVID-19 and experienced negative emotions. Thus, interventions to improve risk information resources and popularize knowledge related to emotion regulation to the public may effectively reduce information-avoidance behavior among vulnerable individuals. On the one hand, the government should consider providing more positive risk information to motivate, and reassure the public by demonstrating the benefits and effectiveness of the prevention guidelines instead of simply focusing on the statistics of mortality and infection rates. On the

other hand, the government should help the public to ease their negative emotions using different approaches such as social media, emotional management guidelines, and psychological counseling.

A few limitations of this study should be noted. First, although correlations between the variables were revealed in the current study, the cross-sectional design did not allow for causal conclusions in terms of the relationship analyzed. Moreover, due to the urgency of treatment of respondents who were infected with COVID-19 and insufficient manpower, we just focused on the prediction of perceived epidemic risk to information-avoidance behavior and its mediation effect, lacking justification of the respondent. Therefore, the results of this study should be confirmed by further longitudinal studies. Second, all data were collected through a survey of Chinese respondents with COVID-19 treated in modular hospitals in Shanghai, which undermined the generalization of results. Moreover, the sample in this study was quite asymmetric in relation to the level of education, which was a factor intuitively related to the individual's ability to assimilate information from reliable sources and to interpret and value this information (Viswanath, 2005). In this case, the information-avoidance behavior may be influenced by schooling according to the level of education, even though the results did not change significantly when we carried out the analysis independently in two groups determined by schooling (low and high schooling) and the previous study demonstrated that schooling did not interfere with information-avoidance behavior (Gaspar et al., 2016). Therefore, caution should be used when extending the results to populations in other regions or other groups. Finally, the association between the perceived epidemic risk of COVID-19 and information-avoidance behavior appeared to be more complex, which may be affected by several factors, such as informational subjective norms, personal characteristics, and coping resources (Loiselle, 2019; Soroya et al., 2021). Feelings of fear and powerlessness could only explain a small part of it. We have not investigated other important factors concerning this relationship. Therefore, a more comprehensive model should be established to explore the psychological path of the association between the perceived epidemic risk of COVID-19 and information-avoidance behavior in the future.

In summary, this study has made two contributions. First, it established a relationship between the perceived epidemic risk of COVID-19 and information-avoidance behavior in the context of a public health emergency. Specifically, the perceived epidemic risk of COVID-19 could positively predict information-avoidance behavior. Second, it revealed the psychological path of perceived epidemic risk positively predicted information-avoidance behavior. Particularly, although perceived epidemic risk did not affect information-avoidance behavior alone through fear, it did affect information-avoidance behavior through fear and powerlessness in turn. In addition, perceived epidemic risk affected information-avoidance behavior through powerlessness. These findings contributed to the theoretical understanding on how the variables related to or affected each other, and further provided insights for practical implications, such as establishing programs that may decrease the fear and powerlessness in crises or emergencies to reduce information-avoidance behavior.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Internal Review Board of the Key Laboratory of Applied Brain and Cognitive Sciences at Shanghai International Studies University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

SX conceived and designed the research, and provided critical revisions. JW, NZ, and KZ collected the data. NZ analyzed the data with feedback from SX. SX and JJ drafted the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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COVID-19 and mental health: A systematic review of international medical student surveys

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Background: The medical school curriculum has imposed psychological stressors on students worldwide, some of which may induce feelings of increased depression and anxiety. Meanwhile, the COVID-19 pandemic has exacerbated the feelings of stress, depression, and anxiety that a portion of medical students experience in their daily life. The aim of this systematic review is to gather concrete data from medical schools around the globe, and further evaluate how the COVID-19 pandemic has impacted medical students' mental health.

Materials and methods: Systematic search of data from PubMed, EMBASE, psycINFO, MEDLINE Complete, and Global Health for studies conducted between December 2019 and July 2021 was conducted. Data from 47 different surveys of medical students from various medical institutions throughout the world were included in this review. These surveys, administered in the form of questionnaires that utilized rating scales, measured anxiety, depression, and stress levels in medical students amidst the COVID-19 outbreak.

Results: The COVID-19 outbreak was found to have negative effects on medical students, most notably causing emotional and behavioral changes and detrimental mental health impacts. Higher levels of stress, depression, and anxiety have been found in medical students since the outbreak.

Conclusion: This systematic review highlights the sustained high prevalence of moderate depression, anxiety and stress among medical students during the COVID-19 pandemic. Appropriate support and research on which

interventions could mitigate these risks is essential in order to ensure that future physicians are properly cared for, and ultimately have the adequate tools needed to provide high quality and empathetic care to future patients.

KEYWORDS

medical students, COVID-19, anxiety, depression, mental health, mood, SARS-CoV-2, anxiety disorder

Introduction

In November 2019, the first SARS-CoV-2 outbreak hit Wuhan, China, which became the epicenter of what would become the worst pandemic of modern society, and the first major one that healthcare professionals and civilians had encountered. This Corona virus disease showed to be an incredibly infectious and debilitating agent that impacted people of all ages around the world. On March 11, 2020, the World Health Organization declared the Corona virus disease a global pandemic (World Health Organization [WHO], 2020). As of August 24, 2021, the World Health Organization has documented 212 million COVID-19 cases, and 4.4 million deaths attributed to this pandemic outbreak (World Health Organization [WHO], 2022). This COVID-19 pandemic has heavily impacted the lives of many people worldwide who are suffering from illness, losing loved ones, or struggling to cope with the new reality of isolation and social distancing. The pandemic has shown the importance of being grateful for the relationships we have, and has proven how valuable mental health truly is. A significant majority of the studies we found focus on mental health of global medical students, and there is a major gap in the literature discussing how the COVID-19 pandemic has impacted medical student mental health in the United States. Despite the emergence of the vaccines and their important role in the decrease in number and severity of cases, it is of utmost importance that we continue to explore how the COVID-19 pandemic impacted the next generation of physicians as they progress in their medical journey.

Significant changes were made to the traditional medical school curriculum throughout the world, leaving many overwhelmed about their belief in their success and furthering the challenges already imposed on medical students. Students have been forced to amend their learning and studying styles, while academic institutions have similarly been strained with the responsibility of changing their previously well-established education curriculum and mode of delivery (Al Samaraee, 2020). Medical education has been notoriously considered as one of the foremost rigorous and demanding academic journeys, with great potential to induce outstanding psychological stress in a medical student (Backović et al., 2013; Awad et al., 2019; Quek et al., 2019). Medical institutions globally have taken significant consideration into documenting how their students have been impacted, but institutions in the United States have been less proactive in the process. As current medical students, we will be focusing our paper on how the overall experience of medical education, with all the pre-listed restrictions and negative effects faced during the pandemic, have affected the psyche of the medical student population.

The rigor, intensity, and challenges that come with online learning during medical school has inevitably led to social isolation, maladaptive behaviors, and feelings of decreased confidence (Alsoufi et al., 2020; Mheidly et al., 2020; Zis et al., 2021). This begs the questions of whether the COVID-19 pandemic has exacerbated the mental health of medical students or had no impact. The primary aim of this systematic literature review is to identify the severity of mental health decline in medical students internationally, and provide updated estimates of the prevalence of depression, stress, and anxiety amongst medical students from various countries throughout the COVID-19 pandemic. Utilizing this data will aid in preparation for future life-changing events that may have similar impedances on medical students' life. The data will ultimately emphasize the necessity in evaluations and treatments to mitigate mental health challenges, and will hopefully induce additional strategies that medical institutions can employ. We ultimately believe that medical students' mental health during the COVID-19 pandemic has been negatively exacerbated, and that feelings of anxiety, depression, and stress are more prominent. In order to ensure that future physicians are able to provide adequate and competent care to their patients, it is imperative that institutions around the world develop strategies to improve these students' mental health.

Materials and methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Page et al., 2021a,b). The review was not registered and a review protocol was not prepared in a formal document, but is discussed thoroughly below. Review authors were unable to find a duplicate registered protocol and given the unique nature of the review question, review authors

did not believe registration was necessary. Review authors have no competing interests to declare. There were no sources of financial or non-financial support for this review.

Search strategy

Articles were retrieved through a systematic search of PubMed, EMBASE, psycINFO, MEDLINE Complete, and Global Health. Searches for each database were conducted on August 9th, 2021. The overarching search tool included our Rocky Vista University database, which encompasses the more specific databases previously listed. The same search string was used for each database.

The search string for each database was the following: ("medical student" or "medical students") AND ("COVID-19" or "Corona virus" or "2019-nCOV" or "SARS-CoV-2" or "CoV-19") AND ("anxiety" or "depression" or "stress" or "anxiety disorder" or "mental health" or "mood").

Inclusion and exclusion criteria

Studies were included if they met the following criteria: (1) presented original research (2) published in English since the outbreak of COVID-19 in December 2019; (3) assessed depression, anxiety or stress among medical students; (4) used an established or well-designed method to measure depression, anxiety or stress; (5) provided sufficient information to calculate prevalence of depression, anxiety or stress among health care workers (e.g., percentage or sample size and number). We excluded studies that focused on non-medical students (including undergraduate, graduate, or other health profession students; medical residents or doctors), discussion of medical students grouped with non-medical students, studies that did not involve measurements of anxiety, depression, or stress, studies that solely collected anxiety, depression, or stress data using questions with binary responses (for example, only reported anxiety data collected from the question, "did you experience anxiety during the pandemic?" with available answer responses "yes" or "no"), studies that did not involve study of impact of COVID-19, studies that did not contain concrete data, including published conference abstracts, and studies that were not in English.

Study selection

Authors DP, MB, VB, VK, and MZ screened all titles and abstracts against the selection criteria. There was 99% agreement between reviewers. Full texts for selected studies were reviewed by DP, MB, VB, VK, and MZ. When the relevance of a study was unclear, the authors reread the full text of each study and discussed their disagreements on inclusion versus exclusion criterion until disagreements were resolved. Citations were generated by manual input into Zotero.

Data collection

Data was independently and manually extracted by authors DP, MB, VB, VK, and KC and reviewed collectively by DP, MB, and VK. No study data requiring confirmation from authors was identified. The following data was extracted from included studies, with use of a standardized form: (1) Study Characteristics: country, population, sample method, sample size, response rate, gender, and age; (2) Outcome: reported statistical analysis of depression, anxiety, and stress levels from psychological scales, instruments used, related factors assessed, and relevant outcomes and results. Additional data collected by studies outside of the specified parameters were not reported. All reported effect measures for outcomes were drawn from study data and were not independently verified given the number of included studies and that all included studies were peer-reviewed. Reported data was not synthesized given the wide range of outcomes between studies and the goals of this review.

Quality assessment

The studies included were assessed for risk of bias using the instrument from Agarwal et al. "Risk of Bias in Cross-Sectional Surveys of Attitudes and Practices." Rather than giving us a single risk of bias for a single study, when addressing cross-sectional surveys, this instrument will help us provide risk of bias on a domain-by-domain basis, instead of one overall risk of bias rating and/or when the domains are inter-related with one another (Quek et al., 2019). This instrument was selected for its applicability to these review–all studies included is cross-sectional surveys–and its adaption from an established tool, the Cochrane risk-of-bias instrument for randomized trials (Cochrane methods Bias, 2022). As determined by the instrument, risk of bias was assessed across five different domains: (1) Is the source population representative of the population of interest? (2) Is the response rate adequate? (3) Is there little missing data? (4) Does the study have a pilot study? (5) Is there any evidence for the reliability and validity of the survey instrument? Each domain is rated on a four-point scale with 1 signifying "definitely yes" (low risk of bias) and 4 signifying "definitely no" (high risk of bias). Quality assessments for the studies included in this review can be found in **Supplementary Appendix Table 3**. Reported certainty assessments were drawn from study data and were not independently verified given the number of included studies and that all included studies were peer-reviewed.

Results

Introduction

The literature search identified 832 articles published between December 1st, 2019 and August 9th, 2021 (Figure 1). 101 duplicates were removed. 273 articles were removed during title and abstract screening, and 458 articles were subjected to full-text analysis and 411 articles were removed according to the inclusion/exclusion criteria described above. In total, 47 studies were included in this review. Analysis of 40 of the most relevant studies has been organized by country or region below. A breakdown of studies by country includes: Nine studies in China, one study in Australia, one Kazakhstan, three studies in Turkey, one study in Saudi Arabia, two studies in Germany, two studies in Japan, five studies in the United States of America, one study in Italy, one study in Nepal, one study in Libya, two studies in Canada, one study in Bangladesh, one study in Jordan, one study in Ireland, six studies in India, one study in Lebanon, two studies in Brazil, one study in Morocco, one study in Singapore, one study in Thailand, one study in Peru, one study in Pakistan, and one study in Russia. Study characteristics, prevalence data,

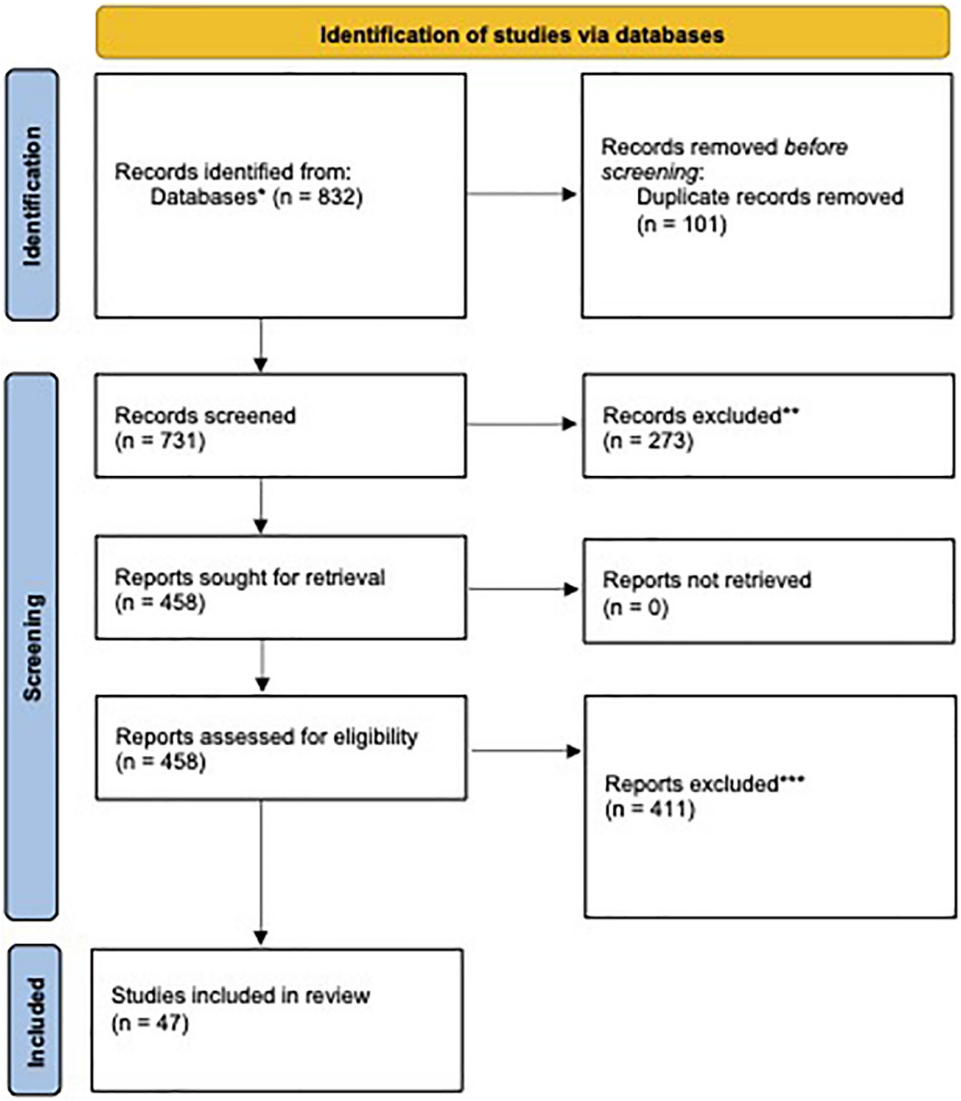

FIGURE 1
PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only. *Breakdown by source: PubMed (*n* = 220), EMBASE (*n* = 354), PsycINFO (*n* = 13), MEDLINE complete (*n* = 206), and global health (*n* = 39). **Exclusion was done manually by researchers. No automation tools were used. Reasons included (1) did not involve medical students, (2) did not study the impact of COVID-19, (3) not accessible in English, and (4) publications that were not full-text (i.e., conference abstracts). ***Reasons for exclusion included (1) did not involve measurements of anxiety, depression, or stress, (2) medical students were grouped with non-medical students, and (3) self-reported anxiety, depression, or stress.

and relevant results for all 47 included studies can be found in **Supplementary Appendix Tables 1, 2**.

Study quality varied by study. The most common drawbacks for studies were associated with limited response rate and small sample size. The majority of studies used reported data from cross-sectional surveys, which have certain inherent biases, as discussed below. Response rate was generally low, which is not unexpected for voluntary surveys. Data analyses were determined to be appropriate for all studies.

Across all studies and regions, COVID-19 was reported to have a nearly ubiquitous negative impact on medical student populations and was associated with increased levels of anxiety, stress, and depression. The following results are described based on geographical regions. This was done to compare how different articles varied and shared similarities amongst each other in specific regions because they share the underlying commonality of geography. Some countries had more papers published then others, hence why China and India had their own sections instead of being included in sections with other regionally similar countries. From a grand scale, this model allows for simplicity to compare different geographical regions amidst the differences in how national governments reacted to the pandemic. As a result, these differences in public policy are the basis for how medical schools were affected, and hence their students' mental health as well.

China

In our evaluation of various studies from China, COVID-19 was generally reported to have a negative impact on medical student mental health, most prominently by exacerbating students' anxiety, depression, and stress levels. For example, a cross-sectional study on medical students from 3 Chinese medical universities was conducted to evaluate perceived stress, insomnia, and depression using the Perceived Stress Scale (PSS), Insomnia Severity Index (ISI), and Patient Health Questionnaire 9 (PHQ-9). Of 29,663 participants, perceived stress was significantly associated with depression and insomnia (Liu et al., 2021). Utilizing the Depression, Anxiety and Stress Scale (DASS-21), researchers in another study involving 1,041 participants detected that 26.8% of students in China had elevated levels of depression, 20.2% had elevated levels of anxiety, and 11.1% had elevated levels of stress (Zhang et al., 2021a). Fujian Medical University conducted a survey that assessed 906 medical students from 12 different medical colleges, revealing a positive relationship between mental stress and loneliness. This university also reported that the pandemic increased students' mental stress due to fears of becoming infected with COVID-19 (Zheng et al., 2021). Meanwhile, Shantou University Medical College assessed two surveys conducted throughout the course of the pandemic, with 1,069 responses in the first study and 1,511 students in the second study, which revealed a rise in stress and anxiety levels between the two time-points (Zhang et al., 2021b). Additionally, three medical universities in Western China found that students had moderate to high levels of stress based on a distributed survey. Average item scores for stressors included in the survey were 2.72 for academics, 2.31 for psychosocial and 2.07 for health-related stressors, where a score of 1 indicated participants strongly disagreed with the item being a stressor and 5 indicated participants strongly agreed with the item being a stressor (Wang et al., 2021). At China Medical University, 666 participants were included in a research article where 64 (9.6%) of the participants reported depression from March to April 2020 (Zhao et al., 2021). Another cross sectional study that surveyed 5,982 medical students found that prevalence rates of mild to severe depressive symptoms were 35.2% and of anxiety symptoms were 22.8% (Yin et al., 2021). Students with low to medium levels of social support had higher risks of experiencing depressive or anxiety symptoms (Yin et al., 2021). Both COVID-19 exposure and living in areas with higher COVID-19 cases was positively associated with mild to severe depressive or anxiety symptoms (Yin et al., 2021). Lastly, medical students at Changzhi Medical College were surveyed for levels of anxiety and stress; the proportions of students with mild, moderate, and severe anxiety were 21.3, 2.7, and 0.9% respectively (Cao et al., 2020). Students that lived alone, were from rural areas, from families without a steady income, those who lived with parents, and those with an acquaintance infected with COVID-19 were all found to more likely experience severe anxiety (Cao et al., 2020). Also, worry about academic delays and influence of epidemic on daily-life was found to have moderate and positive correlation with levels of anxiety (Cao et al., 2020). A negative association between social support and anxiety symptoms experienced by students was found during the COVID-19 outbreak (Cao et al., 2020).

India

Studies discussing anxiety, depression, and stress levels were also conducted among medical students in India. A study conducted in Chennai City surveyed 500 medical students between the ages of 17–20 (Saravanan et al., 2021). Men in the study had an anxiety prevalence rate of 69%, while only 31% of females experienced anxiety (Saravanan et al., 2021). Depression rates were 34% in men and 27% in females (Saravanan et al., 2021). Furthermore, researchers from a study conducted at the Medical College of North India of 331 students concluded that students' uncertainty about the duration of the medical degree and exams was positively correlated with stress (Indian Journal of Public Health Research and Development, 2020). Lastly, a cross-sectional study was conducted on medical students in Bengaluru, India, which found that 23.2% of the students had depression, 20.7% had anxiety and 13% had stress ranging from mild to extremely severe (Shailaja et al., 2020). Students with adaptive attitudes and behaviors experienced less severe

depression, anxiety, and stress than other students (Shailaja et al., 2020).

Rest of Asia, excluding the Middle East

Studies were also administered in other parts of Asia, including Pakistan, Japan, Bangladesh, Kazakhstan, Nepal, and Singapore. At Harian Medical College in Pakistan, a study of 233 students showed a significant decrease in the level of depression and an increase in the level of anxiety and stress among medical students (Masud et al., 2021). At the Okayama University School of Medicine in Japan, a survey of 473 medical students found that students' mental health status significantly worsened after the Japanese State of Emergency regarding the pandemic was implemented (Nishimura et al., 2021). 29.8% of these students had concerns about transitioning to an online learning format, which was correlated with generalized anxiety and depression (Zhao et al., 2021). A cross-sectional study from Showa University School of Medicine furthermore showed a significant degree of psychological distress among 28.5% of the students (Arima et al., 2020). Researchers in Nepal surveyed various medical colleges using the Hospital Anxiety and Depression Scale (HADS), demonstrating a positive correlation between depression and anxiety levels in students (Risal et al., 2020). A similar cross-sectional study in Bangladesh administered HADS to 425 medical students, indicating that 65.9% of medical students had varying levels of anxiety: 27.3% mild, 26.8% moderate, and 11.8% severe (Safa et al., 2021). Additionally, 49.9% of the medical students were found to have varying degrees of depressive symptoms, with 3.3% of surveyed students reporting severe depressive symptoms (Safa et al., 2021). Students who had significant fears of becoming infected with the virus were at higher risk for anxiety and depression by 3.5 and 2.7 fold, respectively (Safa et al., 2021). A questionnaire-based cross-sectional study of medical students in Kazakhstan at Astana Medical University analyzed the impact of the transition to online learning. Interestingly, the study revealed that depression and anxiety decreased after transitioning from traditional learning to online learning (Bolatov et al., 2021). In addition, students that had academic difficulties or who lived alone during the quarantine were more prone to depression and anxiety (Bolatov et al., 2021). Lastly, there was an online survey conducted among medical students in Singapore during the COVID-19 lockdown period demonstrated that students with lower perceived susceptibility to infection had a lower anxiety score (Koh et al., 2021).

Middle East

Relevant studies conducted in the Middle East surveyed medical student populations in Turkey, Saudi Arabia, Jordan, Iran, and Lebanon. A cross-sectional survey study was conducted of medical students at Bezmialem Vakif University in Istanbul, Turkey. Of the participants, GAD-7 scores showed that 19.7% were experiencing severe anxiety, 17.4% moderate anxiety and 37.1% mild anxiety (Bilgi et al., 2021). PHQ-9 scores revealed that 21.9% were experiencing moderate to severe depression, and 23% mild depression (Bilgi et al., 2021). In a separate online survey questionnaire, students at the Faculty of Medicine of Yeni Yüzyıl University in Istanbul were found to have increased anxiety and distress as determined respectively by PSS and Impacts Events Scale-Revised (IES-R) scores (Torun and Torun, 2020). Mean scores were higher in women than men (Torun and Torun, 2020). A survey of 553 medical students at six medical schools in Jordan found that COVID-19 negatively impacted the stress levels of 56.2% of students, as assessed by Kessler's psychological stress scale (K10) (Seetan et al., 2021). Stress levels of students at the King Saud University College of Medicine (KSU) in Saudi Arabia were also assessed using K10. Overall stress levels were found to be significantly higher in female medical students and 3rd year medical students (Abdulghani et al., 2020). In addition, 22.3% of the students reported experiencing severe stress related to online learning (Abdulghani et al., 2020). Lastly, a descriptive survey study was conducted on medical students at the American University of Beirut Faculty of Medicine (AUBFM) in Lebanon. The majority reported that they felt more stressed after shifting to online classes and would be willing to go back to on-campus classes (Bachir et al., 2021).

South America

Studies of medical student populations in Brazil and Peru were also analyzed as a part of this review. Students at Jundiai Medical School in Brazil reported high levels of stress during the COVID-19 pandemic, with first-year students reporting the most severe levels of stress. The survey also assessed HADS scores, which were found to have a negative correlation with year in school (Perissotto et al., 2021). A separate study conducted at Jundiai Medical School also found an inverse relationship between class year and depression, as first year medical students had the highest prevalence rates of depression (Miskulin et al., 2020). In Peru, 1,238 medical students were recruited to participate in a study, which reported that 74, 57, and 65% of the participants experienced depressive, anxious, and distress symptoms, respectively (Huarcaya-Victoria et al., 2021).

North America

Studies conducted in the US and Canada were included in this review. A large study involving 1,428 medical students from 40 U.S. medical schools surveyed anxiety and depression using GAD-7 and PHQ-9; 30.6 and 24.3% screened positively

for anxiety and depression, respectively (Halperin et al., 2021). Median GAD-7 and PHQ-9 scores were higher for females and preclinical students and median GAD-7 scores were higher among those with acquaintances diagnosed with COVID-19 (Halperin et al., 2021). Next, a cross-sectional survey was administered to medical students in clinical training at the University of California San Francisco School of Medicine, the University of California Irvine School of Medicine, Tulane University School of Medicine, the University of Illinois College of Medicine, the Ohio State University College of Medicine, and Zucker School of Medicine during the initial peak of the pandemic, April-May 2020. This investigation disclosed that 84.1% of the students reported increased levels of stress and anxiety due to the pandemic (Lee et al., 2021). Furthermore, according to GAD-7 scores, 34.3% showed mild, 16.1% were moderate, and 9.5% had severe anxiety symptoms (Lee et al., 2021). Female students were more likely to experience anxiety (Lee et al., 2021). In a separate survey involving students from these medical schools, students reported that the pandemic moderately affected their stress and anxiety levels with 84.1% of the participants reporting feeling "at least somewhat anxious" (Harries et al., 2021). In another study, a nationwide online survey was administered to medical students throughout the U.S. Of 852 participants, 66.1% experienced mild to severe anxiety (Guo et al., 2021). Mean PSS scores were highest among second through fourth year medical students (Guo et al., 2021). Students with preexisting mental health conditions had significantly higher stress and anxiety scores and students attributed the increased stress to COVID-19 (Guo et al., 2021). The last U.S. cross-sectional study analyzed in this review revealed that medical students reported higher levels of stress, anxiety, and depression than other graduate students (Nikolis et al., 2021). In a survey of 10 Canadian medical schools, 45% of surveyed medical students reported higher levels of stress than usual (Abbas et al., 2020). A different Canadian medical school reported that 58% of surveyed students felt more depressed and students with a prior history of depression or anxiety reported increased symptoms of anxiety and depression (ElHawary et al., 2021).

Europe

Surveys were also conducted in the United Kingdom, Italy, and Germany. At the University College Dublin School of Medicine, 54.5% of students reported increased levels of stress ranging from moderate to extreme (O'Byrne et al., 2021). High levels of stress were more prevalent in females and international students (O'Byrne et al., 2021). At Magna Graecia University School of Medicine in Italy, 354 students were surveyed and 48.9% of the participants indicated an increased anxiety state (Abenavoli et al., 2021). In another study, a cross-sectional online survey was conducted on medical students at University Medical Center Hamburg-Eppendorf, Germany. Students were found to be experiencing "clinically unproblematic" levels of anxiety and depression symptoms, as assessed through Patient Health Questionnaire-4 (PHQ-4) scores (Guse et al., 2020). A final study from Germany reported that distress levels were found to be high and significantly correlated with academic context but notably, not with their private lives (Loda et al., 2020).

Australia and Africa

Finally, three studies were included from Australia and Africa. In Australia, 297 students participated in a study using K10 to measure psychological distress (Lyons et al., 2020). The study reported a mean K10 score of 20.6, indicating moderate psychological distress (Lyons et al., 2020). In Morocco, the mental health of medical students throughout the country was assessed using PHQ-9, GAD-7, and K10. Out of 549 students, 62.3 and 74.6% screened positively for symptoms of anxiety and depression, respectively (Essangri et al., 2021). In a study involving 2,430 students from 15 medical schools in Libya, 64.5% of the students were determined to have varying degrees of anxiety according to GAD-7 scores (Elhadi et al., 2020). 37.5, 16, and 11% of students were determined to have mild, moderate and severe anxiety, respectively (Elhadi et al., 2020). Anxiety was significantly associated with living status and internal displacement (Elhadi et al., 2020). Furthermore, 21.6% of students had a PHQ-9 score indicating moderate to severe depression and 88% of the students scored positively for mild depression (Elhadi et al., 2020).

Discussion

As we had asked the question of whether the COVID-19 pandemic had exacerbated the mental health of medical students or had no impact, the literature review was conducted to better understand the severity of mental health decline in medical students internationally, and provide updated estimates of the prevalence of depression, stress, and anxiety amongst medical students from various countries throughout the COVID-19 pandemic. After gathering the data and finalizing our results, we ultimately have found that medical students' mental health during the COVID-19 pandemic has certainly been negatively exacerbated, and that feelings of anxiety, depression, and stress are more prominent.

In a meta-analysis conducted before the pandemic involving 40,348 medical students across the globe, researchers found the prevalence of anxiety to be 33.8%–a rate higher than that of the general population (Quek et al., 2019). Many factors can explain this high rate, including the financial burden, sleep deprivation, overwhelming workload, and lack of free time

to find adequate methods to cope with chronic stress (Quek et al., 2019). In addition to anxiety, researchers have found higher rates of depression in medical students compared with the general public (Abenavoli et al., 2021). In an analysis of 167 cross-sectional studies, it was reported that the rate of depression among medical students was 27.2%, and of suicidal ideation was 11.1% (Liu et al., 2020). It was also discovered that among those who screened positive for depression, only 15.7% of medical students sought professional treatment (Liu et al., 2020). Anxiety and depression were found among students of all levels of education. Both studies did not find statistical significance of anxiety or depression among medical students and non-medical students, although the non-medical student groups often included those in professional or graduate programs, which may indicate that anxiety and depression are a consequence of the stressors of higher education in general. Nonetheless, these studies show that medical students experience higher rates of anxiety and depression, at baseline, compared to the general public. This is important to note in order to discuss the burden of the COVID-19 pandemic on medical students.

This systematic review highlights the implications of a global pandemic on medical student mental health. In this evaluation, COVID-19 was generally reported to have a negative impact on medical student mental health, including depression, anxiety and stress, worse than the baseline levels mentioned above. These levels, however, vary by country and region. This variance was expected by the researchers, as cultural diversity contributes profoundly to mental health. Culture impacts "ways in which health and illness are perceived, health seeking behaviors, attitudes of the consumer as well as the practitioners and mental health systems" (Gopalkrishnan, 2018). In other words, the lens through which a person interprets, copes with, and treats their mental health. Therefore, the purpose of this study was to encapsulate global data to interpret how medical students' mental health was impacted by COVID-19. The discussion is organized similarly to how the results were outlined in order to maintain fluidity; however, it is acknowledged that some are organized by country, and other by region or continent. This form of organization is due to the quality and quantity of data found in the systematic review.

China

Through a large meta-analysis consisting of ten cross-sectional studies involving 30,817 Chinese medical students, 29% reported depression and 21% reported anxiety; these pre-pandemic prevalence rates were similar to the findings reported globally (Zeng et al., 2019). Our review of the literature revealed a general increase in depression, anxiety and stress in this population during the COVID-19 pandemic; however, severity trended downward through the course of the pandemic. Researchers credited the initial prevalence of these mental health issues to virtual learning, increased loneliness, prolonged periods of isolation, fear of infection, poor social support, living in regions with high rates of COVID-19 exposure and infection, living alone, experiencing financial insecurities and worrying about academic delays. The protective factors against mental health issues included the availability of coping resources, online learning support, volunteer opportunities, personal resilience, and social support. A study conducted on the general population in China, during the COVID-19 pandemic, discussed the need for the following public health policies: developing and utilizing effective screening protocols at the government level to identify risk factors and provide intervention, especially targeting young individuals, individuals with lower socio-economic status, who have been quarantined, and those with severe stress (Duan et al., 2020). While this study did not assess medical students specifically, these findings could be applied at an institutional level, such as a medical school, because they take into account strategies that may be effective for Chinese individuals.

India

Large studies on pre-pandemic rates of mental health disorders among medical students in India are scarce. One systematic review analyzed 47 studies and found elevated depression, anxiety and stress rates at 39.2, 34.5, and 51.3% respectively, with females experiencing higher rates (Sarkar et al., 2022). These prevalence rates are almost double those found globally, which may be due to cultural factors including high familial expectations, constraints for pursuing alternate interests, and the stigma surrounding mental health issues in general (Sarkar et al., 2022). Through our analysis of the literature, depression, anxiety and stress rates during the COVID-19 pandemic were variable. The majority of studies conducted during the pandemic were small-scale studies. The general trend identified was an increase in the prevalence and severity of anxiety and stress, with depression rates remaining relatively unchanged. Significant predictors of negative mental health discussed by researchers included poor sleep quality, pre-existing mental health disorders, fears of contracting and spreading COVID-19, infection with COVID-19, and direct interaction with COVID-19 patients. One systematic review that conducted data pre-pandemic emphasized regular mental health screenings with the use of standardized instruments, although did not offer solutions outside of screening (Sarkar et al., 2022).

Rest of Asia, excluding the Middle East

Data from Pakistan, Japan, Bangladesh, Kazakhstan, Singapore, and Nepal was compiled to represent the rest of Asia, excluding the Middle East. The studies conducted in

Pakistan, Kazakhstan, and Singapore revealed a decrease in student reports of depression during the COVID-19 pandemic, with researchers crediting this drop in depression rates to the transition from tradition to online learning platforms (Bolatov et al., 2021; Koh et al., 2021; Saravanan et al., 2021). This contrasts what was found in Japan, where students were more likely to be depressed and anxious if they had concerns about the switch to online learning (Nishimura et al., 2021). Rates of anxiety increased during the pandemic in Pakistan, Japan, Nepal, and Bangladesh. The researchers reported that students were at risk of worsening anxiety symptoms if they lived alone during the pandemic or worried about becoming infected with COVID-19. While it is acknowledged that Asia is a massive continent with vastly diverse cultures, researchers have made some generalized statements about Asians and mental health. For instance, researchers have investigated how emotional expression impacts mental health, citing shame as one of the reasons why Asian individuals are hesitant to seek professional help (Gopalkrishnan, 2018). Furthermore, Asian cultures may be more collective and family oriented, with a heavy focus on spirituality, impacting the way in which mental health is interpreted and treated (Gopalkrishnan, 2018).

Middle East

Pre-pandemic levels of anxiety, depression and stress in the Middle East were variable and challenging to find. Studies in Turkey, Jordan, Saudi Arabia, Iran, and Lebanon reported high levels of anxiety, stress, and depression during the pandemic with an overall negative impact on students' psychological state. Similar to what studies in other countries found, many of the students disliked online learning platforms and had worse rates of mental health problems if they lived alone during the pandemic. It is postulated that mental health research in Arab cultures may be lacking due to the general stigma and differences in beliefs and actions toward the treatment of anxiety and depression (Zolezzi et al., 2018).

South America

Two studies in South America analyzed the relationship between students' year in school and mental health effects. The majority of students found that students that experienced their first years of medical school during the pandemic reported higher levels of depression, anxiety, and stress than students in their last years of school.

North America

Students in North America reported high levels of anxiety, depression and stress compared to global rates, with up to 84.1% of students reporting an increase in stress and anxiety and 58% of students reporting worsening depression. Risk factors included female gender, those with acquaintances diagnosed with COVID-19 and those with pre-existing mental health conditions. The increase in prevalence of anxiety, depression and stress may indicate that medical students in North America are especially susceptible to the emotional consequences of pandemics. Numerous studies found from the United States highlighted that, indeed, medical student mental health had worsened during COVID-19; however, the call for reform and policy change lacked evidence-based examples. For instance, one such study highlighted the need for "supplying students with resources, including counseling, peer advocacy, and support" (Halperin et al., 2021). In fact, most programs likely had mental health "resources" prior to the pandemic; therefore, this study is a call on medical schools, especially those that are located in countries with real-time access to mental health care, to trial interventions and identify which ones actually work. For instance, in a country like the United States, one that claims to value mental health and has worked to destigmatize mental illness, research needs to include interventions and practical applications of data. Another pandemic is inevitable and steps should be taken to minimize damage.

Europe

Students in Ireland, Italy, and Germany were included in this review, and were found to experience moderate to severe stress, and an increase in anxiety and depressive symptoms, notably citing academic context to be a significant source of psychological distress. Future studies could analyze Eastern European medical student mental health, as these countries were underrepresented in the current literature.

Africa and Australia

Minimal results were found from Australia and Africa. As expected, medical students in Australia experienced moderate psychological stress. One study conducted in Libya revealed that a majority of students experienced some degree of anxiety and depression, with almost 100% of students reporting depression and 22.7% reporting some form of suicidal ideation. These are the highest prevalence rates found in this systematic review. The COVID-19 pandemic occurred during the Libyan Civil War which may account for these towering numbers, as war can have drastic effects on one's well-being. Research conducted on refugees from Africa has indicated that this group might be more reluctant to talk therapy, as there may be a perception that expressing emotions and talking about painful topics causes more harm than good (Gopalkrishnan, 2018). These researchers have also highlighted a general mistrust in clinicians as a product of perpetual racism as evidenced by historical and current persecution of African individuals (Gopalkrishnan, 2018).

Strengths

This systematic review analyzed 47 articles from 24 different countries around the globe. The results discussed in this systematic review are consistent with prevalence rates reported in other systematic reviews on the impact of COVID-19 on medical student mental health. This study is important because it takes into account the global population. While a decline in mental health was expected, the takeaway message from this review is that culture does indeed influence mental health in many ways. It impacts attitudes and beliefs about mental health in general, the symptoms, understanding and treatment associated with distinct conditions, and one's willingness to seek treatment. This review highlighted the differences in prevalence of anxiety and depression in the global medical student population, and shed light on gaps in the data within certain countries and regions.

Limitations

This systematic review is limited due to the inherent bias that exists with survey studies, as well as use of many different measures of mental health without proper standardization. This review analyzed the results of self-reported mental health conditions, whereas the gold standard for establishing a diagnosis involves clinical interviewing to measure psychiatric symptoms. Many different survey formats were analyzed in this paper, which may have resulted in varying levels of mental health problems between surveys, leading to under and over representations in the literature without an objective scale being used. In addition, sample sizes and response rates varied between surveys, where the larger studies or studies with higher response rates conducted might be better representations of the sample population. The majority of the studies were conducted during or after the COVID-19 pandemic and failed to gather baseline data to compare pre-and post-pandemic levels and, generally, there was a large gap in the literature assessing medical student mental health prior to the pandemic. Finally, there are clear gaps in the existing literature with certain regions and countries. Whereas countries like China and the United States had ample research poured into this topic, South American and European data was scarce. Therefore, a true assessment of global medical student mental health cannot be made as many countries are not represented adequately.

Conclusion and implications

Our hypothesis that medical student mental health was negatively impacted by the COVID-19 pandemic in terms of anxiety, depression and stress, was found to be correct. This systematic review is important because it highlights that medical students are particularly at risk for experiencing mental health consequences, as they experience higher prevalence rates of mental health conditions compared to the general public at baseline. These outcomes are due to a myriad of factors including the disruption of clinical training and transition to online learning, adjustment to social isolation, experiencing financial constraints, having poor social support, caring for COVID-19 patients, having challenges to accessing care, being an preclinical student, female gendered students, exposure to high-risk environments, and lacking abilities to effectively cope during unprecedented times. Protective factors included living with family during isolation periods, having ample social support, and participating in coping activities such as regular exercise. This review suggests that there should be an increased awareness and focus on medical student mental health, especially during public health emergencies such as the COVID-19 pandemic. In order to avoid student physician burn out, schools should consider providing more resources such as access to counselors and professional mental health care, as well as encourage students to employ protective coping strategies. Many of the articles highlighted the importance of utilizing validated screening protocols at the institutional level. For example, schools could start to require yearly PHQ-9 and GAD-7 screenings for their students; as titers must be routinely checked to prevent serious infection, students should also be screened for severe anxiety and depression.

As described above, mental health on a global scale generally worsened during the COVID-19 pandemic. While many researchers discussed the need for effective screening procedures to identify risk and provide intervention strategies, those intervention strategies were hardly discussed or entertained. Rather than studying prevalence data for an already at-risk population, it would be more beneficial to employ intervention strategies and monitor the effects of therapy, medication management or other accessible coping resources. Or, rather than applying these Band-Aids, so to speak, it is worth considering change at an institutional level. It would be worth determining which specific aspects of medical school during a global pandemic were the most impactful on mental health and broadly implementing them. For instance, if mental health was made worse by online learning, incorporating in-person labs or lectures back into the schedule should be considered while weighing the risk of mental illness with the risk of contracting COVID-19. Lastly, the topic of global mental health should be addressed in countries like the United States, a country with incredible cultural diversity, as culture impacts every aspect of mental health. In order for U.S. schools to take care of their global students, they must take these cultural considerations into account before inciting change.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

DP, MB, MZ, VB, VK, and KC contributed to data curation, formal analysis, and investigation. RR contributed to project administration and supervision. All authors contributed to conceptualization and writing—review and editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.1028559/full#supplementary-material

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The impact of self-regulated learning strategies on academic performance for online learning during COVID-19

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The COVID-19 pandemic led higher education institutions to transition to online learning. The present study was designed to investigate students' self-regulated learning strategies on academic performance in online learning. We analyzed the differences in college students' self-regulated learning (SRL) strategies according to their grade point average (GPA). The study included 1,163 students at a distance education university in China. Two online questionnaires were used to determine online SRL strategies. GPA scores were obtained from the university exam database to determine academic performance. The analysis showed that there are great differences between different self-regulated strategies and between different students when accepting the online learning. The analysis also showed that self-evaluation, metacognitive self-regulation, and effort regulation were positive predictors of academic progress, besides, self-evaluation and effort regulation had mutual influence effect on the improvement of GPA in online learning. These data will help teachers, education policymakers, and education administrators adopt and implement online learning services to improve students' academic performance.

KEYWORDS

self-regulated learning strategies, online learning, metacognition, academic performance, college students

1. Introduction

In January 2020, when the COVID-19 pandemic broke out, many changes were made in various sectors of life, including education. In response to the impact of the COVID-19 pandemic on the field of education, many universities transitioned to remote learning where classes were held online and the teaching mode changed to online teaching, which has completely changed the learning mode of college students (Crawford et al., 2020). In the online learning mode, students and teachers lack face-to-face interaction and communication as they did in a classroom, and it is difficult to perceive the micro-changes of each other's expressions and actions in the process of communication. Online learning relies on the use of asynchronistic and synchronistic interaction within a virtual environment (Serdyukov, 2020). Further, students who study

online have more opportunities to learn information and access learning resources flexibly and autonomously instead of studying completely according to the teacher's guidance (Waha and Davis, 2014). In the learning process, teachers are no longer the leaders and regulators of learning, but they truly become participants and instructors of learning. All in all, this is a new learning mode characterized by flexible teaching and active learning (Nikolaki et al., 2017; Nerantzi, 2020). Many studies have shown that academic success in an online learning environment requires high level of self-regulated learning (SRL) skills and great ability to control the learning process (Broadbent and Poon, 2015; Jia, 2021). Thus, self-regulation becomes a crucial factor for successful online learning.

A variety of definitions have been used to describe SRL. Zimmerman posited that SRL is "the degree to which students are meta-cognitively, motivationally, and behaviorally active participants in their own learning process" (Zimmerman, 1990) which has been the most widely accepted definition. SRL is generally described as a cyclical process, often triggered by the formulation of goals and the subsequent employment of strategies, followed by engagement in reflection and the formulation of new learning goals (Zimmerman, 2002). In addition, students' SRL ability is dynamically developed, and the learning environment can influence the way students learn (Chen and Bonner, 2020). In other words, the same learning strategy usually works differently in different environments (Broadbent and Poon, 2015). Examining SRL strategies in the online learning environment is important given that this environment has been noted as requiring individuals to be more autonomous in their learning.

The rapid development of online learning during the pandemic led to the accumulation of online learning data that provide a basis for quantitative research on online learning. However, our understanding of teaching and learning in this new environment is relatively lacking. Most studies about online learning focus on the weak online teaching facilities, the adverse impact of home environment, the adjustment of students' thinking styles, the degree of cohesion of curriculum design, and the sense of online learning efficacy (Carter et al., 2020; Pokhrel and Chhetri, 2021; Ulfatun et al., 2021). Sintema et al. found students' levels of academic performance are likely to decline due to reduced time spent engaging with learners and a lack of counseling with teachers when they experience online learning (Sintema, 2020). However, SRL ability is to accurately analyze and choose appropriate methods and strategies to adapt to the new environment and achieve academic success in the face of such environmental changes (Araka et al., 2020). Most researchers believe that self-regulation is a context-specific process (von Suchodoletz et al., 2015). Effective implementation of learner support requires an understanding of which SRL strategies are most effective in online learning environment. Therefore, it is very important to investigate the academic performance and analyze the SRL capabilities and strategies under a passive online learning mode during the pandemic, which can provide a useful reference and insight for future teaching and learning changes.

Thus, this study aims to analyze the differences and associations in SRL strategies based on their academic performance, to understand how students could best apply SRL strategies to achieve academic progress within the online environment.

1.1. Academic performance in online learning environments

Academic performance can be generally defined as achieving a particular result in an exam or subject and is ordinarily expressed in terms of a numerical grade or grade point average (GPA) (Richardson et al., 2012). The higher the GPA, the better the students' academic performance. In the most study of predicting academic performance for online learning, the theory of SRL has been used as theoretical grounding (You, 2016). The prediction model based on SRL theory proposed that students who manage their time appropriately, persevere in understanding the learning material were more likely to achieve higher grades in the online learning (Broadbent and Poon, 2015). For example, Kizilcec et al. found that task management strategies, such as reserving time in the week for studying, starting and finishing a chapter on the same day, working with others on the course, having clear objectives and planning around those goals, and applying what one has learned were helpful for online learning (Kizilcec et al., 2017). Muilenburg et al. also found statistically significant relationship between age, gender, or ethnicity (Muilenburg and Berge, 2005). At the same time, some studies have found an increase in students' academic performance in emergency remote teaching (Iglesias-Pradas et al., 2021). Although some measures show a positive impact on achieving academic success, there is a gap about how COVID-19 (stay-at-home) measures and online learning affects students' academic performance.

A large number of researchers have shown that a positive association exists between SRL strategies and college students' academic outcomes (Nota et al., 2004; Kramarski and Gutman, 2006; Beishuizen and Steffens, 2011; Richardson et al., 2012). The application of SRL strategies typically predicts high academic achievement (Broadbent and Poon, 2015). Students' SRL in an online learning environment specifically manifests their ability to develop their own learning goals, formulate the entire learning plan in advance, effectively use learning content and materials, be effective in the learning process, and regulate and conduct a self-reflective assessment of learning results (Artino, 2007). The unique feature of online learning is that it gives students control over when, what, and how to study to a great extent (Dumford and Miller, 2018). As the online learning

environment is characterized by autonomy, self-regulation becomes a critical factor for success in online learning. Researchers have suggested that SRL is of greater importance in online learning environments due to its autonomous nature (Wong et al., 2019).

1.2. SRL strategies and academic performance

A widely accepted classification of SRL strategies was first described by Pintrich as follows: rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, and help-seeking (Pintrich et al., 1991). In the student's learning process, these strategies interact with one another in each cycle, changing the student's SRL skills and strategies (Bandura and Cervone, 1986). As SRL strategies that students perform, these SRL strategies were a function of an individual's desire to achieve in their learning and necessary for the success of learning in the online environment. From the perspective of social cognition, the development of SRL skills and strategies is affected by the interaction of personal, behavioral, and environmental factors, in the form of reciprocal causality (Zimmerman and Bandura, 1994; Zakiah and Fajriadi, 2020). Thus, certain strategies may be more effective in certain environments than others (Ashley and Tuten, 2015).

The role of learning strategies in gaining academic success has been widely investigated for campus-based college students. In 2012, Richardson, Abraham, and Bond conducted a retrospective study and meta-analysis of the relationship between college students' learning strategies and GPA. The results showed that effort regulation was the most important learning strategy positively correlated with academic outcomes, followed by time and learning environment management and metacognitive self-regulation, whereas rehearsal, elaboration, and organization had the least empirical support (Richardson et al., 2012; Broadbent and Poon, 2015). The development of SRL is an active process. With the changes and development of students' learning environment, SRL strategies will inevitably change as well. Research has found that the most powerful SRL strategies are metacognition, time management, and effort adjustment (Richardson et al., 2012). Broadbent and Poon found that four learning strategies including metacognition, time management, effort regulation, and critical thinking were significantly associated with online learner's grades (Broadbent and Poon, 2015). To sum up, the existing literature showed that in an online learning environment, SRL strategies were related to students' academic performance. However, due to the different characteristics of each learning strategies and the different challenges faced by students, the effect of the SRL strategies involved in predicting academic performance may be different in different environments. Thus, the exploration of the predictors of online learning success, the effect of different strategies on academic performance and the effectiveness of different SRL strategies under the online learning model during the pandemic is becoming increasingly important.

2. Methods

2.1. Study design

This study was based on longitudinal GPA data collected from 1,163 college students in China. The Online Self-regulated Learning Questionnaire (OSLQ) and Motivated Strategies for Learning Questionnaire (MSLQ-B) were used to include SRL strategies. Before investigating the questionnaires, G-power was used to budget the sample size. The effect size $t = 0.8$, $\alpha = 0.001$, and the power $P = 0.95$ were selected. The calculated sample size and the total sample size were 73 and 146, respectively. The number of valid questionnaires were 388, which can reach the priori sample size. The questionnaire items were written in English and translated into Chinese. To ensure cross-linguistic equivalence, the results were independently translated back to English by two English professors.

2.2. Participants

All participants were from a public university located in Shandong Province, China. From March to July 2020, due to the impact of COVID-19, universities generally adopted an online teaching model. Undergraduates receiving online lectures are our research objects. We recruited 1,163 undergraduates enrolled in online learning during the second term of the 2019–2020 school year. By comparing their GPA obtained in three semesters, we selected a total of 410 students who had significantly increased and decreased GPA in the online learning mode. We posted an online questionnaire, and 406 students volunteered to be part of the study and completed the online survey (the efficiency recall rate was 99.02%). In order to ensure the quality of the questionnaire, we gathered students to fill in the questionnaire in the classroom. Before answering the questionnaire, we carefully explained to the students the purpose of the questionnaire, the notes for filling in and the expectation of getting real feedback from everyone. After receiving the questionnaire, we calculated the average response time and set the upper and lower limits of time according to the mean $\pm$ 2 standard deviation. We finally got 388 high-quality questionnaires and about 4.4% of the extreme duration samples were screened out. Among the 388 students, 54.12% ($n = 210$) were female, and 45.88% ($n = 178$) were male. As for their age, 100% ($n = 388$) of the students were aged 18–22, and their average age was 19.74 years old ($SD = 0.53$).

2.3. Data collection

The students' GPA scores were obtained from the scoring system. The research conducted online questionnaires to investigate the SRL strategies of students with fluctuating GPA. The students completed the questionnaires to measure their SRL ability and strategies. All students were briefed about the purpose of this study before answering the questionnaire. In addition, we obtained the approval of the ethics committee of Liaocheng University. The participants filled out the surveys voluntarily with no negative consequences for not filling them. The questionnaire items were designed in English and translated into Chinese.

2.4. Online SRL

SRL is a process that changes as the learning environment changes. With the change and development of students' learning environment, the measurement method of SRL is bound to change. Therefore, the OSLQ developed by Barnard was used in this study to measure students' SRL level in online learning (Barnard et al., 2009). The OSLQ measures the skills that involve the various processes in the regulation of cognitive and metacognitive aspects, motivation, and behavior. The OSLQ is a means of assessing individuals' SRL in online learning situations by asking about their cognitive and metacognitive strategies for learning (Amir and Kamal, 2011). This scale has 24 items measuring six dimensions: environment structuring (four items), goal setting (five items), time management (three items), help-seeking (four items), task strategies (four items), and self-evaluation (four items). The responses are rated on a 5-point Likert scale ranging from 1 (none at all) to 5 (a great deal). Barnard et al. demonstrated that the OSLQ had good reliability and validity in both online and hybrid environments in two separate studies (Barnard et al., 2009). We employed confirmatory factor analysis (CFA) to test all variables' construct validity and used the standards for good fit to determine whether the variable had good structural validity (Hu and Bentler, 1998): $X^2/df < 5$, root mean square error of approximation (RMSEA) < 0.1, and comparative fit index (CFI) > 0.90. The online SRL indicators of CFA were $X^2/df = 3.27$, RMSEA $= 0.08$, and CFI $= 0.93$.

2.5. SRL strategies

To assess students' SRL strategies, we administered the MSLQ-B, which is a self-report survey. Originally, the MSLQ included 81 items separated into two categories: motivation and learning strategies. Because we were only concerned with the learning strategies, a learning strategy questionnaire was used in this study to determine students' SRL strategies. The learning strategies include 31 items regarding students' use of different cognitive and metacognitive strategies and 19 items concerning students' management of different resources (Pintrich et al., 1991). The subdimensions of learning strategies were rehearsal (four items), elaboration (six items), organization (four items), critical thinking (five items), metacognitive self-regulation (twelve items), time and study environment (eight items), effort regulation (four items), peer learning (three items), and help-seeking (four items). The MSLQ-B makes use of a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). CFA results showed that the SRL strategies fit indices were $X^2/df = 4.54$, RMSEA $= 0.09$, and CFI $= 0.93$.

2.6. Analysis procedures

The current study explored the students' SRL strategies based on their GPA in online learning mode. The GPA was obtained in score system with the consent of the manager. Descriptive analysis and questionnaire reliability analysis including all demographic variables and the subscale scores of the OSLQ and MSLQ-B were completed in SPSS 22.0. The subscale scores from the OSLQ and MSLQ-B for the GPA-up and GPA-down students were analyzed by SPSS 22.0 (independent-sample t-test). Multivariate analysis of variance and influence effect were conducted in SPSS 22.0. $p < 0.05$ was considered a significant difference. All graphics were drawn using GraphPad Prism software. The data used to support the findings of this study are available from the corresponding author upon request.

2.7. Ethics statement

We obtained the approval from the ethics committee of Liaocheng University. The participants completed the surveys voluntarily with no negative consequences for not completing them. All participants gave written informed consent following the Declaration of Helsinki.

3. Results

3.1. Descriptive analysis of the OSLQ and MSLQ-B

To explore the SRL situation of students with different academic performance in the online learning mode, we screened out 410 students with | GPA changes | > 1.0 in online learning mode. We posted OSLQ and MSLQ-B online questionnaire, and finally got 388 high-quality questionnaires. Among the 388 students with the highest GPA changes, 202 GPA-down students and 186 GPA-up students were identified. At the same time, we conducted questionnaires on the status of online SRL strategies

TABLE 1 Cronbach's α for the subscales of OLSQ and MSLQ-B.

Cronbach's α for the subscale of OSLQ		Cronbach's α for the subscale of MSLQ-B	
Dependent variable	**α**	**Dependent variable**	**α**
Goal setting	0.91	Rehearsal	0.82
Environmental structuring	0.86	Elaboration	0.91
Task strategies	0.83	Organization	0.82
Time management	0.88	Critical thinking	0.85
Help-seeking	0.80	Metacognitive self-regulation	0.86
Self-evaluation	0.91	Time and study environment	0.90
		Effort regulation	0.71
		Peer learning	0.77
		Help-seeking	0.73

TABLE 2 Descriptive statistics of online learning strategies.

Variables	Min	Max	Mean	SD
Goal setting	1.00	5.00	3.86	0.69
Environmental structuring	1.00	5.00	4.01	0.59
Task strategies	1.25	5.00	3.70	0.69
Time management	1.00	5.00	3.81	0.67
Help-seeking	1.00	5.00	3.76	0.64
Self-evaluation	1.00	5.00	3.86	0.74
Rehearsal	2.00	5.00	3.80	0.58
Elaboration	1.17	5.00	3.80	0.60
Organization	1.50	5.00	3.80	0.59
Critical thinking	1.40	5.00	3.74	0.58
Metacognitive self-regulation	2.00	5.00	3.68	0.64
Time and study environment	1.63	5.00	3.88	0.55
Effort regulation	2.00	5.00	3.63	0.63
Peer learning	1.67	5.00	3.71	0.64
Help-seeking	1.50	5.00	3.68	0.55

n = 388.

of these 388 students. The reliability of the OSLQ and MSLQ-B was calculated using Cronbach's α coefficient. Cronbach's α for the measure of OSLQ and MSLQ-B was 0.96 and 0.97, respectively, which demonstrated that the internal consistency of the scale was acceptable. As shown in Table 1, Cronbach's α for all subscales ranged from 0.71 to 0.91, which indicates good reliability.

3.2. Descriptive statistics of online learning strategies

The descriptive statistics of OSLQ and MSLQ-B strategies variables for the students that participated in online learning were presented in Table 2. The results showed that different SRL strategies exhibits large differences, but also between students. The highest score of all SRL strategies were consistent with 5, but the lowest score varied greatly from 1 to 2. The mean values ranged from 3.63 to 3.88. The highest average score of learning strategies was environmental structuring, and that of effort regulation was the lowest, which were 4.01 and 3.63, respectively. All SRL strategies also showed large standard deviation (SD) implying a large dispersion of values among individuals. The above analysis showed that there are great differences between different SRL strategies and between different students when accepting the online learning mode during the pandemic.

3.3. Differences between GPA-up and GPA-down students in online SRL

One of the factors that determine the success of online learning is the level of student SRL. Thus, understanding the capabilities of SRL is essential for achieving academic success during this pandemic. Six OSLQ subscales, associated with each of the SRL subprocesses (Barnard et al., 2009), were used (goal setting, environmental structuring, task strategies, time management, help-seeking, and self-evaluation) to analyze the online SRL between GPA-up and GPA-down students. To facilitate the comparison, SRL and all subscale scores were graphed according to different groups (Figure 1). The multi-indicator histogram (independent-sample t-test) revealed that all participants reported an average number between 3.7 and 4.1 for both GPA-up and GPA-down students. Environmental structuring got the highest score, while task strategies got the lowest score. In addition, GPA-up students scored significantly greater than GPA-down students on the self-evaluation subscale ($F = 5.6$, $p < 0.05$, with 95% confidence intervals of -0.30 to -0.01). There was no significant difference in other SRL subscales. This finding suggests that self-evaluation relates

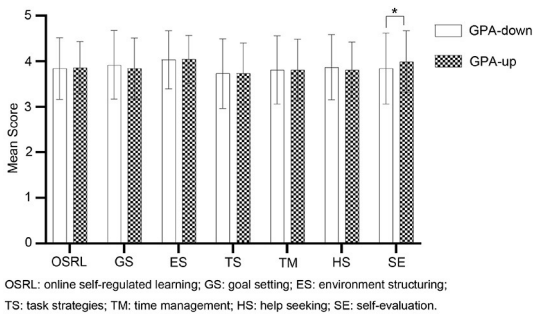


FIGURE 1
The differential analysis between two sets of samples. White represents GPA-down students based on GPA changes ≤−1.0. The black points represent GPA-up students screened based on GPA changes ≥1.0. Stars represent significant differences between the two groups.

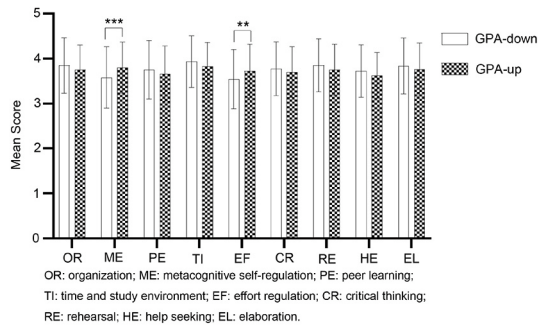


FIGURE 2
Graphed scores of GPA-up and GPA-down students in the SRL strategies. White indicates GPA-down students, black points indicate GPA-up students, and stars represent significant differences between the two groups. No stars indicate no significant differences in SRL strategies.

to students' improved academic performance when studying online.

3.4. Differences between GPA-up and GPA-down students in SRL strategies

In order to further analyze whether there is any difference in self-regulated learning strategies between GPA-up and GPA-down students. The MSLQ-B, including rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, and help-seeking, was used to further analyze the SRL strategies of GPA-up and GPA-down students. Independent-sample t-test was performed using SPSS 22.0. The results revealed that the subscales' scores of the MSLQ-B were between 3.5 and 4.0, which shows a high level of SRL strategies. More importantly, metacognitive self-regulation ($F = 4.67$, $p < 0.001$) and effort regulation ($F = 0.60$, $p < 0.01$) had a significant difference between GPA-up and GPA-down students. As seen in Figure 2, the mean scores of metacognitive self-regulation and effort regulation for GPA-up students were higher than those of GPA-down students significantly. The results also indicated that there are no statistically salient variations among the other SRL strategies. To summarize, metacognitive self-regulation and effort regulation strategies acted as promoters of online academic progress.

3.5. The mutual influence effect

To examine the mutual influence effect of metacognitive self-regulation, effort regulation, and self-evaluation on the improvement of GPA during online learning, we employed the multivariate analysis of variance. Table 3 and Figure 3 present the mutual influence effect model was significant: $R^2 = 0.11$, $F = 3.13$, $p < 0.01$. From Table 3, we compared the F-value and p-value of ME, Ef, SE, ME*Ef, ME*SE, Ef*SE, and ME*Ef*SE interaction, and found that the F-value of Ef is the largest ($p < 0.01$). It is concluded that the main effect of effort regulation is significant, while the main effect of metacognitive self-regulation and self-evaluation is not significant. Besides, the interaction effect between effort regulation and self-evaluation is also significant ($F = 4.59$, $p < 0.05$). Figure 3 presents the interaction pattern of SE and Ef on students' GPA improvement during online learning at different SE levels. As the self-evaluation levels increased, the effect of effort regulation on GPA improvement increased for the students with low effort regulation ($F = 12.51$ and $p < 0.01$, with 95% CIs of 0.13–0.46). However, for students with high self-evaluation, there is no significant difference in the improvement of GPA between high effort regulation and low effort regulation.

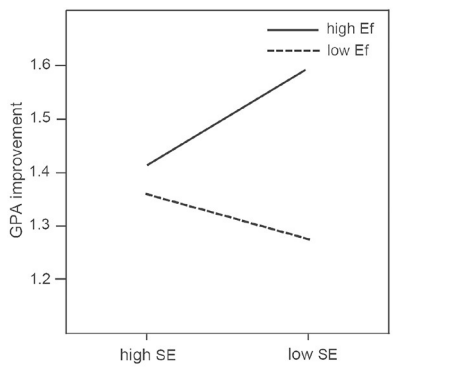
4. Discussion

In view of the lack of empirical studies in SRL strategies to understand how online learning can be supported, this paper conducted an empirical study on students' learning strategies to further understand the possible ways to promote academic performance in online learning. During the pandemic, universities in China have implemented the online learning mode. By analyzing the SRL strategies of students in online learning, we found that there are great differences between different SRL strategies and between different students when accepting the online learning. Challenges to online learning are generally considered to include accessibility, affordability, flexibility, learning pedagogy, self-regulated learning, and education policy (Murgatroyd, 2021). China has good network

TABLE 3 The multivariate analysis of ME, Ef, and SE on the improvement of GPA.

Source	Type sun of squares	df	Mean square	*F*	*p*
Corrected model	2.114a	7	0.30	3.13	0.004
Intercept	232.06	1	232.06	2406.10	0
ME	0.13	1	0.13	1.32	0.25
Ef	0.90	1	0.90	9.32	0.003
SE	0.03	1	0.03	0.26	0.61
ME*Ef	1.61E-06	1	1.61E-06	0	0.10
ME*SE	0.12	1	0.12	1.19	0.28
Ef*SE	0.44	1	0.44	4.59	0.03
ME*Ef*SE	0	1	0	0.002	0.97
Error	17.17	178	0.10		
Total	370.52	186			
Corrected total	19.28	185			
a.R Squared	0.11				

n = 186; ME, metacognitive self-regulation; Ef, effort regulation; SE, self-evaluation.



SE: self-evaluation; Ef: effort regulation; GPA: grade point average.

FIGURE 3
The interaction pattern of SE and Ef on students' GPA improvement.

infrastructure and digital equipment, and students hardly have equipment and information technology problems. At the same time, the online teaching mode is basically the same as the synchronous or asynchronous live broadcast mode. Therefore, the main influencing factor of academic performance is the difference of students' self-regulated learning ability. The OSLQ and MSLQ-B showed that GPA-up students' self-evaluation, metacognitive self-regulation, and effort regulation were significantly higher than those of GPA-down students. These results suggest that the students who are reflective of their learning behavior and persevere in understanding the learning material despite challenges faced are more likely to achieve academic progress in online learning.

Self-evaluation is a process comprising self-judgments of present performance and self-reactions to these judgments (Brown, 2014). Metacognitive strategies include electing the most effective strategy to approach learning tasks, planning, monitoring one's understanding, and modifying one's learning strategies based on the feedback of learning results (Lai, 2011; Lehmann et al., 2014). Research shows that self-evaluations, reflections, and metacognition are cross-concept relationships, and self-evaluations can help students learn and develop metacognition (Arp, 2016). Thus, the two questionnaires are consistent with each other. The SRL cyclical phases (forethought, performance, and reflection) suggested that every strategies at any phase will have an effect on the subsequent phase (Zimmerman, 1990). Self-evaluation, metacognitive self-regulation, and effort regulation run through the whole cycle of SRL and interact to promote students' academic progress. Some researches focusing on personal characteristics show that self-evaluation is used to explain learners' academic achievements and learning satisfaction. At the same time, self-evaluation is assumed to be a trigger for learners' self-regulation, because people with high self-evaluation are more confident and positive about the results of their efforts, and are more likely to be motivated and participate in learning (Diep et al., 2017). These positive evaluations of individual abilities will stimulate a high degree of motivation to deal with challenges and problems, thus promoting the coping process and improving online learning performance.

Previous research shows that metacognitive strategies contributed the most to academic performance (Goradia and Bugarcic, 2017; Dumford and Miller, 2018). The OSLQ and MSLQ-B results showed that metacognitive strategies also had effect on improving academic performance in the online learning mode during the pandemic, perhaps because learners

who engaged in metacognitive strategies were more likely to achieve their goals and engaged more deeply with course assessments. According to Frith, the role of metacognition enables individuals to monitor their current knowledge and skills levels, plan and allocate limited learning resources with optimal efficiency, and evaluate their current learning state (Frith, 2012). However, one study reported that face-to-face teaching practices do not encourage students to use metacognitive strategies (Haidar and Al Naqabi, 2008) because these young adults often still rely on co-regulation from parents or teachers to provide learning orientation (Robson et al., 2020). As learners move to online environments, they may face challenges that they have never encountered before. For example, in an online environment, students' social interaction with teachers is indirect, and there is a lack of effective supervision and evaluation of students' learning (Anthonysamy et al., 2020). Effective metacognitive learners are skilled in self-assessment, recording supervised learning, setting goals, managing time, learning from peers, demonstrating persistence and flexibility, all of which contribute to self-regulated learning (Clark and Dumas, 2016).

Our results also showed that effort regulation plays a significant role in improving academic performance. Effort regulation can be defined as a resource management strategy that refers to the ability to perform even when tasks are viewed as very challenging or uninteresting (Boyraz et al., 2016). Pintrich and Zusho also pointed out that the volitional dimension that determines effort regulation is a key factor in the use of metacognitive strategies (Pintrich and Zusho, 2002). Students with high effort conditioning showed persistence in completing tasks, while students with low effort conditioning were more likely to give up before completing tasks (Richardson et al., 2012). Therefore, effort regulation can be viewed as a necessary precondition for metacognitive self-regulation of learned behavior. In general, online education provides a highly autonomous environment. To be successful, a high degree of self-regulation is essential, while this lack of ability can be compensated for by teacher guidance in a face-to-face classroom (Artino and Stephens, 2009). The online learning environment lacks the effective supervision of teachers, thus, students who can not use this strategy by themselves got poor academic performance.

The mutual influence effect of metacognitive self-regulation, effort regulation, self-evaluation on the improvement of GPA show that effort regulation had the largest main effect. For students with low SE, high Ef can significantly improve their online academic performance. Effort regulation is the embodiment of volition which will enable people to control not only themselves, but also their environment, so as to reduce the obstacles achieving their goals (Kim and Bennekin, 2016). Students who had higher effort regulation have strong volition and motivation, and they are less likely to give up in the face of difficulties.

This study provides evidence that metacognitive self-regulation, effort regulation, and self-evaluation skills in online learning can significantly improve students' academic performance. The results highlights that students should apply these three strategies above in order to increase the likelihood of academic progress in online learning. An important revelation obtained is that educators should consciously exercise students' metacognitive skills, self evaluation, self monitoring in the learning process, which will help students play an important supporting role in future SRL, online learning, and even lifelong learning. Developing students' SRL skills may ultimately be the focus of education in the future.

5. Limitations and future research

One shortcoming of this research is that this study was in the middle of a pandemic (fear, uncertainty, etc.) and students' academic performance may be affected by psychological factors. Future research could consider cross-validating our measurements by collecting data from two groups of students at roughly the same time point in a semester. In addition, the learning environment has been noted to influence the way students learn (Severiens et al., 2001). In terms of online contexts, research found that metacognition influences cognitive and emotional engagement, and metacognitive awareness significantly facilitated effective self-regulation (Lehmann et al., 2014; Norman and Furnes, 2016). Future research could focus on comparing whether metacognitive strategies have different effects on academic performance in online and offline learning environments. At the same time, considering that students' SRL ability is a dynamic development process, we can explore how to enhance students' metacognitive skills through online learning, thereby improving students' academic performance. In the later stage, the dynamic change process of students' SRL can be analyzed in depth based on the time axis to find the development mechanism of SRL ability. Finally, although this study demonstrates that some individual SRL strategies are associated with academic performance, autonomous learning strategies are rarely used in isolation. Future research should explore the influence of the combination of learning strategies in a specific environment on SRL.

6. Conclusion

In this study, the online SRL questionnaire and learning strategy questionnaire results showed that there are great differences between different SRL strategies and between different students when accepting the online learning during the pandemic. The students whose academic performance is significantly improved in online learning are more capable of using metacognitive strategies, self evaluation, and effort regulation strategies than those whose academic performance

is declined. Students with metacognitive skills were indeed able to adjust their learning in the new learning environment and were able to put more effort into regulating the learning process in online learning. This research will help teachers and students establish practices on how to use effort regulation and metacognitive strategies to improve student academic performance, as those students who lack effort regulation and metacognitive strategies may find themselves at a significant disadvantage in online learning (Anthonysamy, 2021).

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of Liaocheng University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

LX and SP provided the substantial contributions to the research conception and design. LX analyzed and interpreted the data. LX, PD, and CL wrote and revised the paper. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Influence of fear of COVID-19 on depression: The mediating effects of anxiety and the moderating effects of perceived social support and stress perception

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Objective: Explore the influence of fear of COVID-19 on depression, with anxiety as a mediator and perceived social support and stress perception as moderates.

Methods: From February to March 2020, 1,196 valid data were collected online through questionnaire by cluster sampling method. Fear of COVID-19 Questionnaire, the Patient Health Questionnaire 9-Item Scale (PHQ-9), the Generalized Anxiety Disorder 7-Item Scale (GAD-7), the Perceived Social Support Scale (PSSS) and the10-item Perceived Stress Scale (PSS-10) were used as the survey instrument, and the participants were female undergraduates from a liberal arts college of a Chinese university. Common method bias was assessed using Harman's single-factor test in SPSS and confirmatory factor analysis in AMOS. The levels of participants' anxiety, depression and perceived social support were described using frequency and percentage, Pearson Correlation test was used to measure the correlation between the variables. The PROCESS macro for SPSS (Model 1, Model 4, and Model 21) were applied to examine the mediating effect and moderating effect of the model.

Results: Fear of COVID-19 can positively influence depression, anxiety plays a mediating role between fear of COVID-19 and depression, perceived social support negatively moderates the relationship between fear of COVID-19 and anxiety, and stress perception positively moderates the relationship between anxiety and depression. These five variables can form a moderated mediating effect model.

Conclusion: Fear of COVID-19, anxiety and stress perception are risk factors for depression, perceived social support is a protective factor for depression. Reducing the fear of COVID-19, anxiety and stress perception and enhancing perceived social support are beneficial to reduce the level of depression.

KEYWORDS

fear of COVID-19, depression, anxiety, perceived social support, stress perception

1. Introduction

The outbreak of the novel coronavirus disease 2019 in December 2019 swept the world in a short time. On March 9, 2020, the World Health Organization (WHO) announced that COVID-19 has become a global pandemic (World Health Organization, 2020). The characteristics of the suddenness, severity, prevalence and uncertainty of the COVID-19 made people deeply fearful (Cooke et al., 2020; Wu et al., 2021). Fear of COVID-19 has led to a decline in individual mental health and an increase in negative emotions such as depression and anxiety (Li et al., 2020). Undergraduates are in adolescence, their psychological development is not very mature, and they are prone to psychological problems due to the pressure of learning and employment (Auerbach et al., 2016, 2018). Fear of COVID-19 has made the psychological problems of undergraduates who lack social experience and coping measures more serious (Pierce et al., 2020; Son et al., 2020).

Fear of COVID-19 has different effects on undergraduates of different genders and majors (Pieh et al., 2020; Prowse et al., 2021). Studies have shown that female are more sensitive to the external environment, and fear of COVID-19 is more likely to bring them psychological problems (Gao et al., 2020; Li et al., 2020; Wang et al., 2020; Xiao et al., 2020; Zhang et al., 2020). A meta-analysis study on college students' fear of COVID-19 showed that the mean of Fear of COVID-19 Scale (FCV-19S) score in women (17.11, 95% CI: 16.59–17.64) was higher than that in men (15.21, 95% CI: 14.33–16.08). A meta-analysis of fear of COVID-19 on adults showed that the mean of Fear of COVID-19 Scale (FCV-19S) score in women (20.67, 95% CI: 18.62–22.73) was higher than that in men (18.21, 95% CI: 15.99–20.42). Moreover, the mean score in Asian women and men was 19.70 and 17.68 and in American women and men was 20.39 and 16.15 (Luo et al., 2021; Wang et al., 2022). COVID-19 has brought different effects on the mental health of undergraduates of different majors. Wei et al. (2020) investigated 1,580 undergraduates, the results showed that the scores of depression, neurasthenia, fear, compulsion anxiety and hypochondriasis factors of liberal arts, science and engineering, and medical undergraduates were statistically different. In terms of fear factors, liberal arts undergraduates scored higher than medical undergraduates. Wang et al. (2021) investigated 3,179 undergraduates and found that liberal arts undergraduates scored higher in GAD-7 than art and other categories undergraduates, and liberal arts undergraduates scored higher in PHQ-9 than science and engineering undergraduates. Min and Sun (2021) investigated 790 undergraduates and found that liberal arts undergraduates scored higher than science and engineering undergraduates in SCL-90. Since undergraduates of different genders and majors have different responses to the COVID-19, in order to make the research more targeted, this paper will explores the influence of fear of COVID-19 on female undergraduates majoring in liberal arts.

Previous studies have shown that fear of COVID-19 has a positive influence on anxiety and depression, but few studies have paid attention to whether anxiety leads to depression or depression leads to anxiety during the COVID-19 pandemic. This study believes that fear of COVID-19 will lead to anxiety and depression at the same time, but anxiety can play a mediating role between fear of COVID-19 and depression, because during the COVID-19 epidemic, individuals can get less help, and anxiety will be transformed into depression in the case of helplessness, that is, individuals will have the experience of learned helplessness when dealing with the fear of COVID-19, which leads to depression. As an important protective factor, social support can reduce the negative influence of external stimuli on individuals. This study believes that perceived social support, as a moderating variable, affects the relationship between fear of COVID-19 and anxiety, that is, under the condition of low perceived social support, the relationship between fear of COVID-19 and anxiety is closer. The COVID-19 epidemic and other factors inevitably bring stress to individuals, but individuals have different perceptions of stress. Therefore, this study takes the stress perception as a moderating variable, and believes that the relationship between anxiety and depression is closer in the case of high stress perception. Due to the complexity of the environment, perceived social support and stress perception often coexist, and they jointly influence the relationship between fear of COVID-19 and anxiety and depression. Based on this, this study constructs a moderated mediating effect model that can answer not only "how" fear of COVID-19 influence depression, but also "when" this effect is stronger or weaker. The specific theoretical model is shown in Figure 1.

2. Theory and hypotheses

2.1. The influence of fear of COVID-19 on depression

Fear is a negative emotion that occurs when an individual perceives a threat to himself or his environment, it is associated with danger, injury or pain (Scalabrini et al., 2020). Humans are born to fear all sorts of different things, and COVID-19 has inevitably caused individual fear (Schimmenti et al., 2020). Undergraduates' fear of COVID-19 has both direct and indirect factors. The direct factor is the concern about the influence of COVID-19 on their health, and the indirect factor is the concern about the influence of COVID-19 on their family, study, employment and future. According to the cognitive vulnerability theory of depression (Beck and Dozois, 2011), the fear of COVID-19 leads to individuals unable to view the COVID-19 epidemic correctly, exaggerating the direct and indirect negative influence of the COVID-19 epidemic on personal health and future development, and underestimating the individual's coping ability, which leads to depression. Although scholars have different definitions of depression, they agree that "low mood" is the typical symptom of depression, and the core manifestation of depression is "anhedonia." According to the hopeless theory of depression (Abramson et al., 1989), the fear brought by COVID-19 can arouse undergraduates' attention to

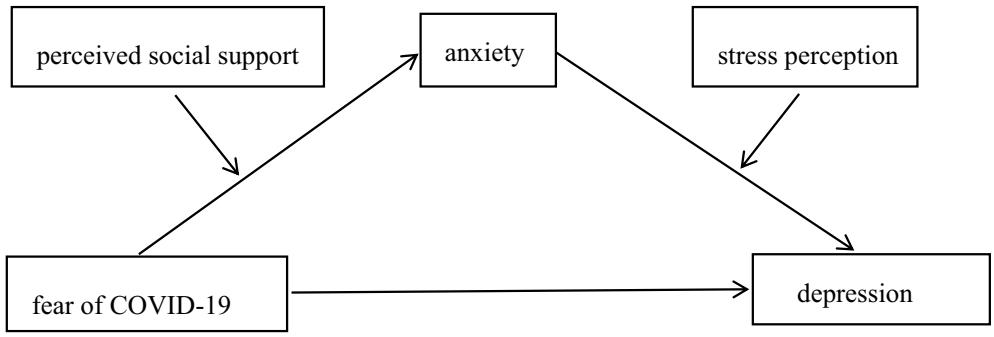

FIGURE 1
Hypothesized model.

their health at the beginning, however, the accompanying insecurity and negative emotions can cause the individual to feel hopeless and helpless, which leads to depression. Several studies have shown that fear is an important risk factor for depression (Ying et al., 2014), the COVID-19 pandemic has led to increased levels of depression among undergraduates (Deng et al., 2020; Vahedian-Azimi et al., 2020). Therefore, the following hypothesis is proposed:

> *H1*: Fear of COVID-19 positively influences depression.

2.2. The mediating effect of anxiety on the relationship between fear of COVID-19 and depression

Anxiety refers to the complex emotional state such as tension, uneasiness, sadness and trouble when individuals subjectively believe that there will be some adverse consequences or dangerous situations. The COVID-19 has threatened the health of undergraduates and their families, and their academic, employment and interpersonal interactions are affected (Hasan and Bao, 2020), all of these can make undergraduates anxious (Koçak et al., 2021; Mahmud et al., 2021). Several studies have shown that anxiety levels among undergraduates have increased during the COVID-19 pandemic (Bakioglu et al., 2021; Li et al., 2021; Zhan et al., 2021). Therefore, it can be speculated that the fear of COVID-19 has led to increased anxiety among undergraduates. Although there are similarities between anxiety and depression, there are obvious differences between them. The typical characteristic of anxiety is nervousness, while the typical characteristic of depression is hopelessness, helplessness and worthlessness caused by low mood (Beuke et al., 2003). When the individual's anxiety cannot be relieved for a long time, or even continues to strengthen, it is possible to produce depression (Reinherz et al., 1989, 1993). Studies proved that 5-hydroxytryptamine in depression is significantly lower than that in anxiety disorder. The continuous spectrum of 5-hydroxytryptamine from normal to slightly reduced to moderately reduced seems to prove the development process from normal to anxiety to depression (Lou and Niu, 2009). According to the anxiety-depression continuum hypothesis (Sufka et al., 2006), the occurrence of anxiety and depression disorders has a clear chronological order, which can be roughly divided into three stages: (1) anxiety stage; (2) conversion stage of anxiety and depression; (3) depression stage (Liang et al., 2017). These two studies seem to suggest that anxiety causes depression. In the face of the negative influence of COVID-19, undergraduates will have anxiety such as nervous and worry at the beginning. However, as individuals have few active measures to take in the face of COVID-19, their anxiety cannot be alleviated, which will lead to depression (Faraci et al., 2022; Zhang et al., 2022). Therefore, the following hypothesis is proposed:

> *H2*: Anxiety plays a mediating role between the fear of COVID-19 and depression.

2.3. The moderating effect of perceived social support on the relationship between fear of COVID-19 and anxiety

Both the main-effect model and the buffering model of social support believe that social support can relieve stress and improve mental health (Etzion, 1984; Cohen and Wills, 1985; Masten, 2001). Whether it directly increases individual happiness, reduces negative emotions such as anxiety and depression, or buffers the negative influence of negative events on individuals, social support will play a positive role (Sun et al., 2021). For individuals, it is very important to understand social support, because no matter how much material and spiritual support, if individuals think it has no effect on them, then these support will not be effective. During the COVID-19 epidemic, the role of perceived social support is particularly prominent due to the limited conditions (Lai et al., 2020; Szkody et al., 2021). When undergraduates perceive low levels of social support, fear of COVID-19 causes more anxiety. When undergraduates perceived higher levels of social support, although the anxiety increases as the fear of COVID-19 increases, the level of increase has decreased compared with the former. Therefore, the following hypothesis is proposed:

> *H3*: Perceived social support plays a moderating role between the fear of COVID-19 and the anxiety, and the relationship between fear of COVID-19 and anxiety is stronger when perceived social support is low.

2.4. The moderating effect of stress perception on the relationship between anxiety and depression

Stress is an individual's arousal state and nervous response to stimulation (Rehman et al., 2021). Stress perception is an individual's cognition and evaluation of stress. From the cognitive evaluation theory (Lazarus, 1991, 1998), COVID-19 has affected everyone's life and brought stress to everyone. However, different people have different subjective perceptions of COVID-19. Some people have a lot of stress when facing COVID-19, while others have less stress. Therefore, the same stressful event produces different perception of stress in each person. The fear of COVID-19 inevitably generates stress perception among undergraduates. At a high level of stress perception state, depression will increase quickly with the increase of anxiety. At the lower levels of stress perception state, although depression will increase with the increase of anxiety, the increased level has decreased compared with the former. Therefore, the following hypothesis is proposed:

> *H4*: Stress perception plays a moderating role between the anxiety and the depression, and the relationship between the anxiety and the depression is stronger when stress perception is high.

2.5. A moderated mediating effect among the five variables

In previous part of the paper, we assumed that the fear of COVID-19 had a positive influence on depression, and that anxiety played a mediating role between the fear of COVID-19 and depression. The mediating model composed of these three variables was conducive to exploring "how" fear of COVID-19 influenced depression. In order to explore the "boundaries" and "conditions" of fear of COVID-19 influencing depression, it is assumed that perceived social support plays a moderating role between fear of COVID-19 and anxiety, and stress perception plays a moderating role between anxiety and depression. The moderating model is helpful to explore the influence of fear of COVID-19 on depression "when" is stronger or weaker. The relationship between fear of COVID-19, depression, anxiety, perceived social support and stress perception can further constitute a double-moderated mediating effect model, that is, perceived social support and stress perception jointly moderated the mediating effect of anxiety between fear of COVID-19 and depression. Perceived social support and stress perception can be combined into four modes: high perceived social support and high stress perception, high perceived social support and low stress perception, low perceived social support and high stress perception, low perceived social support and low stress perception. Since perceived social support is a protective factor and stress perception is a risk factor, this study infers that under the conditions of high perceived social support and low stress perception, fear of COVID-19 has less indirect influence on depression through anxiety; under the condition of low perceived social support and high stress perception, fear of COVID-19 has more indirect influence on depression through anxiety. Therefore, the following hypothesis is proposed:

> *H5*: Fear of COVID-19, depression, anxiety, perceived social support and stress perception can form a double-moderated mediating effect model, perceived social support and stress perception jointly moderated the mediating effect of anxiety between fear of COVID-19 and depression.

3. Materials and methods

3.1. Population

According to the information released by the Ministry of Education of the People's Republic of China on August 30, 2021, the number of Chinese undergraduate students in 2020 was 18,257,460, including 9,804,641 female students, accounting for 53.702%. The number of liberal arts students was 9,158,085, accounting for 50.161% (Ministry of Education of the People's Republic of China, 2021). The estimated number of female liberal arts undergraduates in 2020 will be about 4.91 million. In order to make the study more targeted, we chose female undergraduate students of liberal arts as participants and use questionnaire survey method to collect data. The participants were female undergraduates from freshman to senior year in a liberal arts college of a university in China.

3.2. Data collection

This study collected data through questionnaire by cluster sampling method. The criteria for inclusion of the participants were: (1) female undergraduate, (2) major in liberal arts, and (3) voluntary participation in the study. The questionnaire was distributed from February to March 2020, due to the prevention and control of COVID-19 at that time, "Wenjuanxing (a widely used and professional questionnaire platform)" was selected for online testing. The confidentiality of the results was emphasized before the test, and the questionnaire was filled out voluntarily by the participants. A total of 1,213 questionnaires were distributed online, after collecting the questionnaire, review the answers, delete linear and wavy answers, and 1,196 valid questionnaires were collected. The exclusion criteria of the participants are mainly based on the answers to the questionnaire. The

questionnaires with one of the following conditions are excluded: (1) the questionnaire answers in a straight line, and (2) the questionnaire answers in waves.

3.3. Demographic profile

Table 1 presents the demographic characteristics of the sample. Of the 1,196 participants, 212 (17.726%) were in grade one, 325 (27.174%) in grade two, 337 (28.177%) in grade three and 322 (26.923%) in grade four; 69 (5.769%) participants were aged 18 years and below, 203 (16.973%) were aged 19 years, 315 (26.338%) were aged 20 years, 301 (25.167%) were aged 21 years, 295 (24.666%) were aged 22 years, and 13 (1.087%) were aged 23 years and above; 935 (78.177%) participants majored in Chinese language and literature, 68 (5.686%) majored in Teaching Chinese to speakers of other language, 132 (11.037%) majored in Drama and film, and television literature, and 61 (5.100%) majored in Secretarial studies; 721 (60.284%) participants currently live in Henan province and 475 (39.716%) in other province (not Henan province); 651 (54.431%) participants' family addresses were in urban district and 545 (45.569%) in county town.

3.4. Measurement

3.4.1. The fear of COVID-19 questionnaire

The Fear of COVID-19 Questionnaire was used to measure the participants' fear of COVID-19. It developed by ourselves according to the questionnaire preparation procedure (Wu, 2010), contained 4 items, each item was rated on a 5-point Likert scale, ranging from 1 to 5 (1 = strongly disagree, 5 = strongly agree), with higher scores indicating higher levels of fear. The contents of the 4 items are as follows: "I fear that I will infect COVID-19″, "I fear that my family will infect COVID-19″, "I fear that my relatives and friends will infect COVID-19″, "I fear that COVID-19 will have a huge influence on my future." In this study, the Cronbach's alpha of this questionnaire was 0.915, the composite reliability (CR) was 0.919, the average variance extracted (AVE) was 0.744.

3.4.2. The patient health questionnaire9-item scale

The Patient Health Questionnaire9-Item Scale (PHQ-9) was used to measure the participants' depressive. It contained 9 items, measure the frequency of symptoms in the last 2 weeks, each item was rated on a 4-level rating model (0 = none, 1 = less than half the time, 2 = more than half the time, 3 = almost every day), total scores range from 0 to 27, with higher scores indicating higher levels of depressive (0–4 = no depression, 5–9 = mild depression, 10–14 = moderate depression, 15–19 = moderately severe depression, 20–27 = severe depression). The sample items include "Little interest or pleasure in doing some things," "Trouble concentrating on things, such as reading the newspaper or watching television." A large number of academic researches have shown that PHQ-9 with good reliability and validity (Kroenke et al., 2001; Richardson et al., 2010; Hu et al., 2014). In this study, the Cronbach's alpha of this questionnaire was 0.911, the composite reliability (CR) was 0.913, the average variance extracted (AVE) was 0.543.

TABLE 1 Demographic information of sample (*N*=1,196).

Characteristics	Item	*n*	%
Grade	One	212	17.726
	Two	325	27.174
	Three	337	28.177
	four	322	26.923
Age	18 years and below	69	5.769
	19	203	16.973
	20	315	26.338
	21	301	25.167
	22	295	24.666
	23 years and above	13	1.087
Major	Chinese language and literature	935	78.177
	Teaching Chinese to speakers of other language	68	5.686
	Drama and film, and Television literature	132	11.037
	secretarial studies	61	5.1
Province	Henan Province	721	60.284
	Other provinces (not Henan Province)	475	39.716
Family	Urban district	651	54.431
Address	County town	545	45.569

3.4.3. The generalized anxiety disorder7-item scale

The Generalized Anxiety Disorder7-Item Scale (GAD-7) was used to measure the participants' anxiety. It contained 7 items, measure the frequency of symptoms in the last 2 weeks, each item was rated on a 4-level rating model (0 = not at all, 1 = several days, 2 = more than half the days, 3 = nearly every day), total scores range from 0 to 21, with higher scores indicating higher levels of depressive (0–4 = no anxiety, 5–9 = mild anxiety, 10–14 = moderate anxiety, 15–21 = severe anxiety). The sample items include "Feeling nervous, anxious, or on edge," "Trouble relaxing." A large number of academic researches have shown that GAD-7 with good reliability and validity (Spitzer et al., 2006; Löwe et al., 2008; Qu and Sheng, 2015). In this study, the Cronbach's alpha of this questionnaire was 0.937, the composite reliability (CR) was 0.938, the average variance extracted (AVE) was 0.685.

3.4.4. The perceived social support scale

The perceived social support scale (PSSS) was used to measure the participants' social support. It developed by Jiang (1999), which referred to the scale developed by Zimet et al. (1988). It contained 12 items, each item was rated on a 5-point Likert scale, ranging from 1 to 5 (1 = strongly disagree, 5 = strongly agree), with higher scores indicating higher levels of social support. PSSS has three dimensions as family support, friend support, and special person support, each dimension involves 4 items. The sample items include "My family really tries to help me," "I have friends with whom I can share my joys and sorrows." Academic research has shown that PSSS with good reliability and validity (Chen et al., 2018; De Maria et al., 2018). In this study, the Cronbach's alpha of this questionnaire was 0.961, the composite reliability (CR) was 0.960, the average variance extracted (AVE) was 0.669.

3.4.5. The 10-item perceived stress scale

The10-item perceived stress scale (PSS-10) was used to measure the participants' stress perception. It contained ten items (six positively items, 1, 2, 3, 6, 9, 10; and four negatively items 4, 5, 7, 8), measure the stress the participants felt in the past month, each item was rated on a 5-point Likert scale, ranging from 0 to 4 (0 = never, 1 = occasionally, 2 = sometimes, 3 = often, 4 = always), total scores range from 0 to 40, with higher scores indicating higher levels of perceived stress (0–13 = low pressure level, 14–19 = medium pressure level, and 20–40 = high pressure level). The sample items include "In the last month, how often have you felt that things were going your way," "In the last month, how often have you found that you could not cope with all the things that you had to do." Academic research has shown that PSS-10 with good reliability and validity (Cohen et al., 1983; Wang et al., 2015; Kaya et al., 2017). In this study, the Cronbach's alpha of this questionnaire was 0.854, the composite reliability (CR) was 0.848, the average variance extracted (AVE) was 0.395.

3.5. Statistical analysis

Data analyses were conducted using SPSS23.0 and AMOS23.0 (Wu, 2009, 2010), all comparisons were two-tailed, and p-values < 0.05were considered statistically significant. First, to establish the validity of the data, common method bias was assessed using Harman's single-factor test in SPSS23.0 and confirmatory factor analysis in AMOS23.0. Second, descriptive analyses were conducted, participants' sociodemographic characteristics and the levels of anxiety, depression and stress perception were described using frequency and percentage, Pearson Correlation test was used to measure the correlation between the variables. Third, hypothesis test were conducted using regression analysis and Hayes' PROCESS macro for SPSS; to explore the direct effect of the fear of COVID-19 on depression by regression analysis; Model 4 of PROCESS was employed to test whether anxiety mediated the effect of the fear of COVID-19 on depression; Model 1 of PROCESS was employed to test whether perceived social support moderated the effect of the fear of COVID-19 on anxiety and stress perception moderated the effect of anxiety on depression; Model 21 of PROCESS was employed to test the double-moderated mediating effect model composed of five variables such as fear of COVID-19, depression, anxiety, perceived social support and stress perception (Hayes, 2013). In addition, mediating effect and moderating effect analyses were tested using non-parametric bootstrapping methods, the 95% confidence interval produced by the bootstrapping procedure was examined and if zero was not included within the confidence interval, the effect was considered significant (Preacher and Hayes, 2004; Preacher et al., 2007; Hayes, 2009).

4. Research results

4.1. Validity and reliability

The questionnaire used in this study, except for the fear of COVID-19 questionnaire which is self-compiled, the other four questionnaires (PHQ-9, GAD-7, PSSS, and PSS-10) are frequently used in psychological research. The Patient Health Questionnaire9-Item Scale (PHQ-9), the Generalized Anxiety Disorder7-Item Scale (GAD-7), the Perceived Social Support Scale (PSSS) and the 10-item perceived stress scale (PSS-10) have good reliability and validity under different cultural backgrounds and are widely used by researchers in various countries.

In this study, the Cronbach's alpha of all questionnaires was higher than 0.85, CR was higher than 0.84, and AVE was higher than 0.5 except for one questionnaire which was 0.395. The standard value of Cronbach's a is generally supposed to be 0.70 and higher (Rasool et al., 2019). According to Fornell and Larcker suggested, CR should exceed 0.6, and AVE should exceed 0.5 under ideal condition (Fornell and Larcker, 1981), while 0.36–0.5 are acceptable (Yin, 2018; Zhang and Zheng, 2021). So the Cronbach's alpha, CR and AVE of the questionnaires in this study all meet the standard.

4.2. Measure results of PHQ-9, GAD-7, and PSS-10

Measure results of PHQ-9, GAD-7, and PSS-10 are presented in Table 2. Among 1,196 participants, PHQ-9 was used to measure depression, and the prevalence of "no depression (0–4)"was 38.796%, "mild depression (5–9)"was 41.388%, "moderate depression (10–14)"was 12.709%, "moderately severe depression (15–19)"was 5.100%, "severe depression (20–27)"was 2.007%. GAD-7 was used to measure anxiety, and the prevalence of "no anxiety (0–4)"was 49.080%, "mild anxiety (5–9)"was 40.886%, "moderate anxiety (10–14)"was 7.609%, "severe anxiety (15–21)"was 2.425%. PSS-10 was used to measure stress perception, and the prevalence of "a low-pressure level (0–13)"was 24.498%, "medium pressure level (14–19)"was 37.291%, "high-pressure level (20–40)"was 38.211%.

4.3. Descriptive statistics and correlation analysis

Means, standard deviations and correlations of the variables used in the analysis are presented in Table 3. The results reveal that the fear of COVID-19 is significantly positively correlated with depression ($r=0.268$, $p<0.01$), anxiety ($r=0.312$, $p<0.01$), perceived social support ($r=0.095$, $p<0.01$), and stress perception ($r=0.300$, $p<0.01$). Depression is significantly positively correlated with anxiety ($r=0.783$, $p<0.01$), stress perception ($r=0.641$, $p<0.01$) and significantly negatively correlated with perceived social support ($r=-0.264$, $p<0.01$). Anxiety is significantly negatively correlated with perceived social support ($r=-0.233$, $p<0.01$) and significantly positively correlated with stress perception ($r=0.648$, $p<0.01$). Perceived social support is significantly negatively correlated with stress perception ($r=-0.336$, $p<0.01$).

4.4. The test of common method bias

In order to control the bias effect of common methods, the questionnaires with good reliability and validity were used as the measuring instruments. In the test process, the confidentiality of the results was emphasized, and some questionnaire items were scored using the reverse scoring method.

Harman single factor test was used to examine the common method (Podsakoff et al., 2003; Zhou and Long, 2004). The results of the exploratory factor analysis showed that the number of factors without rotation was greater than 1, and the variance interpretation percentage of the first principal component was 33.062%, less than 40%. This study also used confirmatory factor analysis to examine the common method bias in AMOS. Set the number of common factors as 1, and incorporate all items of the questionnaire into the

TABLE 2 Measure results of PHQ-9, GAD-7, and PSS-10.

Variable	Questionnaire	Score	Content	*n*	%
Depression	PHQ-9	0–4	No depression	464	38.796
		5–9	Mild depression	495	41.388
		10–14	Moderate depression	152	12.709
		15–19	Moderately severe depression	61	5.100
		20–27	Severe depression	24	2.007
Anxiety	GAD-7	0–4	No anxiety	587	49.080
		5–9	Mild anxiety	489	40.886
		10–14	Moderate anxiety	91	7.609
		15–21	Severe anxiety	29	2.425
Stress perception	PSS-10	0–13	Low pressure level	293	24.498
		14–19	Medium pressure level	446	37.291
		20–40	High pressure level	457	38.211

PHQ-9, the Patient Health Questionnaire9-Item Scale; GAD-7, the Generalized Anxiety Disorder7-Item Scale; PSS-10, the10-item perceived stress scale.

TABLE 3 Mean, standard deviation, and correlation analysis results of each variable.

Variable	*M*	SD	1	2	3	4	5
1. FC	13.703	4.453	1				
2. Depression	6.432	5.095	0.268**	1			
3. Anxiety	4.902	4.083	0.312**	0.783**	1		
4. PSS	46.273	10.313	0.095**	−0.264**	−0.233**	1	
5. SP	17.243	5.770	0.300**	0.641**	0.648**	−0.336**	1

**$p<0.01$; *M*, mean; SD, standard deviation; FC, fear of COVID-19; PSS, perceived social support; SP, stress perception.

same common factor for confirmatory factor analysis. The fitting index was as follows: $\chi^2/df = 32.043$, RMSEA = 0.161, SRMR = 0.208, TLI = 0.371, CFI = 0.402, the results show that the data fitting index is not good. According to the above research, it can be inferred that there was not significant common method bias in the measurement.

4.5. Hypothesis testing

The input method was used for linear regression analysis in SPSS, and the results revealed that the fear of COVID-19 positively influences depression ($B = 0.306$, SE = 0.032, $p < 0.001$). Therefore, Hypothesis 1 was verified.

In SPSS, the PROCESS macro was used to select Model 4 provided by Hayes for mediating effect analysis. As shown in Table 4, anxiety is a mediating variable, fear of COVID-19 is an independent variable, and depression is a dependent variable. Fear of COVID-19 can positively influences anxiety ($B = 0.312$, SE = 0.027, $p < 0.001$), anxiety can positively influences depression ($B = 0.774$, SE = 0.019, $p < 0.001$), fear of COVID-19 cannot positively influences depression ($B = 0.026$, SE = 0.019, $p > 0.05$), indirect effect is 0.242 (BootSE = 0.024, BootCI [0.196,0.290]), the mediating effect accounts for 90.299% of the total effect. Because anxiety has a significant mediating effect between fear of COVID-19 and depression, hypothesis 2 is verified.

In SPSS, the PROCESS macro was used to select Model 1 provided by Hayes for moderating effect analysis. It can be seen from Table 5, when perceived social support is a moderating variable, the interaction coefficient between the fear of COVID-19 and perceived social support is significant ($B = -0.122$, SE = 0.023, $p < 0.001$), it shows that perceived social support plays a moderating role. Therefore, hypothesis 3 has been verified. In order to better understand the moderating effect of perceived social support between the fear of COVID-19 and anxiety, the perceived social support is taken at three different levels according to the average value and the average value plus or minus a standard deviation (M–1SD, M, M + 1SD). When the level of perceived social support is low (M–1SD), anxiety will increase by 0.466 standard deviations for every 1 standard deviation increase in fear of COVID-19.When the level of perceived social support is high (M + 1SD), anxiety will increase by 0.222 standard deviation for every 1 standard deviation increase in fear of COVID-19. This suggests that when the perceived social support level is low, the correlation between fear of COVID-19 and anxiety is closer. The simple slope analysis diagram of fear of COVID-19 and anxiety drawn with perceived social support as the moderating variable reflects the same rule (Figure 2). It can be seen from Table 5, when stress perception is a moderating variable, the interaction coefficient between the anxiety and stress perception is significant ($B = 0.040$, SE = 0.014, $p < 0.01$), it shows that stress perception plays a moderating role. Therefore, hypothesis 4 has been verified. In order to better understand the moderating effect of stress perception between the anxiety and depression, the stress perception is taken at three different levels according to the average value and the average value plus or minus a standard deviation (M–1SD, M, M + 1SD). When the level of stress perception is low (M–1SD), depression will increase by 0.564 standard deviations for every 1 standard deviation increase in anxiety. When the level of stress perception is high (M + 1SD), depression will increase by 0.644 standard deviation for every 1 standard deviation increase in anxiety. This suggests that when the stress perception level is high, the correlation between anxiety and depression is closer. The simple slope analysis diagram of anxiety and depression drawn with stress perception as the moderating variable reflects the same rule (Figure 3).

In order to better explore the relationship between the five variables, in SPSS, we use the PROCESS macro developed by Hayes and choose model21 to test the moderated mediating effect. According to Table 6, both perceived social support and stress perception jointly moderated the mediating effect of anxiety, but the direction and magnitude of the moderating effect were different. When the perceived social support level was low (M–1) and the stress perception level was high (M + 1), the indirect effect was the largest, reaching 0.300. When perceived social support level was high (M + 1) and stress perception level was low (M-1), the indirect effect was smallest, reaching 0.125.

TABLE 4 Mediating effect test.

	B	SE	*t*	*p*	LLCI	ULCI
FC → anxiety	0.312	0.027	11.356	0.000	0.258	0.366
Anxiety → depression	0.774	0.019	40.852	0.000	0.737	0.812
FC → depression	0.026	0.019	1.374	0.170	−0.011	0.063
	Effect					
Total effect	0.268	0.028	9.606	0.000	0.213	0.323
Direct effect	0.026	0.019	1.374	0.170	−0.011	0.063
	Effect	BootSE			BootLLCI	BootULCI
Indirect effect	0.242	0.024			0.196	0.290

B, unstandardized coefficients; SE, standard error; *t*, independent sample *t*-test; LLCI, the lowest value of the confidence interval; ULCI, the highest value of the confidence interval; FC, fear of COVID-19.

TABLE 5 Moderating effect test.

	B	SE	*t*	*p*	LLCI	ULCI
FC → anxiety	0.344	0.026	13.099	0.000	0.293	0.396
PSS → anxiety	−0.294	0.027	−10.975	0.000	−0.346	−0.241
FC × PSS	−0.122	0.023	−5.364	0.000	−0.167	−0.078
	Effect					
PSS (*M*−1)	0.466	0.036	13.104	0.000	0.396	0.536
PSS (*M*)	0.344	0.026	13.099	0.000	0.293	0.396
PSS(*M* + 1)	0.222	0.034	6.537	0.000	0.155	0.288
	B					
Anxiety → depression	0.604	0.025	24.503	0.000	0.556	0.652
SP → depression	0.243	0.023	10.568	0.000	0.198	0.288
Anxiety × SP	0.040	0.014	2.950	0.003	0.014	0.067
	Effect					
SP (*M*−1)	0.564	0.033	17.303	0.000	0.500	0.628
SP (*M*)	0.604	0.025	24.503	0.000	0.556	0.652
SP (*M* + 1)	0.644	0.023	28.065	0.000	0.599	0.689

B, unstandardized coefficients; SE, standard error; *t*, independent sample *t*-test; LLCI, the lowest value of the confidence interval; ULCI, the highest value of the confidence interval; FC, fear of COVID-19, PSS, perceived social support; SP, stress perception, *M*, mean.

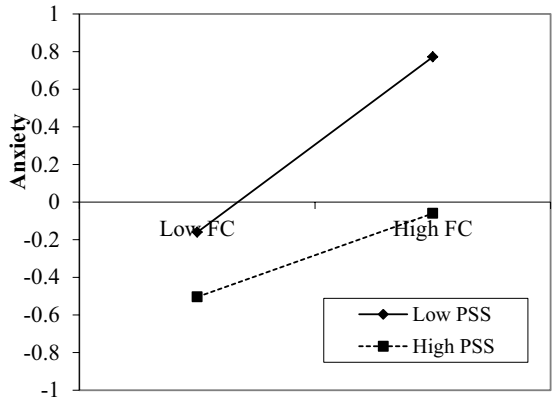

FIGURE 2
Moderating effect of PSS on the relationship between FC and anxiety. FC, fear of COVID-19; PSS, perceived social support.

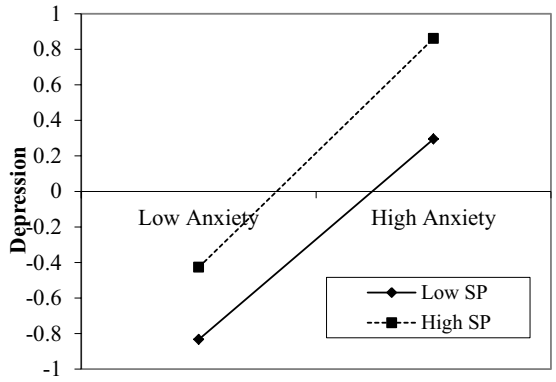

FIGURE 3
Moderating effect of SP on the relationship between anxiety and depression. SP, stress perception.

5. Discussion

The purpose of this paper is to explore the mechanism and boundary conditions of the influence of fear of COVID-19 on depression, this study constructed a moderated mediating effect model with anxiety as the mediating variable and perceived social support and stress perception as the moderating variable. The results showed that fear of COVID-19 not only directly affected depression, but also indirectly affected depression through anxiety; the first half of the mediation pathway was moderated by perceived social support and the second half by stress perception. Perceived social support and stress perception jointly moderated the mediating effect of anxiety between the fear of COVID-19 and depression, and this effect is the smallest when the level of perceived social support is high and the level of stress perception is low, and the largest when the level of social perceived support is low and the level of stress perception is high.

5.1. Theoretical implications

First, proved that fear of COVID-19 can positively predict depression and anxiety, enrich the related research of depression and anxiety. The cognitive vulnerability theory of depression believes that the individual's wrong and distorted cognitive

TABLE 6 Mediating effects of anxiety on different moderated levels of PSS and SP.

PSS	SP	Effect	BootSE	BootLLCI	BootULCI
M−1SD	*M*−1SD	0.262	0.030	0.204	0.321
M−1SD	*M*	0.281	0.030	0.223	0.340
M−1SD	*M*+1SD	0.300	0.032	0.238	0.362
M	*M*−1SD	0.194	0.021	0.154	0.237
M	*M*	0.207	0.021	0.169	0.250
M	*M*+1SD	0.221	0.022	0.180	0.265
M+1SD	*M*−1SD	0.125	0.023	0.083	0.172
M+1SD	*M*	0.134	0.023	0.090	0.180
M+1SD	*M*+1SD	0.143	0.024	0.096	0.191

PSS, perceived social support; SP, stress perception; SE, standard error; LLCI, the lowest value of the confidence interval; ULCI, the highest value of the confidence interval; M, mean; SD, standard deviation.

concept of things leads to the emergence of depression (Beck and Dozois, 2011). Fear of COVID-19 made individuals unable to correctly understand and evaluate themselves and the situation, which leads to depression. The hopeless theory of depression believes that the negative explanation and attribution model lead to individual despair (Abramson et al., 1989), which leads to depression. When individuals are afraid of COVID-19, they are more likely to have feelings of helplessness and hopelessness, and this negative emotion leads to depression. Anxiety is a negative emotional state generated by an individual to a stimulus that may pose a threat. Fear of COVID-19 itself is a negative stimulus, which will inevitably increase individual anxiety. Therefore, this study believes that fear of COVID-19 can positively influence depression and anxiety, which is consistent with the conclusions of previous studies (Huang and Zhao, 2020; Warren et al., 2021).

Second, discussed the mediating effect of anxiety, and deepened the understanding of the relationship between anxiety and depression. In previous studies, anxiety and depression were often studied as outcome variables, and less explored who was the independent variable and who was the dependent variable between them. The main reason is that anxiety and depression are highly correlated, and even "different diseases have the same origin," so it is difficult to clarify the relationship between them. Whether it is a normal emotional reaction or a psychopathological state, anxiety and depression are both negative experiences and often occur together, which shows the complexity of the relationship between anxiety and depression (Brady and Kendall, 1992). Scholars generally divide the relationship between anxiety and depression into three categories (Liang et al., 2017). The first category is continuous spectrum theory. It is believed that anxiety and depression are different manifestations of the same disease. With the aggravation of the original disease and the continuation of the course of the disease, anxiety may be secondary to depression, and depression may also be secondary to anxiety. The second category is dichotomous theory. It is believed that anxiety and depression have different causes, different manifestations and different treatment methods, which are two different forms of emotional states and mental diseases. At present, this is the view accepted by most scholars. The third category is the theory of comorbidity. It is believed that when anxiety and depression coexist, they are independent disease entities different from anxiety and depression, and they have the same biological basis and similar clinical manifestations (Yuan et al., 2001; Colleen et al., 2014). This study believes that anxiety and depression are two different negative emotional states or symptoms, so during the COVID-19, it is more meaningful to explore the relationship between them. The fear of COVID-19 has triggered the anxiety of undergraduates (Ye et al., 2020), and during the epidemic, there are fewer ways and channels to alleviate or eliminate anxiety than before. In this case, undergraduates are more likely to have a sense of helplessness and hopelessness, which will lead to depression (Abramson et al., 1978; Faraci et al., 2022). This proves that anxiety plays a mediating role between fear of COVID-19 and depression.

Third, discussed the protective role of perceived social support, and supported the main-effect model and the buffering model of social support. Both the main effect model and the buffer model of social support believe that social support is an important protective factor for individual mental health (Cohen and Wills, 1985; Ratanasiripong, 2012; Tambag et al., 2018), especially during the COVID-19 pandemic, social support is even more important. Social support itself is the combination of objective and subjective products, no matter how much objective material support, if individuals do not understand, then it will not work. During the COVID-19 pandemic, due to the limitation of conditions, all kinds of actual material support are less than usual. Therefore, it is more appropriate to use perceived social support as the research index and measurement tool. For undergraduates with a low level of perceived social support, their anxiety increased significantly with the increase of fear of COVID-19, because the COVID-19 had a tremendous influence on their study and life. When they feel a low level of social support, they will feel more isolated and helpless, resulting in a high level of anxiety. For undergraduates with a higher level of perceived social support, their anxiety level will increase with the increase of fear of COVID-19, but compared with undergraduates with lower level of perceived social support, their anxiety level is not as high as the former. This is because undergraduates with high level of

perceived social support will have negative emotions such as anxiety when facing the COVID-19, but when they think that they have more social support as the backing, their psychological tension and anxiety will be relieved, so their anxiety will not be so strong.

Fourth, discussed the risk role of stress perception, and deepen the understanding of cognitive evaluation theory. Stress perception is an individual's subjective cognition and evaluation of stress events. According to Lazarus's cognitive evaluation theory (Lazarus, 1991, 1998), for the same stress event, different individuals have different cognition and evaluation, so they feel different stress. Although the COVID-19 has brought stress to everyone (Ying et al., 2014), the stress perception by different individuals is not the same. Undergraduates with high stress perception feel more stress, so with the increase of anxiety, their depression level will increase rapidly. Undergraduates with low level of stress perception perceive less stress, with the increase of anxiety, although their depression level will also increase, compared with undergraduates with high level of stress perception, the increase rate of depression level has slowed down.

Fifth, explored the jointly moderating effect of perceived social support and stress perception, and enrich the related research of the dynamic effect model of social support theory. The dynamic effect model of social support theory holds that social support and stress will affect the physical and mental health of individuals at the same time (Monroe and Steiner, 1986), and the relationship between social support and stress is also influencing and interacting with the changes of external conditions. In this study, both perceived social support and stress perception moderated the mediating effect of anxiety, and the result shows that when the level of social support is low and the level of stress perception is high, fear of COVID-19 has the greatest influence on depression through the mediation of anxiety; When the level of social support is high and the level of stress perception is low, fear of COVID-19 has the least influence on depression through the mediation of anxiety.

5.2. Practical implications

This study may have the following implications in practice: First, during the COVID-19 pandemic, more care and help should be given to female liberal arts undergraduates. In this study, the results showed that in terms of depression, if divided by 5 points (Zhan et al., 2021; Zhang et al., 2022), the detection rate was 61.204%; In terms of anxiety, if divided by 5 points (Li et al., 2021), the detection rate was 50.920%. This shows that female liberal arts undergraduates have a relatively high detection rate of depression and anxiety. The data shown in a published article can be used as a comparison (Zhu et al., 2021), the study used the PHQ-9 and GAD-7 to survey medical staff and general public in a Chinese city from February to March 2020. The results show that in terms of depression, if divided by 5 points, the detection rate of medical staff was 33.398%, the detection rate of general public was 32.758%. In terms of anxiety, if divided by 5 points, the detection rate of medical staff was 38.668%, the detection rate of general public was 42.495%. It can be seen from the above comparison that the detection rate of both medical staff and general public is lower than that of female liberal arts undergraduates. Therefore, we believe that female liberal arts undergraduates need more care, support and help from society, school and family (Jing et al., 2021). Second, measures should be taken to reduce the fear of COVID-19 among undergraduates. Fear of COVID-19 is a risk factor for mental health, which can directly lead to the increase of depression and anxiety. It is necessary to let undergraduates learn relevant knowledge of epidemic prevention and control, and let them know that as long as they pay attention to protection, they can effectively reduce the risk of infection, so as to reduce the fear of COVID-19.Third, the anxiety of undergraduates should be reduced. Anxiety played a completely mediating role in this study, which shows that anxiety is more likely to lead to depression during the COVID-19 pandemic. We should reduce anxiety by guiding undergraduates to formulate reasonable learning and physical exercise plans and opening a psychological hotline. Fourth, let undergraduates perceived a higher level of social support. Family members should communicate more, so that undergraduates can feel the warmth of their families and the love of their parents. The school should communicate with undergraduates through various channels to make them realize that the school cares and supports them at all times. Fifth, we should reduce the stress perception level of undergraduates. Stress perception is the individual's subjective understanding and evaluation of stress events. During the COVID-19 pandemic, we should reduce the stress events that may pose a threat to undergraduates, cultivate undergraduates' positive mentality and healthy personality, and let them correctly deal with all kinds of stress.

6. Limitations and future research

The limitations of this study are mainly manifested in four aspects. First, the participants are only female students from one liberal arts college in one university in China, no male students, no undergraduates in other majors, the universality and representativeness of the sample are insufficient. In the future, male students, undergraduates in other majors and more universities in more provinces in China should be sampled to improve the representativeness of the results. Second, the relationship between variables is explained by cross-sectional research, and the distinction between causality is insufficient. Future studies should collect longitudinal data at different time points to further verify the relationship between variables. Third, the fear of COVID-19 Questionnaire in this study was developed by the author himself. Although it has good reliability and validity in this study, more studies are needed to verify it when it is popularized. Fourth, there is a complex relationship between anxiety and depression. This paper only studies the relationship between anxiety and depression with female students of liberal arts as participants in the context of COVID-19. More studies on the relationship between anxiety and depression need to

be conducted with different groups as participants in different backgrounds, so as to better discuss the relationship between anxiety and depression.

7. Conclusion

This study constructed a moderated mediating effect model to explore the mechanism and boundary conditions of the influence of fear of COVID-19 on depression. The results were as follows: (1) Fear of COVID-19 positively influence depression. (2) Anxiety plays a mediating role between fear of COVID-19 and depression. (3) Perceived social support negatively moderates the relationship between fear of COVID-19 and anxiety, and stress perception positively moderates the relationship between anxiety and depression. (4) Perceived social support and stress perception jointly moderate the mediating effect of anxiety between fear of COVID-19 and depression. When the level of perceived social support is low and the level of stress perception is high, fear of COVID-19 has the greatest influence on depression through the mediating effect of anxiety. When the level of perceived social support is high and the level of stress perception is low, fear of COVID-19 has the least influence on depression through the mediating effect of anxiety.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Research Ethics Committee of the Institute of Psychology and Behavior, Henan University. All participants agreed to participate in the study. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

XL and DG designed the study and contributed to the acquisition and interpretation of data, XL and YJ did the literature review and wrote the research protocol. XL and PY drafted and revised the manuscript. XL and DG contributed to the revisions in depth for the manuscript. All authors contributed to and approved the final manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.1005909/full#supplementary-material

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Understanding the impact of the COVID-19 pandemic on the career choices of individuals by using career sailboat model

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Career sailboat model (CSM) is a postmodernist career-counseling model in which career decision-making involves four interrelated and interactive dimensions: individual/personal factors, social factors, system-related factors, and chance factors. According to the CSM, because these factors are interrelated, in case of disclusion of any of them while making a career decision may lead an individual to make unfitting career choices. From this perspective, an unexpected event such as a natural disaster can be considered under the category of chance factor and it can impact other factors -individual, social and system-related- which have an influence on the individual's career choice as well as its impact varies according to the individual, social and system-related factors. This article aims to understand the effects of COVID-19, as a chance factor, on other constructs -individual/personal, social, and system-related- of the CSM and their overall impacts on people's career decision-making process. To be able to understand the impact of such a global calamity, the research done during the COVID-19 period has been used in this research. It is concluded that when a calamity like COVID-19 comes into the scene as a chance factor can have a significant impact on an individual's perspective regarding their career.

KEYWORDS

career counseling, career decision making, career sailboat model, the COVID-19 pandemic, career choices

Introduction

Globalization is an ever-evolving process and rapid transformations in information technologies drive the present age to witness enormous changes in almost every field of human life (Watts, 1996). The economy and the job market are also getting their transformational share from this change. More explicitly, changes in the economy have a reciprocal relationship with the changes in career choices, job market, work content, the values of society regarding jobs, and goals and meanings attached to work (Maree, 2010). That is why there is an immediate urgency for career counseling to speed up with these changes and evolve accordingly to fulfill the latest demands, requirements, or expectations

(Watson, 2004; Savickas, 2006; Kriwas, 2013). When we consider the constant and rapid transformations in the approaches of career counseling, it is seen that there is a gradual shift from emphasizing the interests of individuals for supply–demand in the job market; to helping individuals for flexibility and gaining skills to adjust to fast-changing work environments and different types of jobs. In other words, today's world requires individuals to demonstrate flexibility and mobility in their career course rather than stability (Savickas, 2012).

Person-environment fit theories such as Theory of Vocational Personalities and Work Environment (Holland, 1959) and Theory of Work Adjustment (Dawis and Lofquist, 1984; Dawis, 2005) and process-focused developmental theories such as Super (1980) can be considered as traditional career counseling models concerning the instrument that they used. Traditional career counseling theories contain quantitative methods for finding a proper job for the counselee or enhancing their career development. In other words, psychological tests were extensively used in traditional methods (Maree, 2010). However, in the postmodern era, the new approaches are derived from the interpretive paradigm (Savickas, 2005) and are more relative to qualitative methods. According to postmodernism, there is no absolute truth; instead, every individual creates their own reality. This view leads counselors to guide their counsel to construct their own stories and careers by identifying their vocational behavior and experiences in the workplace (Savickas, 2005). It can be concluded that in today's world, assessments based on test results alone are not enough to understand the suitable career for individuals.

Postmodernist approaches to career counseling mainly carry a constructivist view which means they combine various widely used career theories, give importance to contextual features, and guide individuals to construct the self and the meaning (Young and Collin, 2004; Korkut-Owen and Niles, 2020). Career Sailboat Model (2015) developed by Fidan Korkut-Owen and her colleagues is one of the postmodern theories of career counseling and is consistent with the constructivist view. In this article, we try to examine the components of the Career Sailboat Model by using examples of the COVID-19 pandemic.

Career sailboat model

As a postmodernist career development theory, the Career Sailboat Model is in line with constructivism. It supports Patton (2005) claim that career decision-making cannot depend on a single moment; it is an ongoing process that individuals construct throughout their lives. Career Sailboat Model "focuses on the determination of career goals and decision-making following self-discovery and possible opportunities" for the counselee (Korkut-Owen et al., 2015b, p. 7).

In career counseling, metaphors have a significant prospect of filling the gap between theory and practice (Amundson, 2003), and in Career Sailboat Model, a sailboat metaphor is used to make the counselees visualize their career choice process (Figure 1 is the visual representation of the model). A journey with a sailboat requires a hull, a mainsail, a foresail, wind, and waves. In this model, every necessity of the voyage represents various factors in an individual's life that affect their career path. More specifically, the hull represents the individual/personal factors; the mainsail symbolizes the social factors; the foresail depicts the system-related factors, and finally, wind and waves illustrate the chance factor.

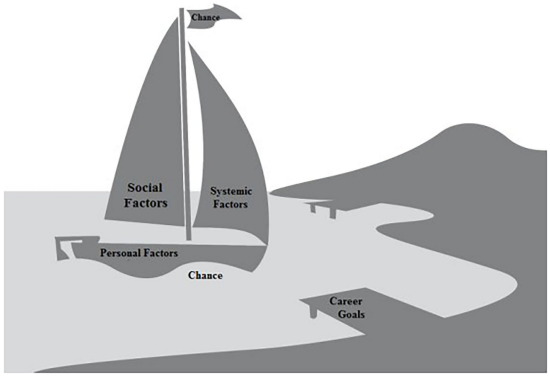

FIGURE 1
Career sailboat model (Korkut-Owen et al., 2010).

These factors can be defined as the following:

- Personal/Individual Factors: The condition of the hull is essential for engaging in a successful voyage. In the same manner, carefully examining the counselee's interests, abilities, academic achievements, personality, physical/health conditions, aptitudes, skills, values, goals, expectations, perception of the ideal job, and other factors associated with individuals themselves is crucial for one's career course.
- Social Factors: The mainsail is the principal sail that makes it possible for the sailboat to progress windward. Similarly, the social features of the counselee's life such as family characteristics, family commitments, the culture that they have grown up in and cultural perception about careers and genders, the social structure, cultural values and traditions, and media have a significant influence on the career choices of individuals. For instance, children are most likely to identify themselves with their parents' occupational site (Whiston and Keller, 2004) and, parents have the most important share in the environmental conditions that allow the emergence of the potential power that an individual has (Pişkin, 2002). Besides these, related to the influence of media, when it is asked students about their professional aspirations they typically addressed someone whom they see on television or read about in books (Cooper, 2013).
- System-Related Factors: Foresail is the sail situated at the front side of the sailboat. If one knows how to use it adequately, it helps to handle the vessel easier and increases the speed. Likewise, even though one does not have much ability to control system-related factors such as location,

labor markets, economics, governmental factors, laws, education, and assessment (examination) systems; being aware of these realities and their effect on the career course, one can drive the ship safely to the right port.

- The Chance Factor: Wind and waves are always present and they are the determinants of temperature, current, weather activities, etc. which affect the safety and security of the voyage. Even though these factors can be managed to some degree, currents are not decided by the sailor or an unexpected shift in wind speed can be uncontrollable. This is why waves and wind represent the chance factor. "Extraneous factors" that one has almost no control over "can influence career choice and progress toward a vocation goal" (Korkut-Owen et al., 2015b, p. 5). Unexpected coincidences, a chance meeting, an unexpected discovery, an accident, health conditions, natural events, or a worldwide pandemic just as COVID-19 can change the course of the sailboat drastically.

In the model, every factor is defined as a substantial construct for the voyage of a sailboat, because these factors are interrelated (Korkut-Owen et al., 2015b). They have an influence on each other; they share a dynamic relationship.

This article aims to understand, as a chance factor, the impact of the COVID-19 pandemic, on the other factors that Career Sailboat Model presents as they have a profound effect on an individual's career choices. In other words, as an extraneous factor COVID-19 pandemic influenced the other factors namely individual/personal factors, social factors, and system-related factors.

The COVID-19 pandemic

Human history many times faced the emergence of various types of communicable diseases and their spread over a large area. Bubonic Plague, severe acute respiratory syndrome (SARS), influenza (Spanish flu, Asian flu, Hong Kong flu, Russian flu, etc.), and Middle East respiratory syndrome (MERS) were some of the most destructive pandemics that emerged in the 20th and 21st centuries. Each pandemic or epidemic caused enormous damage to almost every aspect of human life. Many crises occurred because of these pandemics' adverse impacts on health, bonds in society, economic development, and political scenarios (Qiu et al., 2017).

The world is now trying to deal with the effects of a brand-new and deadly disease. The agent is Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-COV-2) and for this reason named COVID-19 (stands for Coronavirus disease) by World Health Organization (Sohrabi et al., 2020; World Health Organization, 2021). According to the data shared by WHO, globally, as of the end of 2021, there have been 272 million confirmed cases of COVID-19, and this number includes more than 5 million people's death (World Health Organization, 2021). The COVID-19 pandemic has damaging effects on mental health, too. For example, a study conducted with 1,210 participants by Wang and colleagues in February 2020 in China exhibited that 53.8% of respondents ranked the psychological effect of the pandemic as moderate or severe; 16.5% reported their depressive symptoms as moderate to severe, and 28.8% of them reported moderate to severe anxiety symptoms. According to the research that had been done by using the electronic health records of 5.2 million young people, during the COVID-19 pandemic, eating disorders incidents were 15.3% higher in 2020 when it is compared with previous years (Taquet et al., 2021). Also, the pandemic crisis has resulted in a momentous decline in employment, especially for women, youth, and medium- and low-skilled workers (Monitor, 2021, 7th ed.; Park and Inocencio, 2020; Maestripieri, 2021; Sun et al., 2021). The data shared by International Labor Organization (Monitor, 2021, 8th ed.,) declares that in 2019, the youth represented only 13 percent of total employment; however, with the outbreak of the pandemic, they made up 34.2 percent of employment losses in 2020.

These numbers undoubtedly reveal that COVID-19 has devastating effects on millions of people. Even though people had faced pandemics in early history, still the outbreak of COVID-19 is considered an unexpected event. In the course of career decisions, before the emergence of this infectious disease, one might not take a pandemic into account to draw oneself a future career plan accordingly. However, when a sailboat comes across an unexpectedly strong wave that can damage the hull and the sails, in turn, these can change the course or the destination port; an impactful event like the COVID-19 Pandemic can change and influence personal, social, and system-related factors in an individual's life which can affect the career course.

This article seeks to demonstrate by using the studies related to the COVID-19 pandemic, how COVID-19, as a chance factor, has an influence on personal, social, and system-related factors that are mentioned in the Career Sailboat Model and how these four factors can influence the overall career course of an individual.

The COVID-19 pandemic vs. individual/personal factors

Personal factors refer to individual characteristic features that can impact an individual's career choices. As specified in Career Sailboat Model "interest, aptitudes, skills, values, goals, expectations, personal characteristics, physical/health conditions, perception of the individual about him/herself and professions, past and current experiences, job experience, vocational maturity, hobbies, perceptions of the ideal job, self-efficacy, learning experience and academic achievement" can be counted as individual/personal factors which can have an effect on individual's career course (Korkut-Owen et al., 2015a, p. 5).

Our individual differences shape the way we perceive the situation and this is why every individual experiences this unhoped-for pandemic incident very uniquely. Thus, the distinctive experiences of individuals can lead them to feel and behave differently as well in their career course. For example, during the pandemic healthcare workers were in a very critical

position; they had to deal with hundreds of patients, they were working extended hours without sleeping and they were always at risk of infection. Thus, it could be very reasonable for many students to give up on this profession. However, 62.7% of nursing students in China reported that COVID-19 has a positive influence on their future career choice in nursing (Bai et al., 2021). The important point is students who are influenced positively also reported less severe depression and anxiety than the others who decide not to choose to nurse for their future careers. In addition, being satisfied with the majors in medicine is associated with an increase in willingness to be a specialist in respiratory medicine and infectious disease after the pandemic (Deng et al., 2021).

During the pandemic, maybe the most heard phrases were social isolation and social distance. Schools switched to distance learning, and the home office idea and remote work became prominent. That is why some researchers assumed that the new work and education arrangements are the "golden age for introverts" (Brooks and Moser, 2020), and as extroversion is associated with activity and sociability, this period had more negative effects on extroverts. Liu et al. (2021) support this assumption. Based on the data, extroverts, it is more likely to experience higher levels of stress during the period of the COVID-19 pandemic as they were not able to engage in social activities the way they could before the pandemic. However, because introverts have relatively fewer social interactions than extroverts (Lucas et al., 2008), they did not suffer from this period the way their extrovert counterparts do. On the other hand, Wei (2020) deviates from this common belief and literature. According to the research, individuals with higher introversion or lower extraversion are more likely to experience higher loneliness, depression, and anxiety as a response to changing social environment concerning COVID-19. If it is considered the behavior pattern of introverted individuals, the results can be understandable: As, introverts are engaged in fewer help-seeking activities (Swickert et al., 2002; Atik and Yalçin, 2011; Kakhnovets, 2011), and they are more likely to turn inward to cope with negative experiences and emotions (Shapiro and Alexander, 1975), as claimed by Wei, these personal traits of introverts can be the reason for their depression and anxiety. Even though in the literature, extroverts' and introverts' reasons for suffering from negative emotions like anxiety and stress are different, it is clear that they both experienced increases in those negative emotions. And unfortunately, from the perspective of an individual's career, anxiety and stress can lead young individuals to make wrong decisions (Remmers and Zander, 2018) or future anxiety about their career may not allow them to make fruitful decisions (Mahmud et al., 2021). In a similar manner, employees having these negative emotions severely can result in impaired work performance, accidents, and sickness absence (Haslam et al., 2005) and those can cause disadvantages in an individual's career. This is why it is very important for individuals and career counselors to understand the actual reason for experiencing negative emotions and how those affect the career path. For example in the case of introverts and extroverts, we can conclude that individuals who engage in more introverted behaviors can be more comfortable working from home unless there is no hazardous situation like COVID-19 which is an enormous stressor. For them, remote working is not the cause of their distress but the negative environment that the COVID-19 pandemic created. Understanding this point can help individuals to make better career choices and besides, and it helps counselors to guide their clients in a more realistic and beneficial way.

The fear and uncertainty that pandemic conditions created increased anxiety and worries in the workforce about their future career (Wang et al., 2020). On the contrary, psychologically resilient and hopeful individuals' are more skillful in career adaptability and career optimism in the case of future career plans (Keleş and Özkan, 2016; Özkan, 2017; Alnıaçık et al., 2021). Besides, psychological resilience is highly correlated with self-efficacy and active coping (Rees et al., 2015). Self-efficacy is an individual's belief in their own capacity to adequately perform a particular task (Bandura, 1977), and self-efficacy is moderately correlated with work performance (Stajkovic and Luthans, 1998; Judge et al., 2007). Coping is an adjustment process as a response to a negative event (Rees et al., 2015), and seeking the use of coping strategies is highly associated with greater job satisfaction (Welbourne et al., 2007). The research conducted by Karaşar and Canlı (2020) with 518 people from Turkey shows that educators and people with higher levels of education are psychologically more resilient and researchers infer that the level of education can be positively correlated with coping skills and depression prevention. In addition, there is more research supporting the findings (Bonanno, 2004; Frankenberg et al., 2013). On the other hand, Bozdağ and Ergün's (2020) results contradicted the previous findings: The research is done in Turkey with 214 healthcare workers including doctors, nurses, and other healthcare workers. Doctors found their psychological resilience level is the lowest among other healthcare workers. With respect to these two studies, it can be said that occupational stressors can be influential on people's resilience. Being psychologically resilient is a beneficial skill for individuals to deal with work stress resulting from the changing work environment caused by the pandemic. Low levels of resilience can cause experiencing negative emotions more often which can have a great negative impact on work performance.

Based on the Career Sailboat Model, COVID-19 is a chance factor that has an impact on an individual factor's career choices. According to their personal characteristics, people are influenced differently. The pandemic can affect or trigger being vulnerable to anxiety or stress, perception of work, practicing physical activities, the desire of engaging in activities with people or dislike of social environments, self-efficacy, level of resilience, and flexibility level to adapt to changing situations. In turn, all these factors influenced by the chance factor can affect the career pattern of an individual.

The COVID-19 pandemic vs. social factors

The social factors of career choice imply the factors related to society. The immediate environment in which the individual lives

is raised, or somehow the person interacts has an influential aspect on the career choice. According to Korkut-Owen et al. (2015b), family characteristics, structures, and values, the expectations and realities of the culture regarding career, common values, gender roles, social structure, traditions, exposure to media, etc. can be counted as influential social factors in individuals' career course.

During the COVID-19 pandemic, related to their job experience and work environments, individuals encountered different types of challenges or conveniences. Much research done during the COVID-19 period has shown that the social factors mentioned above are essential factors responsible for the distinct experiences of individuals.

As mentioned earlier, not to let the COVID-19 virus spread more, many companies switched to remote work (Hickman and Saad, 2020). Besides, to control the pandemic, governments decided to close most child care centers (Shockley et al., 2021) and schools by continuing with remote learning. Even though the decision was sensible to reduce the transmission of the virus (Cauchemez et al., 2009), it resulted in a substantial increase in the childcare responsibilities of parents of a young child. The situation was especially formidable for dual-earner parents because they had to simultaneously fulfill both their work responsibilities and childcare (Shockley et al., 2021). On the other hand, as researchers demonstrate, mothers and fathers were not affected in the same manner; the pandemic exacerbated the gender gap (Arntz et al., 2020; Carli, 2020; Feng and Savani, 2020; Collins et al., 2021). As Feng and Savani (2020) mentions, in the literature, even though post-COVID-19 period there were little or no gender differences in work productivity or job satisfaction; during the pandemic, working mothers' perceived work productivity and job satisfaction are more negatively affected than fathers. Many families, intentionally or unintentionally, revert to the traditional gender roles that imply women are responsible for childcare and housework, while men have to work (Ickes, 1993). Collins et al. (2021) after examining the U.S.A population of dual-earner and married heterosexual parents from February to April 2020 found that the work hours of mothers of young children were more vulnerable to reduction. While the fathers' work hours were relatively unchanged, mothers' work hours decreased by about 5 percent at the peak of COVID-19. The decrease in work performance, reduction in work hours, being not able to satisfy the work expectations can be penalized by inflexible employers (Stone, 2007; Blair-Loy, 2009), and in the case, that male worker's performance remains the same can deliver them the disproportionate benefit in pay raises promotions, or work-related opportunities (Collins et al., 2021).

The families that do not construct equal division of housework cause women to receive the lowest well-being and performance (Shockley et al., 2021). As Ozer (1995) shows the burden of domestic labor, childcare, homeschooling, and the responsibilities of the paid job relative to lower well-being and greater psychological distress. On the other hand, the application of the egalitarian strategy which means couples perform division of labor allowed husbands and wife to preserve their well-being and maintain satisfactory job performance (Shockley et al., 2021).

The family structure, values and beliefs, cultural expectations, and gender roles are social factors that have an impact on the career course, according to CSM. From the examples, it can be inferred that COVID-19 influenced these factors. For instance, as it is mentioned above, during the COVID-19 period for some couples, the traditional gender roles became more obvious and some couples carried an egalitarian pathway of dealing with the responsibilities. In both cases, the outcomes are different in the work performance, psychological well-being, job satisfaction, and career advancement of individuals. If a woman is not expected to be responsible for all the housework, and childcare while she is pursuing her career, she also can get a chance to be successful, receive good pay and promotions for their work, and more importantly, she does not lose her job. Similarly, having a discouraging family can be seen as a disadvantage for many students. It is very important whether families are supporting the remote learners while they are in lessons or as they think their son/daughter is doing "nothing" so they can cook, clean, or do mechanical work. In other cases, whether families have enough time for their children to support their learning, can be a very distinctive feature for especially primary school students in the future. Shortly, the way individuals receive support from their social environment affects their success in their careers. This is why it can be said that the effect of COVID-19 on the social structure and the way the social norms receive it affects individuals' future career decisions.

The COVID-19 pandemic vs. system-related factors

Unless making a critical change in their lives, system-related factors are the ones that individuals have limited ability to control over them. Governmental issues, policies and priorities, technological advancement of the country, laws, economics, location, labor market, assessment system of the region, and education system are counted as system-related factors.

In the absence of vaccines and medication, most governments made some interventions tailored to their society to control the spread of the COVID-19 virus. Some governments used quite harsh and restrictive methods such as lockdowns executed by police or army interventions; whereas, others tried to use risk-communication methods which are less disruptive such as educating and actively communicating with the public about the virus and encouraging them to keep social distance and staying home (Haug et al., 2020).

Curfews, lockdowns, and restricting places where people can gather for an extended period, such as shops, restaurants, work offices, schools, universities, etc. were helpful strategies to gain control over the damage of the virus. While these measures were protecting people from the physical effect of the virus, they created some other consequences. For example, they lead to drastic

changes in the job market, business sector, and consumer behavior (Donthu and Gustafsson, 2020). Countries around the globe adopted distinct approaches to managing the dramatic changes in the job markets and infrastructure. The countries that have enough financial strength, supported businesses to help them to remain in the job market; however, the others could not afford to do the same. In the latter, small businesses especially could not deal with the changes in the economy and they were forced to close.

The sectors that need the physical presence of customers, such as tourism, entertainment, and hospitality faced the highest employment loss (Donthu and Gustafsson, 2020). It is very likely that before the pandemic, students who consider taking part in the tourism sector could change their minds. According to İflazoğlu et al. (2021), 44.7% of the adolescents receiving tourism education think that the tourism sector is not a reliable choice due to the pandemic.

When we turn the other side of the coin, we see that internet-based businesses are dramatically booming; online shopping, online entertainment, food delivery, online education, and so on. For instance, during the pandemic gyms were closed because of the lockdowns, or people preferred to stay at home as a precaution for probable infection. During this period, personal trainers began to create content on digital platforms (e.g., Youtube, Instagram) and online training, digital fitness, yoga, and various physical activity contents gained popularity (Sokolova and Perez, 2021; Kim, 2022). Besides, even though restaurants were physically closed, they implemented many different innovations and improved their products and service to meet the growing demand for online food delivery (Gavilan et al., 2021).

Staying home was a substantial response to prevent the spread of the COVID-19 virus during the absence of vaccines and medicines. However, it caused severe economic consequences across the globe. From the Great depression in 1930, to the COVID-19 period, we encountered the largest rate of employment loss (Donthu and Gustafsson, 2020). This pressure on the job market led to changes in producer and customer behavior. It can be said that novel situations can cause different demands. Even when the case is income and employment loss, the flexibility and suitability of individuals can help individuals to make innovations for their workplaces, change their mindsets, be open to novel options, and benefit from the new opportunities to build a new career plan.

Conclusion

Career Sailboat Model is a postmodern career-counseling model in line with constructivism. More explicitly, by using a sailboat metaphor gives individuals enough space to create their own career path and their own story. The Career Sailboat model has four main components responsible for individuals' career choices. These are individual factors, social factors, system-related factors, and chance factors. These factors are interrelated and have dynamic relationships. This is why while an individual makes their decision they all both affect each other and influence the career course.

In this article, we defined the COVID-19 Pandemic as a chance factor, and with the examples from the literature regarding COVID-19 we tried to examine how it affected other factors namely individual, social and system-related, and made predictions about how all these factors can affect the overall career decision with the effect of COVID-19.

For example, the experienced anxiety and stress levels correlated with psychological resilience and self-efficacy. If the career that the individual pursues has high levels of stressors but the individual has a lower level of flexibility and resilience, the chosen career can lead the individual to experience depression or other negative emotions. In the case of Covid-19, individuals had a chance to evaluate their flexibility as a response to a changing work environment.

Besides, the social environments of individuals are also influenced by the situation COVID-19 created. Some families became supportive and egalitarian while some others went back to more traditional values which resulted in a widening gender gap. The gender gaps put women employees in a more vulnerable position and put their careers in danger. Inequality in the share of responsibilities in housework and childcare caused women to experience less work satisfaction than their male colleagues, which used to be almost equal.

It is known that there is no country that is not affected by COVID-19. However, it does not have the same impact on developed, developing, or underdeveloped countries. Their available resources to support the public were not equal for every country, and most counties could not provide enough financial support. From the time of the Great Depression, we experienced the highest level of employment loss. All these factors can have triggering effects on the future career anxiety of individuals. Students may consider engaging in such professions that do not get affected by extreme events as much as tourism sector does.

In short, there is always a chance to encounter extraneous events in our lives. Our experience of these events gets its shape according to our personal features, the characteristics of the environment we are engaged in, and the major system we belong to, and these events can affect all of these factors and our experience as well. There is an endless reciprocal dialog between different factors. This is why the occurrence of these types of extraordinary events can lead us to redefine our career paths. In the article, we aimed to demonstrate how accurate the Career Sailboat Model is by stating that combining all these factors is crucial to construct one's career decision and supporting its use more extensively by career counselors. Even though the world encountered pandemics earlier, none of them had large-scale consequences as much as COVID-19 caused. That is why there are still limited resources, and further research on the impact of COVID-19 on career choices will be beneficial to demonstrate the effects.

Even though the world encountered pandemics earlier, none of them had large-scale consequences as much as COVID-19 caused. That is why the literature is limited, and further research on the impact of COVID-19 on career choices will be beneficial to understand the dynamics. In career choices in the post-pandemic era, it is essential to investigate how career choices have been affected by human-made or natural calamities such as the COVID-19 pandemic. The recent pandemic outbreak opened doors to new career choices and brought new job market challenges. The pandemic has changed our perception of traditional day job office working culture. It made us realize that we no longer depend on office settings to work, and it made us consider online home-based jobs, irrespective of daily traveling. In terms of time, quality, accountability, transparency, and cost-effectiveness, such transformations must be examined. The pandemic has given a glimpse of working online home-based jobs and understanding its advantages and disadvantages.

On the other hand, service delivery jobs were unable to work from home during this period. Instead, many people who were engaged in that type of job, for example, health workers, police officers, or shipping workers had to work even more than they usually do; however, also they earned even higher; therefore, understanding their experiences and why people want to engage in these jobs or drop them off is significant. In addition to chance factors, researchers can deeply investigate the impacts of other factors (personal, social, and system-related) in the Career Sailboat Model. Researching, exploring, and working on understanding all these aspects is thought that will be enlightening for career counseling professionals in terms of aligning with current trends in career choices and job markets.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Family functioning buffers the consequences of the COVID-19 pandemic for children's quality of life and loneliness

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COVID-19 resulted in mass quarantine measures early in the pandemic. This disruption of daily life widened inequities and made children one of the most vulnerable populations during the crisis. This national, cross-sectional "COVID-Kids" study collected data from almost 500 parent–child dyads using standardized measures to better understand the effects of COVID exposure and impact on children's quality of life and loneliness. Data were collected *via* social media from May to July 2020. According to parent proxy and child self-report, United States children experienced worse quality of life ($p<0.0001$; $d=0.45$ and 0.53) and greater child-reported loneliness ($p<0.0001$) when compared to normative, healthy samples (i.e., children who do not have a chronic medical condition). Older children ($r=0.16$, $p=0.001$) and female children ($r=0.11$, $p=0.02$) reported greater loneliness. Higher child-reported family functioning scores were associated with better quality of life ($r=0.36$, $p<0.0001$) and less loneliness ($r=-0.49$, $p<0.0001$). Moderated mediation analyses indicated the indirect effect of parent COVID impact on the association between COVID exposure and child quality of life was weaker in the context of better family functioning. Results of this study raise concern for the short-and long-term sequelae of the pandemic on the physical and mental health of children. Healthcare providers and researchers must find new and innovative ways to protect the well-being of children. Strengthening family functioning may buffer the effects of the pandemic and improve overall quality of life in our "COVID Kids."

KEYWORDS

COVID-19, pandemic, quality of life, loneliness, family functioning, children

Introduction

In 2020, the novel coronavirus (COVID-19) rapidly spread around the world and was declared a pandemic by the World Health Organization (WHO; Imran et al., 2020). The United States has been one of the most affected countries, with over 96 million infections and almost 1 million deaths as of September 2022 (Team, 2021; Centers for Disease Control and

Prevention, 2022). To mitigate the public health crisis, mass quarantine measures ("lockdown") have included stay-at-home orders, mandated masking, curfews, work from home, and cessation of many in-person activities, including school attendance for children. This disruption of daily life and routines widened inequities and made children and adolescents one of the most vulnerable populations during the crisis (Quinn et al., 2016; Golberstein et al., 2020; Wang et al., 2020).

While much is known about children's reactions to natural disasters (Pina et al., 2008; Schoenbaum et al., 2009; McDermott and Cobham, 2012), less is known about their response to pandemics. Exposure to natural disasters can result in symptoms of post-traumatic stress, depression, anxiety, and behavioral problems in children (Pina et al., 2008; Schoenbaum et al., 2009). Among the few studies that have examined past pandemics' impact on children's mental health (i.e., equine influenza, H1N1, and Ebola), negative psychological outcomes such as stress, helplessness, and risky behavioral problems have been reported (Meherali et al., 2021). Although the direct physical sequelae of the COVID-19 virus may be less severe in children, the pandemic has resulted in significant indirect effects on children's physical, social, and mental health (Ghosh et al., 2020; Golberstein et al., 2020; Wang et al., 2020; Zar et al., 2020; Nobari et al., 2021; Samji et al., 2021; Elharake et al., 2022). In one of the earliest surveys of over 2,000 youth with mental health needs in the United Kingdom, over 80% reported the pandemic resulted in worse mental health, 87% reported greater social isolation, and 31% had reduced access to mental healthcare (YoungMinds, 2020). Among 115 adolescent girls in the Netherlands, one in four reported depressive symptoms above the clinical cut-off during the first COVID-19 lockdown, and had an increased risk of depressive symptoms when they reported poor family functioning (Vacaru et al., 2022). In another study, children in both Canada and China had drastically reduced rates of physical activity and increased sedentary behavior during the pandemic (Moore et al., 2020; Xiang et al., 2020). Chinese children had increased distraction, irritability, and fear in the early months of quarantine (Jiao et al., 2020).

In the United States, similar effects of the COVID-19 pandemic on children's quality of life and psychosocial functioning have been reported. Longitudinal studies of youth well-being during the pandemic found that children and adolescents reported higher levels of internalizing and externalizing problems when they experienced more pandemic-related stressors (Rosen et al., 2021; Weissman et al., 2021). Children in the United States are also engaging in less physical activity and greater amounts of screen time, despite findings that suggest better health behaviors are associated with improved mental health outcomes (Tandon et al., 2021). Stress and anxiety in parents, as well as exposure to increased information regarding the pandemic, may cause uncertainty, fear, and other psychological and social consequences for children (Fiorillo and Gorwood, 2020). A study of a community-based sample of mothers and children found that pandemic-related stressors led to an increase in maternal mental health symptoms, which then predicted greater psychopathology symptoms among adolescents (Lengua et al., 2022). Moreover, COVID-19-related threat information from parents and the community contributed to greater fear in children, particularly for younger children (Uy et al., 2022). While parent distress has been shown to contribute to child stress and post-traumatic stress disorder during disaster (Kelley et al., 2010), family, social, and school connectedness may be protective for high risk youth (Foster et al., 2017) and improve long-term adult health (Steiner et al., 2019). A greater understanding of the role of connectedness, particularly its potential to buffer the effects of the pandemic, is needed.

The current pandemic provides a real-world opportunity for investigation of the effects of severe stress on social and emotional well-being in children while experiencing disruption of daily routines and social isolation. A better understanding of this experience provides an opportunity for healthcare providers, educators, and caregivers to identify high risk youth and engage in a rapid response or prevent future sequelae. Thus, our objective was to examine quality of life and loneliness among United States children in the early months of the COVID-19 pandemic and to explore demographic and family factors related to child well-being. Specifically, we examined the mediating role of COVID-19 impact and the moderating roles of family functioning and communication with friends on associations between COVID-19 exposure and child quality of life and loneliness. We hypothesized that greater reported COVID-19 impact on parents or children would directly and significantly affect the quality of life of children.

Materials and methods

Participants

This paper presents a cross-sectional analysis of quality of life and loneliness among United States children early in the COVID-19 pandemic. Eligible parents were older than 18 years of age and had a child enrolled in public school prior to the COVID-19 pandemic. Youth were: (a) 8–17 years of age, (b) English speaking, (c) typically enrolled in school outside of the home, and (d) living with a participating caregiver. Children with developmental delays and children who were home schooled prior to the COVID-19 pandemic were excluded.

Ethical considerations

Institutional review board (IRB) approval was obtained (STUDY00001019). The institutional IRB determined informed written consent would not be required, as participants were providing implied consent by clicking on the Facebook Ad and completing all questions. The Facebook Ad led all participants to a study summary description. Participants were instructed by

Abbreviations: CEFIS, COVID-19 Exposure and Family Impact Scale; PedsQL, Pediatric Quality of Life Inventory.

proceeding to complete the study questions, they were providing consent to participate. No protected health information was collected, the study was anonymous, and participants could stop participation at any time. No questions were required to be answered to proceed to other questions.

Data collection

Data on the effects of COVID-19 on school-aged children were collected from parent–child dyads through a pay per click ad campaign on Facebook. Consent and assent were implied *via* participants' voluntary completion of the anonymous survey, which they could exit out of at any time. Parents completed a survey about the effects of the COVID-19 pandemic on school-aged children. After parents completed their portions, the survey was then directed to the oldest child who was willing to complete child measures. Data collection ended after an 8-week period.

Internet based recruitment

To adapt to the challenges of conducting clinical research during the pandemic and quickly obtain a reasonable sample size, families were recruited remotely using an 8-week pay per click Facebook Ad campaign from May 2020 until July 2020. Because Facebook users must be at least 13 years of age, the ad invited parents to participate in a survey about the effects of the COVID-19 pandemic on school-aged children with a chance to win a $100 Amazon gift card. After clicking on the Facebook link, a summary describing the purpose, benefits, risks, time commitment, and rights as a research volunteer was provided to all parents, this included an invitation to their child to participate.

Measures

Demographic characteristics

Data were collected from the parent about themselves and partner (if applicable), including number of children, sex, race, ethnicity, marital status, geographic location, income, employment status, occupation, and COVID-19 exposure. Parents were also asked about the participating child's age, grade, sex, race, ethnicity, receipt of home instruction, method of home instruction, social contact with friends, and method of communication with friends.

COVID-19 exposure and family impact scale

This measure was created using a rapid iterative process by members of the Center for Pediatric Traumatic Stress (Kazak et al., 2021). It captures exposure to potentially traumatic aspects of COVID-19 and assesses the impact of the pandemic on the family. Part 1 consists of 28 yes/no responses measuring exposure to COVID-19 and associated disruptions, generating a total exposure score. Sample items include having a stay-at-home order, school closure, or a family member continue to work outside the home. Internal consistency for COVID-19 exposure in our sample was $\alpha = 0.63$. Part 2 is comprised of 12 items measuring the impact of the COVID-19 pandemic. Ten items are rated on a five-point scale (i.e., impact on parenting, independence, how family members get along), and two items assess distress on a 10-point scale. Higher summary scores indicate greater exposure to COVID-19 stress and more negative impact/distress. Internal consistency for COVID-19 impact in our sample was $\alpha = 0.83$. Because a child version of the CEFIS was unavailable, we adapted seven questions from the adult version to measure impact. Internal consistency for child-reported COVID-19 impact in our sample was $\alpha = 0.75$.

Pediatric Quality of Life Inventory™ 4.0 generic core scales

Children completed this 23-item measure, which includes four scales: Physical Functioning, Emotional Functioning, Social Functioning, and School Functioning (Varni et al., 2003). Items are rated from 0 to 4 and reverse scored. A total score is calculated ranging from 0 to 100, with higher scores indicating better quality of life. Reliability and validity have been documented, and data allow for comparisons to means from healthy populations (i.e., children ages 2–16 who do not have a chronic medical condition; Varni et al., 2003; Huang et al., 2013). Additionally, internal consistency for COVID-19 exposure in our sample was $\alpha = 0.91$. Children are considered to have compromised quality of life if scores fall more than one standard deviation below the population mean of 82.87 for total functioning.

NIH toolbox and PROMIS measures

Children completed the NIH Toolbox Loneliness (seven items) and PROMIS® short form Family Relationship (four items) measures. Items are rated using a 5-point scale, with higher scores indicative of higher levels of the construct, which can be positive (family functioning) or negative (loneliness). Both measures generate T-scores ($M = 50$; $SD = 10$) normed to the general population. The NIH Toolbox and PROMIS® are well-validated and reliable measures of self-reported health outcomes (Bevans et al., 2010). Internal consistency for loneliness in our sample was $\alpha = 0.92$ and for family functioning was $\alpha = 0.87$.

Statistical analysis

Data were analyzed using SPSS software, version 26. Descriptive statistics were calculated for demographic characteristics and primary variables of interest. Parent and child reported PedsQL scores were compared to the mean PedsQL score for the healthy population (Varni et al., 2003) using *t*-tests ($\alpha = 0.05$; two-way). Child reported loneliness was analyzed similarly. To identify potential covariates prior to running multivariate models, Pearson correlations ($\alpha = 0.05$; two-way) were conducted between primary dependent variables (i.e., quality of life, loneliness) and demographic factors, as well as COVID exposure, COVID impact, family functioning, and communication with friends.

The PROCESS macro for SPSS (Hayes, 2017) was used to conduct moderated mediation analysis using ordinary least squares regression in four separate models. Child age, sex, ethnicity and prior family income was controlled for in each model where COVID-19 exposure was the primary independent variable,

COVID-19 impact was the mediator, and either the PEDSQL or loneliness was the outcome; then communication with friends or family functioning were tested as potential moderators of the association between COVID impact and quality of life or loneliness. Indirect effects were assessed using 95% bias-corrected confidence intervals based on 10,000 bootstrap samples; the effect was considered significant when confidence intervals did not contain zero. Thereafter, conditional indirect effects of exposure on outcome was examined through the mediator, followed by second stage moderation. A simple mediation analysis was conducted when the moderator was non-significant.

Results

Sample characteristics

A total of 461 parent/child dyads (Figure 1 consort diagram) completed self-report measures. Tables 1, 2 provide demographic descriptions of parent and child participants. Child participants were equally distributed by sex (49% female, $n = 223$), with a mean age of 11.8 years old (range 8–17, $SD = 2.72$). Most parent participants were mothers (95% female, $n = 435$), White (91%, $n = 418$), and non-Hispanic (93%, $n = 423$). While 26% ($n = 118$) of parents were unemployed, almost half reported an annual income prior to COVID-19 greater than $100,000. Most families were from the Midwest; however, all 50 U.S. states were represented.

COVID exposure and impact

Parent report

The mean COVID-19 exposure score was 8.08 ($SD = 2.59$) on a scale of 25. The largest proportion of COVID-19 exposure reflected indirect events, such as closure of schools and daycares (99.8%, $n = 460$), stay at home orders (96.5%, $n = 445$), disruption in education (94.4%, $n = 435$), missing important events (85.9%, $n = 396$), and inability to visit/care for family members (78.7%, $n = 362$). Only 12.2% ($n = 56$) of participants had direct exposure due to a family members' diagnosis of COVID-19, and COVID-related deaths affected only 1.1% ($n = 5$) of the sample.

The average COVID impact score was 35.03 ($SD = 6.91$) on a scale of 0 to 50. Parents reported a mean distress score of 6.20 ($SD = 2.11$) for themselves and 5.97 ($SD = 2.26$) for children. Children's self-reported distress score was 5.04 ($SD = 2.49$), which was significantly lower than parent report of child distress

TABLE 1 Child dyad demographic characteristics (N=461).

	Mean (SD)* or *n* (%)
Child age in years (SD)	11.85 (2.72)
Gender	
Male	236 (51.4%)
Female	223 (48.6%)
Race	
American Indian/Native American	4 (0.9%)
Asian	19 (4.1%)
Black or African American	25 (5.4%)
Native Hawaiian/Pacific Islander	3 (0.7%)
White	416 (90.2%)
Other (fill-in text response)	16 (3.5%)
Ethnicity	
Hispanic or Latino	43 (9.4%)
Non-Hispanic	415 (90.6%)

*SD, standard deviation.

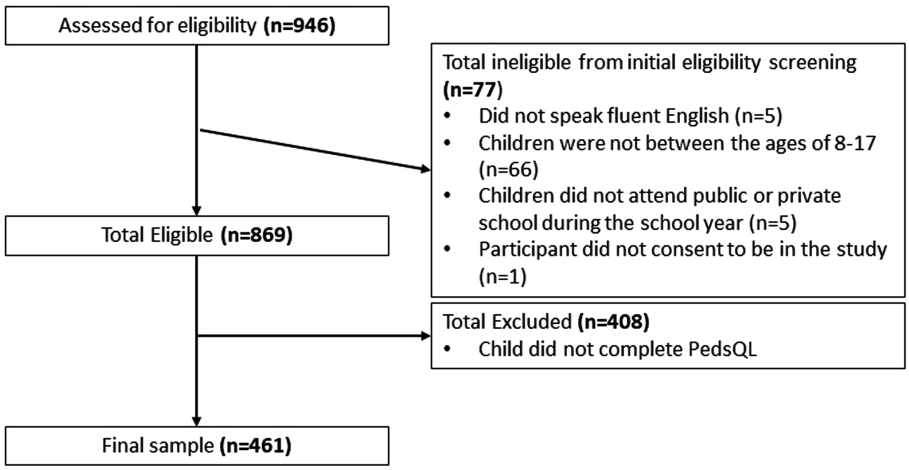

FIGURE 1
Consort diagram describing sample included.

TABLE 2 Parent dyad demographic characteristics (*N*=461).

	Mean (SD)* or *n* (%)
Gender	
Male	23 (5.0%)
Female	435 (95.0%)
Race	
American Indian/Native American	4 (0.9%)
Asian	14 (3.0%)
Black or African American	14 (3.0%)
Native Hawaiian/Pacific Islander	3 (0.7%)
White	418 (90.7%)
Other (fill-in text response)	16 (3.5%)
Ethnicity	
Hispanic or Latino	33 (7.2%)
Non-Hispanic	423 (92.8%)
Income	
Under $25,000	31 (6.8%)
$25,001–$50,000	57 (12.6%)
$25,001–$75,000	54 (11.9%)
$75,001–$100,000	86 (18.9%)
$100,001–$150,000	137 (30.2%)
More than $150,000	85 (18.7%)
Other	4 (0.9%)
Average years of education (SD)	15.53 (4.57)
Current employment status	
Working full-time (>30 h/week)	264 (57.6%)
Working part-time (<30 h/week)	76 (16.6%)
Unemployed	118 (25.8%)
Current relationship status	
Single (includes separated, divorced, and widowed)	59 (12.8%)
Married or living with Someone	400 (87.2%)

*SD, standard deviation.

$t(457) = -9.13$, $p < 0.0001$. However, child-reported parent distress scores were similar to parent self-report 6.15 ($SD = 2.53$). Overall, both parents and children reported higher distress scores for parents than children.

Child report

Because a child version of the CEFIS was unavailable, we adapted seven questions from the adult version to measure impact. Approximately 30% ($n = 135$) of children reported COVID-19 improved how family members got along, while 38% ($n = 174$) reported it made it worse. About 44% ($n = 172$) reported a negative impact on sibling relationships. Most children reported negative effects on emotional well-being, including worry (58.5%, $n = 266$) and mood (56.3%, $n = 255$).

Quality of life and loneliness

Comparisons to normative, healthy population (i.e., healthy children) means for parent and child reported quality of life and child reported loneliness scores are displayed in Table 3. Both parent and child-reported PedsQL total scores were significantly lower (worse) than the normative mean ($p < 0.0001$; $d = 0.45$ and 0.53; Varni et al., 2003). Parent and child-reported domains of emotional, physical, and school functioning were also significantly below the normative mean ($p < 0.0001$); however social functioning was not. Dyad reports of child quality of life were strongly correlated ($r = 0.75$; $p < 0.0001$). The mean child-reported loneliness score was 56.12 ($SD = 11.27$), which was significantly higher (worse) than normative scores.

Factors associated with child quality of life and loneliness

Table 4 includes correlations between demographic factors, child quality of life, and child loneliness. Older children reported greater loneliness ($r = 0.16$, $p = 0.001$). Females also had greater loneliness than males ($r = 0.11$, $p = 0.02$). Higher prior income was significantly correlated with better child-reported overall quality of life ($r = 0.21$, $p < 0.0001$). Higher child-reported family functioning scores were strongly associated with better quality of life ($r = 0.36$, $p < 0.0001$) and less loneliness ($r = -0.49$, $p < 0.0001$). Child communication with friends was also significantly correlated with quality of life ($r = 0.19$, $p < 0.0001$) and loneliness ($r = -0.13$, $p = 0.006$).

Exploration of communication with friends and family functioning as moderators of indirect effects

We expected that the indirect effect of parent COVID-19 impact on associations between COVID-19 exposure and both child quality of life and loneliness would vary in the context of communication with friends and family functioning. Moderated mediation analyses indicated that communication with friends did not affect the strength of these associations (95% CI: −0.09 to 0.34 for quality of life and −0.24 to 0.08 for loneliness); however, the indirect effect of parent COVID impact was weaker in the context of better family functioning for quality of life (95% CI: 0.001 to 0.024), but not for loneliness (95% CI: −0.01 to 0.0009; Figures 2, 3; Simple Slopes in Figure 4). Given that our moderators did not have an effect on our moderated mediation loneliness models, a simple mediation analysis was conducted and was significant (95% CI: 0.04 to 0.31; Figure 5).

Discussion

While the direct physical effects of COVID-19 on children appear less severe than adults (Ghosh et al., 2020; Zar et al., 2020)

TABLE 3 Comparison of parent and child reports of child quality of life to norms.

	Normative sample *M* (*SD*)	Current sample *M* (*SD*)	df*	*t*-value	Pr>|*t*|**	(95% CI)***
PEDSQL child report						
Total functioning	82.87 (13.16)	75.35 (15.12)	6,431	11.69	**<0.0001**	6.26–8.78
Physical functioning	86.86 (13.88)	80.67 (18.47)	6,421	8.98	**<0.0001**	4.84–7.54
Emotional functioning	78.21 (18.64)	63.41 (21.18)	6,420	16.26	**<0.0001**	13.01–16.59
Social functioning	84.04 (17.43)	82.20 (17.77)	6,407	2.18	**0.03**	0.18–3.50
School functioning	79.92 (16.93)	71.91 (18.57)	6,367	9.71	**<0.0001**	6.39–9.63
PEDSQL parent report						
Total functioning	81.34 (15.92)	74.12 (16.16)	10,319	7.09	**<0.0001**	5.22–9.22
Physical functioning	83.26 (19.98)	78.00 (20.15)	10,300	4.13	**<0.0001**	2.76–7.76
Emotional functioning	80.28 (16.99)	59.83 (21.45)	10,294	18.74	**<0.0001**	18.31–22.59
Social functioning	82.15 (20.08)	82.72 (17.49)	10,285	0.45	0.66	−3.08–1.94
School functioning	76.91 (20.16)	73.93 (20.79)	8,715	16.09	**<0.0001**	18.25–23.33
Loneliness score	50.00 (10.00)	56.12 (11.27)	460	11.66	**<0.0001**	5.09–7.15

*df = Degrees of freedom.
**Pr > |*t*| = The *p*-value of a *t*-test.
***95% CI = 95% Confidence Interval.
Bold values are statistically significant.

TABLE 4 Correlations between demographic characteristics and child report of quality of life and loneliness.

Variable									
1. PEDSQL total functioning									
2. Loneliness	**−0.60****								
3. Family relationships	**0.36****	**−0.49****							
4. Communication with friends	**0.19****	**−0.13****	−0.01						
5. Child age	−0.07	**0.16****	**−0.15****	**0.21****					
6. Child sex	0.03	**0.11***	−0.03	**0.15****	−0.01				
7. Child ethnicity	**0.13****	0.03	−0.01	0.08	−0.02	−0.06			
8. Prior income	**0.21****	−0.01	**−0.12***	**0.13****	0.03	−0.06	**0.17****		
9. COVID exposure	**−0.20****	0.06	−0.05	**−0.09***	−0.06	0.02	**−0.16****	**−0.26****	
10. COVID impact	**−0.30****	**0.25****	**−0.18****	−0.09	−0.06	−0.05	**0.11***	−0.06	**0.14****

*$p < 0.05$. **$p < 0.01$.
Bold values are statistically significant.

results from this study early in the pandemic suggest United States children experienced worse quality of life and greater loneliness when compared to normative samples. These outcomes were worse for girls and older children and raise concern for short-and potentially long-term mental health sequelae due to the pandemic. The effects of the pandemic on children were partially explained by COVID-related distress in parents. While social connection with friends did not buffer this indirect effect, better family functioning appeared to be protective. These findings are particularly relevant for healthcare providers, educators, and caregivers, who may be in a position to assist children in the midst of the pandemic.

Children in our study also experienced greater loneliness than normative samples, which has been described in adults (Van Tilburg et al., 2020; Wickens et al., 2021), but less so in youth during the pandemic. Although an anticipated result of public health restrictions during COVID-19, loneliness is not benign. A recent systematic review found an association between loneliness and mental health problems, specifically depression and anxiety in children and adolescents (Loades et al., 2020). Notably, loneliness was also associated with mental health problems up to 9 years later (Loades et al., 2020). It is also connected with increased depression in girls and social anxiety in boys (Mak et al., 2018; Liu H. et al., 2020). This is concerning given prolonged social distancing and the length of time adolescents have been remote learning during the COVID-19 pandemic.

Drastic changes to lifestyle, school, and physical activity have psychosocial consequences for children (Wang et al., 2020). During

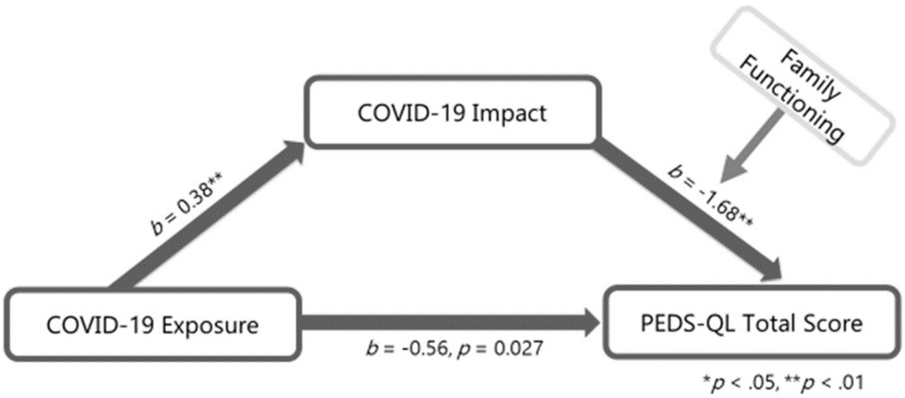

FIGURE 2
Quality of life moderated mediation. Interaction between COVID-19 Impact and family functioning b=0.03, p=0.02; r-squared for the model: 0.26; index of moderated mediation=0.01, 95% CI [0.001, 0.02]; this model controls for age, gender, ethnicity and prior family of which income and ethnicity was significantly associated with PEDS-QL total score.

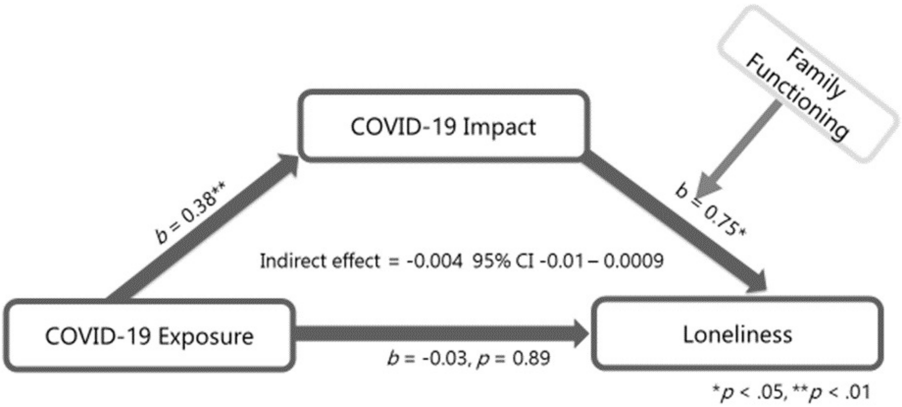

FIGURE 3
Loneliness moderated mediation. Interaction between COVID-19 Impact and family functioning b=−0.01, p=0.19; r-squared for the model: 0.30; this model controls for age, gender, ethnicity and prior family income of which gender and age were significantly associated with PEDS-QL total score.

the pandemic, home confinement, social distancing from peers and extended family, fear of infection for self or family, and lack of educational resources create feelings of uncertainty and anxiety in children (Imran et al., 2020), which can lead to more serious effects on mental health. In our study, both parents and children reported lower overall quality of life for children when compared to normative samples. All domains of quality of life (total, physical, emotional, and school) except the social domain were affected. This finding is interesting given most children were not physically attending school and social distancing measures were in place to mitigate spread of the virus. This decrease in health-related quality of life has been reported among children in other countries as well (Xie et al., 2020; Ravens-Sieberer et al., 2021).

Our findings indicated worse quality of life for adolescents (i.e., 12–18) relative to children (i.e., 8–12), as well as girls relative to boys. This is similar to the Canadian study that also reported high depression and loneliness in adolescent girls (Castellino et al., 2012) and a recent meta-analysis reporting an increased prevalence of clinically elevated anxiety in females (Racine et al., 2021). Additionally, a United Kingdom study on mental health and loneliness in adolescents during the COVID-19 pandemic reported a significant association between loneliness and being female (Cooper et al., 2021). These results are not surprising given the influence of peer contact on well-being as well as the importance of developing independence in adolescence (Fegert et al., 2020). Adolescents, specifically adolescent girls, are a population vulnerable to mental health concerns, such as depression, in the healthiest of times (Ellis et al., 2020). The COVID-19 pandemic brought about distanced or virtual peer relationships, isolation from friends, restriction in extracurricular activities, and missed major life events. These factors are likely to accentuate risks and require special attention.

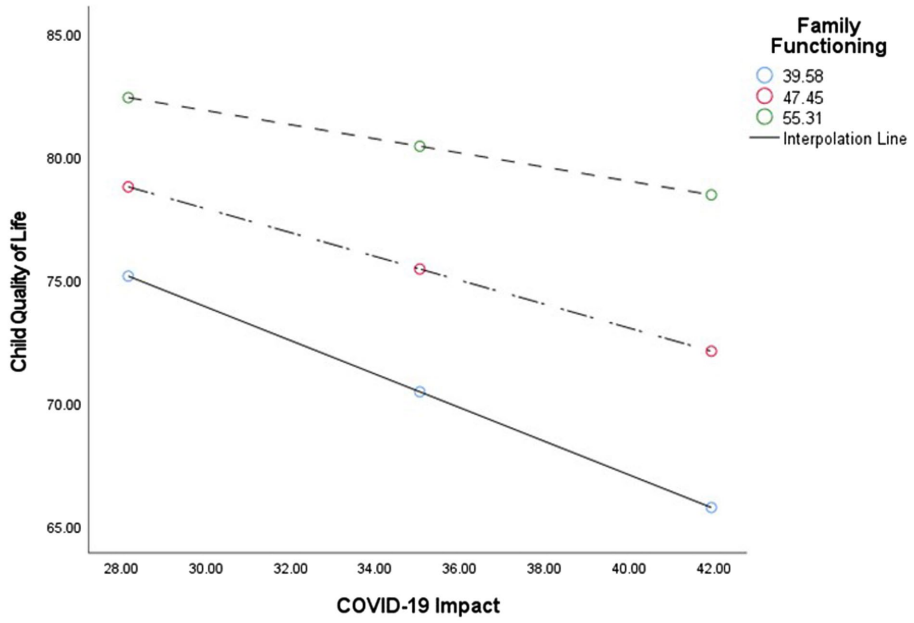

FIGURE 4
Simple slopes. Illustration of the simple-slope analyses for Family functioning with child quality of life and COVID-19 impact scores.

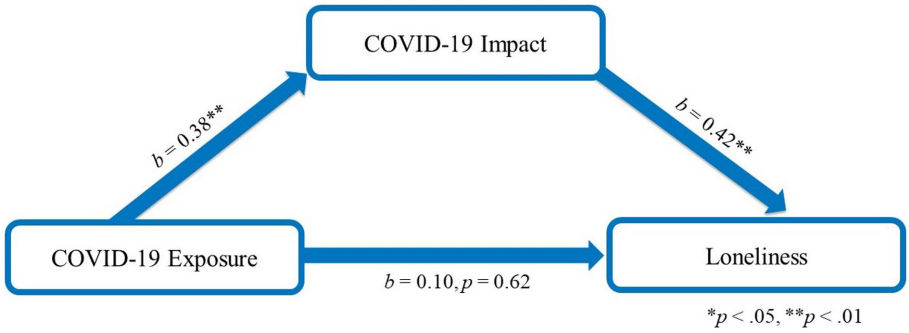

FIGURE 5
Loneliness mediation model. R-squared for the model: 0.10; this model controls for age, gender, ethnicity and prior family income of which gender and age were significantly associated with loneliness total score.

Data suggest parental stress influences outcomes in children (Schor, 2003; Louie et al., 2017; Ren et al., 2020; Spinelli et al., 2020; Calvano et al., 2022). One study during the pandemic found parental presence may decrease child stress (Wang et al., 2020). Similarly in our study, when controlling for age, sex, and income, parent reported COVID-impact (distress) was a contributing factor to worse overall quality of life and loneliness reported by children. This could be expected when one considers the stress the pandemic has elicited in parents. In a study examining caregiver strain among parents (a majority of whom were mothers) over 75% of parents reported the strain of caregiving as moderate or high during the COVID-19 pandemic (Radomski et al., 2022). Parents have experienced uncertainty related to physical health and financial strain due to unemployment and decreased wages (Achdut and Refaeli, 2020; Sharma et al., 2020). Parents have been faced with additional pressures of working from home, blurring boundaries between work and family (Cusinato et al., 2020), while balancing remote learning and lack of access to childcare or extended family caregivers. In addition, studies have shown that social isolation can negatively affect adult psychological health (Liu J. J. et al., 2020), further adding to parental stress during the pandemic.

We expected that the ability to maintain social connections and family functioning would be protective for children's well-being. However, communication with friends, direct or virtually, did not attenuate the association between parent-reported COVID

impact and quality of life or loneliness in children. Other studies have also shown worsening depression with increased virtual communication with friends, but no association with loneliness (Ellis et al., 2020). However, family functioning was protective for children, which is similar to findings suggesting less depression or depressive symptoms in adolescents that reported increased family time or experienced higher quality of family functioning (Ellis et al., 2020; Vacaru et al., 2022). Another study of 93 parent–child dyads reported that better family functioning was positively associated with higher health-related quality of life in children (Taha et al., 2022). Furthermore, developmental literature supports the protective role of positive family relationships for children exposed to adversity (Crum and Moreland, 2017; Masten, 2018). Thus, in our study, children were more effected by parental COVID-19 impact and strong family relationships were able to buffer the reported decrease in quality of life and increase in loneliness. Despite the perception adolescents prioritize friends (Laursen and Veenstra, 2021), our findings emphasize the need for strengthening family relationships during times of crisis.

To our knowledge, this is one of few studies using a large sample of parent–child dyads to examine protective factors related to quality of life and loneliness during the pandemic. However, findings should be considered in the context of several limitations. The use of social media to recruit participants is not without criticisms, as it could introduce ascertainment bias and restricted participation of anyone without social media access. We also asked for participation from the oldest willing child, further limiting generalizability. Parents were primarily White, non-Hispanic mothers. While considerable efforts were made to increase diversity, future research with under-represented populations is needed. The overall COVID exposure score in this sample was low, which may reflect the early timing of data collection. In addition, examination of effect sizes indicated some associations, although significant, were relatively weak. Identification of other robust factors associated with child well-being is important. Given the cross-sectional nature of this study, further investigation into the long-term effects of the COVID-19 pandemic on quality of life and emotional well-being is needed.

Despite limitations, this study increased our understanding of the collateral damage occurring in a large sample of United States children during the COVID-19 pandemic. While they may largely escape the direct physical consequences, most children will suffer from some decline in their quality of life and/or emotional well-being. These findings also reinforce the idea that the family unit and parent distress are important contributing factors to child outcomes during the pandemic. Pediatricians, teachers, and community members should assist parents in recognizing the contribution of stress on child outcomes, and strong efforts must be aimed at mitigating this stress and encouraging parental self-care. We can only hope that the resilience that often sustains children's development will allow them to recover from the repercussions of the pandemic. In the meantime, we must do everything possible to provide them opportunities for a normal childhood and improve their long-term physical and emotional well-being.

Conclusion

Children are a vulnerable population deeply affected by the unintended consequences of the pandemic. Although the peak of the initial pandemic may have passed, a shift to mitigating the harm invoked by the pandemic on child well-being is necessary. Healthcare providers and researchers alike must find new and innovative ways to protect child mental health, strengthen family functioning, and thus improve overall long-term quality of life of our "COVID Kids."

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Nationwide Children's Hospital Institutional Review Board. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

MS and CG developed the concept and design of the study. MS, KH, and AO were responsible for conducting the study. MS, AO, KH, JR, and SU analyzed the data and drafted this manuscript. CG, TA, and JR provided revisions. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Come together: The importance of arts and cultural engagement within the Liverpool City Region throughout the COVID-19 lockdown periods

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Introduction: Arts and cultural engagement activities have long been found to support wellbeing within the general population. In particular, community arts and cultural involvement during the COVID-19 pandemic have been an invaluable source of mental health and wellbeing support for many individuals across the globe. The initial move to remote engagement following the first United Kingdom lockdown demonstrated the importance of hybrid provisions, with isolated and vulnerable individuals finding online provisions important for wellbeing. With restrictions on movement and service access in the United Kingdom having gradually eased from March 2021, it is now important to explore how individuals navigated the ability to engage with either remote or in-person provisions. The current study aimed to explore the impact of the COVID-19 pandemic on arts and cultural engagement during periods of restrictions and initial easings on movement within the Liverpool City Region.

Method: The study consisted of two waves of qualitative interviews within a broader longitudinal study. Twelve interviews were conducted during wave 1, which aimed to capture data during the initial COVID-19 lockdown period and the initial easing of restrictions. Eight of these participants were interviewed again for wave 2, which aimed to capture data during the winter 2020 lockdown period.

Results: Framework analysis revealed three overarching themes: (1) The Importance of Arts and Culture for Personal Enrichment, (2) Belongingness through Socialization, and (3) Transitioning and Adjusting Throughout the COVID-19 Pandemic.

Discussion: Findings presented in the current study provide further evidence of the value of arts and cultural activities in supporting wellbeing. Specifically, the current data emphasize the value of arts and cultural engagement throughout the COVID-19 pandemic and particularly during times of national restriction. Furthermore, the current study demonstrated that remote engagement provided important wellbeing support throughout the pandemic in a way that protected against mental health consequences, but with limitations on feelings of social connectedness within online environments. Amidst continuing risks from the COVID-19 virus and feelings of uncertainty, this study highlights the importance of hybrid provisions.

KEYWORDS
arts engagement, mental health, wellbeing, online provision, COVID-19

1. Introduction

Recent research has highlighted the short-term detrimental impacts that the COVID-19 pandemic and associated United Kingdom lockdown periods have had on the mental health and wellbeing of the British adult population (Iob et al., 2020; Pierce et al., 2020; Kromydas et al., 2021; Niedzwiedz et al., 2021; Wetherall et al., 2022). Specifically, findings have drawn attention to the mental health risks faced by vulnerable groups in particular, with increased mental health risks among individuals with pre-existing mental health conditions (Iob et al., 2020; Burton et al., 2021; Di Gessa et al., 2021; O'Connor et al., 2021; Wetherall et al., 2022); young adults (Niedzwiedz et al., 2021; O'Connor et al., 2021; Wetherall et al., 2022); women (Iob et al., 2020; Niedzwiedz et al., 2021; O'Connor et al., 2021; Wetherall et al., 2022); and individuals from racialized minorities (Iob et al., 2020; Katikireddi et al., 2021; Niedzwiedz et al., 2021). These mental health risks further interact with bigger physiological risks, with vulnerable groups also at an increased risk of developing long COVID symptoms following a COVID-19 infection (Thompson et al., 2021) and experiencing general healthcare disruption (Di Gessa et al., 2021). While individuals who were already experiencing mental health difficulties have been among the most vulnerable, findings have also highlighted mental health risks among the general United K population (Pierce et al., 2020). Specifically, around 29% of United Kingdom adults were found to have developed a common mental health condition (e.g., anxiety or depression) by April 2020, having reported no mental health conditions in the year before the COVID-19 pandemic (Chandola et al., 2020). However, the nation-wide scale of the United Kingdom lockdown periods and the impact of the broader COVID-19 pandemic mean that even individuals who have not developed a specific mental health difficulty have had to navigate fluctuating wellbeing (Robinson et al., 2022; Wetherall et al., 2022). Furthermore, mental health and wellbeing consequences have lasted beyond the initial lockdown period, with findings of decreased wellbeing during the initial easing of lockdown restrictions from July 2020 (Robinson et al., 2022; Wetherall et al., 2022) and worsened depression and loneliness from October 2020, alongside the return of lockdown restrictions in the United Kingdom (Wetherall et al., 2022). With ongoing risks to health posed by the COVID-19 virus and changing safety advice from the United Kingdom government, the fluctuating disruption to everyday life and individual wellbeing are likely to continue.

This rise in mental health struggles increases the demand for readily accessible services that can provide mental health support and encourage general wellbeing (Worsley et al., 2022). Healthcare services providing such support have faced pressures from before the COVID-19 pandemic that have resulted in reduced capacity to support patients (Allison et al., 2018; Cummins, 2018). These pressures together with the reduction in access to healthcare for mental health support during the pandemic highlight the need for research to focus on alternative methods of broader wellbeing support (Howarth et al., 2020; Younan et al., 2020; Worsley et al., 2022). In particular, community arts and cultural involvement during the COVID-19 pandemic has been an invaluable source of wellbeing support for many individuals across the globe (Mak et al., 2021; Meyrick and Barnett, 2021; Bu et al., 2022; Worsley et al., 2022). Importantly, research has shown that individuals in vulnerable groups and thus at risk of greater mental health consequences were often more likely to increase their arts and cultural engagement during the COVID-19 lockdown periods (Mak et al., 2021). However, findings also indicate that individuals from lower income families have reduced their engagement in arts and culture during the pandemic (Bu et al., 2022). This highlights a need to explore how restricted access to community support such as local arts and cultural activities has impacted on vulnerable individuals who may have struggled to access remote activities. Furthermore, Green et al. (2021) found that in-person, but not remote, contact was important in reducing depression and loneliness. By contrast, the findings show that weekly remote social engagement had little impact on individuals facing inequalities and struggling with symptoms of depression and loneliness. However, the initial move to remote engagement following the first United Kingdom lockdown demonstrated the importance of hybrid provisions, with isolated and vulnerable individuals finding online provisions important for wellbeing (Worsley et al., 2022). With restrictions on movement and service access in the United Kingdom having gradually eased from March 2021, it is now important to explore how individuals navigated the ability to engage with either remote or in-person provisions.

The current study aimed to examine the impact of the COVID-19 related reduced access to arts and culture engagement on wider wellbeing for individuals within the Liverpool City Region (LCR) at two critical time points: (Wave 1) during the October 2020 to February 2021 lockdown and (Wave 2) following the initial easing of restrictions from March 2021. For this exploration, the focus was on talking to individuals who had, to any extent previously engaged with arts and cultural activities before the COVID-19 United Kingdom lockdown periods. The aim of Wave 1 was to explore (i) the personal impacts of the lockdown periods starting March 2020 on access to arts and culture for individuals living within the LCR and (ii) any changes in how participants accessed arts and culture during the short-term easing of access restrictions throughout summer 2020. The aim of Wave 2 was to explore how the gradual easing of restrictions

impacted on the ways and types of arts and cultural engagement for individuals within the LCR. This paper combines findings from Waves 1 and 2 to explore the fluctuations in arts and cultural access for individuals living within the LCR, and to further explore what these changes mean for future arts and cultural access beyond the COVID-19 pandemic.

2. Materials and methods

2.1. Participants

Participants were recruited *via* social media advertisement and through partner organizations' publicity and communication channels (newsletter, webpages, and social media) into a larger longitudinal study which sought to explore the value of arts and cultural involvement throughout the COVID-19 pandemic in the LCR. A total of 12 participants (2 male, 10 female) took part in interviews conducted at wave 1 (January to February 2021), with eight (1 male, 7 female) of these participants also contributing data to Wave 2 (April–May 2021). Eligibility criteria required participants to be 18 years of age or over and fluent English speakers. Most of the participants (9 in Wave 1 and 5 in Wave 2) were aged 45 years or older. The participants were predominantly White British (11 in Wave 1 and 7 in Wave 2). Eight participants in Wave 1 and six participants in Wave 2 had used mental health services in the past or were using them at the time of participation. Four participants in Wave 1 and two participants in Wave 2 disclosed having a disability or multiple disabilities. The study was approved by the University of Liverpool Research Ethics Committee (reference: 7994).

2.2. Measures

2.2.1. Interview schedule

Semi-structured interview schedules were devised for Waves 1 and 2 separately. For Wave 1 (see Supplementary material), structured questions focused on: (i) experiences of arts and culture pre-pandemic (e.g., motivations for engagement and benefits of engagement); (ii) engagement during the initial United Kingdom lockdown period in March 2020 (e.g., motivations to continue engagement, what was missed most and methods of access); (iii) engagement during lockdown easing during summer 2020 (e.g., how engagement changed during this time) and (iv) engagement during the winter lockdown (beginning December 2020 for the general United Kingdom population, but starting in October 2020 for many districts within the LCR due to local risk) and plans for future engagement (e.g., return, or not, to in-person engagement).

For Wave 2 (see Supplementary material), structured questions focused on: (i) overall sense of the impact of lockdown on arts and cultural engagement (e.g., were any activities missed) and (ii) plans to return to arts and cultural activities as restrictions continued to ease (e.g., plans to return to in-person activities and how participants were seeking out and evaluating whether to attend events).

2.3. Procedure

Participants took part in semi-structured qualitative interviews following informed written consent for each wave. For Wave 1, data were intended to capture: (i) the impact of the first United Kingdom lockdown (beginning March 2020) on arts and cultural engagement within the LCR; (ii) the impact of the short-term easing of restrictions from June 2020 and any changes to local arts and cultural engagement during this time; (iii) the impact of the winter 2020 lockdown (beginning December 2020) for the wider United Kingdom population on engagement and future plans to engage following further easing of United Kingdom restrictions throughout 2021. The 4th author, a female post-doctoral researcher who is trained in qualitative interviewing to doctoral level, conducted Wave 1 interviews.

For Wave 2, data were intended to explore: (i) the overall impact of the previous lockdown experiences upon engagement with arts and cultural activities within the LCR and (ii) immediate and future plans for arts and cultural engagement with restrictions on access to arts and culture easing within the United Kingdom. The 2nd author, who is also a female post-doctoral researcher trained in qualitative interviews to doctoral level, conducted Wave 2 interviews (upon handover from 4th author who started new role ahead of data collection for this wave).

All interviews across both waves were either conducted as video calls or telephone interviews due to COVID-19 restrictions. Interview duration ranged from 25 to 50 min.

2.4. Analysis

Audio data from interviews were recorded and transcribed verbatim. Transcription for both waves was completed by the first author who has prior experience of interview transcription for post-graduate research. Resultant transcripts were not returned to participants, as there were no areas of unclarity or missing data. Qualitative data from participant interviews were analyzed using Framework Analysis (Ritchie and Spencer, 1994). Framework Analysis was chosen due to its ability to incorporate inductive and deductive coding, preventing data loss while enabling comparisons across time points, a factor important for the larger study. The analysis was conducted within NVivo 10[1] (Castleberry, 2014). Waves 1 and 2 were initially analyzed separately, with the final results combined due to large overlaps in data across the waves. The analysis stages were as follows:

1 An older version of NVivo was used due to a limited access to newer versions during the Covid-19 pandemic.

1. Immersion: The first author transcribed interview data, keeping memos on points of interest to summarize the data to the rest of the team and for reference in later stages of analysis. For Wave 1, the 4th author made detailed memos on emerging ideas for each interview. For Wave 2, similar memos were made by the 2nd author. For both Waves 1 and 2, the memos created by the interviewing researchers consisted of field notes recorded at the time of interview as well as post-interview reflections.
2. Organizing: The first author sorted all data across Waves 1 and 2 into an organizational framework within NVivo 10. For Wave 1, the organizational framework was devised from the memo notes of key emerging ideas made by the 4th author in stage 1. For Wave 2, the final framework from Wave 1 was used to organize Wave 2 data in order to explore key differences and similarities between the two waves.
3. Indexing: The first author applied line-by-line coding to all Wave 1 and 2 transcripts within separate NVivo 10 files. For Wave 1 data, the first author selected three of the 12 transcripts that were felt to best capture the data. These three transcripts were then line-by-line coded by the 2nd and 3rd authors. These authors met with the first author to discuss resultant coding. Discussions established consistency and agreement in coding. Where codes differed between coders, agreement was achieved through further discussion of the data. For Wave 2, the 2nd author selected the three key transcripts, due to her familiarity with the original interviews. The same three coders discussed codes for Wave 2 and agreement was reached too. For both waves, a combination of inductive and deductive coding was used, relying on participants' own language where possible (Saldaña, 2009).
4. Charting: The first author used reflections from stages 1–3 to recode data and move codes into initial subthemes and wider themes. Emerging themes were then discussed bi-weekly with the rest of the team and reframed to capture mutual understandings of the data.
5. Mapping: Initially, two frameworks were produced, one for Wave 1 data and one for Wave 2. This separation enabled the team to explore core similarities and differences between the two time points. Once both frameworks had been agreed upon by the whole team, it became evident that the findings from both waves were similar, and data from Wave 1 and 2 were combined.

3. Results

Three overarching themes were identified from the data: (1) The Importance of Arts and Culture for Personal Enrichment; (2) Belongingness through Socialization; (3) Transitioning and Adjusting throughout the COVID-19 Pandemic. A number of subthemes were identified for each overarching theme (see Table 1).

3.1. The importance of arts and culture for personal enrichment

3.1.1. Integration within personal narratives and identities

All participants felt that engagement with arts and culture over time had played an important part in their lives. Many participants further emphasized the ways in which arts and culture had played a pivotal role in their lives, building on their sense of personal narrative and identity:

> *[P1, W1] 'Music's sort of was my sort of thing, it's what informed my working life and it's also something I've been involved in with education and it's something that's always been part of my family, and I support the Phil[harmonic]'s education programme.'*
>
> *[P3, W1] 'it's been a big part of my work, but also my identity as well.'*

These values meant that access to arts and culture was of particular personal importance to all participants, especially in maintaining a sense of general wellbeing and positive mental health across time. Therefore, the restricted access to arts and culture during the COVID-19 lockdown periods had resulted in a sense of loss among participants:

> *[P10, W1] 'I've just felt sort of half the person I am because of this whole sort of area of me where I'm not finding any expression and just seems to have gone quiet.'*

TABLE 1 Overarching themes and subthemes.

Themes	Subthemes
The importance of Arts and Culture for Personal Enrichment	Integration Within Personal Narratives and Identities
	Arts and Culture for Personal Growth
	Breaking from the norm
Belongingness through Socialization	Sharing Within Personal Networks
	Collective Feeling in Shared Spaces
	Local and Wider Community Involvement
Transitioning and Adjusting Throughout the COVID-19 Pandemic	Considerations Around Remote Inclusion
	Broadened Horizons
	Returning to In-Person Events

> *[P9, W1] 'it's almost like culture, which was always a large part of my life, when we all rushed home last March, I feel like I lost it on the way home'*

As illustrated by [P10, W1], participants who had felt arts and culture were an important cornerstone in their lives experienced a perceived loss of self.

For some participants, the lockdown restrictions had resulted in reduced engagement with arts and cultural activities, both personally and within community groups. This reduction was attributable to difficulties with translating activities online as well as broader difficulties that arose from living through the turbulence of the COVID-19 pandemic:

> *[P9, W1] 'I've really struggled to listen to music and to enjoy it the way that I did in the past…I'm finding it incredibly difficult to read more than a couple of pages at a time, I think I've spent too much time scrolling on my phone, just the same old pervasive boredom that most people have gone through really. I've not even accessed anything like Zoom gigs or anything like that. I feel like I dropped out really of all of it when lockdown happened'.*
>
> *[P4, W2] 'I stopped reading because I could not really concentrate on books. I stopped watching the television as well, other than odd things, because I could not find I could concentrate for long enough.*

However, there was a sense that the life-long value of arts and culture had led to resilience in the face of adversity, particularly for those who continued engaging remotely. This felt resilience helped during times of particular difficulty experienced within the COVID-19 pandemic:

> *[P1, W1] 'Yeah, I'm reaping the benefits now, years later, of things that happened to me in school, things that my family did…those things stayed with them, and they passed them on. So, I'm really, really pleased that I've had that experience that's been there to fall back on.'*
>
> *[P2, W1] 'They [arts and cultural activities] are very much part of my life, and very much part of my mental health and wellbeing, there's no doubt about that. I cannot imagine how I'd get here without having had the opportunity to do the distanced participation.'*

3.1.2. Arts and culture for personal growth

Part of the value participants had found in arts and cultural activities over time stemmed from a sense of importance placed upon expanding the mind through creative exploration. Specifically, participants found value in the ability to learn new skills, take on new perspectives and build self-esteem:

> *[P2, W1] 'So, there's been a sort of cross-traditional thinking that goes on, or used to go on, in the Everyman, which causes you to think through what our own attitudes are to modern times. We're both in our seventies, so I think it's important really, it keeps the mind turning over.'*
>
> *[P9, W1] 'It's just being exposed to it, it's what culture does is not it? It exposes you to different sounds, to different thoughts, to different experiences, to different visuals. It helps you grow, and keep adding more outlook I suppose, because you are being open to new ideas and new ways of expression all the time.'*

During the lockdown periods, this focus generally shifted toward continuing self-growth through remote engagement with arts and cultural activities. In particular, participants showed an interest in learning skills that enabled digital creativity and networking through the distribution of creative content *via* social networking services:

> *[P1, W1] 'I started trying to play with GarageBand (a software application to record, arrange and mix musics) …I managed to record three parts for the chorus and the first verse…it took me about a week really 'cos I did not know what I was doing really but I was really pleased with myself'.*
>
> *[P6, W1] 'I started Instagram, I'd never used Instagram before last year, but I put the choir on Instagram and managed the Instagram account for the choir. You're trying to get people, to raise the profile of the choir a bit, so I was following all sorts of people and reading things.'*

These explorations of remote engagement largely resulted in an increased willingness for creative risk-taking among participants. This moved them toward forms of arts and culture which they may not have otherwise accessed:

> *[P10, W1] 'my husband and I…probably take more risks going to things that we would not otherwise have done, online…I just think "oh, you know what, I'll give that a try. I've got nothing better to do (laughs) so might as well give that a try." I've probably gone to a broader range of things than I would have done pre pandemic, so that's probably a good thing.'*
>
> *[P12, W1] 'it's still a treat for me, time to get tickets to go and see live performances. And so, I am a little bit more conservative in what I choose and base it upon what I know I will like. So, because of the extent, it kind of stops you from taking a chance and experimenting a bit. But when it's there for you, it allows you to say "oh, I may like this or may not it does not matter." But I can try it out which is quite good.'*

In this way, the earlier mentioned sense of loss was balanced against a sense of opportunity among participants to broaden their horizons when it came to exploring arts and cultural activities that they could draw personal benefits from.

3.1.3. Breaking from the norm

Before the pandemic, participants often engaged with local arts and cultural activities as a means to break up the tasks and strains associated with day-to-day life:

> *[P12, W1] 'my kind of day job is quite process driven, it's really nice for me to participate in things [that] are just completely different and I find it just refreshes my mind, because it's completely different. You know that saying about the change is as good as a rest, I find it really refreshing.'*
>
> *[P8, W1] 'You get engrossed in it and it's a form of escapism, you are not thinking about all the other things going on like what you are having for tea, or what you need to pick up from the supermarket, you are just engrossed for that period of time.'*

It appeared that the use of arts and cultural opportunities in this way had led to the earlier mentioned integration of arts and cultural experiences within the personal narratives of the participants.

During times of national restriction, this sense of needing a break from the difficulties of everyday life became more apparent to participants. As a result, they actively tried to seek out enriching, often novel, experiences to break up and enrich their days:

> *[P11, W1] 'I tried to put some variety into the day. Maybe trying to do something different. Maybe trying to see it as an opportunity to try things that I would not normally try'.*
>
> *[P2, W1] 'I suppose belonging to the choir and having it to look forward to, and looking back on it after the rehearsal, looking back on what happened that day, in that rehearsal, and what we are supposed to get ready for next week, it sort of keeps me going.'*

In this sense, arts and cultural opportunities continued to offer similar, but now more important, benefits for participants during the lockdown restrictions as they had prior to the COVID-19 pandemic. However, at times where national restrictions had been eased, participants reported an increased desire to re-engage with arts and culture in person, as a means to fulfil this heightened need for escapism:

> *[P4, W1] 'when it was allowed. I thought 'right I'm going down, and I'm going to go to some museums or exhibitions I have not seen.' I got cheap tickets and a cheap hotel room and I just thought 'just do it."*
>
> *[P2, W2] 'the Trail of Light, I went to that. And I've seen some of the outside Biennial stuff when I have gone into town for a walk just to change the scenery.'*

Therefore, while remote opportunities to partake in arts and cultural activities were able to replicate some of the benefits of enriching day-to-day life, there was a sense that in person engagement offered a more rewarding opportunity for this purpose.

3.2. Belongingness through socialisation

3.2.1. Sharing within personal networks

The personal gains that participants had experienced from engagement with arts and culture throughout life were found to enrich their social connections in similar ways. Before the pandemic, participants had relied upon arts and cultural activities as catalysts for forming deeper connections with close friends and family. These deeper connections emerged from imaginative creativity leading to more meaningful shared experiences:

> *[PC, W1] 'I enjoy going with people as well, it's a part of who you are to share that experience with someone else…I think that's become more and more clear that I love doing that, I love to be part of an experience with someone else'.*
>
> *[P8, W1] 'So, there's the person that you are with, the fact that you are having that experience together, so you have that connection and then obviously after that you can always remember that experience and laugh or smile about it and tell the story.'*

Within the lockdown periods, there was a sense among participants that being able to access arts and culture within their social networks remained important for their wellbeing. As a result, participants had reported emulating these shared cultural experiences through online means. In this way, social media platforms and video call applications provided participants with an accessible way to re-engage with arts and culture within their personal social networks:

> *[P3 W1] 'My younger brother is interested in arts and culture as well, so we try, we are in two separate households but we sort of Facetime each other in the interval and things to reach out so it feels like we have gone to the theatre together a little bit [laughs].'*
>
> *[P4, W1] 'about four of my friends…we all started watching national theatre [laughs] online together on a Thursday night. So, we just made a point of Thursday national theatre online, and we'd all have a little WhatsApp group, and we would just pass comments.'*

However, most participants reported missing the depth of connection that was felt when engaging together in physical creative environments:

> *[P10, W1] 'for me, I most miss playing, being able to play with other musicians.'*
>
> *[P6, W1] 'I feel like I've gotten to know them quite well in book club over the years, because we have chatted once every*

> *month or six weeks. That is not the same on Zoom, it is not the same.'*

Overall, findings then indicate that online platforms (e.g., WhatsApp) enabled participants some sense of enriching social connection but in a way that could again not replicate the particular value of being together in-person for arts and cultural activities.

3.2.2. Collective feeling in shared spaces

As well as enhancing personal social connections, these shared physical spaces were felt to enhance the shared experience among audiences. Specifically, the liveness that resulted in physical spaces created a sense of shared emotional contagion, enhancing both the personal and social benefits of the experience:

> *[P3, W1] 'I went to see the giants in Liverpool with my mum… we just caught the end bit, and we have got a video of us absolutely laughing and making the best time of it, it was just so magnificent, and I think in that moment everyone just felt this sense of like elation, and joy, and celebration'.*
>
> *[P1, W1] 'I just think that the feel of live theatre is brilliant because there's a group of people there who in a way are exposing themselves in all sorts of ways and emotionally to you. And you are there with other people, and I find you experience emotions very intensely at the theatre.'*

Participants reported that these atmospheric benefits that had been felt in physical spaces were not replicable when connecting with others remotely. Instead, there was a sense of physical separation, which hindered the ability to feel moved together or personally within a shared experience:

> *[P3, W1] 'I'm kind of not getting is that shared experience. Me sitting at home with my headphones on does not give me the same butterflies in my belly or get me all angry and riled up about the world, in the same way that it might in a venue or when we are on the streets in a festival. That's the thing I think, I feel I've not got from lockdown.'*
>
> *[P8, W1] 'say if it's a concert, with the band themselves, when they are talking to the audience or they are singing a particular song, you sort of bounce off the reaction of the people on the stage as well as the people in the crowd. So, that goes then. So, it feels a little bit empty.'*

Additionally, participants had previously found value in the liminal spaces and surrounding social opportunities available during in-person engagements. In this way, physical spaces were found to personally and socially enrich arts and cultural events in a way that was lost when connecting remotely:

> *[P3, W1] 'you feel like you can go the bar afterwards and you can bump into someone and you are happy to have a chat about what you have just watched.'*
>
> *[P5, W1] 'You'd make a day or an evening of it. So, you'd go for a few drinks beforehand, you'd go to the event afterwards. So, it's not just the participation, it's what happens before and after.'*

Similarly, participants reported having previously felt a sense of emotional sharing with artists through engagement with their work or performances. However, this sense of connection was also hindered by lack of physical presence when engaging with arts online:

> *[P6, W1] 'it's like the person who painted this was there too and you are not separated by the internet or television screen, because that's the thing with being in the presence of something historical, you are actually there with something that's hundreds or thousands of years old, seeing it on TV does not give you that same kind of emotional attachment'.*

3.2.3. Local and wider community involvement

Among participants there was a strong sense of pride in belonging to the culture of the LCR due to the strong sense of community that was felt within the region, particularly in relation to the value of arts and culture that is felt within the city region:

> *[P1, W1] 'It's been fab talking to people from other cities and from all over the world about how brilliant Liverpool is [laughs]…they are surprised sometimes that Liverpool has so much to offer in terms of so many different aspects of culture.'*
>
> *[P12, W1] 'I think one of the interesting things about the Liverpool City Region in particular is that you cannot even stand at the bus stop without having a chat with somebody. You catch somebody there and you start having a chat. And again, it's another new perspective, so is like a community sort of experience.'*

During the lockdown periods, participants often felt unable to engage with this sense of local culture and community due to restricted access. Instead, they had a sense that the difficulties experienced throughout the pandemic transcended cultural identities, encouraging people to come together regardless of their geographical area. This shift toward a wider sense of community was enhanced by participants often finding it easier to engage with arts and cultural events outside of the LCR through remote provisions which were aimed at national over regional inclusion:

> *[P12, W1] 'It is nice though, because we are all in it together, moments where it does not matter kind of how wealthy you are, how intelligent you are, we are all on a level playing field.'*
>
> *[P6, W1] 'The National Theatre live stuff was fabulous but that's obviously London based. I do not think I did anything else in Liverpool during the first lockdown.'*

However, as local arts and cultural activities began to move online, participants had expressed a keenness to re-engage with local services. Due to the sense of familiarity and identity evoked when engaging with local events remotely, it seemed that these opportunities were felt as more enriching:

> *[P10, W1] 'the Liverpool Phil(harmonic) then started doing their video on-demand concerts, some of those managed to have socially distanced audiences…I could deal with that 'because they all played on that stage, I know a lot of people in the orchestra anyway quite well. I know the hall, I know what it's like to sit there, so it did not feel as foreign'.*
>
> *[P3, W1] 'there's usually a festival every May called LightNight …the guys moved the festival online so I kind of just sat on Facebook on that night and they'd release like a video of a choir doing a song or something like that, and that was quite lovely to feel a part of that.'*

This keenness to re-immerse in the LCR culture was particularly prominent during times when lockdown restrictions were eased and local provisions were once again accessible. During these times, participants were keen to re-visit local venues in person and engage with events that held a sense of personal and community relevance within the culture of the region:

> *[P3, W2] 'Linda McCartney had been married to Paul McCartney. And so, the photographs that she was taking was of a particular era and a particular kind of music and a particular kind of lifestyle…which obviously resonates with my own life memories of a certain period'.*
>
> *[P4, W1] 'I'd been to the Linda McCartney at the Walker and the Don McCullin at the Tate, I'd made a point of booking tickets for them.'*

However, participants expressed concerns for the future availability of such arts and cultural events within the LCR. In particular, they were worried about the impact of the pandemic on local artists and venues:

> *[P9, W1] 'How many venues, how many bands will still be going? How many theatre companies, how many theatres? How many art galleries? Are they going to be unable now to afford to put on the big hitting exhibitions? There's so many unknown[s], even your favourite restaurant, is that still going to be there when all of this ends?'*
>
> *[P10, W1] 'An underlying concern now how the arts will continue… I do worry about very sheer variety of professional arts in Liverpool, how will that will be affected.'*

This concern appeared to particularly motivate participants further toward wanting to engage in local arts and cultural activities while they were available.

3.3. Transitioning and adjusting throughout the COVID-19 pandemic

3.3.1. Considerations around remote inclusion

As highlighted in sections 3.1. and 3.2., the move from in-person to remote provisions resulted in a mixture of positive and negative responses from participants, with some aspects of arts and cultural engagement being seen as irreplaceable through remote provisions. Concerns raised among participants around the available remote provisions largely centered around the majority of engagement opportunities being delivered online. This frequently led to access barriers, with internet connectivity difficulties, inaccessible content and screen fatigue being common areas of difficulty for participants:

> *[P6, W1] 'We probably talk for about an hour and a half, maybe a couple of hours, about as much as I can cope with to be honest on the computer, I've had enough after about an hour and a half of looking at a screen.'*
>
> *[P3, W1] 'I've struggled to do workshops and if you are watching a piece of online theatre it freezes [laughs] and stuff like this, ah it is really irritating.'*

When barriers such as these arose during remote engagement, participants often chose to drop out of the activity altogether. For some, this hindered their motivation for wider engagement opportunities during the pandemic:

> *[P1, W1] 'I sort of missed the first one even though I was trying to connect and I just let it put me off. So, I did not bother with the rest of it.'*
>
> *[P3, W1] 'my internet was really bad and so I dropped out. So, that sort of put a stop to that.'*

Throughout the pandemic, some participants additionally experienced emotional difficulties in engaging remotely with arts and culture. These difficulties highlighted the changes and challenges brought about by the pandemic:

> *[P10, W1] 'they have this different version introducing the concert, and it was empty, there was nobody there… Then they did the concert, and I just wept, and wept.'*
>
> *[P3, W1] 'it was just really quite sad that they were like 'so these are steps that you can do with a partner, but if you have not do it like this.' And I was like feeling really… clearly making a point of me being on my own [laughs].'*

These difficulties largely related to the fact that participants were actively comparing remote engagement to in-person experiences. As a result, there was a sense that the format of many remote engagement opportunities offered a pale imitation of what had previously been available in person, leaving participants unfulfilled:

> *[P8, W1] 'I'm seeking connection and not getting that because it's not interactive. So, it's not quite filling the hole that I'm seeking it out to fill.'*
>
> *[P6, W1] 'I did try and do some of the Liverpool University concerts online, but I just could not, I do not know. I mean I watched them with my partner, but it just did not feel the same, slightly bizarre.'*

There was an indication as a result of these feelings that remote provisions should offer something that poses different benefits to in person events, as opposed to attempting to replicating in person events online.

3.3.2. Broadened horizons

However, there was a sense that participants had begun to reframe the way they thought about remote provisions throughout the pandemic. As restrictions eased and the return to in-person events became more feasible, many had started to view remote engagement opportunities as complementary to the in-person ones, especially where it was felt that remote opportunities had suitably considered methods to enhance online engagement. In particular, participants were drawn to the improved accessibility that came with many remote engagement opportunities:

> *[P3, W1] 'my mum has a long-term health condition and sometimes going into environments can make that worse. And so, actually, to be able to access a place from home allows us to share that in a way that we either would not be able to before or it would have consequences which would cause stress or upset.'*
>
> *[P11, W1] 'if I was worried from a COVID point of view, or if I was ill, or I was unfortunate enough to have a long-term illness or disability, I'm really grateful that things have been made available in different ways.'*

Additionally, participants acknowledged that engagement with remote provisions provided an increased sense of control over events. In this way, they were better able to schedule arts and cultural activities into their lives, as well as to connect with new communities and cultures:

> *[P3, W2] 'Suddenly, the world as it were, become more readily available. You know, or I got more used to the fact that I can look at people who dance in different parts of Europe or Africa or Asia or South America, you know, it's online and it's just brilliant.'*
>
> *[P8, W2] 'One of the things that we did as part of that was, we collaborated on Zoom with a similar singing group in New York.'*

As a result of this reframing of remote cultural engagement, there was a sense among participants of wanting both online and in-person opportunities to continue after the pandemic:

> *[P3, W1] 'I do not think online activities will replace them necessarily, because I think talking to friends and things like that, I think everybody misses coming together with that sort of community feeling. But I think it will improve, I think it will be like an addition to [in-person], which is probably going to have quite wide-reaching benefits.'*
>
> *[P5, W1] 'I can see the benefit of both in a way 'cos you think 'I've got that live stream I can watch it again, like having a DVD.' And then when they tour, or play, I'll still go and see them anyway 'cos that's what people are like with bands'*

Some participants particularly appreciated how arts providers were finding new ways to maximize available services and methods of connecting people to arts and culture from home. In this way, remote opportunities became an interesting and unique way to connect with arts and culture:

> *[P3, W1] 'So, it was our job to kind of act as investigators…we would use Google maps to sort of help unravel everything…we'd all be talking on Zoom and then there would be someone in the chat function from the company who were hosting this event saying 'I've got another clue for you.' …they had really thought about how that platform benefited your experience. It wasn't like, 'just use Zoom and forget you are on Zoom.' It was all integrated'.*
>
> *[P5, W1] 'on BBC radio four, where basically they wanted a different way of telling a story…they sent a postcard a day and each postcard had a bit of the story… you received several postcards, sent on different days over a two-week period. Then at the end of it you just literally read them, and they were significant to the story'*

As a result, there was a sense among participants that the value of remote engagement would remain beyond the COVID-19 pandemic if services continue to provide novel experiences. There was a sense that creative thinking was needed across society in order to explore how remote provisions might continue to offer experiences in addition to in person events, as opposed to seeking to replace them.

3.3.3. Returning to in-person events

While many participants had indicated an interest to continue with remote provision, all participants were keen to return to in-person events. This was largely influenced by a desire to return to 'normality':

> *[P7, W1] 'As soon as I can get out and do the things I used to do I will be and with other people'.*
>
> *[P9, W1] 'I am very much looking forward to getting back into that rhythm of accessing culture regularly and being part of a community, I cannot wait for that. It's getting me through.'*

However, participants were continuing to balance this desire for a return to life in person with the risks that COVID-19 posed in accessing in-person venues. Many participants felt that remote provisions would remain important during this transition period, despite a desire to re-engage in in-person events:

> *[P11, W1] 'there's going to be a quite long period, I think of adjustment, rebalancing, considering risk. Say in a few months' time if things started to reopen, would I want to go to them? Or would I still prefer online? I guess there's going to be a transition period.'*
>
> *[P2, W1] 'it's an art gallery so you are not really talking much at all to the other people, because you are going around looking at whatever you are looking at for yourself. But just the fact of other people being around, although they were all properly spaced, but you could see there were other people around.'*

A particular difficulty among participants during this transitional period was continued uncertainty; participants felt unable to plan ahead in regards to arts and cultural engagement, due to concerns that restrictions might be re-introduced:

> *[P5, W1] 'Well, it's frustrating the sort of stop-start motion to all our lives, but I understand the reason.'*
>
> *[P1, W2] 'when we were still in lockdown, the roadmap has just been released, so I did not plan anything in advance when that started to happen. It's always been just waiting until it has happened, and then waiting until everybody else would rush out and do stuff, and then see what I feel like doing.'*

While many participants had been planning to return to in-person events as soon as opportunities became available, the ongoing health risks of COVID-19 created an overall sense that participants wanted to see remote provisions continue. In particular, the data presented here highlighted the importance of hybrid participation options for in-person events as well as the inclusion of remote opportunities that sought to offer some new experience that drew on the online environment.

4. Discussion

4.1. Summary of findings

The current study aimed to explore the impact of the COVID-19 pandemic on arts and cultural engagement during periods of restrictions and initial easing on movement within the LCR. Wave 1 data were collected to explore the impact of the lockdown periods on involvement with arts and culture and any resulting benefits from engagement. Wave 2 data aimed to explore changes associated with the gradual easing on movement restrictions.

4.1.1. Arts and culture supporting mental wellbeing

Findings presented in the current study provide further evidence of the value of arts and cultural activities in supporting wellbeing (Coulton et al., 2015; Fancourt et al., 2019; Fancourt and Finn, 2019; Fancourt and Steptoe, 2019; Fancourt and Tymoszuk, 2019; Worsley et al., 2022). Specifically, the current data emphasized the value of local arts and culture within personal narratives and personal identities. This intrinsic value of arts and culture led some participants to feel an initial loss of self with the imposing of lockdown restrictions that negatively impacted wellbeing. However, among those who continued to engage with arts and culture through online means, there was a sense of resilience in the face of adversity that promoted wellbeing. This supports previous findings that arts and cultural engagement during the COVID-19 pandemic has provided a source of mental health support (Mak et al., 2021; Meyrick and Barnett, 2021; Bu et al., 2022; Worsley et al., 2022).

As previously demonstrated by Worsley et al. (2022), participants highlighted the importance of regular remote engagement throughout the lockdown periods in giving them something to look forward to, a break away from the difficulties created by the pandemic. In general, participants felt that arts and culture had always been an important break away from the mundane aspects of day-to-day life, becoming more important during times of adversity. The value demonstrated through remote access indicates that the continuation of remote provision may prove a useful means of engagement for those unable to engage in-person beyond the pandemic. In particular, remote engagement allowed some form of social engagement, making participants feel more connected. These findings somewhat contradict previous findings that in-person but not remote contact was important for reducing depression and loneliness (Green et al., 2021). While there was a general sense that in-person social contact boosted wellbeing in ways that could not be identically replicated remotely, remote contact still promoted wellbeing for many participants.

4.1.2. Comparing remote access to in-person engagement

The inability of remote engagement to completely replicate the enjoyment and associated benefits of in-person engagement was emphasized by participants. Specifically, online environments were unable to provide smaller but important social experiences around events and liminal spaces, such as the walk back from an event, which boost opportunities for personal reflection and social connecting. These results further develop findings that remote contact does not reduce loneliness in the same way as in-person engagement (Green et al., 2021). Together with findings on mental health and wellbeing support (see "Arts and culture supporting mental wellbeing"), the current study demonstrates that remote arts and cultural engagement can reduce feelings of loneliness but in a way that is perhaps not as socially enriching as in-person events. This left participants largely keen to return to in-person events to experience a sense of togetherness with artists and other attendees.

Furthermore, while remote engagement offered some benefits during the pandemic, many barriers to access were raised across participants. Specifically, online remote events were associated with screen fatigue and were often impeded by problems with internet connectivity. These barriers sometimes resulted in disengagement and raised concerns among the current sample for others in their communities who they felt were of lower social economic status and who may not have the same means and opportunities to access online events. Together with previous findings reporting reduced remote engagement among lower income families (Bu et al., 2022), this further highlights the need for remote activities to provide varying means of engagement that are accessible to all individuals within local communities.

4.1.3. Potential for hybrid models

Despite the limitations of online engagement, many participants were keen for remote opportunities to continue beyond the pandemic. Upon the initial easing of movement restrictions, participants tended to reframe their view of remote opportunities from a pale imitation of in-person events to something that could potentially offer added value: in addition to rather than instead of. However, current remote provisions were perceived as not reaching their full potential to offer complimentary experiences. This arose from limitations of current software and online environments, which had tended to encourage the replication of in-person ways of connecting rather than encouraging new and interesting ways to connect together with arts and culture. This highlights a need for new and innovative means of remote engagement that can add value to in-person opportunities as well as introducing new or adapted ways to connect online. Specifically, current methods of audience engagement and wider social connection were limited and often had to be initiated through social media rather than being easily integrated within services. Such adaptations and potential developments to online environments could potentially enhance the mental health and wellbeing benefits offered through remote engagement (Bu et al., 2022).

In the immediate future, it was felt that it will be important for remote opportunities to continue and to further develop. Although restrictions in the United Kingdom have since lifted entirely at the time of writing, the perceived risks of the COVID-19 virus meant that some participants felt safer engaging online, with others returning to some in-person events but finding value in the ability to take part online to reduce potential COVID-19 exposure. Together with prior findings (Mak et al., 2021; Meyrick and Barnett, 2021; Bu et al., 2022; Worsley et al., 2022), this highlights a need for arts and cultural activities to continue online even with the return of in-person opportunities in order to offer an alternative means of mental health and wellbeing support for those who are unable to engage in person. Furthermore, participants found that remote engagement increased their connectivity with other communities, while in-person events allowed them to connect with their local culture. In this way, a hybrid of in-person and remote arts and cultural activities holds the potential to enhance the social and wellbeing benefits of arts and cultural involvement (Coulton et al., 2015; Fancourt et al., 2019; Fancourt and Finn, 2019; Fancourt and Steptoe, 2019; Fancourt and Tymoszuk, 2019; Worsley et al., 2022).

4.2. Limitations and future research

The majority of participants included in the present study engaged with remote arts and cultural activities *via* online provisions. Therefore, the sample is not representative of individuals who have not had access to an internet connection during the COVID-19 pandemic. Therefore, it is important for future research to explore arts and cultural access throughout the pandemic among low socio-economic status households, particularly those who have had some level of reduced access to online resources for remote engagement. Similarly, the current study did not focus specifically on demographics who may face particular social disadvantages such as individuals from racialized minorities, individuals with pre-existing mental health conditions, young adults and women (Bu et al., 2022). This is particularly important due to the mental health risks faced by such individuals who are socially disadvantaged (Bu et al., 2022). Therefore, research which takes a particular focus on these groups is necessary to inform ways in which hybrid provisions can be adapted in order to remain inclusive, particularly among those in need of community wellbeing support. Furthermore, future research should explore differences in engagement among those who had been experiencing pre-existing mental health conditions due to the increased mental health risks faced by this group during the pandemic (Iob et al., 2020; Burton et al., 2021; Di Gessa et al., 2021; O'Connor et al., 2021; Wetherall et al., 2022).

5. Conclusion

In conclusion, the findings of the present study build upon previous research (Mak et al., 2021; Meyrick and Barnett, 2021; Bu et al., 2022; Worsley et al., 2022) to emphasize the value of arts and cultural engagement throughout the COVID-19 pandemic and particularly during times of national restriction. Furthermore, the current study provides further insight into the differences between remote and in-person engagement in resulting wellbeing (Bu et al., 2022). Here it was demonstrated that remote engagement provided important mental health support throughout the pandemic, but with limitations on feelings of social connectedness within online environments. Amidst continuing risks from the COVID-19 virus and feelings of uncertainty, this study highlights the importance of hybrid provisions. However, further research is needed to explore how in-person and remote engagement has continued to change with the full easing of restrictions on access.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by University of Liverpool Research Ethics Committee (reference: 7994). The patients/participants provided their written informed consent to participate in this study.

Author contributions

JB and EB conceived the study. MW and AA collected the qualitative data. MW and AA coded a subset of transcripts. MW identified emerging themes from Wave 1 data and produced preliminary findings which were presented at a partner meeting. MC analyzed the qualitative data to finalize the framework, in consultation with the research team. MC wrote the first draft of the manuscript. JB, EB, JW, AA, and MW read, commented on, and revised the manuscript providing important intellectual input. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.1011771/full#supplementary-material

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Effects of COVID-19 pandemic on mental health among frontline healthcare workers: A systematic review and meta-analysis

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Background: As some countries announced to remove Coronavirus Disease 2019 (COVID-19) border, it indicates that the COVID-19 may have entered its terminal stage. In this COVID-19 pandemic, the mental health of frontline healthcare workers (HCWs) experienced unprecedented challenges. However, the impact of the COVID-19 pandemic on mental health among frontline HCWs lacks a high-quality and long-term systematic review and meta-analysis.

Methods: We conducted a systematic review and meta-analysis according to PRISMA guidelines. The system searches EMBASE, MEDLINE, PsycINFO, Cochrane Library, ScienceNet, and ERIC. Analyze the mental health problems of frontline HCWs in different regions and periods, including insomnia, stress, anxiety and depression. This study was registered in PROSPERO under the number CRD42021253821.

Results: A total of 19 studies on the effects of COVID-19 pandemic on mental health among frontline HCWs were included in this study. The overall prevalence of insomnia was 42.9% (95% CI, 33.9–51.9%, $I^2 = 99.0\%$) extracted from data from 14 cross-sectional studies (n = 10 127), 1 cohort study (n = 4,804), and 1 randomized controlled trial (RCT; n = 482) in 10 countries. The overall prevalence of stress was 53.0% (95% CI, 41.1–64.9%, $I^2 = 78.3\%$) extracted from data from nine cross-sectional studies (n = 5,494) and 1 RCT study (n = 482) from eight countries. The overall prevalence of anxiety and depression was 43.0% (95% CI, 33.8–52.3%, $I^2 = 99.0\%$) and 44.6% (95% CI, 36.1–53.1%, $I^2 = 99.0\%$) extracted from data from 17 cross-sectional studies (n = 11,727), one cohort study (n = 4,804), and one RCT study (n = 482) from 12 countries. The prevalence of stress and depression was higher in 2020, while the prevalence of insomnia and anxiety was higher in 2021. The prevalence of mental health problems among physicians was higher than that of other frontline HCWs. The prevalence of mental health problems among frontline HCWs is higher in South America and lower in North America.

Conclusions: This systematic review and meta-analysis showed that the COVID-19 pandemic have significant effects on mental health among frontline HCWs. The overall prevalence of insomnia, stress, anxiety and depression

among frontline HCWs is high. Therefore, the health policy-makers should pay attention to and respond to the mental health problems of frontline HCWs in the context of public health emergencies.

Systematic review registration: https://www.crd.york.ac.uk/PROSPERO/.

KEYWORDS

mental health, frontline healthcare workers, COVID-19, systematic review, meta-analysis

Background

The Coronavirus Disease 2019 (COVID-19) pandemic has existed since January 2020 and has become a major global health crisis (Chu et al., 2020; Wu et al., 2020; Gottlieb et al., 2021). The mental health of frontline HCWs has encountered unprecedented challenges because of long-term and high load medical care, COVID-19 prevention, nucleic acid detection and vaccination (Wang W. et al., 2020; Dai et al., 2021; Skowronski and De Serres, 2021). Some studies shows that the prevalence of mental health disorders among frontline HCWs during the COVID-19 pandemic is very high, but the prevalence rates in different studies vary greatly (Wasserman et al., 2020; Lotta et al., 2021; Lumley et al., 2021). Insomnia among frontline HCWs varied across studies from 19.7 to 73.7% (Giardino et al., 2020; Wang L. Q. et al., 2020), those of stress varied from 26.8 to 83.1% (Alshekaili et al., 2020; Elkholy et al., 2021), those of anxiety varied from 14.2 to 77.3% (Wang L. Q. et al., 2020; Elkholy et al., 2021), and those of depression varied from 14.3 to 81.0% (Giardino et al., 2020; Lee et al., 2021). Consequently, there are systematic differences in most of what we know about the mental health risks and problems among frontline HCWs.

Although systematic differences in studies have been the subject of frequent inquiry, the differences may be more prominent under the special background of COVID-19 (Salehi et al., 2020). Particularly, the specialty of HCWs, online surveys, severity of COVID-19, or study regions may lead to substantial changes in the results (Böger et al., 2021). Studies also report conflicting findings about whether frontline HCWs' insomnia, stress, anxiety, and depression vary by sex, specialty, region, or other characteristics (Haravuori et al., 2020; Wang L. Q. et al., 2020). However, few studies have synthesized the effects of various factors on the results. Furthermore, the current studies on the effects of COVID-19 pandemic on mental health mainly focuses on the general population, students, or patients with COVID-19 (Kinder and Harvey, 2020; Salari et al., 2020; Deng et al., 2021). There is a lack of high-quality and long-term systematic review and meta-analysis of the effects of the COVID-19 pandemic on the mental health of frontline HCWs.

Although some rapid systematic reviews or meta-analysis during the outbreak of the pandemic also focused on the mental health of frontline HCWs, they lacked high-quality meta-analysis or did not cover the whole process of the COVID-19 pandemic, and could not obtain long-term, more professional evidence-based data (Pappa et al., 2020; Schneider et al., 2022). As some countries announced to remove COVID-19 border, it indicates that the COVID-19 may have entered its terminal stage. In order to better understand the effects of COVID-19 pandemic on the mental health among frontline HCWs in different periods and regions, we conducted a comprehensive systematic review and meta-analysis focused on evaluating the following questions: (1) What is the overall estimated prevalence of insomnia, stress, anxiety, and depression among frontline HCWs during the COVID-19 pandemic? (2) What are the differences of mental health problems among frontline HCWs in different periods and regions during COVID-19? This unified framework can highlight the mental health problems of frontline HCWs in public health emergencies, and provide health policy-makers with strategic information based on evidence-based medicine.

Methods

Search strategy and selection criteria

All studies published between January 1, 2019, and December 31, 2021, that reported on the mental health of frontline HCWs affected by the COVID-19 pandemic, such as insomnia, stress, anxiety, and depression, were identified using EMBASE, MEDLINE, PsycINFO, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Web of Science, and ERIC. Government databases websites, conference proceedings, and medical society websites were also searched (independently performed by J.T. and W.Q.L.). The investigators screened the reference lists of identified articles using the approaches recommended by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA; Moher et al., 2009). Computer-based searches used terms related to the mental health of frontline HCWs during the COVID-19 pandemic (see Table 1). Studies which published in peer-reviewed journals that reported data on frontline HCWs and

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TABLE 1 Search strategy.

Insomnia	Stress	Anxiety	Depression	Frontline healthcare workers	COVID-19	Others
1. Insomnia 2. Sleep disorders 3. Sleep problems 4. OR /# 1 –# 3	5. Stress 6. Stress response 7. Stress disorder 8. Acute stress disorder 9. Traumatic stress disorder 10. OR /#5 –#9	11. Anxiety 12. Anxiety disorder 13. Anxious distress 14. OR / #11 –#13	15. Depress 16. Depressed 17. Depression 18. Depressive disorder 19. Major depression 20. Major depressive disorder 21. MDD 22. OR / #15 –#21	23. Doctor 24. Physician 25. Nurse 26. Health Personnel 27. Health care Provider 28. Health worker 29. Healthcare provider 30. Healthcare worker 31. Frontline healthcare workers 32. Healthcare professional 33. Medical staff 34. Medical worker 35. OR / #23 –#34	36. SARS-CoV-2 37. Infection 38. COVID-19 virus disease 39. 2019 novel coronavirus infection 40. 2019-nCoV infection 41. Coronavirus disease 2019 42. 2019-nCoV disease 43. COVID-19 44. OR / #36 –#43	45. Mental health 46. Psychological problems 47. Psychological disorder 48. Prevalence 49. Incidence 50. OR / #45 –#49
Combined search	#4 OR #10 OR #14 OR #22 AND #35 AND #44 AND #50					

used a validated method to assess insomnia, stress, anxiety, and depression were also included.

Inclusion criteria must be that the study population is frontline healthcare workers in COVID-19 affected countries or areas. Only high-quality studies evaluating the prevalence rates of specific mental health problems such as insomnia, stress, anxiety and depression are eligible for inclusion. However, mental health problems such as post-traumatic stress disorder, psychotic disorder and obsessive-compulsive disorder were excluded because of the limited number of high-quality studies. Additionally, broad terms such as "psychological distress and psychological abnormality" were excluded as they can be difficult to quantify.

Data extraction

The investigators (J.Z. and W.Y.) independently extracted the following information from each article using a standardized form: study design, country, survey period, specialty, sample size, average age, diagnostic methods, screening instrument outcome, and reported prevalence of insomnia, stress, anxiety, and depression. To eliminate studies involving the same population or multiple identical publications. The quality of non-randomized studies was assessed by the modified version of the Newcastle-Ottawa Scale (NOS; Stang, 2010). This scale assesses the quality of the study through five dimensions: sample representativeness, sample size, comparability between respondents and non-respondents, ascertainment of insomnia, stress, anxiety, and depression, and statistical quality (Supplementary Table 1). Studies were judged to be at low risk of bias (≥3 points) or high risk of bias (<3 points). The third reviewer (N.Z.) adjudicates all discrepancies.

Data analysis

Prevalence estimates of insomnia, stress, anxiety, and depression were calculated by pooling the study-specific estimates using random-effects meta-analysis. It accounted for between study heterogeneity. The 95% confidence intervals of the studies were calculated by the Clopper Pearson method, which considered the asymmetry. Study heterogeneity was assessed by standard χ^2-tests and I^2 statistics. Heterogeneity values ≥75% indicated considerable heterogeneity. The characteristics of different study levels were grouped, and hierarchical meta-analysis and meta-regression were carried out (van Houwelingen et al., 2002). The impact of individual studies on the estimation of overall prevalence was explored by sensitivity analysis. Bias secondary to study effects was studied by funnel diagram and Egger's test. All analysis were performed using R Foundation for Statistical Computing (version 4.1.1; Computing, 2022). The statistical test of all studies was two-sided and used a significance threshold of $P < 0.05$. This study is registered on PROSPERO, number CRD42021253821.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

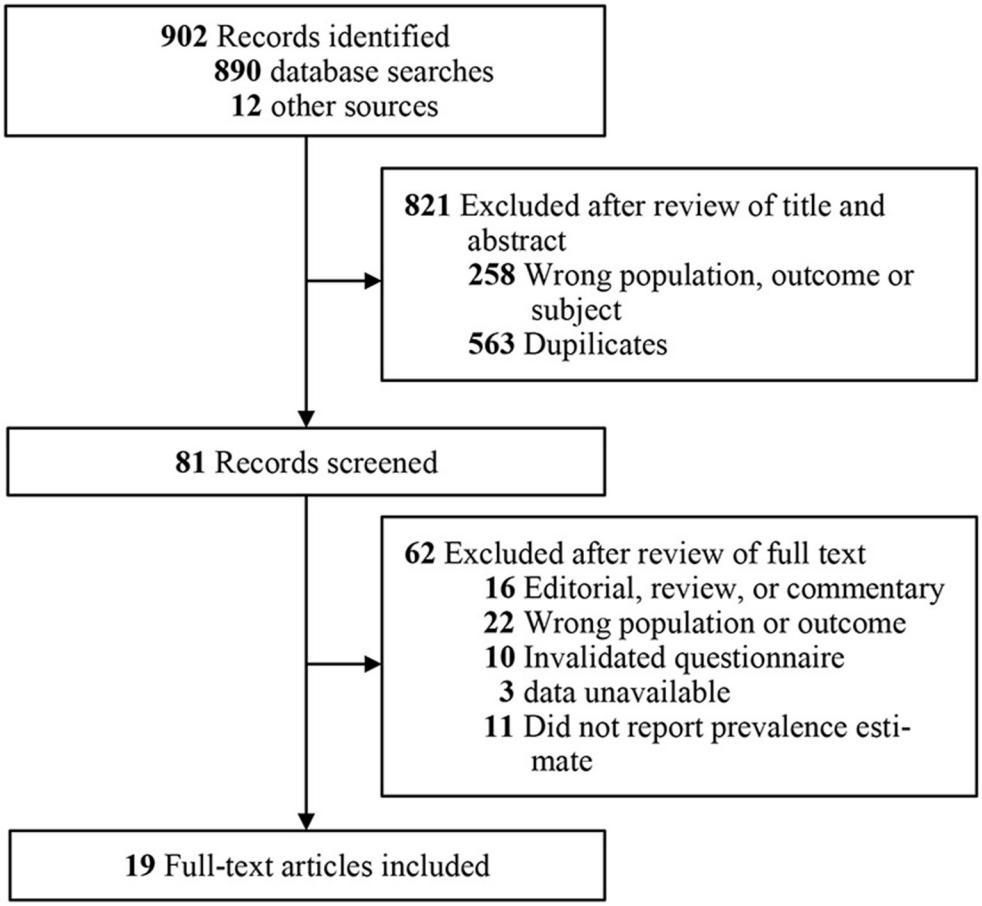

FIGURE 1
Flow diagram for identifying studies and selection.

Patient and public involvement

The development of the research question was informed by the mental health status among frontline HCWs during the COVID-19 pandemic. Patients were not advisers in this study, nor were they involved in the design, recruitment or conduct of the study. Results of this study will be made publicly available through open-access publication where study participants may access them.

Results

Study characteristics

Seventeen cross-sectional studies (n = 11,727), one cohort study (n = 4,804), and one RCT study (n = 482) involving 17,013 individuals were included in this study (Figure 1). The study involved 12 countries, including one in North America, one in South America, five in Europe, four in Asia, and one in Africa. Sixteen studies recruited participants from first frontline physicians and nurses, while three recruited participants exclusively from physicians. There were an average of 895 participants per study, ranging from 98 to 4,804. Thirteen studies assessed insomnia using the Insomnia Severity Index (ISI), 2 used the Pittsburgh Sleep Quality Index (PSQI), and one used the Sleep Condition Indicator (SCI). Five studies assessed stress using the Depression, Anxiety and Stress Scale (DASS-21), two used the 10-item Perceived Stress Scale (PSS-10), one used the 22-item Impact of Event Scale–Revised (IES-R), one used the Effort Reward Imbalance (ERI), and one used the 4-item Primary Care PTSD screen (PC-PTSD). Nine studies assessed anxiety using the Generalized Anxiety Disorder 7-item (GAD-7), five used the Depression, Anxiety and Stress Scale (DASS-21), two used the Goldberg depression and anxiety scale (GADS), one used the Effort Reward Imbalance (ERI). Eight studies

assessed for depression using the Patient Health Questionnaire-9 (PHQ-9), five used the Depression, Anxiety and Stress Scale (DASS-21), two used the Goldberg Depression and Anxiety Scale (GADS), two used the 2-item Patient Health Questionnaire (PHQ-2), one used the Hospital Anxiety and Depression Scale (HADS), and 1 used the Patient Health Questionnaire-8 (PHQ-8). All studies were evaluated by the NOS quality assessment criteria, two studies received five points, six received four points, five received three points, and six received two points (Table 2, Supplementary Table 2).

Prevalence of insomnia or insomnia symptoms

A meta-analysis of insomnia or insomnia symptoms among frontline HCWs during the COVID-19 pandemic reported by 16 studies showed a summary prevalence of 42.9% (7,068/15 413 individuals, 95% CI, 33.9–51.9%). There was significant evidence of between study heterogeneity (Q = 2,106.2, $P < 0.001$, $\tau^2 = 0.03$, $I^2 = 99.0\%$). A sensitivity analysis showed that no individual study had an impact on the overall prevalence estimate of more than 3% (Supplementary Table 3). The estimated values were stratified by screening instrument and outcome definition. Summary prevalence estimates ranged from 43.5% of the ISI (6,121/13,893 individuals, 95% CI, 35.4–51.6%, Q = 1,149.3, $\tau^2 = 0.02$, $I^2 = 99.0\%$) and 49.3% of the PSQI (914/1,365 individuals, 95% CI, −8.6–107.2%, $Q = 185.1$, $\tau^2 = 0.17$, $I^2 = 100.0\%$; Table 3).

According to study-level characteristics, there were statistically significant differences in prevalence estimates between multi-center studies [6,504/13,655 (49.0%; 95% CI, 37.7–60.4%)] and non-multi-center studies [564/1,758 (32.1%; 95% CI, 23.6–40.7%)] ($Q = 0.02$, $P = 0.02$). Studies were further stratified by continent or region. Studies performed in the South America [780/1,059 (73.7%; 95% CI, 70.9–76.4%)] has the highest prevalence, which is significantly different from those performed on other continents ($Q = 47.1$, $P < 0.001$). When studies were stratified by study period and individual specialty, prevalence estimates were not statistically significant differences ($P > 0.05$; Table 7A). By NOS criteria, studies with more thorough descriptive statistics reporting [2,968/5,183; 54.2% (95% CI, 37.5–70.9%)] had higher prevalence estimates than those with less comprehensive descriptive statistics reporting [4,100/10,230; 34.2% (95% CI, 27.0–41.3%); $Q = 4.7$, $P = 0.03$]. The estimated prevalence was not significantly different when studies were stratified by sample representativeness, size, comparability between respondents and non-respondents, ascertainment of insomnia, or total NOS score ($P > 0.05$; Table 8A; details of the NOS appear in Supplementary Table 1).

Prevalence of stress or stress symptoms

There were 10 studies on the prevalence of stress or stress symptoms among frontline HCWs during the COVID-19 pandemic. The meta-analysis pooling of the prevalence estimates was 53.0% (3,284/5,976 individuals, 95% CI, 41.1–64.9%), with significant evidence of between study heterogeneity ($Q = 897.7$, $P < 0.001$, $\tau^2 = 0.04$, $I^2 = 99.0\%$). A sensitivity analysis showed that the impact of individual studies on the estimation of the overall prevalence estimate was <6% (Supplementary Table 4). The estimated values were stratified according to screening instrument and outcome definition, showing that summary prevalence estimates ranged from 78.3% for the PSS-10 (6,121/13,893 individuals, 95% CI, 67.5–89.0%, $Q = 5.8$, $\tau^2 = 0.01$, $I^2 = 83.0\%$) and 41.1% for the DASS-21 (1,453/3,298 individuals, 95% CI, 28.6–53.7%, $Q = 234.6$, $\tau^2 = 0.02$, $I^2 = 98.0\%$; Table 4).

According to the study-level characteristics of the study period, study design, individuals‘ specialty, and continent or region, prevalence estimates were not significantly different ($P > 0.05$; Table 7B). Prevalence estimates of studies with more sample representative reporting [3,207/5,869; 50.9% (95% CI, 38.3–63.6%)] were lower than those with less sample representative reporting [77/107; 72.0% (95% CI, 63.6–80.4%); $Q = 7.4$, $P = 0.007$] when evaluated by NOS criteria. There was a significant difference ($Q = 4.3$, $P = 0.04$) between the prevalence estimates of studies with lower valid of ascertainment [261/647 (40.3%; 95% CI, 36.6–44.0%)] and more valid of ascertainment [3,023/5,329 (54.4%; 95% CI, 41.6–67.2%)]. The prevalence estimates were not significantly different when studies were stratified by comparability between respondent and non-respondent, sample size, descriptive statistics reporting, or total NOS score ($P > 0.05$; Table 8B; details of the NOS appear in Supplementary Table 1).

Prevalence of anxiety or anxiety symptoms

The meta-analysis of anxiety or anxiety symptoms among frontline HCWs during the COVID-19 pandemic reported by the 19 studies showed a summary prevalence of 43.0% (6,509/17,013 individuals, 95% CI, 33.8–52.3%), and there was significant heterogeneity between studies (Q = 3,019.0, $P < 0.001$, $\tau^2 = 0.04$, $I^2 = 99.0\%$). A sensitivity analysis showed that the impact of individual studies on the overall prevalence estimate was <7% (Supplementary Table 5). According to stratification by instrument and outcome definition, summary prevalence estimates ranged from 44.0% for the GAD-7 (2,644/6,195 individuals, 95% CI, 31.6–56.5%, $Q = 818.0$, $\tau^2 = 0.04$, $I^2 = 99.0\%$), 43.2% for the DASS-21 (1,373/3,298 individuals, 95% CI, 34.1–51.5%, Q =98.3, $\tau^2 = 0.01$,

TABLE 2 Selected characteristics of the 19 studies included in this systematic review and meta-analysis.

References	Country	Survey period	Specialty	Number of participants	Age, *y*	Men, No. (%)	Study design (survey methods)	Diagnostic methods	Outcome definition	NOS
Giardino et al. (2020)	Argentina	June 5, 2020 to June 25, 2020	Physicians, physicians in trainee, psychologists	1,059	Mean (SD), 41.7 (10.7)	287 (27.1)	Multicenter cross-sectional study (online survey)	ISI GADS	≥8 A ≥ 5 D ≥ 2	2
Wang L. Q. et al. (2020)	China	February 26, 2020 to March 3, 2020	Physicians, nurses	274	NR	62 (22.6)	Cross-sectional study (online survey)	PSQI PHQ-9 GAD-7	≥6 ≥5 ≥5	4
Alshekaili et al. (2020)	Oman	April 8, 2020 to April 17,2020	Physicians, nurses, allied health	574	Mean (SD), 36.3 (6.5)	228 (20.0)	Multicenter cross-sectional online study (online survey)	ISI DASS	≥8 S ≥ 16 A ≥ 8 D ≥ 10	3
Elkholy et al. (2021)	Egypt	April 2020 to May 2020	Physicians, nurses, non-specialized nurse	502	No. (%) ≤30 y: 232 (46.2)	251 (50.0)	Multicenter cross-sectional study (online survey)	ISI PHQ-9 GAD-7 PSS-10	≥8 ≥5 ≥5 ≥9	4
Lee et al. (2021)	Korean	June 22 2020 to July 8, 2020	Physicians, nurses	406	No. (%) <40 y: 225 (55.4)	115 (28.3)	Cross-sectional study (online survey)	ISI PHQ-9 GAD-7	≥8 ≥10 ≥5	4
Haravuori et al. (2020)	Finland	June 4, 2020 to June 26, 2020	Physicians, nurses, psychologists	4,804	Mean (SD), 44.2 (11.3)	538 (11.4)	Prospective multicenter cohort study (online survey)	ISI PHQ-2 OASIS	≥8 ≥3 ≥8	2
Liu et al. (2020)	China	March 7, 2020 to March 17, 2020	Obstetrician, midwive	2,126	NR	49 (2.3)	Multicenter cross-sectional study (online survey)	ISI PHQ-9 GAD-7	≥8 ≥5 ≥5	2
Almater et al. (2020)	Saudi Arabia	28 March 2020 to 4 April 2020	Ophthalmologists	107	Mean (SD), 32.9 (9.6)	60 (56.1)	Cross-sectional study (online survey)	ISI PHQ-9 GAD-7 PSS-10	≥8 ≥5 ≥5 ≥9	2
Cui et al. (2020)	China	February 1, 2020 to February 19, 2020	Female nurses	334	No. (%) ≤30 y: 202 (54.0)	NR	Cross-sectional online study (online survey)	ISI PHQ-9 GAD-7	≥8 ≥5 ≥5	3
Lai et al. (2020)	China	January 29, 2020 to February 3, 2020	Physicians, nurses	1,257	No. (%) ≤30 y: 605 (48.1)	293 (23.3)	Multicenter cross-sectional study (online survey)	ISI PHQ-9 GAD-7 IES-R	≥8 ≥5 ≥5 ≥9	5
Magnavita et al. (2020a)	Italy	April 27, 2020 to May 27, 2020	Anesthetists	155	No. (%) ≤35 y: 118 (76.7)	74 (47.8)	Cross-sectional study (online survey)	SCI ERI GADS	≥16 ≥2 A ≥ 5 D ≥ 2	2

(Continued)

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TABLE 2 (Continued)

References	Country	Survey period	Specialty	Number of participants	Age, *y*	Men, No. (%)	Study design (survey methods)	Diagnostic methods	Outcome definition	NOS
Shechter et al. (2020)	United States	April 9, 2020 to Apr 24, 2020	Physicians, residents/fellows, nurses	657	No. (%) ≤35 y: 347 (76.7)	143 (19.9)	Multicenter cross-sectional study (online survey)	PHQ-2 GAD-2 PC-PTSD	≥3 ≥3 ≥3	3
Tiete et al. (2020)	Belgium	April 17 2020 to May 25, 2020	Physicians, nurses	647	No. (%) ≤30 y: 149 (23.0)	140 (21.6)	Multicenter cross-sectional study (online survey)	ISI DASS-21	≥8 S ≥ 16 A ≥ 8 D ≥ 10	3
Youssef et al. (2020)	Egypt	April 1, 2020 to April 15, 2020	Physicians, nurses	540	Mean (SD), 37.3 (9.2)	294 (94.4)	Multicenter cross-sectional study (online survey)	ISI DASS-21	≥8 S ≥ 16 A ≥ 8 D ≥ 10	5
Azoulay et al. (2021)	France	October 30, 2020 to December 1, 2020	Physicians, nurses	845	NR	274 (32.4)	Multicenter cross-sectional study (online survey)	HADS	A ≥ 8 D ≥ 8	4
Di Mattei et al. (2021)	Italy	May 9, 2020 to July 13, 2020	Physicians, nurses, psychologists, healthcare assistants	1,055	Mean (SD), 44.7 (11.3)	256 (24.3)	Multicenter cross-sectional study (online survey)	ISI DASS-21	≥8 S ≥ 16 A ≥ 8 D ≥ 10	3
Fiol-DeRoque et al. (2021)	Spain	May 14, 2020 to July 25, 2020	Physicians, nurses, nurse assistants	482	Mean (SD), 41.3 (10.4)	81 (16.8)	RCT (Online and mobile phone survey)	ISI DASS-21	≥8 S ≥ 16 A ≥ 8 D ≥ 10	4
Guo et al. (2021)	China	May 15, 2020 to May 31, 2020	Physicians, nurses	1,091	No. (%) ≤45 y: 888 (81.4)	356 (32.6)	Multicenter cross-sectional study (online survey)	PSQI PHQ-9 GAD-7	≥6 ≥5 ≥5	4
Wright et al. (2021)	United States	April 1, 2020 to May 7, 2020	Physicians, nurses	98	Mean (SD), 42.9 (11.0)	NR	Cross-sectional study (online survey)	PHQ-8 GAD-7	≥10 ≥5	2

A, Anxiety; D, Depression; DASS-21, The Depression, Anxiety and Stress Scale; ERI, Effort Reward Imbalance; GAD-7, Generalized Anxiety Disorder 7-item; GAD-2, 2-item Generalized Anxiety Disorder Scale; GADS, Goldberg depression and anxiety scale; HADS, Hospital Anxiety and Depression Scale; S, Stress; ISI, The seven-item Insomnia Severity Index; IES-R, 22-item Impact of Event Scale–Revised; NOS, Newcastle-Ottawa Score; OASIS, Overall Anxiety Severity and Impairment Scale; PC-PTSD, 4-item Primary Care PTSD screen; PHQ-9, Patient Health Questionnaire-9; PHQ-2, 2-item Patient Health Questionnaire; PSS-10, 10-item Perceived Stress Scale; PSQI, Pittsburgh Sleep Quality Index; NR, not reported; S, Stress; SCI, Sleep Condition Indicator.

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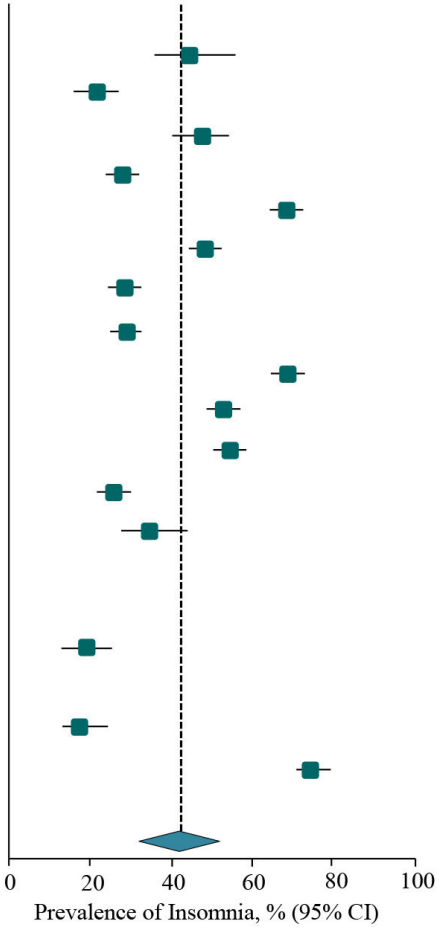
TABLE 3 Meta-analysis of the prevalence of insomnia or insomnia symptoms among frontline HCWs during the COVID-19 pandemic.

Source	No. insomnia	Total No.	SE	Prevalence, % (95% CI)	Weight (%)
Insomnia Severity Index score ≥8					
Almater et al. (2020)	48	107	0.048	44.9 (35.5–54.3)	5.9
Alshekaili et al. (2020)	120	574	0.017	20.9 (17.6–24.2)	6.3
Cui et al. (2020)	154	334	0.027	46.1 (40.8–51.4)	6.2
Elkholy et al. (2021)	154	502	0.021	30.7 (26.6–34.8)	6.3
Giardino et al. (2020)	780	1,059	0.014	73.7 (70.9–76.4)	6.3
Haravuori et al. (2020)	2,157	4,804	0.007	44.9 (43.5–46.3)	6.3
Lai et al. (2020)	427	1,257	0.013	34.0 (31.5–36.6)	6.3
Liu et al. (2020)	729	2,126	0.010	34.3 (32.3–36.3)	6.3
Tiete et al. (2020)	445	647	0.018	68.8 (65.3–72.3)	6.3
Youssef et al. (2020)	280	540	0.022	51.9 (47.6–56.2)	6.3
Di Mattei et al. (2021)	552	1,055	0.015	52.3 (49.4–55.2)	6.3
Fiol-DeRoque et al. (2021)	128	482	0.020	26.6 (22.7–30.5)	6.3
Lee et al. (2021)	147	406	0.024	36.2 (31.5–40.9)	6.2
Summary prevalence $I^2 = 99.0\%$, $\tau^2 = 0.02$, $P < 0.001$	6,121	13,893	0.004	43.5 (35.4–51.6)	
Sleep Condition Indicator score ≥16					
Magnavita et al. (2020a)	33	155	0.027	21.3 (14.8–27.8)	6.1
Pittsburgh Sleep Quality Index score ≥6					
Wang L. Q. et al. (2020)	54	274	0.024	19.7 (15.0–24.4)	6.2
Guo et al. (2021)	860	1,091	0.012	78.8 (76.5–81.2)	6.3
Summary prevalence $I^2 = 100.0\%$, $\tau^2 = 0.17$, $P < 0.001$	914	1,365	0.013	49.3 (−8.6–107.2)	
Pooled summary estimate $I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$	7,068	15,413	0.004	42.9 (33.9–51.9)	100.0



Studies are stratified by screening modality. The vertical dashed lines indicate the pooled summary estimate (95% CI) for all studies and horizontal lines indicate 95% confidence intervals of the estimate.

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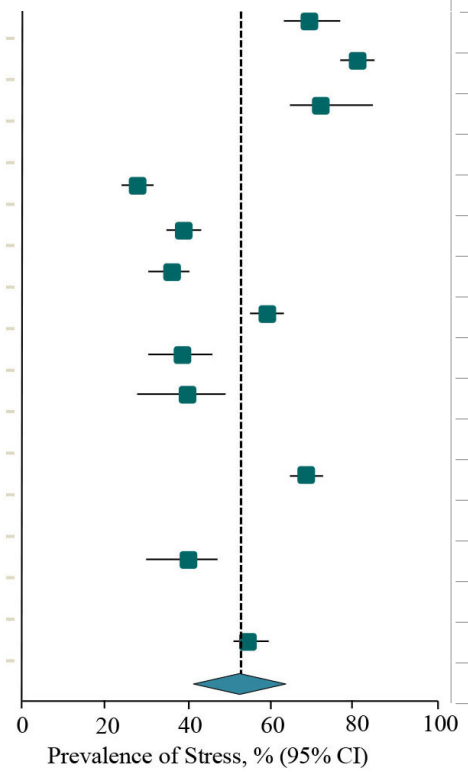
TABLE 4 Meta-analysis of the prevalence of stress or stress symptoms among frontline HCWs during the COVID-19 pandemic.

Source	No. stress	Total no.	SE	Prevalence (95% CI)	Weight (%)
10-item Perceived Stress Scale ≥ 9					
Almater et al. (2020)	77	107	0.043	72.0 (63.6–80.4)	9.7
Elkholy et al. (2021)	417	502	0.017	83.1 (79.8–86.4)	10.1
Summary prevalence $I^2 = 83.0\%$, $\tau^2 = 0.01$, $P = 0.02$	499	609	0.016	78.3 (67.5–89.0)	
The Depression, Anxiety and Stress Scale ≥ 16					
Alshekaili et al. (2020)	154	574	0.018	26.8 (23.3–30.3)	10.1
Tiete et al. (2020)	261	647	0.019	40.3 (36.6–44.0)	10.1
Youssef et al. (2020)	201	540	0.021	37.2 (33.1–41.3)	10.0
Di Mattei et al. (2021)	643	1,055	0.015	60.9 (57.9–63.8)	10.1
Fiol-DeRoque et al. (2021)	194	482	0.022	40.2 (35.9–44.5)	10.0
Summary prevalence $I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.00001$	1,453	3,298	0.009	41.1 (28.6–53.7)	
22-item Impact of Event Scale-Revised ≥ 9					
Lai et al. (2020)	899	1,257	0.013	71.5 (68.9–74.1)	10.1
Effort Reward Imbalance ≥2					
Magnavita et al. (2020a)	64	155	0.040	41.3 (33.5–49.1)	9.7
4-item Primary Care PTSD screen ≥ 3					
Shechter et al. (2020)	374	657	0.019	56.9 (53.2–60.6)	10.1
Pooled summary estimate $I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.00001$	3,284	5,976	0.006	53.0 (41.1–64.9)	100.0



Studies are stratified by screening modality. The vertical dashed lines indicate the pooled summary estimate (95% CI) for all studies and horizontal lines indicate 95% confidence intervals of the estimate.

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$I^2 = 96.0\%$), and 46.4% for the GADS (835/1,214 individuals, 95% CI, −12.8–105.6%, $Q = 341.3$, $\tau^2 = 0.18$, $I^2 = 100.0\%$; Table 5).

According to study-level characteristics, the prevalence of studies performed in South America [810/1,059 (76.5%; 95% CI, 73.9–79.1%)] was higher than that on other continents, and the difference was statistically significant ($Q = 152.9$, $P < 0.001$). When studies were stratified by study design, period, and individuals specialty, the prevalence estimates of anxiety were not significantly different ($P > 0.05$; Table 7C). There were no statistically significant differences in prevalence estimates of six-dimensional stratification when evaluated by NOS criteria ($P > 0.05$; Table 8C; details of the NOS appear in Supplementary Table 1).

Prevalence of depression or depressive symptoms

A meta-analysis of depression or depressive symptoms among frontline HCWs during the COVID-19 pandemic reported by the 19 studies yielded a summary prevalence of 44.6% (7,452/17,013 individuals, 95% CI, 36.1–53.1%), with significant difference between study heterogeneity ($Q = 2{,}410.8$, $P < 0.001$, $\tau^2 = 0.04$, $I^2 = 99.0\%$). Sensitivity analysis suggested that no individual study had an impact on the overall prevalence estimate of more than 5% (Supplementary Table 6). According to stratification by instrument and outcome definition, prevalence estimates ranged from 46.3% for the PHQ-9 (2,896/6,097 individuals, 95% CI, 32.0–60.5%, $Q = 975.6$, $\tau^2 = 0.04$, $I^2 = 99.0\%$), 45.8% for the DASS-21 (1,485/3,298 individuals, 95% CI, 37.0–54.5%, $Q = 105.5$, $\tau^2 = 0.01$, $I^2 = 96.0\%$), 55.5% for the GADS (904/1,214 individuals, 95% CI, 5.2–105.7%, $Q = 173.9$, $\tau^2 = 0.13$, $I^2 = 99.0\%$), and 39.8% for the PHQ-2 (1,849/5,461 individuals, 95% CI, 24.1–55.5%, $Q = 62.4$, $\tau^2 = 0.01$, $I^2 = 98.0\%$; Table 6).

The estimated values were stratified according to study-level characteristics. The prevalence estimates between multi-center studies [5,286/10,353 (52.6%; 95% CI, 42.7–62.6%)] and non-multi-center studies [2,141/6,660 (33.3%; 95% CI, 23.7–42.9%); $Q = 7.5$, $P = 0.006$] were statistically significance. Studies were further stratified by continent or region. Studies performed in the South America [858/1,059 (81.0%; 95% CI, 78.7–83.4%)] had the highest prevalence, which was significantly different from those performed on other continents ($Q = 187.8$, $P < 0.001$). The prevalence estimates were not significantly different when studies were stratified by study period and individual specialty ($P > 0.05$; Table 7D). When assessed by NOS criteria, studies with more thorough descriptive statistics reporting [3,005/5,183; 56.5% (95% CI, 45.3–67.7%)] had higher prevalence than those with less thorough descriptive statistics reporting [4,422/11,830; 37.7% (95% CI, 28.9–46.5%); $Q = 6.7$, $P = 0.01$]. There were no statistically significant differences in prevalence estimates between studies stratified by sample representativeness, sample size, comparability between respondents and non-respondents, ascertainment of depression, or total NOS score ($P > 0.05$; Table 8; details of the NOS appear in Supplementary Table 1).

Assessment of publication bias

Visual examination of the funnel plot reporting on insomnia, stress, anxiety, and depression revealed minimal asymmetry (Supplementary Figures 1–4), suggesting that there was no significant publication bias ($P = 0.75$; $P = 0.69$; $P = 0.16$; $P = 0.51$ using the Egger test).

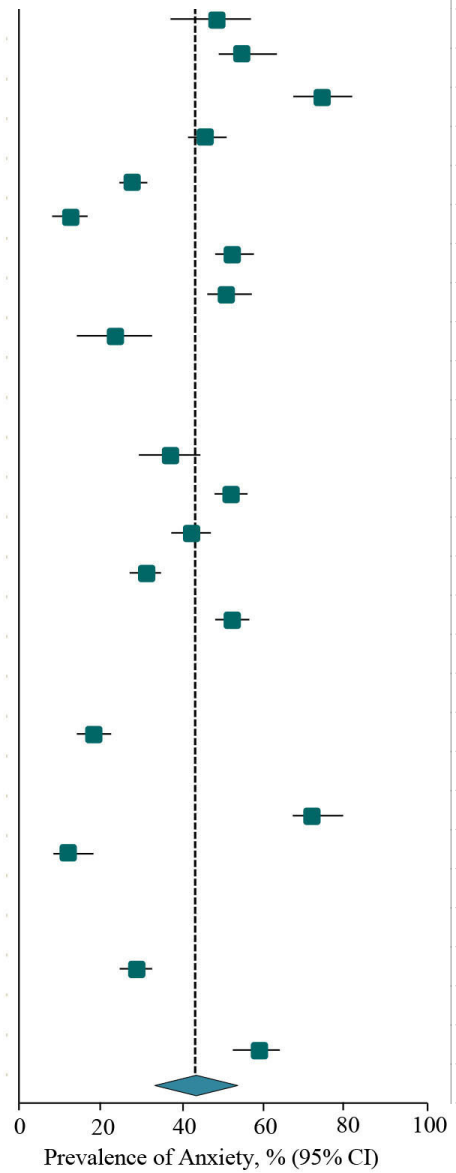
Discussion

The systematic review and meta-analysis of 19 studies involving 17,013 frontline HCWs in 12 countries during the COVID-19 pandemic demonstrated that 42.9% (range, 33.8–52.3%) and 53.0% (range, 41.1–64.9%) of workers reported insomnia and stress, and 43.0% (range, 33.8–52.3%) and 44.6% (range, 36.1–53.1%) screened positive for anxiety and depression, respectively. This data is significantly higher than the prevalence of anxiety (31.9%), depression (33.7%), and stress (29.6%) among general population population during the COVID-19 pandemic (Salari et al., 2020), and is similar to the prevalence of depression (45.0%), anxiety (47%), and insomnia (34%) among patients with COVID-19 (Deng et al., 2021). Compared with the small pandemic of SARS in 2002 and MARS in 2012, COVID-19 has a greater psychological impact on HCWs (Boden et al., 2021; Magnavita et al., 2021). This is closely related to the unknown characteristics of COVID-19, the high risk of exposure to infection, and multiple work pressures. However, Magnavita et al. (2020b) pointed out that the frequency of anxiety and depression among HCWs during the early stage of the COVID-19 pandemic was not higher than the commonly recorded during periodic checks in the years preceding the epidemic, which may be related to the severity of the epidemic in the region or the type of work involving front-line or non-front-line workers. These findings are concerning given that the development of mental health among HCWs has been linked to an increased long-term risk of future mental health diseases.

It is important to note that all participants were assessed through online self-report inventories rather than the gold-standard diagnostic clinical interviews. The sensitivity and specificity of these instruments for estimating symptoms of insomnia, stress, anxiety, and depression vary substantially (Supplementary Table 7). In the evaluation of insomnia and stress, the sensitivity of the ISI (Morin et al., 2011; 99%,

TABLE 5 Meta-analysis of the prevalence of anxiety or anxiety symptoms among frontline HCWs during the COVID-19 pandemic.

Source	No. anxiety	Total no.	SE	Prevalence, % (95% CI)	Weight (%)
Generalized Anxiety Disorder 7-item ≥ 5					
Almater et al. (2020)	50	107	0.048	46.7 (37.3–56.1)	5.1
Cui et al. (2020)	186	334	0.027	55.7 (50.4–60.9)	5.2
Elkholy et al. (2021)	388	502	0.019	77.3 (73.6–81.0)	5.3
Lai et al. (2020)	560	1,257	0.014	44.6 (41.9–47.3)	5.3
Liu et al. (2020)	609	2,126	0.010	28.6 (26.6–30.6)	5.3
Wang L. Q. et al. (2020)	39	274	0.021	14.2 (10.1–18.3)	5.3
Guo et al. (2021)	578	1,091	0.015	53.0 (50.1–55.9)	5.3
Lee et al. (2021)	211	406	0.025	52.0 (47.1–56.9)	5.3
Wright et al. (2021)	23	98	0.043	23.5 (15.1–31.9)	5.1
Summary prevalence $I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.00001$	2,644	6,195	0.006	44.0 (31.6–56.5)	
The Depression, Anxiety and Stress Scale ≥ 8					
Alshekaili et al. (2020)	217	574	0.020	37.8 (33.9–41.7)	5.3
Tiete et al. (2020)	338	647	0.020	52.2 (48.3–56.1)	5.3
Youssef et al. (2020)	230	540	0.021	42.6 (38.5–46.7)	5.3
Di Mattei et al. (2021)	338	1,055	0.014	32.0 (29.3–34.7)	5.3
Fiol-DeRoque et al. (2021)	250	482	0.023	51.9 (47.4–56.4)	5.3
Summary prevalence $I^2 = 96.0\%$, $\tau^2 = 0.01$, $P < 0.00001$	1,373	3,298	0.009	43.2 (34.1–51.5)	
OASIS ≥ 8					
Haravuori et al. (2020)	934	4,804	0.006	19.4 (18.2–20.6)	5.3
Goldberg Depression and Anxiety Scale ≥ 5					
Giardino et al. (2020)	810	1,059	0.013	76.5 (73.9–79.1)	5.3
Magnavita et al. (2020a)	25	155	0.030	16.1 (10.2–21.9)	5.2
Summary prevalence $I^2 = 100.0\%$, $\tau^2 = 0.18$, $P < 0.00001$	835	1,214	0.013	46.4 (−12.8–105.6)	
2-item Generalized Anxiety Disorder Scale ≥ 3					
Shechter et al. (2020)	216	657	0.018	32.9 (29.4–36.4)	5.3
Hospital Anxiety and Depression Scale ≥ 8					
Azoulay et al. (2021)	507	845,845	0.017	60.0 (56.7–63.3)	5.3
Pooled summary estimate $I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.00001$	6,509	17,013	0.004	43.0 (33.8–52.3)	100.0



Studies are stratified by screening modality. The vertical dashed lines indicate the pooled summary estimate (95% CI) for all studies and horizontal lines indicate 95% confidence intervals of the estimate.

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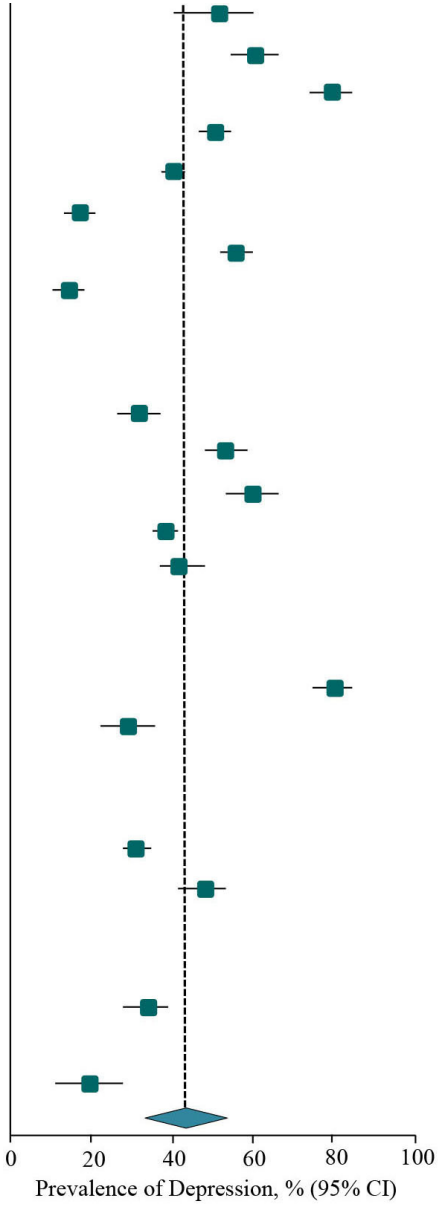
TABLE 6 Meta-analysis of the prevalence of depression or depressive symptoms among frontline HCWs during the COVID-19 pandemic.

Source	No. depression	Total no.	SE	Prevalence (95% CI)	Weight (%)
Patient Health Questionnaire-9 ≥ 5					
Almater et al. (2020)	56	107	0.048	52.3 (42.9–61.7)	5.0
Cui et al. (2020)	202	334	0.027	60.5 (55.2–65.8)	5.2
Elkholy et al. (2021)	398	502	0.018	79.3 (75.8–82.8)	5.3
Lai et al. (2020)	634	1,257	0.014	50.4 (47.7–53.1)	5.3
Liu et al. (2020)	885	2,126	0.011	41.6 (39.4–43.8)	5.3
Wang L. Q. et al. (2020)	44	274	0.022	16.1 (11.8–20.4)	5.3
Guo et al. (2021)	612	1,091	0.015	56.1 (53.2–59.0)	5.3
Lee et al. (2021)	58	406	0.017	14.3 (10.9–17.6)	5.3
Summary prevalence $I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.00001$	2,896	6,097	0.006	46.3 (32.0–60.5)	
The Depression, Anxiety and Stress Scale ≥ 10					
Alshekaili et al. (2020)	196	574	0.020	34.1 (30.2–38.0)	5.3
Tiete et al. (2020)	345	647	0.020	53.3 (49.4–57.2)	5.3
Youssef et al. (2020)	319	540	0.021	59.1 (54.9–63.2)	5.3
Di Mattei et al. (2021)	419	1,055	0.015	39.7 (36.8–42.6)	5.3
Fiol-DeRoque et al. (2021)	206	482	0.023	42.7 (38.2–47.2)	5.3
Summary prevalence $I^2 = 96.0\%$, $\tau^2 = 0.01$, $P < 0.00001$	1,485	3,298	0.009	45.8 (37.0–54.5)	
Goldberg Depression and Anxiety Scale ≥ 2					
Giardino et al. (2020)	858	1,059	0.012	81.0 (78.7–83.4)	5.3
Magnavita et al. (2020a)	46	155	0.037	29.7 (22.5–36.9)	5.1
Summary prevalence $I^2 = 99.0\%$, $\tau^2 = 0.13$, $P < 0.00001$	904	1,214	0.013	55.5 (5.2–105.7)	
2-item Patient Health Questionnaire ≥ 3					
Haravuori et al. (2020)	1,534	4,804	0.007	31.9 (30.5–33.3)	5.3
Shechter et al. (2020)	315	657	0.019	47.9 (44.2–51.6)	5.3
Summary prevalence $I^2 = 98.0\%$, $\tau^2 = 0.01$, $P < 0.00001$	1,849	5,461	0.006	39.8 (24.1–55.5)	
Hospital Anxiety and Depression Scale ≥ 8					
Azoulay et al. (2021)	305	845	0.017	36.1 (32.8–39.4)	5.3
Patient Health Questionnaire-8 ≥ 10					
Wright et al. (2021)	20	98	0.041	20.4 (12.4–28.4)	5.1
Pooled summary estimate $I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.00001$	7,452	17,013	0.004	44.6 (36.1–53.1)	100.0



Studies are stratified by screening modality. The vertical dashed lines indicate the pooled summary estimate (95% CI) f .nd horizontal lines indicate 95% confidence intervals of the estimate.

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TABLE 7 Meta-analysis of the prevalence of insomnia, stress, anxiety, and depression among frontline HCWs during the COVID-19 pandemic stratified by study-level characteristics.

	Study-level characteristics	No. of studies	No. positive	Total no.	Prevalence, % (95% CI)		*P*-value
A	**Study design**						
	Multicenter ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	10	6,504	13,655	49.0 (37.7–60.4)		0.02*
	Non multicenter ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	6	564	1,758	32.1 (23.6–40.7)		
	Study period						
	2020 ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	12	5,381	12,379	40.9 (31.9–50.1)		0.57
	2021 ($I^2 = 100.0\%$, $\tau^2 = 0.06$, $P < 0.001$)	4	1,687	3,034	48.5 (24.5–72.6)		
	Specialty						
	Physicians only ($I^2 = 99.0\%$, $\tau^2 = 0.10$, $P < 0.001$)	3	861	1,321	46.7 (10.5–82.9)		0.80
	Physicians and nurses ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	13	6,207	14,092	41.9 (32.6–51.3)		
	Continent or region						
	Africa ($I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	2	434	1,042	41.3 (20.5–62.1)		<0.001**
	Asia ($I^2 = 99.0\%$, $\tau^2 = 0.05$, $P < 0.001$)	8	2,587	6,276	39.4 (23.6–55.1)		
	Europe ($I^2 = 99.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	5	3,315	7,143	42.9 (30.1–55.3)		
	South America	1	780	1,059	73.7 (70.9–76.4)		
B	**Study design**						
	Multi-center ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	6	2,532	4,730	48.9 (34.7–63.2)		0.49
	Non-multi-center ($I^2 = 99.0\%$, $\tau^2 = 0.07$, $P < 0.001$)	4	752	1,246	59.2 (33.8–84.6)		
	Study period						
	2020 ($I^2 = 99.0\%$, $\tau^2 = 0.05$, $P < 0.001$)	8	2,447	4,439	53.6 (38.6–68.7)		0.82
	2021 ($I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	2	839	1,537	50.6 (30.3–70.9)		
	Specialty						
	Physicians only ($I^2 = 96.0\%$, $\tau^2 = 0.05$, $P < 0.001$)	2	141	262	55.6 (26.5–86.7)		0.79
	Physicians and nurses ($I^2 = 100.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	8	3,143	5,714	52.1 (38.7–65.6)		
	Continent or region						
	Africa ($I^2 = 100.0\%$, $\tau^2 = 0.10$, $P < 0.001$)	2	618	1,042	60.2 (15.2–105.2)		0.41
	Asia ($I^2 = 100.0\%$, $\tau^2 = 0.09$, $P < 0.001$)	3	1,130	1,938	56.7 (23.4–89.9)		
	Europe ($I^2 = 97.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	4	1,162	2,339	45.8 (33.5–58.1)		
	North America	1	374	657	56.9 (53.2–60.6)		

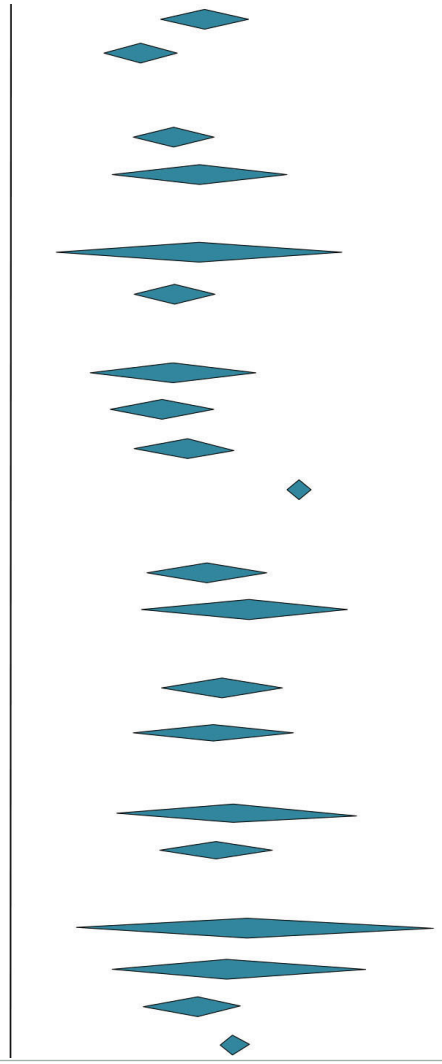

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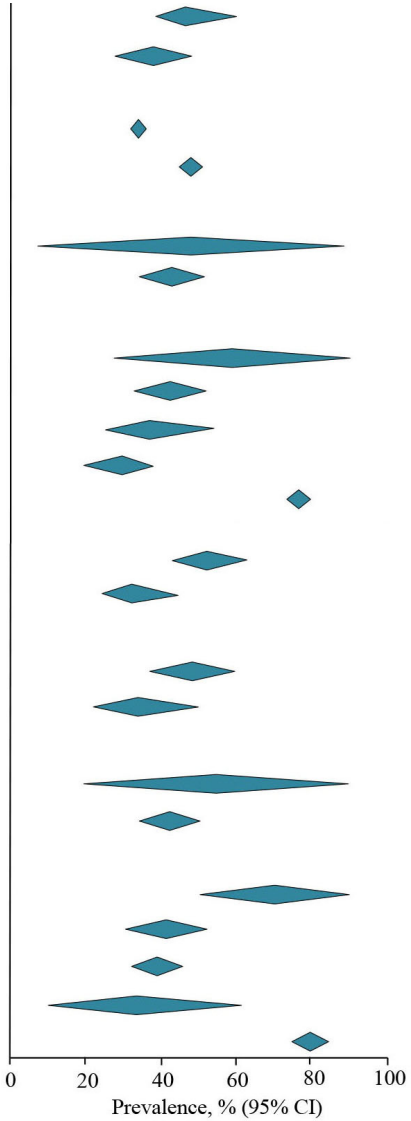
TABLE 7 (Continued)

	Study-level characteristics	No. of studies	No. positive	Total no.	Prevalence, % (95% CI)	*P*-value
C	**Study design**					
	Multi-center ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	11	4,791	10,353	48.9 (38.1–59.7)	0.15
	Non-multi-center ($I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	8	1,709	6,660	37.7 (27.1–48.4)	
	Study period					
	2020 ($I^2 = 98.0\%$, $\tau^2 = 0.05$, $P < 0.001$)	13	4,652	13,036	34.1 (33.4–34.9)	0.64
	2021 ($I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	6	2,485	3,977	46.9 (45.5–48.5)	
	Specialty					
	Physicians only ($I^2 = 99.0\%$, $\tau^2 = 0.14$, $P < 0.001$)	3	388	502	46.5 (4.3–88.7)	0.90
	Physicians and nurses ($I^2 = 99.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	16	5,624	15,692	43.8 (36.9–50.6)	
	Continent or region					
	Africa ($I^2 = 99.0\%$, $\tau^2 = 0.06$, $P < 0.001$)	2	618	1,042	59.9 (25.9–93.9)	<0.001**
	Asia ($I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	8	2,233	6,169	41.4 (31.8–51.1)	
	Europe ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	6	2,392	7,988	38.6 (23.1–54.2)	
	North America ($I^2 = 75.0\%$, $\tau^2 = 0.00$, $P = 0.04$)	2	239	755	29.0 (19.9–38.1)	
	South America	1	810	1,059	76.5 (73.9–79.1)	
D	**Study design**					
	Multicenter ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	11	5,286	10,353	52.6 (42.7–62.6)	0.006**
	Non multicenter ($I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	8	2,141	6,660	33.3 (23.7–42.9)	
	Study period					
	2020 ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	13	5,888	13,143	49.0 (38.1–60.0)	0.10
	2021 ($I^2 = 99.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	6	2,232	3,977	35.1 (22.3–47.7)	
	Specialty					
	Physicians only ($I^2 = 99.0\%$, $\tau^2 = 0.09$, $P < 0.001$)	3	935	1,321	54.5 (19.5–89.4)	0.52
	Physicians and nurses ($I^2 = 99.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	16	6,492	15,692	42.8 (35.3–50.2)	
	Continent or region					
	Africa ($I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	2	717	1,042	69.2 (49.4–89.0)	<0.001**
	Asia ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	8	2,687	6,169	40.6 (29.3–51.8)	
	Europe ($I^2 = 96.0\%$, $\tau^2 = 0.01$, $P < 0.001$)	6	2,855	7,988	39.0 (32.5–45.5)	
	North America ($I^2 = 97.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	2	335	755	34.4 (7.4–61.3)	
	South America	1	858	1,059	81.0 (78.7–83.4)	



A, insomnia or insomnia symptoms; B, stress or stress symptoms; C, anxiety or anxiety symptoms; D, depression or depressive symptoms.

*P < 0.05, **P < 0.01. The area of each diamond is proportional to the inverse variance of the estimate. Horizontal ext iamonds indicate 95% CIs of the estimate.

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TABLE 8 Meta-analysis of the prevalence of insomnia, stress, anxiety, and depression among frontline HCWs during the COVID-19 pandemic stratified by NOS components and total score.

	NOS components	No. of studies	No. positive	Total no.	Prevalence, % (95% CI)	*P*-value
A	**Sample representativeness**					
	Less representative ($I^2 = 89.0\%$, $\tau^2 = 0.01$, $P < 0.001$)	3	931	2,567	41.1 (32.1–50.1)	0.83
	More representative ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	13	6,137	12,306	42.5 (32.7–52.3)	
	Sample size					
	<200 participants ($I^2 = 94.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	2	61	262	32.8 (9.7–55.9)	0.37
	≥200 participants ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	14	6,987	15,413	44.2 (34.7–53.8)	
	Respondent-non-respondent comparability					
	Less comparable ($I^2 = 99.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	6	4,299	9,306	45.4 (33.4–57.3)	0.91
	More comparable ($I^2 = 99.0\%$, $\tau^2 = 0.06$, $P < 0.001$)	10	2,769	6,107	44.3 (30.2–58.5)	
	Ascertainment of Insomnia					
	Less valid ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	2	2,602	5,451	56.8 (33.4–80.2)	0.23
	More valid ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	14	4,911	10,609	40.9 (29.8–51.9)	
	Descriptive statistics reporting					0.03*
	Less thorough ($I^2 = 98.0\%$, $\tau^2 = 0.01$, $P < 0.001$)	9	4,100	10,230	34.2 (27.0–41.3)	
	More thorough ($I^2 = 99.0\%$, $\tau^2 = 0.05$, $P < 0.001$)	7	2,968	5,183	54.2 (37.5–70.9)	
	Total Newcastle-Ottawa score					
	<3 points ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	5	3,747	5,183	43.9 (29.5–58.4)	0.87
	≥3 points ($I^2 = 99.0\%$, $\tau^2 = 0.05$, $P < 0.001$)	11	3,321	7,162	42.4 (29.4–55.4)	
B	**Sample representativeness**					
	Less representative	1	77	107	72.0 (63.6–80.4)	0.007**
	More representative ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	9	3,207	5,869	50.9 (38.3–63.6)	
	Sample size					
	<200 participants ($I^2 = 96.0\%$, $\tau^2 = 0.05$, $P < 0.001$)	2	141	262	56.6 (26.5–86.7)	0.79
	≥200 participants ($I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	8	3,143	5,714	52.1 (38.7–65.6)	
	Respondent-non-respondent comparability					
	Less comparable ($I^2 = 90.0\%$, $\tau^2 = 0.01$, $P < 0.001$)	4	1,158	1,974	57.8 (49.8–65.8)	0.44
	More comparable ($I^2 = 99.0\%$, $\tau^2 = 0.05$, $P < 0.001$)	6	2,126	4,002	49.8 (31.2–68.5)	

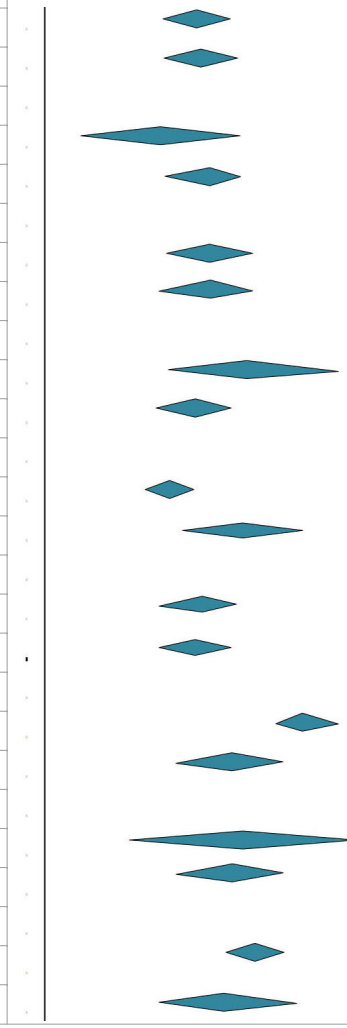

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TABLE 8 (Continued)

	NOS components	No. of studies	No. positive	Total no.	Prevalence, % (95% CI)		*P*-value
	Ascertainment of stress						
	Less valid	1	261	647	40.3 (36.6–44.0)		0.04*
	More valid ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	9	3,023	5,329	54.4 (41.6–67.2)		
	Descriptive statistics reporting						
	Less thorough ($I^2 = 99.0\%$, $\tau^2 = 0.05$, $P < 0.001$)	5	1,652	2,943	53.9 (34.4–73.4)		0.89
	More thorough ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	5	1,632	3,033	52.1 (35.3–68.9)		
	Total Newcastle-Ottawa score						
	<3 points ($I^2 = 96.0\%$, $\tau^2 = 0.05$, $P < 0.001$)	2	141	262	56.6 (26.5–86.7)		0.79
	≥3 points ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	8	3,143	5,714	52.1 (38.7–65.6)		
C	**Sample representativeness**						
	Less representative ($I^2 = 97.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	4	859	2,665	38.6 (22.9–54.3)		0.44
	More representative ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	15	5,641	14,348	45.7 (37.1–54.3)		
	Sample size						
	<200 participants ($I^2 = 93.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	3	98	360	28.5 (11.2–45.7)		0.06
	≥200 participants ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	8	6,411	16,653	47.1 (38.9–55.2)		
	Respondent-non-respondent comparability						
	Less comparable ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	8	2,996	10,061	37.3 (24.3–50.3)		0.14
	More comparable ($I^2 = 98.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	11	3,504	6,952	49.2 (36.6–58.1)		
	Ascertainment of anxiety						
	Less valid ($I^2 = 96.0\%$, $\tau^2 = 0.01$, $P < 0.001$)	2	1,272	5,451	46.8 (36.4–57.1)		0.90
	More valid ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	17	5,228	11,562	43.9 (34.9–52.9)		
	Descriptive statistics reporting						0.06
	Less thorough ($I^2 = 99.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	12	3,693	11,830	39.4 (30.4–48.4)		
	More thorough ($I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	7	2,807	5,183	52.6 (42.0–63.2)		
	Total Newcastle-Ottawa score						
	<3 points ($I^2 = 99.0\%$, $\tau^2 = 0.05$, $P < 0.001$)	6	2,442	8,349	38.9 (21.5–56.4)		0.43
	≥3 points ($I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	13	4,058	8,664	46.6 (38.4–54.9)		

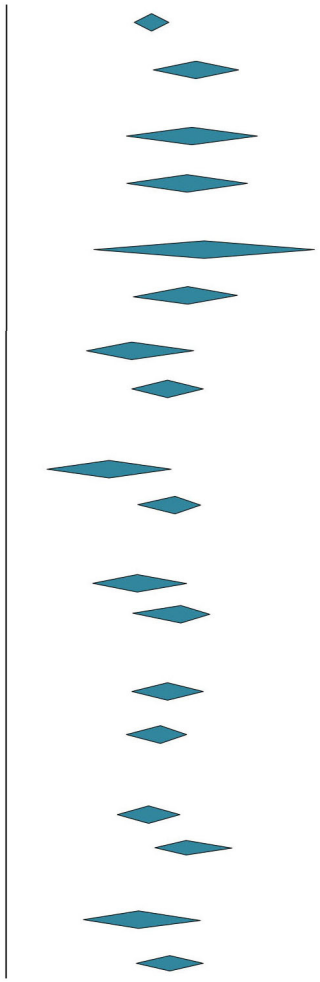

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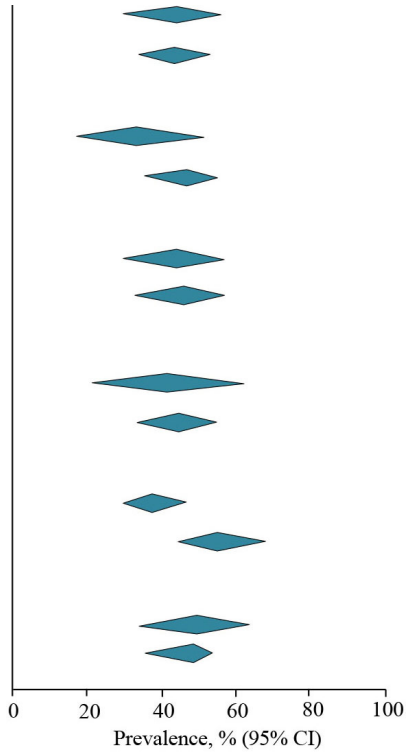
TABLE 8 (Continued)

	NOS components	No. of studies	No. positive	Total no.	Prevalence, % (95% CI)	*P*-value
D	**Sample representativeness**					
	Less representative ($I^2 = 96.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	4	1,138	2,665	43.8 (30.0–57.6)	0.91
	More representative ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	15	6,289	14,348	44.8 (34.6–55.1)	
	Sample size					
	<200 participants ($I^2 = 92.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	3	122	360	33.9 (17.8–51.1)	0.21
	≥200 participants ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	16	7,330	16,653	46.5 (37.2–55.8)	
	Respondent-non-respondent comparability					
	Less comparable ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	8	4,108	10,061	43.1 (29.0–57.3)	0.79
	More comparable ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	11	3,319	6,952	45.6 (34.2–57.1)	
	Ascertainment of depression					
	Less valid ($I^2 = 99.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	2	1,879	5,451	42.5 (21.6–63.5)	0.84
	More valid ($I^2 = 99.0\%$, $\tau^2 = 0.04$, $P < 0.001$)	19	5,548	11,562	44.8 (35.3–54.4)	
	Descriptive statistics reporting					
	Less thorough ($I^2 = 99.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	12	4,422	11,830	37.7 (28.9–46.5)	0.01*
	More thorough ($I^2 = 98.0\%$, $\tau^2 = 0.02$, $P < 0.001$)	7	3,005	5,183	56.5 (45.3–67.7)	
	Total Newcastle-Ottawa score					
	<3 points ($I^2 = 99.0\%$, $\tau^2 = 0.06$, $P < 0.001$)	6	3,374	8,349	42.9 (23.8–62.0)	0.82
	≥3 points ($I^2 = 99.0\%$, $\tau^2 = 0.03$, $P < 0.001$)	13	4,053	8,664	49.4 (36.1–53.1)	



A, insomnia or insomnia symptoms; B, stress or stress symptoms; C, anxiety or anxiety symptoms; D, depression or depressive symptoms.

*P < 0.05, **P < 0.01. The area of each diamond is proportional to the inverse variance of the estimate. Horizontal extremes of the diamonds indicate 95% CIs of the estimate.

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95% CI, 97–100%) and IES-R (Lee, 2012; 86%, 95% CI, 67–94%) was higher than that of the others. However, that of ESS (Siegrist et al., 2014; 76%, 95% CI, 63–86%, 20%) and PC-PTSD (Li et al., 2019; 57%, 95% CI, 45–68%) are the least. When estimating anxiety symptoms, the specificity of the HADS-A (Hitchon et al., 2020) was 78% (95% CI, 69–85%), which was lower than that of the others. In contrast, the PHQ-9 (Williams et al., 2002) has high sensitivity (88%, 95% CI, 74–96%) and specificity (88%, 95% CI, 85–90%) for diagnosing major depression and has been proven to be comparable with the administered assessments by clinicians, whereas the GHQ (Williams et al., 2002) has low specificity (66%, 95% CI, 57–74%). In addition, all self-report measures were conducted online because of the COVID-19 pandemic which may affect the accurate evaluation of symptoms.

The sub-analysis revealed potentially important differences, such as study period, specialty and region. The prevalence of stress and depression is higher in 2020 and that of insomnia and anxiety is higher in 2021. This probably reflects the already established psychological problems of the population that have changed with the evolution of COVID-19 (Simon et al., 2020; Kola et al., 2021). HCWs changed from stress and depression during the outbreak of the COVID-19 pandemic to mild psychological problems of sleep and anxiety with the normalization of COVID-19 prevention and control. In the HCWs specialty, the prevalence of psychological problems of physicians is higher than that of other HCWs. This is related to the working hours and strength of the physicians at the frontline of COVID-19 (Elbay et al., 2020). By region, the prevalence of HCWs in South America is higher, while the prevalence of anxiety and depression in North America is lower, which is related to local economic level, contact tracing, isolation and management, and other measures (Fitzpatrick et al., 2020; Goularte et al., 2021).

Furthermore, according to NOS criteria analysis, variation in sample size contributed significantly to the observed heterogeneity in the study. Studies with fewer participants usually produced more extreme prevalence estimates of stress, indicating publication bias. However, for insomnia, anxiety, and depression, studies with more participants usually produced more extreme prevalence estimates. These differences were partly captured by the NOS score, which assessed the risk of bias in each study. Studies with a higher risk of bias produced higher prevalence estimates of insomnia and stress, while studies with a lower risk of bias produced higher prevalence estimates of anxiety and depression. These findings may be related to the heterogeneity between studies on study design (i.e., multicenter vs. non multicenter), online surveys, study period of COVID-19, positions of frontline HCWs, and severity of regional pandemic.

Most opinions show that psychological strategies are the mediating factor to change these outstanding problems, although the stressors (COVID-19 pandemic) cannot be changed (Mediavilla et al., 2022). Importantly, increasing the so-called social support barriers (i.e., factors that increase the use of social support, even when available) might also contribute to improving the mental health of HCWs (Thoresen et al., 2014). With mounting evidence suggesting an association between reported discrimination against COVID-19 and poor mental health outcomes among HCWs, mental health strategies at the community level could take the form of anti-stigma campaigns (Taylor et al., 2020). At the policy level, addressing various common problems reported by HCWs, including increased workload, shortage of protective equipment, or lack of standardized operating procedures, may also enable HCWs to help reduce the negative consequences of mental health problems (Erquicia et al., 2020).

Limitations

When interpreting the results of this study, several limitations should be considered. First, a substantial amount of the heterogeneity among frontline HCWs remained unexplained by the variables examined. We attempted to reduce these impacts by assessing and reporting the risk of bias. Second, most studies were observational and lacked enough cohort studies; thus, they were vulnerable to the effects of confounding factors. It is necessary to explore the psychological impacts on frontline HCWs during the COVID-19 pandemic over a longer and more prospective period (Shanafelt et al., 2020; Pan et al., 2021). It can be helpful in clarifying the mental state of this population in the future. Third, fewer studies can be included in this meta-analysis because of the special background of the COVID-19 pandemic, which is difficult to analyze through different dimensions of mental health problems. At present, most studies focus on how to control the pandemic, but the mental health of frontline HCWs is easy to be ignore (Greenberg et al., 2020; The, 2020; de Vroege and van den Broek, 2021).

Conclusions

This systematic review and meta-analysis showed that the COVID-19 pandemic have significant effects on mental health among frontline HCWs. The overall prevalence of insomnia, stress, anxiety and depression among frontline HCWs is high. Therefore, the health policy-makers should pay attention to and respond to the mental health problems of frontline HCWs in the context of public health emergencies.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding authors.

Author contributions

JT, XS, JZ, and CH conceived the study aims. JT and WL undertook screening for the review. JZ and WY extracted data and checked it. YP and NZ undertook risk of bias assessment. JT, XS, and JZ developed the analysis plan. CH oversaw data analysis. JT drafted the initial manuscript. JZ edited the initial draft. XS verified the data. JT, XS, and CH obtained funding for the study. All authors conceptualized and approved the research protocol, which outlined the aims and study methods used here, provided critical comments on the manuscript, had access to the data, and approved the final version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.1096857/full#supplementary-material

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Health-related quality of life and depressive symptoms of patients with chronic diseases and the general population before and during the COVID-19 pandemic in Korea

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Objective: The unprecedented coronavirus disease 2019 (COVID-19) outbreak has resulted in a global crisis that negatively impacted physical well-being and mental health. Our goal was to investigate the impact of the COVID-19 pandemic on health-related quality of life (HRQoL) and depressive symptoms in patients with chronic diseases and the general population in Korea.

Methods: Data from 8341 patients with chronic diseases and 12,395 general population aged ≥20 years who participated in the Korea National Health and Nutrition Examination Survey (2017–2020) were analyzed. Patients with hypertension, dyslipidemia, diabetes, cerebrovascular disease (stroke), heart disease (myocardial infarction or angina pectoris), or cancer were classified as patients with chronic diseases. The general population was defined as those not suffering from corresponding chronic diseases. A modified EuroQol-5 Dimensions (EQ-5D), with three levels (0: extreme problems; 0.5: some problems; 1: no problems) for each dimension in EQ-5D, was used to assess HRQoL. To analyze depressive symptoms among patients with chronic diseases and the general population, we used the Patient Health Questionnaire-9 (PHQ-9) and defined a PHQ-9 score ≥10 as having a depressive symptom. Multivariate linear and logistic regression analyses were used to analyze HRQoL and depressive symptoms before and during the COVID-19 pandemic.

Results: The HRQoL level was significantly lower in patients with chronic diseases compared to the general population on all dimensions both before and during the COVID-19 pandemic (all value of p <0.05). Patients with chronic diseases had significantly lower HRQoL levels associated with the anxiety/depression dimension during the COVID-19 pandemic than in the pre-pandemic period (0.940±0.002 vs. 0.929±0.004, value of p = 0.041). In addition, patients with chronic diseases were more likely to report depressive symptoms during the COVID-19 pandemic than in the pre-pandemic period (Odds ratio (OR): 1.755, 95% confidence interval (CI): 1.209–2.546, value of p = 0.003). However, this association was not observed in the general population (OR: 1.275, 95% CI: 0.933–1.742, value of p = 0.13).

Conclusion: The COVID-19 pandemic affected the HRQoL and psychological health in patients with chronic diseases with higher anxiety/depression during the pandemic than in the pre-pandemic period. These results suggest that it is urgent to establish continuous management guidelines, including psychosocial management for high-risk groups, and to improve the existing healthcare system.

KEYWORDS

anxiety, COVID-19, chronic disease, depressive symptoms, Korea, quality of life

1. Introduction

The emergence of the coronavirus disease 2019 (COVID-19) pandemic has resulted in a worldwide public health crisis (World Health Organization, 2020a,c), with sudden alterations to daily routines stemming from restrictions on social interactions, physical distancing measures, and isolation protocols potentially leading to psychological harm, including feelings of loneliness, fear, anxiety, and depression (Brooks et al., 2020; Lee, 2020; Luo M. et al., 2020; Talevi et al., 2020; Dorri et al., 2021). Studies have shown that COVID-19 had a negative effect on the quality of life (QoL) and psychological health, such as anxiety and depression (Brooks et al., 2020; Luo M. et al., 2020; Talevi et al., 2020; Dorri et al., 2021), as reflected by the new term "Corona Blues" (combining COVID-19 and blues, meaning depression) (Lee, 2020). A study in China with 1593 participants aged ≥18 years reported that those affected by quarantine had a higher prevalence of anxiety (12.9% vs. 6.7%) and depression (22.4% vs. 11.9%) than those unaffected by quarantine during the COVID-19 pandemic (Lei et al., 2020). Moreover, according to a study from the US including 1441 adults aged ≥18 years, the prevalence of depressive symptoms during the pandemic increased threefold to 27.8% compared with the prevalence obtained by the 2017–2018 National Health and Nutrition Examination Survey that included data on depressive symptoms of 5065 participants (Ettman et al., 2020). In South Korea, the Korean Society of Traumatic Stress Studies conducted a COVID-19 National Mental Health Survey, which revealed that the prevalence of suicidal ideation in June 2022 was 12.7%, which remained elevated in comparison to the 9.7% recorded in March 2020, during the initial phase of the COVID-19 outbreak (Ministry of Health and Welfare, 2022). Additionally, a one-year analysis of anxiety and depression levels following the initial COVID-19 outbreak reported a 55.8% prevalence, representing an 8.3% increase from 2020 (Lee and Kim, 2021). Consequently, in light of these findings, the World Health Organization (WHO) has emphasized the necessity for providing psychosocial support to address the mental burden associated with the COVID-19 pandemic (World Health Organization, 2020b).

The COVID-19 outbreak has also overloaded the healthcare system (e.g., due to limited manpower due to infection among healthcare workers, and shortages of hospital beds, equipment, or medicine) (Jazieh et al., 2020; Ennab and Ibdah, 2021; Romano et al., 2021; Shin et al., 2021). Indeed, some hospitals were forced to suspend regular healthcare services temporarily to respond to COVID-19 (Jazieh et al., 2020; Breast Screening Working Group (WG2) of the COVID-19 and Cancer Global Modelling Consortium et al., 2021), and patients have avoided hospital visits to limit the risk of COVID-19 infection (Cheng et al., 2021; Hammad et al., 2021; Kim et al., 2021). The above circumstances contributed to delays in diagnosis, management, or treatment of disease to some extent (de Joode et al., 2020; Jazieh et al., 2020; Breast Screening Working Group (WG2) of the Covid-19 and Cancer Global Modelling Consortium et al., 2021). Patients with chronic diseases such as hypertension, dyslipidemia, diabetes, cerebrovascular disease, heart disease, or cancer–collectively referred to as patients with underlying medical conditions, who have a higher risk of developing serious illness due to COVID-19 (Aggarwal et al., 2020; Dai et al., 2020; Liang et al., 2020; Zhou et al., 2020; Centers for Disease Control and Prevention, 2022c) might experience psychological burden (de Joode et al., 2020; Kayikcioglu et al., 2020; Wang Y. et al., 2020; Kim and Kim, 2022a,c; Ozkan et al., 2022). For example, a retrospective study in the UK analyzed the impact of COVID-19 on patient-reported health outcomes at a 30-day follow-up after hospitalization for acute stroke (Ozkan et al., 2022). Patients hospitalized during the pandemic (n = 95) had exacerbation of anxiety, depression, fatigue, pain, and sleep disturbance and reduced social participation and physical function compared with those hospitalized before the COVID-19 pandemic ($n = 106$) (Ozkan et al., 2022). In addition, a study conducted in Turkey assessing the impact of the COVID-19 pandemic on 169 patients with a previous history of premature myocardial infarction indicated that about two-thirds of the study patients reported an increased anxiety level (Kayikcioglu et al., 2020).

The QoL is a multidimensional concept that includes the subjective health status that an individual perceives, and health-related quality of life (HRQoL) can be useful for setting health goals and measuring prognosis among clinical patients (Yun et al., 2004; Nam et al., 2007; Centers for Disease Control and Prevention, 2018). Depression is one of the most seriously considered diseases worldwide, and it is also a risk factor for chronic diseases (Keck, 2010). In addition, the Patient Health Questionnaire-9 (PHQ-9) is widely used as a screening tool to detect depression and depressive symptoms (Park et al., 2010). Given the significance of evaluating the impact of the COVID-19 pandemic on HRQoL and depressive symptoms, particularly in individuals with chronic conditions, it is crucial to conduct assessments in order to establish systematic strategies for preserving and promoting HRQoL and mental well-being for both the population with chronic diseases and the general population. Several studies have reported the mental health of patients with chronic diseases since the COVID-19 outbreak using data from 2020. However, some analyses were without data on mental health status before the pandemic (Ahn et al., 2020; Kim et al., 2021; Kim and Kim, 2022c), while others focused on a specific sex group or on patients with a specific type of cancer (Park et al., 2022; Kim and Kim, 2022b).

In this study, our objective was to comparatively examine the impact of the COVID-19 pandemic on the HRQoL and depressive symptoms in patients with chronic diseases and the general population in South Korea, by utilizing the Korea National Health and Nutrition Examination Survey (KNHANES) 2017–2020, an annual nationally representative survey. We aimed to achieve this by comparing data collected pre-pandemic and during the pandemic period.

2. Methods

2.1. Study population

The KNHANES is a large-scale cross-sectional survey conducted by extracting representative samples of the Korean population to identify health status and behaviors, the prevalence of chronic diseases, and food and nutrient intake and to use the findings for creating health policies (Korea Disease Control and Prevention Agency, 2020c). The survey was conducted in 3-year cycles from the first wave in 1998 to the third wave in 2005. Starting from the fourth wave in 2007, the survey was conducted annually after adopting the rolling sample survey format. Data from the eighth wave second year (2020) was recently released. The seventh (2016–2018) and eighth waves (2019–2020) of the KNHANES utilized population and housing census data as the foundation for their sampling frames. In particular, the seventh wave sought to improve the population inclusion rate by incorporating data on Officially Announced Prices for Apartment Housing. The target population for the KNHANES is comprised of individuals aged one and above who reside in Korea, and a representative sample is drawn through a multi-stage clustered

probability design. Specifically, the primary sampling unit is the enumeration district, while the secondary sampling unit is the household. The KNHANES largely consists of a health questionnaire survey, health examination, and nutritional survey. An explanation of the survey design and analytical methods have been described in detail in previous studies (Kweon et al., 2014).

The present study analyzed the KNHANES data from 2017 to 2020 to compare data from before and during the COVID-19 pandemic. The pre-pandemic period was defined as 2017–2019 and the COVID-19 pandemic period was defined as 2020.

The study population included two groups: (1) patients with chronic diseases and (2) the general population. The group of patients with chronic diseases included those with hypertension, dyslipidemia, diabetes, cerebrovascular disease (stroke), heart disease (myocardial infarction or angina pectoris), or cancer. These patients were classified as "patients with chronic diseases" if they met the following criteria: (1) diagnosed by a physician, (2) currently suffering from the disease, (3) have been treated for the disease, or (4) taking medicines related to the disease. Cancer was defined as having at least one of the following types: gastric, liver, colorectal, breast, cervical, lung, thyroid, and other cancers. The general population was defined as those who did not have any of the corresponding chronic diseases.

In the KNHANES 2017–2020 data, 31,588 participants were initially included in the study. However, the following respondents were excluded from the final analysis: (1) those under the age of 20 ($n = 6092$) and (2) respondents with missing statistical weight values ($n = 4760$). As a result, a total of 20,736 individuals were included in the final analysis, with 8341 classified as patients with chronic diseases and 12,395 classified as part of the general population.

Research data from all participants in the KNHANES were used with approval from the Institutional Review Board (IRB) of the Korea Disease Control and Prevention Agency (KDCA) (approval number: 2018-01-03-P-A, 2018-01-03-C-A, 2018-01-03-2C-A). The KNHANES 2017 was conducted without review, according to the IRB of the KDCA.

2.2. Assessment of demographic and lifestyle information

Health behavior information, such as alcohol consumption and smoking status, was collected using a self-reporting format, whereas a trained staff collected information on sex, age, education level, physical activity, QoL, PHQ-9, and morbidities through an interview (Korea Disease Control and Prevention Agency, 2020c). The average monthly equalized household income was calculated by considering the total age-and sex-specific annual income of the household members (Korea Disease Control and Prevention Agency, 2020c) and was categorized as low, mid-low, mid-high, and high. Education level was reclassified into two categories: less than high school education and high school educated or higher. Alcohol consumption was calculated by multiplying the daily frequency of alcohol consumption by the amount of alcohol consumed at one time. For smoking status, the respondents were classified according to whether they smoke every day or occasionally (current smokers), used to smoke but not anymore (former smokers), and never smoked (non-smokers). Anthropometric data were collected by trained staff. Body mass index (BMI) was calculated as the weight (kg) divided by height squared (m^2). For physical activity, the metabolic equivalent task-hours per week (METs-h/week) were calculated, and weight was assigned according to the intensity of each exercise (Ainsworth et al., 1993).

2.3. HRQoL measuring tool

To analyze HRQoL among patients with chronic diseases and the general population, the present study used the EuroQol-5 Dimensions (EQ-5D), a tool used in the KNHANES to measure HRQoL. The EQ-5D is comprised of five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression (Rabin and de Charro, 2001). The validity of EQ-5D in Korea has been evaluated by studies on patients with rheumatic diseases and stroke (Kim et al., 2005; Jo and Bae, 2009). The present study reclassified the existing questions for each dimension in EQ-5D to three levels: 0, extreme problems; 0.5, some problems; 1, no problems. The EQ-5D index, which combines each dimension from EQ-5D, was calculated through the EQ-5D Korean Valuation Study Using Time Trade Off Method (Nam et al., 2007). Further detailed information on this weight was described previously (Nam et al., 2007).

2.4. Depressive symptom screening tool

To analyze depressive symptoms among patients with chronic diseases and the general population, the present study used the PHQ-9, screened biennially in the KNHANES. For this analysis, we used data from KNHANES 2018 and 2020, where the PHQ-9 was available for the analysis (Korea Disease Control and Prevention Agency, 2020c). Validated PHQ-9 (Park et al., 2010) consists of nine questions, and each question has a score of 0 (not at all) to 3 (nearly every day). The distribution of scores is from 0 to 27, and the higher the total score, the more severe the symptoms related to depression. In this study, we defined a PHQ-9 score ≥ 10 as having a depressive symptom (Kroenke et al., 2001).

2.5. Statistical analysis

Based on the complex sampling design of the KNHANES, analyses in the present study were performed by considering all stratification variables, cluster variables, and weights. Categorical variables are presented as frequency and percentage, and continuous variables are presented as mean ± standard error. A multivariate general linear model was conducted to investigate the mean differences in EQ-5D between patients with chronic diseases and the general population across the pre-and pandemic periods. A multivariate logistic regression analysis was performed to examine the prevalence of depressive symptoms in patients with chronic diseases and the general population, in relation to the pre-and pandemic periods of the COVID-19 pandemic; the estimates are presented as the odds ratio (OR) and 95% confidence interval (CI). Potential confounding variables were considered through a preliminary analysis and by reviewing previous studies (Kim and Kim, 2018; Choi et al., 2020; Ettman et al., 2020; Cerezo and Vicario, 2021; Jeppesen et al., 2021; Adzrago et al., 2022; Myers et al., 2022), and sex, age, household income, education level, alcohol consumption, smoking status, BMI, and physical activity were included as covariates. Significant effect modification was not observed in the association between the

survey year (the pre-and pandemic periods of the COVID-19 pandemic) and HRQoL/depressive symptoms. All statistical analyses in the present study were performed using SAS 9.4 version (Statistical Analysis System; SAS Institute Inc., Cary, NC, United States), with the statistical significance level set to $\alpha = 0.05$.

3. Results

3.1. Characteristics of the participants across the pre-and pandemic periods of the COVID-19

In the pre-pandemic period (2017–2019), the number of patients with hypertension, dyslipidemia, diabetes, stroke, myocardial infarction/angina, and cancer among those with chronic diseases were 4174, 3202, 1603, 411, 491, and 900, respectively. During the pandemic period (2020), the number of patients with hypertension, dyslipidemia, diabetes, stroke, myocardial infarction/angina, and cancer among those with chronic diseases were 1226, 1062, 553, 103, 144, and 253, respectively.

Table 1 presents the analysis of demographic characteristics and lifestyle factors among patients with chronic diseases and the general population, in relation to the pre-and pandemic periods of the COVID-19 pandemic. In the sample of 8341 patients with chronic diseases, 6404 participants were surveyed in the pre-pandemic period (2017–2019) and 1937 were surveyed during the pandemic period (2020). Similarly, among the 12,395 members of the general population, 9780 were surveyed in the pre-pandemic period (2017–2019) and 2615 were surveyed during the pandemic period (2020).

The average age of patients with chronic diseases was approximately 64.40–64.53 years, while the average age of the general population was approximately 44.73–44.90 years. The proportion of individuals with higher education (high school graduation or higher) was approximately 50% among patients with chronic diseases, compared to 84–87% in the general population. The BMI of patients with chronic diseases and the general population were 24.67–24.84 kg/m^2 and 23.46–23.70 kg/m^2, respectively. The physical activity levels of patients with chronic diseases and the general population were 15.38–15.83 and 16.77–17.12 METs-h/week, respectively. Other characteristics, such as sex, alcohol consumption, and smoking status, were fairly similar between the two groups of patients with chronic diseases and the general population.

3.2. Comparison of HRQoL between patients with chronic disease and the general population across the pre-and pandemic periods of the COVID-19

A multivariate linear regression analysis was conducted to calculate the adjusted mean levels of EQ-5D as the outcome variable, and to compare these levels between patients with chronic disease and the general population (using two different population groups as the predictor variable) separately for the pre-pandemic period and the

TABLE 1 General characteristics of patients with chronic diseases and the general population across the pre-and the pandemic periods of the COVID-19, KNHANES 2017–2020.

	Patients with chronic diseases (*N*=8,341)		General population (*N*=12,395)	
	Pre (2017–2019)	Pandemic period (2020)	Pre (2017–2019)	Pandemic period (2020)
Sex				
Men	2748 (42.9)	836 (43.2)	4142 (42.4)	1127 (43.1)
Women	3656 (57.1)	1101 (56.8)	5638 (57.6)	1488 (56.9)
Age (years)	64.401 ± 0.147	64.532 ± 0.267	44.900 ± 0.150	44.733 ± 0.304
Household income				
Low	2086 (32.7)	598 (31.0)	1167 (12.0)	298 (11.4)
Mid-low	1678 (26.3)	487 (25.2)	2353 (24.1)	589 (22.6)
Mid-high	1364 (21.4)	426 (22.1)	2893 (29.7)	812 (31.2)
High	1256 (19.6)	421 (21.7)	3340 (34.2)	907 (34.8)
Education level				
Lower than high school education	3287 (53.8)	846 (49.3)	1449 (15.6)	310 (12.7)
High school educated or higher	2820 (46.2)	869 (50.7)	7839 (84.4)	2139 (87.3)
Alcohol consumption[a]	0.700 ± 0.019	0.637 ± 0.033	0.804 ± 0.015	0.757 ± 0.028
Smoking status				
Non-smokers	3774 (59.5)	1153 (60.2)	6014 (62.1)	1616 (62.3)
Former smokers	1717 (27.1)	486 (25.4)	1882 (19.4)	530 (20.4)
Current smokers	851 (13.4)	278 (14.4)	1791 (18.5)	450 (17.3)
Body mass index (kg/m^2)	24.669 ± 0.043	24.841 ± 0.080	23.455 ± 0.036	23.696 ± 0.075
Physical activity (METs-h/week)	15.377 ± 0.276	15.831 ± 0.464	16.770 ± 0.225	17.118 ± 0.397

COVID-19, Coronavirus Disease 2019; KNHANES, Korea National Health and Nutrition Examination Survey; METs-h/week, Metabolic equivalent task-hours per week. Values are presented as *n* (%) or mean ± standard error. [a]The unit of alcohol consumption is the number of standard drinks per day.

TABLE 2 Adjusted mean comparison of EQ-5D between patients with chronic diseases and the general population during the pre-and pandemic periods of the COVID-19.

EQ-5D[a]	Pre-pandemic (2017–2019) (*N*=16,184)			Pandemic period (2020) (*N*=4,552)		
	Patients with chronic diseases (*N*=6,404)	General population (*N*=9,780)	*p*-value	Patients with chronic diseases (*N*=1,937)	General population (*N*=2,615)	*p*-value
Mobility	0.896 ± 0.003	0.916 ± 0.003	<0.001	0.905 ± 0.006	0.920 ± 0.004	0.007
Self-care	0.972 ± 0.002	0.979 ± 0.001	<0.001	0.972 ± 0.004	0.982 ± 0.003	<0.001
Usual activities	0.939 ± 0.003	0.957 ± 0.002	<0.001	0.946 ± 0.005	0.963 ± 0.003	<0.001
Pain/Discomfort	0.844 ± 0.005	0.861 ± 0.004	0.002	0.849 ± 0.009	0.883 ± 0.007	0.002
Anxiety/Depression	0.936 ± 0.003	0.948 ± 0.002	<0.001	0.928 ± 0.005	0.947 ± 0.005	0.004
EQ-5D index	0.928 ± 0.002	0.940 ± 0.002	<0.001	0.931 ± 0.004	0.946 ± 0.003	<0.001

EQ-5D, EuroQol-5 Dimensions; COVID-19, Coronavirus Disease 2019. [a]Each dimension was reclassified into three levels: no problems (1), some problems (0.5), and extreme problems (0). Values are mean levels of EQ-5D ± standard error, adjusting for sex (men and women), age (continuous), household income (low, mid-low, mid-high, and high), education level (less than high school education and high school educated or higher), alcohol consumption (continuous), smoking status (current smokers, former smokers, and non-smokers), body mass index (continuous), and physical activity (continuous).

COVID-19 pandemic period (Table 2). After adjusting for all potential confounding factors, the results indicate that the individual components of EQ-5D were significantly lower in patients with chronic diseases compared to the general population on all dimensions, including mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, both before and during the COVID-19 pandemic (all $p < 0.05$). Additionally, the EQ-5D index was also significantly lower in patients with chronic diseases compared to the general population, both before and during the COVID-19 pandemic ($p < 0.001$).

3.3. Comparison of HRQoL in patients with chronic diseases across the pre-and pandemic periods of the COVID-19

A multivariate linear regression analysis was employed to determine the adjusted mean levels of EQ-5D as the outcome variable, and to compare these levels between the pre-pandemic period and the COVID-19 pandemic period (using different survey years as the predictor variable) in patients with chronic disease (Table 3). After adjusting for all confounding factors, the results indicate that the HRQoL level in the anxiety/depression dimension was significantly lower during the COVID-19 pandemic in comparison to the pre-pandemic period (mean ± standard error: 0.940 ± 0.002 vs. 0.929 ± 0.004, $p = 0.041$). However, there were no significant differences in HRQoL levels in the other dimensions (all $p > 0.05$).

3.4. Comparison of depressive symptoms in patients with chronic diseases and the general population across the pre-and pandemic periods of the COVID-19

A multivariate logistic regression analysis was conducted to calculate odds ratios and confidence intervals for depressive symptoms (based on a PHQ-9 score of ≥ 10) as the outcome variable. The analysis compared the odds of depressive symptoms between the pre-pandemic period (2018) and the COVID-19 pandemic period (2020) separately for patients with chronic diseases ($n = 4041$) and the general population ($n = 5921$) by using different survey years as the predictor variable. The results of this analysis are presented in Table 4. The results indicate that among patients with chronic diseases, the prevalence of depressive symptoms was significantly higher during the COVID-19 pandemic in comparison to the pre-pandemic period, as evidenced by all statistical models (Model 3 OR: 1.755, 95% CI: 1.209–2.546, $p = 0.003$). On the other hand, among the general population, the prevalence of depressive symptoms did not differ between the pre-and pandemic periods of the COVID-19 pandemic, as supported by all statistical models (Model 3 OR: 1.275, 95% CI: 0.933–1.742, $p = 0.13$).

TABLE 3 Adjusted mean values of EQ-5D before and during the COVID-19 pandemic in patients with chronic diseases.

EQ-5D[a]	Patients with chronic diseases (*N*=8,341)		
	Before COVID-19 (2017–2019)	During COVID-19 (2020)	*p*-value
Mobility	0.864 ± 0.004	0.873 ± 0.006	0.12
Self-care	0.962 ± 0.002	0.962 ± 0.004	0.81
Usual activities	0.928 ± 0.005	0.934 ± 0.006	0.23
Pain/Discomfort	0.825 ± 0.005	0.834 ± 0.008	0.28
Anxiety/Depression	0.940 ± 0.002	0.929 ± 0.004	0.041
EQ-5D index	0.915 ± 0.003	0.918 ± 0.004	0.32

EQ-5D, EuroQol-5 Dimensions; COVID-19, Coronavirus Disease 2019. Values are presented as mean ± standard error. [a]Each dimension was reclassified into three levels: no problems (1), some problems (0.5), and extreme problems (0). Values are adjusted for sex (men and women), age (continuous), household income (low, mid-low, mid-high, and high), education level (less than high school education and high school educated or higher), alcohol consumption (continuous), smoking status (current smokers, former smokers, and non-smokers), body mass index (continuous), and physical activity (continuous).

4. Discussion

The current study examined data from the KNHANES 2017–2020 to compare the HRQoL levels and depressive symptoms among patients with chronic diseases and the general population before and during the COVID-19 pandemic. The analysis revealed that the HRQoL level was significantly lower in patients with chronic diseases compared to the general population both before and during the COVID-19 pandemic.

TABLE 4 Change in the prevalence of depressive symptoms between the pre-pandemic and during pandemic periods in patients with chronic diseases and the general population.

PHQ-9 score≥10[a]	Before COVID-19 (2018)	During COVID-19 (2020)	*p*-value
Patients with chronic diseases (*N* = 4,041)			
Model 1	Ref	1.632 (1.141–2.336)	0.008
Model 2	Ref	1.615 (1.135–2.299)	0.008
Model 3	Ref	1.755 (1.209–2.546)	0.003
General population (*N* = 5,921)			
Model 1	Ref	1.222 (0.893–1.674)	0.21
Model 2	Ref	1.224 (0.895–1.673)	0.20
Model 3	Ref	1.275 (0.933–1.742)	0.13

PHQ, Patient Health Questionnaire; COVID-19, Coronavirus Disease 2019. [a]PHQ-9 score ≥ 10 was considered to have depressive symptoms. Values are presented as odds ratios (95% confidence intervals). Model 1: unadjusted. Model 2: adjusted for sex (men and women) and age (continuous). Model 3: additionally adjusted for household income (low, mid-low, mid-high, and high), education level (less than high school education and high school educated or higher), alcohol consumption (continuous), smoking status (current smokers, former smokers, and non-smokers), body mass index (continuous), and physical activity (continuous).

Furthermore, patients with chronic diseases had significantly lower HRQoL levels in the anxiety/depression dimension during the COVID-19 pandemic in comparison to the pre-pandemic period. Additionally, patients with chronic diseases were more likely to experience depressive symptoms during the COVID-19 pandemic. In contrast, the general population did not exhibit a significant difference in the prevalence of depressive symptoms before and during the COVID-19 pandemic.

Previous research has reported that individuals with chronic diseases experience a negative impact on their QoL due to the prolonged nature of treatment and management, and that chronic diseases and mental health are interrelated (Chapman et al., 2005; Calvert et al., 2012; Megari, 2013; Ryoung and Byung-Deog, 2014; Cho, 2021; Centers for Disease Control and Prevention, 2022a). Consistent with these findings, this study revealed that compared to the general population, patients with chronic diseases exhibited lower HRQoL levels in all dimensions, both before and during the COVID-19 pandemic. Furthermore, the COVID-19 pandemic may exacerbate the risk for depression among individuals with chronic illnesses (Chen et al., 2020; Özdin and Bayrak Özdin, 2020; Luo Y. et al., 2020; Wang C. et al., 2020). According to a meta-analysis to assess the levels and prevalence of anxiety, distress, and stress in patients with diabetes during the COVID-19 pandemic, the prevalence of anxiety in type 2 diabetes patients was 20 and 36% in diabetes distress (García-Lara et al., 2022), which were higher than those in the pre-pandemic period [18% (Chaturvedi et al., 2019) and 29.4% (Huynh et al., 2021), respectively]. Similarly, a study in China on 658 patients with breast cancer found that severe anxiety and depression during the COVID-19 pandemic were 8.9 and 9.3%, respectively. This was higher than the results of previous studies of breast cancer patients in China before the COVID-19 pandemic (severe anxiety = 3.5%, moderate to severe depression = 3.5%) (Juanjuan et al., 2020; Lan et al., 2020).

Patients with chronic diseases with weakened immune systems have been identified as a high-risk group for severe COVID-19 infection and its related complications (Centers for Disease Control and Prevention, 2022c), as reported in studies on cancer patients (Dai et al., 2020; Liang et al., 2020; Ofori-Asenso et al., 2020). Therefore, individuals with chronic illnesses may experience increased psychological anxiety due to the fear of COVID-19 exposure. Additionally, disruptions to medical care caused by the outbreak of COVID-19, such as delays or suspensions in testing and treatment (de Joode et al., 2020; Jazieh et al., 2020; Breast Screening Working Group (WG2) of the Covid-19 and Cancer Global Modelling Consortium et al., 2021), are likely to have added a significant mental burden on patients with chronic diseases who require continuous treatment (Guven et al., 2020; Singhai et al., 2020; Kim et al., 2021). According to a study that analyzed the impact of the COVID-19 lockdown on patients with chronic diseases, it was reported that 42% of 181 patients missed regular testing (Saqib et al., 2020). Indeed, a study in China on 141 cancer outpatients reported that 41.8% experienced a delay in treatment, 60.3% feared visiting a hospital, and 85.1% were concerned about treatment delay (Liu et al., 2021). Similarly, a study on 154 patients with breast cancer reported that 18.8% of the patients experienced changes in treatment due to COVID-19, and those who experienced a treatment plan change had higher levels of depression than those who did not (Kim and Kim, 2022b).

Meanwhile, the average age of the chronic disease patients in this study were 64 years old, including mainly the elderly. Elderly individuals have a higher likelihood of developing chronic diseases (National Cancer Information Center, 2019; Korea Disease Control and Prevention Agency, 2020b, 2021; Statistics Korea, 2021). The elderly population, like patients with pre-existing conditions, is more vulnerable to COVID-19, and mortality rates due to COVID-19 are known to be higher than those reported for younger age groups (Wang L. et al., 2020; Centers for Disease Control and Prevention, 2022b,c). Indeed, according to a previous study among the elderly, the prevalence of clinically significant depressive symptoms among older adults increased to 19.8% during the COVID-19 pandemic, as compared to 7.2% before the pandemic onset (Briggs et al., 2021). Moreover, a deeper sense of isolation due to the temporary closure of senior welfare facilities and restrictions on social activities and social exchange since the COVID-19 pandemic could increase the emotional burden on the elderly (Shin et al., 2020). It is also believed that restrictions on visitors through strict control measures in nursing homes during the COVID-19 pandemic could negatively affect the mental health of the elderly in need of care (Chee, 2020).

Despite these interesting findings, the present study had some limitations. Firstly, while potential confounding factors were adjusted through the review of previous studies and a preliminary analysis, some unmeasured or unknown residual confounding factors (e.g., cancer stage, treatment type, treatment stage, and disease severity) that may affect the HRQoL and depressive symptoms of patients with chronic diseases may still exist. Secondly, this study analyzed the period after the COVID-19 pandemic outbreak by limiting it to 2020. There are regional differences in the timing of the COVID-19 epidemic, and HRQoL and the mental health status of patients with chronic diseases and the general population may change according to the different stages of the COVID-19 pandemic. Thus, it is necessary to investigate the long-term effects of COVID-19 on patients with chronic diseases and the general population. Thirdly, the present study was a cross-sectional study, and thus, the causal relationship between the HRQoL and depressive symptoms and COVID-19 could not be identified. Finally, in 2020, the number of participants decreased by about 750 compared with that in the last year due to the COVID-19 pandemic, and information about the HRQoL and

depressive symptoms was collected through surveys. Thus, non-differential misclassification errors might have occurred due to these limitations. However, the KNHANES provides clear guidelines for health surveys (Korea Disease Control and Prevention Agency, 2020a), and all surveys were conducted in the same way as in 2017–2019 with the aid of trained staff to minimize the possibility of errors. Despite these limitations, the present study used highly reliable national sample data to analyze the HRQoL and depressive symptoms of Korean patients with chronic diseases and the general population before and during the COVID-19 pandemic.

Given the prolonged nature of the current pandemic, it is crucial to develop healthcare system guidelines for high-risk groups for infectious diseases. Our findings underscore the importance of enhancing the healthcare service environment to provide adequate psychosocial support during the COVID-19 pandemic, as well as fortifying the healthcare system in anticipation of potential future pandemics. Although we utilized the most up-to-date data available for analysis, we could only capture the initial phase of the COVID-19 outbreak. Therefore, follow-up studies are imperative to gain a more comprehensive understanding of the long-term negative effects of COVID-19 on patients with chronic illnesses, particularly with regards to the prolonged impact on HRQoL and mental health by incorporating data collected since 2020, as the pandemic is still ongoing. Finally, future studies should also investigate the effect of contracting COVID-19, by comparing patients with and without COVID-19 experience and examine the impact of changes in access and speed of care on patients' mental health.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found at: https://knhanes.kdca.go.kr/knhanes/main.do.

Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board of the Korea Disease Control and Prevention Agency. The patients/participants provided their written informed consent to participate in this study.

Author contributions

YP contributed to the writing the original draft, formal analysis, visualization, and software. KP contributed to the conceptualization, supervision, project administration, resources, funding acquisition, validation, and discussion, along with editing the manuscript. All authors have read and agreed to the final version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Satisfaction with online education among students, faculty, and parents before and after the COVID-19 outbreak: Evidence from a meta-analysis

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The COVID-19 pandemic has presented a unique opportunity for the advancement of online education, as billions of students from 190 countries have been compelled to take classes remotely. The degree of satisfaction is considered one of the major factors in determining the quality of online educational programs. As a result, many empirical studies have been conducted on the level of satisfaction with online education over the last two decades. However, few studies have synthesized previous findings from similar research questions. Therefore, to reinforce statistical power, the study aimed to conduct a meta-analysis to examine satisfaction with online education among students, faculty, and parents before and after the COVID-19 outbreak. A total of 52 studies in English were screened from six academic electronic databases, yielding 57 effect sizes using Comprehensive Meta-Analysis (CMA) software. The results showed that the prevalence of satisfaction with online education among students, faculty, and parents before and after the COVID-19 outbreak was 59.5, 75.3, and 70.7%, respectively, with a significant difference between the satisfaction rates of students and those of their faculty and parents. Besides, we conducted a moderator analysis that found that (1) a significantly higher number of students in the pre-pandemic era in countries with developed digital infrastructure and emergency online learning environments were less satisfied with online education than their counterparts in the post-pandemic era, in countries with developing digital infrastructure, and in non-emergency online learning environments. Additionally, a significantly higher proportion of adult education learners reported being satisfied with online education compared to K-12 and university students. (2) The faculty in the non-emergency situation reported almost double the satisfaction rate of their counterparts in the emergency circumstance. With fewer satisfied remote learning students, efforts could be made by providing well-designed online lessons *via* faculty and strengthening digital infrastructure *via* governments to improve student satisfaction.

KEYWORDS

online education, student satisfaction, faculty satisfaction, parent satisfaction, COVID-19, meta-analysis

1. Introduction

As far back as the 1990s, online education has been researched and applied as a supplement to traditional face-to-face classroom learning (Kang et al., 2022). Since then, the pace of development in online education has accelerated along with the thriving technology industry, and an increasing number of students are engaging in the modern era of the digital world

(Prasad, 2022). The spread of the coronavirus disease 2019 (COVID-19) pandemic also gave rise to the online education era. Approximately 1.5 billion students of all ages and levels of education in 190 countries have enrolled in online courses at home to prevent and control COVID-19 (Garcia, 2022; WHO, 2022).

Categorized by temporal constraint, online learning can be roughly divided into two types: asynchronous and synchronous (Persada et al., 2022). Asynchronous online learning refers to the acquiring of knowledge by students from online curricular materials on their own time, and thus, the teacher and students remain independent in both time and space (Friend and Johnston, 2005; Murphy et al., 2010). Despite being less constrained by time, asynchronous online learning indicates a higher demand for students' self-discipline due to limited interaction with instructors (Persada et al., 2022). Unlike asynchronous online learning, another type, synchronous online learning, requires students and teachers to schedule the same time for spontaneously communicating as if they were physically co-present despite being geographically independent (Murphy et al., 2010). Therefore, some scholars believe that asynchronous online learning is "individually based," whereas synchronous online learning is "more like classroom instruction" (Bernard et al., 2004).

Nevertheless, after the outbreak of the COVID-19 pandemic, a brand-new concept, emergency remote education, was put forward, enriching the category of online education. Emergency remote learning refers to a sudden change of instructional delivery to an alternate mode owing to a grave crisis (Tunc and Toprak, 2022). One of the primary misalignments between emergency remote education and traditional online education is that the faculty under the former circumstance is usually deficient in preparing lessons due to time limitations (Ferri et al., 2020; Fuchs, 2022).

Admittedly, online education holds advantages in many aspects, such as convenience, better interaction, and learning effectiveness, but various disadvantages were also reported, including technical obstacles, poor academic performance, and a lack of practical knowledge (Kotrikadze and Zharkova, 2021; Dinh and Nguyen, 2022). To perceive whether advantages prevail over disadvantages, assessing the degree of satisfaction is regarded as one of the major indicators in determining the quality of online educational programs (Dziuban et al., 2015). The definition of satisfaction with online education is multidimensional, relating to factors such as workload, technological support, feedback, and pedagogical skills (Öztürk et al., 2020; Wei and Chou, 2020). From different perspectives, student and faculty satisfaction can be defined as an attitude consequent upon the evaluation of educational experience, services, and facilities (Weerasinghe and Fernando, 2017), while parent satisfaction is not limited to learning itself but includes extra-learning factors such as children's screen time and physical exercise (Harjule et al., 2021).

Reviewing the literature regarding online education satisfaction has aroused scholars' interest far longer than the duration of the COVID-19 pandemic. Over the past two decades, studies conducted in America found that 83.4% of faculty and 88% of students expressed satisfaction with asynchronous online education (Hartman et al., 2000; Swan, 2001). Regarding synchronous online education, 88.5% of faculty at a university in America and 83% of students at a university in Australia reported that they were satisfied with completely online education in the pre-pandemic era (Palmer and Holt, 2009; Wasilik and Bolliger, 2009). After the COVID-19 outbreak, researchers focused on the satisfaction level in emergency remote education. For instance, 49% of students from 12 universities in Romania and 80.7% of parents of primary school students in China were satisfied or very satisfied with emergency online learning (Rucsanda et al., 2021; Zheng et al., 2022). However, numerous empirical studies have concentrated on satisfaction with online learning from students', faculty's, and parents' perspectives before and after the COVID-19 outbreak. Few studies have integrated previous findings from the same research question. Therefore, to aggregate data with a stronger statistical power than any specific study, the study aimed to conduct a meta-analysis based on empirical studies in English to examine satisfaction with online education before and after the COVID-19 outbreak. To reflect the satisfaction rate from a more comprehensive perspective, the current study explores the research question from threefold standpoints: students, faculty, and parents.

2. Method

In this section, methods are introduced to display the integral research process of the current study. Previous studies were first filtered according to the inclusion and exclusion criteria from six academic databases. Then, data were extracted and coded from screened original articles. Statistical analyses, such as investigating heterogeneity, were performed as the last procedure.

2.1. Search strategy

The current study systematically searched six academic electronic databases, including Web of Science, Scopus, ProQuest, EBSCO, PubMed, and Google Scholar, before 5 December 2022. To search and include as many related articles as possible, use search terms (i.e., online education, online learning, emergency remote learning, emergency remote teaching, remote education, virtual learning, distance learning, e-learning, student satisfaction, faculty satisfaction, instructor satisfaction, parent satisfaction). All the possible combinations of these keywords were input in the search bar with the following string: ("online education" OR "online learning" OR "emergency remote learning" OR "emergency remote teaching" OR "remote education" OR "virtual learning" OR "distance learning" OR "e-learning") AND ("student satisfaction" OR "faculty satisfaction" OR "instructor satisfaction" OR "parent satisfaction").

2.2. Inclusion and exclusion criteria

Only studies that met the following filter criteria were deemed eligible and included in this meta-analysis: (1) empirical studies that were available in English (since English is a worldwide lingua franca, scholars from different nations would report achievements in scientific research in English); (2) studies that reported the prevalence of satisfaction with online education; and (3) studies that accurately reported the number of participants. Conversely, studies were excluded if (1) study subjects were not students, faculty, or parents; (2) study subjects were clinical populations (patients with physical or mental disease); (3) studies were not original research but case reports, editorials, reviews, or commentaries; and (4) studies reported duplicate data.

TABLE 1 Summary coding of included student satisfaction studies.

References	Country	Learning phase	Major	Asynchronous or synchronous	Whether or not ERL	Sample size	Rate
Abdous (2019)	USA	University	/	Synchronous	No	3936	69.40%
Agapito and Japos (2021)	Philippines	University	Engineering	Synchronous	No	168	37.76%
Al-Balas et al. (2020)	Jordan	University	Medical	Synchronous	No	652	26.77%
Aldhahi et al. (2021)	SA	University	Diverse	Synchronous	Yes	1226	51.00%
Al-omairi and Hew (2022)	Malaysia	University	/	Synchronous	No	3649	85.80%
Ansar et al. (2020)	Pakistan	University	Diverse	Synchronous	No	600	22.00%
Arain et al. (2022)	SA	University	Medical	Synchronous	Yes	209	30.00%
Cole et al. (2014)	USA	University	Diverse	Synchronous	No	472	58.70%
Cui et al. (2021)	China	K-12	/	Synchronous	No	867	73.90%
Elshami et al. (2021)	UAE	University	Medical	Synchronous	No	370	41.30%
Fiorini et al. (2022)	Malta	AE	/	Synchronous	No	82	88.90%
Garratt-Reed et al. (2016)	Australia	University	psychology	Synchronous	No	56	83.00%
Holmes et al. (2019)	UK	University	/	Synchronous	No	47784	81.00%
Ke and Xie (2009)	USA	AE	Diverse	Synchronous	No	128	91.10%
Li et al. (2021)	China	University	Medical	Synchronous	No	230	36.50%
Maqableh (2021)	Jordan	University	/	Synchronous	Yes	483	29.40%
Mir et al. (2022)	Pakistan	University	/	Asynchronous	No	732	59.00%
Mohamed et al. (2021)	Egypt	University	Diverse	Synchronous	No	782	49.70%
Naciri et al. (2022)	Morocco	University	Medical	Synchronous	No	330	53.30%
Naseer and Rafique (2021)	Pakistan	University	Diverse	Synchronous	No	406	37.70%
Olson et al. (2005)	USA	AE	Diverse	Synchronous	No	70	94.00%
Palmer and Holt (2009)	Australia	University	/	Synchronous	No	761	44.80%
Pelucio et al. (2022)	Brazil	University	Diverse	Synchronous	No	152	29.60%
Potrč et al. (2020)	Slovenia	K-12	/	Synchronous	No	1844	61.47%
Ristić Dedić and Jokić (2021)	Croatia	K-12	/	Synchronous	No	920	41.20%
Rodrigues et al. (2022)	Portugal	University	Medical	Synchronous	No	415	77.00%
Rucsanda et al. (2021)	Romania	University	Music	Synchronous	Yes	220	49.00%
Ruiz-Grao et al. (2022)	Spain	University	Medical	Synchronous	No	139	58.00%
Swan (2001)	USA	University	Diverse	Asynchronous	No	1406	88.00%
Toprak and Tunc (2022)	Turkey	University	Medical	Synchronous	Yes	2290	66.70%
Wolf and Peyre (2018)	USA	University	Medical	Asynchronous	No	30	95.80%
Yekefallah et al. (2021)	Iran	University	/	Synchronous	No	420	41.00%
Zheng et al. (2022)	China	K-12	/	Synchronous	Yes	781	57.00%

Rate, represents satisfaction rate; /, represents the information was unreported; AE, represents adult education; ERL, represents emergency remote learning.

2.3. Data extracting and coding

The data from all included studies were extracted. A predetermined table was designed for coding the extracted information with the following variables: author, publication year, country, learning phase, major, asynchronous or synchronous online education, whether or not emergency remote learning, sample size, and satisfaction rate. Tables 1–3 show the summary coding of the included student, faculty, and parent satisfaction studies.

2.4. Statistical analysis

The results of the current meta-analysis were analyzed by the Comprehensive Software Meta-Analysis (CMA), which is one of the most commonly used software packages to conduct a meta-analysis due to its extensive analytic options and simple interface (Brüggemann and Rajguru, 2022). To calculate the overall satisfaction rate, the software first converted input ratio data into logit data using the formula $logit = Log(p/(1-p))$ and then transformed logit data back into ratio data *via* the formula $var(logit) = \frac{1}{case} + \frac{1}{non-case}$

TABLE 2 Summary coding of included faculty satisfaction studies.

References	Country	Learning phase	Major	Asynchronous or synchronous	Whether or not ERL	Sample size	Rate
Almeda and Rose (2000)	USA	University	Writing	Synchronous	No	9	66.67%
Alqahtani et al. (2022)	SA	University	Diverse	Synchronous	No	1117	71.00%
Arain et al. (2022)	SA	University	Medical	Synchronous	Yes	13	46.00%
Bedriñana et al. (2022)	Peru	University	Diverse	Synchronous	Yes	1029	25.00%
Benito et al. (2021)	Costa Rica, India and Turkey	University	/	Synchronous	Yes	22	82.60%
Chen et al. (2022)	China	K-12	/	Synchronous	No	13730	69.32%
Elshami et al. (2021)	UAE	University	Medical	Synchronous	No	70	74.30%
Evans and Myrick (2015)	USA	University	/	Asynchronous	No	162	66.00%
Fauzi and Khusuma (2020)	Indonesia	K-12	/	Synchronous	Yes	45	20.00%
Fredericksen et al. (2019)	USA	University	/	Asynchronous	No	105	100%
Hartman et al. (2000)	USA	University	/	Asynchronous	No	30	83.40%
Li et al. (2021)	China	University	Medical	Synchronous	No	95	61.10%
McLawhon and Cutright (2012)	USA	University	/	Synchronous	No	110	95.00%
Saini et al. (2021)	India	University	Medical	Synchronous	No	159	96.90%
Seoane et al. (2021)	Spain	K-12	Writing	Synchronous	No	158	84.00%
Truzoli et al. (2021)	Italy	K-12	/	Synchronous	No	107	62.60%
Vishwanathan et al. (2021)	India	University	Diverse	Synchronous	No	104	92.20%
Wasilik and Bolliger (2009)	USA	University	/	Synchronous	No	102	88.50%

Rate, represents satisfaction rate; /, represents the information was unreported; ERL, represents emergency remote learning.

TABLE 3 Summary coding of included parent satisfaction studies.

References	Country	Learning phase	Major	Asynchronous or synchronous	Whether or not ERL	Sample size	Rate
Butz (2003)	USA	K-12	/	Synchronous	No	186	86.02%
Cui et al. (2021)	China	K-12	/	Synchronous	No	867	77.90%
Joseph et al. (2021)	India	K-12	/	Synchronous	No	300	20.00%
Lau et al. (2021)	China	K-12	/	Synchronous	No	3381	53.10%
Rathaliya et al. (2022)	India	K-12	/	Synchronous	No	220	89.00%
Zheng et al. (2022)	China	K-12	/	Synchronous	Yes	781	80.70%

Rate, represents satisfaction rate; /, represents the information was unreported; ERL, represents emergency remote learning.

(Card, 2012). Then, two methods were used to examine moderating effects related to various variables. For continuous variables, meta-regression was used, whereas a subgroup analysis was conducted for categorical variables. In the subgroup analysis, the number of effect sizes under the same moderating variable should be no less than three to guarantee the representativeness of the studies under that certain variable (Zhang et al., 2021).

Heterogeneity was investigated to decide which statistical model (the fixed-effect model or the random-effect model) should be applied. Measuring heterogeneity by I^2 is a crucial evaluation criterion, with an $I^2 > 75\%$ regarded as a cutoff point for choosing the random-effect model, whereas the fixed-effect model should be applied (Huedo-Medina et al., 2006). Besides, Egger's regression test was widely utilized for measuring whether publication bias exists in the meta-analysis because it is more precise and sensitive (Egger et al., 1997; Lin et al., 2018). A sensitivity analysis was also performed to evaluate the robustness of the results.

3. Results

The study results are presented in the following subsections.:First, search results and sample characteristics are described, followed by assessments of heterogeneity and publication bias. Then, we will present the combined effect, sensitivity, and moderator analysis for satisfaction among students, faculty, and parents.

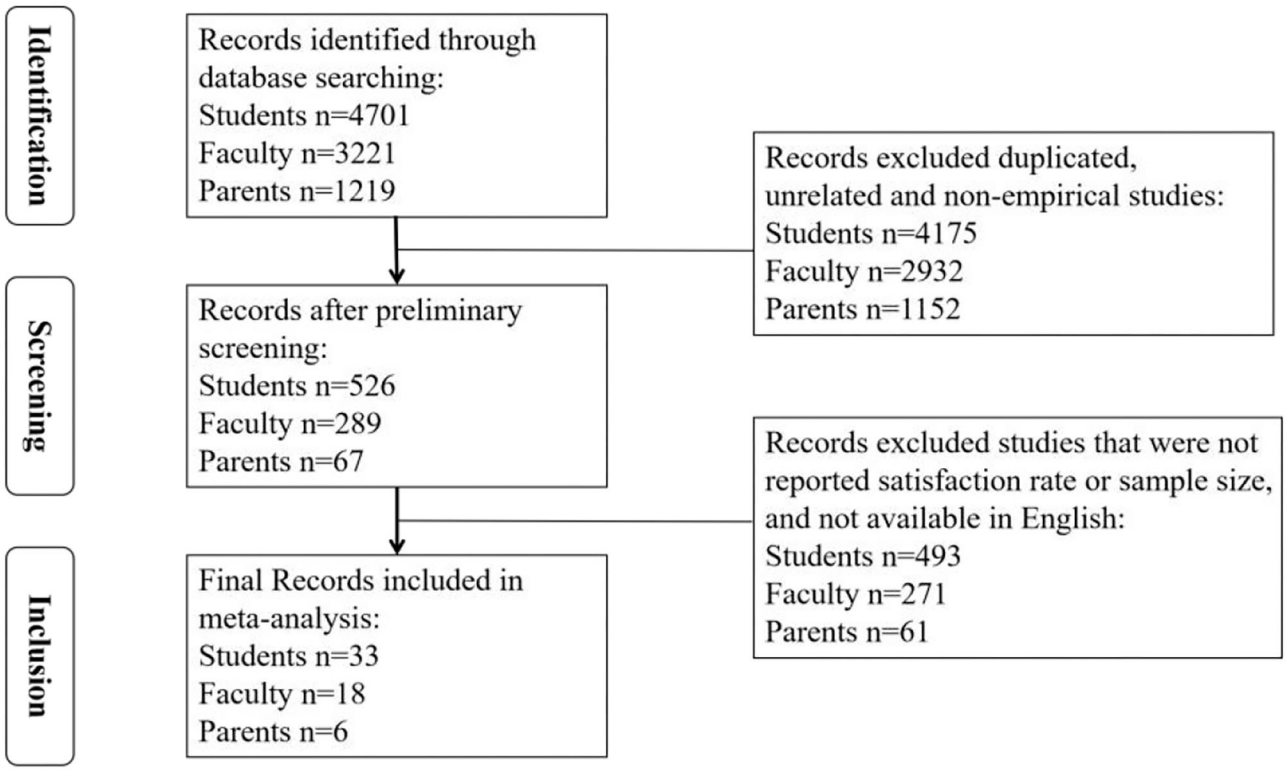

FIGURE 1
A flow diagram of Literature Searching and Screening.

3.1. Search results and sample characteristics

The study screening process is illustrated in Figure 1. Studies on online education satisfaction among students, faculty, and parents were initially identified in six academic electronic databases. After screening based on the abovementioned inclusion and exclusion criteria, 57 effect sizes (33 for students; 18 for faculty; 6 for parents) were generated from 52 research studies (28 reported only student satisfaction; 15 reported only faculty satisfaction; 4 reported only parent satisfaction; 3 reported both student and faculty satisfaction; and 2 reported both student and parent satisfaction).

Overall, a total of 93,686 participants of different ages were included in this meta-analysis. Included studies were conducted in 26 countries (i.e., Australia, Brazil, China, Costa Rica, Croatia, Egypt, India, Indonesia, Iran, Italy, Jordan, Malaysia, Malta, Morocco, Pakistan, Peru, the Philippines, Portugal, Romania, Saudi Arabia, Slovenia, Spain, Turkey, the United Arab Emirates, the United Kingdom, and the United States), covering both developed and developing countries from six continents, namely Africa, Asia, Europe, North America, Oceania, and South America.

3.2. Investigating heterogeneity and publication bias

Heterogeneity test results are displayed in Table 4. It shows that all I^2 results were >75%, and the Q test was significant in student ($P = 0.000$, $I^2 = 99.48$), faculty ($P = 0.000$, $I^2 = 97.99$), and parent ($P = 0.000$, $I^2 = 99.11$) satisfaction studies. Thus, the current study selected the random-effects model as the statistical model (Huedo-Medina et al., 2006). Additionally, the result of Egger's regression test is also shown in Table 4 to assess whether publication bias exists in the meta-analysis. The *P*-value was found to be significant in the studies among students ($p = 0.00$) but not significant in the studies among faculty ($p = 0.88$) or parents ($p = 0.36$), indicating that there was a publication bias that needed to be corrected for studies among students. The trim-and-fill method (Duval and Tweedie, 2000), one of the most commonly used methods, was applied to correct the publication bias found in the studies among the students (Shi and Lin, 2019). A trim-and-fill analysis was performed using STATA statistical software with the "metatrim" command (Alimoradi et al., 2022). The "metatrim" result showed that "no trimming was performed, and the data remained unchanged," indicating that the current student results were robust. The funnel plot assessing publication bias in satisfaction with online education among students, faculty, and parents before and after the COVID-19 outbreak is shown in Figures 2–4.

TABLE 4 Heterogeneity and publication bias test.

Satisfaction	Heterogeneity		Egger's
	P	I^2	*P*
Student	0.00	99.48	0.00
Faculty	0.00	97.99	0.88
Parent	0.00	99.11	0.36

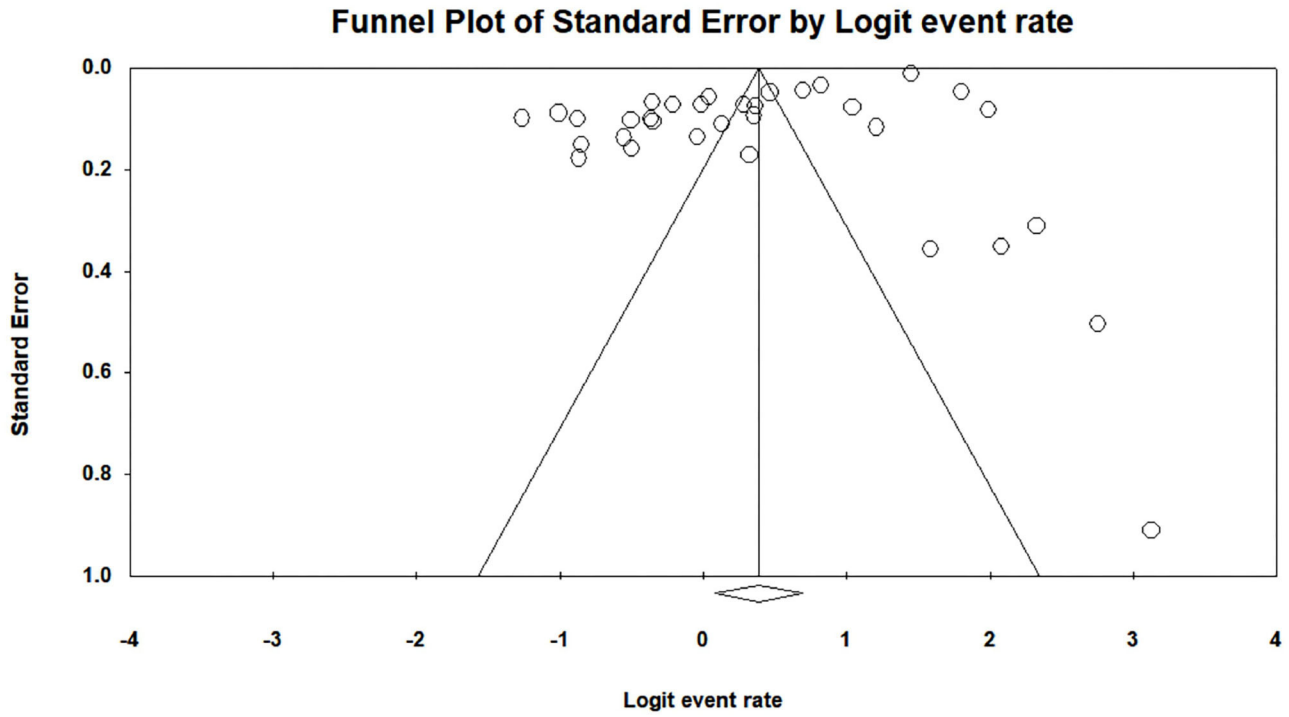

FIGURE 2
A funnel plot assessing publication bias of satisfaction with online education among students before and after the COVID-19 outbreak.

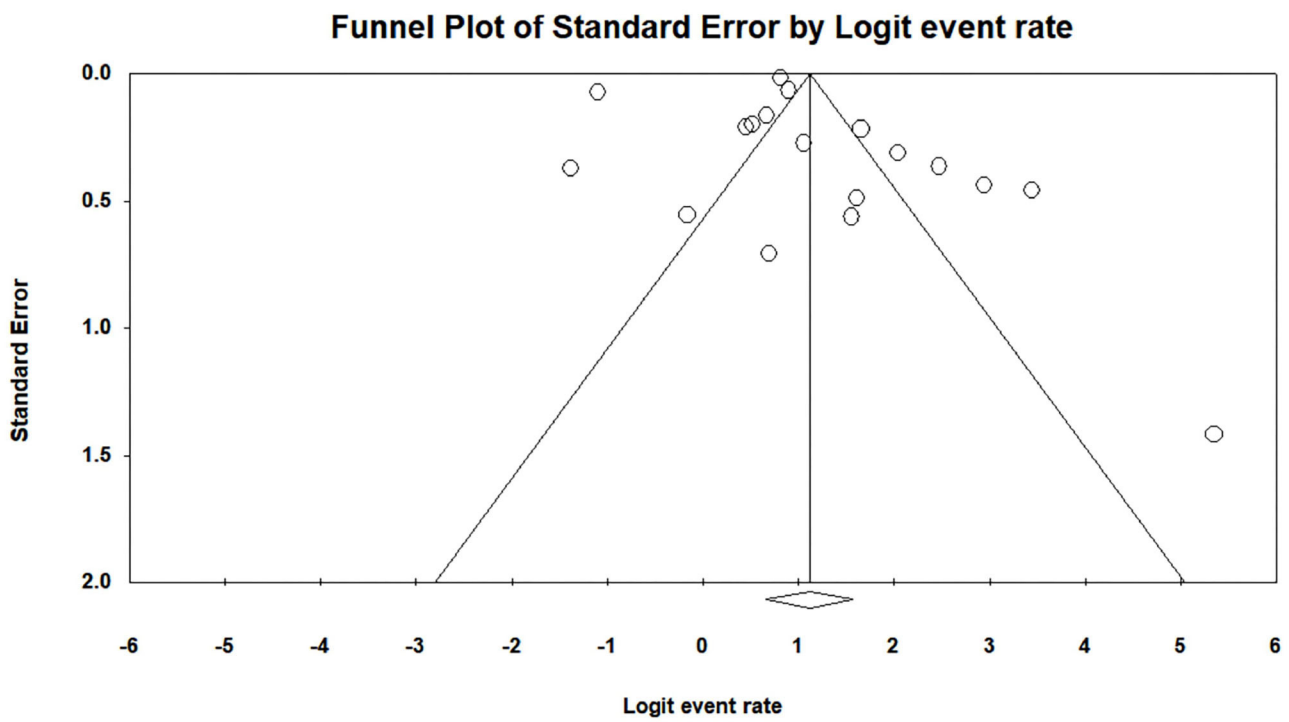

FIGURE 3
A funnel plot assessing publication bias of satisfaction with online education among faculty before and after the COVID-19 outbreak.

3.3. Meta-analysis overall results

Based on the random-effects model, the overall satisfaction rate toward online education among students, faculty, and parents before and after the COVID-19 outbreak was 65.3% (95% CI = [0.603, 0.700]). Furthermore, a sensitivity analysis was carried out, which showed that the prevalence of satisfaction fluctuated between 64.7 and 66.1% after a random individual study was removed from the

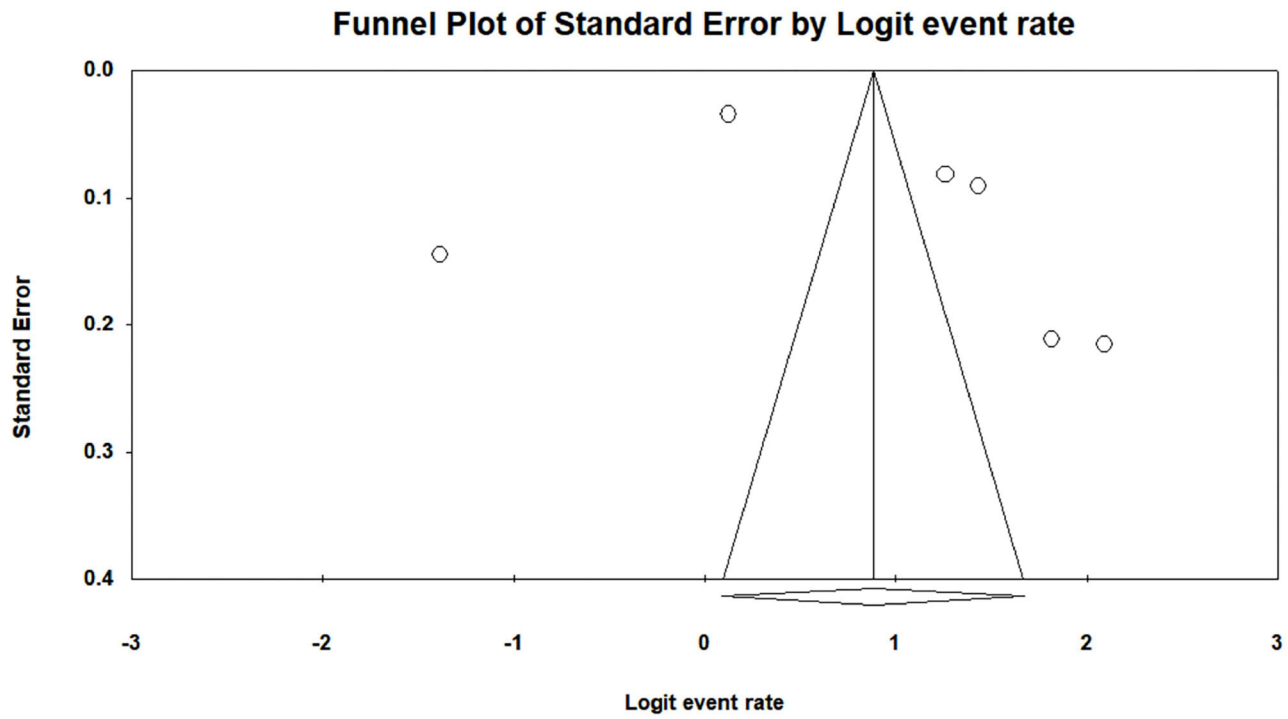

FIGURE 4
A funnel plot assessing publication bias of satisfaction with online education among parents before and after the COVID-19 outbreak.

TABLE 5 Satisfaction with online education among students, faculty, and parents before and after the COVID-19 outbreak and role moderator analysis.

Role	k	Effect size and 95% CI			Heterogeneity	
		R	Lower limit	Upper limit		
Student	33	0.595	0.519	0.666	*Q*	7.293
Faculty	18	0.753	0.660	0.827	*Df*	2
Parent	6	0.707	0.522	0.842	*P*	0.026

overall data. The little difference between the results before and after the sensitivity analysis indicates that the results are highly reliable.

The subgroup analysis by roles is displayed in Table 5, which shows that, ranging from low to high, 59.5% of students (95% CI = [0.519, 0.666]), 70.7% of parents (95% CI = [0.522, 0.842]), and 75.3% of faculty (95% CI = [0.660, 0.827]) were satisfied with online education before and after the COVID-19 outbreak. In addition, the moderating effect of role ($p = 0.026$) shows that students were much less happy with online learning than teachers and parents. The following sections will show the specific satisfaction results from the threefold perspective of students, faculty, and parents.

3.4. Meta-analysis results among students, faculty, and parents

In the current meta-analysis, we analyzed a total of 33 effect sizes and found that 59.5% of students were satisfied with online education. We also examined several variables that could potentially affect satisfaction levels, including the publication year, the timing of the study (before or after the COVID-19 outbreak), whether the online learning was in an emergency, the type of online education (asynchronous or synchronous), the phase of learning (e.g., K-12 or university), and whether the study was conducted in a developed or developing country. The results of this analysis are as follows (see Table 6): (1) The publication year had a significant effect on student satisfaction (b = −0.102, 95% CI = [-0.161,−0.042], $p < 0.001$), indicating that student satisfaction with online education has decreased over the past two decades. (2) The timing of the study (pre- or post-pandemic), whether or not the online learning was in an emergency, the phase of learning (e.g., K-12 or university), and the country's level of development all had significant effects on student satisfaction. Specifically, a significantly higher number of students in the pre-pandemic era (79.7%), emergency online learning situations (62.3%), and developed countries (72.8%) expressed satisfaction with online education compared to their counterparts in the post-pandemic era (50.7%), non-emergency online learning situations (47.1%), and developing countries (45.8%). Additionally, a significantly higher number of adult education learners (91.0%) were satisfied with online studies compared to K-12 (58.9%) or university students (54.8%). (3) The type of online education (synchronous or asynchronous) and students' majors did not affect satisfaction levels significantly.

Regarding faculty satisfaction (see Table 7), 75.3% of faculty expressed satisfaction with online education based on 18 effect sizes. We also examined several variables that could potentially affect satisfaction levels among faculty members, including the publication year, whether the teaching was in an emergency online environment, the timing of the study (before or after the COVID-19 outbreak), the type of online education (asynchronous or synchronous), the

TABLE 6 Moderator analysis for student satisfaction.

Moderator variable	Heterogeneity			Type	K	r	95% CI	
	Q	*df*	*P*				Lower limit	Upper limit
Before or after the COVID-19 outbreak	21.345	1	0.000	Before	9	0.797	0.712	0.861
				After	24	0.507	0.425	0.589
Whether or not EOL	4.288	1	0.038	Yes	6	0.471	0.357	0.588
				No	27	0.623	0.539	0.700
Asynchronous or synchronous	3.411	1	0.065	Asynchronous	3	0.837	0.559	0.954
				Synchronous	30	0.571	0.490	0.648
Learning phase	64.010	2	0.000	K-12	4	0.589	0.461	0.705
				University	26	0.548	0.459	0.634
				AE	3	0.910	0.870	0.939
Major	0.601	1	0.438	Diverse	9	0.617	0.448	0.761
				Medical	9	0.531	0.392	0.666
Developed or developing country	14.997	1	0.000	Developed	16	0.728	0.646	0.797
				Developing	17	0.458	0.353	0.567

ERL, represents emergency remote learning; AE, represents adult education.

TABLE 7 Moderator analysis for faculty satisfaction.

Moderator variable	Heterogeneity			Type	K	r	95% CI	
	Q	*df*	*P*				Lower limit	Upper limit
Before or after the COVID-19 outbreak	3.607	1	0.058	Before	6	0.870	0.716	0.947
				After	12	0.694	0.569	0.796
Whether or not EOL	10.840	1	0.001	Yes	4	0.406	0.201	0.650
				No	14	0.795	0.748	0.835
Asynchronous or synchronous	1.061	1	0.303	Asynchronous	3	0.868	0.583	0.969
				Synchronous	15	0.737	0.630	0.821
Teaching phase	3.208	1	0.073	K-12	4	0.618	0.444	0.766
				University	14	0.804	0.663	0.895
Major	0.207	1	0.649	Diverse	3	0.673	0.283	0.915
				Medical	4	0.767	0.501	0.916
Developed or developing country	3.359	1	0.067	Developed	8	0.831	0.721	0.904
				Developing	10	0.682	0.537	0.799

ERL, represents emergency remote learning.

phase of teaching (e.g., K-12 or university), and whether the study was conducted in a developed or developing country. The results of this analysis are as follows: (1) The publication year did not have a significant effect on faculty satisfaction (b = −0.066, 95% CI = [−0.130, −0.001], $p = 0.046$), indicating that the faculty satisfaction rate hardly changed over time. (2) The effect of whether the teaching was in an emergency online environment was significant ($p = 0.001$); faculty members teaching in a non-emergency situation (79.5%) reported almost double the satisfaction rate of their counterparts in emergencies (40.6%). (3) Other variables, such as the timing of the study (pre- or post-pandemic), the type of online education, the phase of teaching, and the country's level of development, did not significantly affect satisfaction levels.

For the parent satisfaction group in this meta-analysis (see Table 8), the number of effect sizes was 6, which is far less than the number for student and faculty satisfaction. Based on the included studies, 70.7% of parents reported satisfaction with online education. However, due to the limited number of studies on parents of students in different education levels (except for K-12), on remote learning in emergencies, on other majors, and in developed countries, we could not conduct a moderator analysis with these variables. The moderating effect of publication year was non-significant (b = −0.053, 95% CI = [−0.170, −0.064], $p = 0.375$), which suggests that there has been little change in the level of satisfaction among parents over time.

TABLE 8 Moderator analysis for parent satisfaction.

Moderator variable	Heterogeneity			Type	k	r	95% CI	
	Q	*df*	*P*				Lower limit	Upper limit
Before or after the COVID-19 outbreak	/	/	/	Before	/	/	/	/
				After	/	/	/	/
Whether or not EOL	/	/	/	Yes	/	/	/	/
				No	/	/	/	/
Asynchronous or synchronous	/	/	/	Asynchronous	/	/	/	/
				Synchronous	/	/	/	/
Phase	/	/	/	K-12	/	/	/	/
				University	/	/	/	/
Major	/	/	/	Diverse	/	/	/	/
				Medical	/	/	/	/
Developed or developing country	/	/	/	Developed	/	/	/	/
				Developing	/	/	/	/

ERL, represents emergency remote learning; /, represents the number of studies is insufficient to report related data.

4. Discussion

In light of the aforementioned results, a discussion will revolve around the feasible explanation of these findings, integrating them with relevant prior research. In addition, limitations are discussed to guide follow-up studies in the future.

4.1. Main effect analysis

The current study is the first meta-analysis examining satisfaction with online education among students, faculty, and parents before and after the COVID-19 outbreak in English. It synthesized the reported data from previous empirical studies from a threefold perspective over the past two decades. After applying strict inclusion and exclusion criteria, the study included data from 52 studies with 93,686 participants from 26 countries, resulting in 57 effect sizes (33 for students, 18 for faculty, and 6 for parents). Overall, the results of this meta-analysis showed that 59.5% of students, 75.3% of faculty, and 70.7% of parents were happy with online education before and after the COVID-19 outbreak. There was a big difference between the satisfaction rates of students and those of their faculty and parents.

The current findings are broadly consistent with the few previous analogous meta-analysis findings. Some scholars concluded that 63.8% of overall students were satisfied with e-learning after the outbreak of the COVID-19 pandemic (Nakhoda et al., 2021), a slight difference from the result of 59.5% in this study. The results suggest that around 60% of students find online learning an effective method for acquiring knowledge and staying on track with their coursework. There is limited research on meta-analyses of faculty and parent satisfaction with online education.

4.2. Moderating effect analysis

The study used moderator analysis to examine the effect of several variables, including the publication year, the timing of the study (before or after the COVID-19 outbreak), whether the study was conducted during an emergency online learning period, the type of online education (asynchronous or synchronous), the phase of learning (K-12, university, or adult education), the students' major, and whether the study was conducted in a developed or developing country. Regarding the publication year, the moderating effect was only significant among students (fewer students reported satisfaction with distance education over the past two decades). In contrast, faculty and parent satisfaction were unaffected over time. The different evaluations of satisfaction can explain the reason behind this discrepancy. From the perspective of students, their satisfaction is associated with the value of the learning experience since they tend to construct a knowledge system in the social context of interacting with faculty and other students, engaging in activities, and receiving feedback (Bandura, 2001; Thurmond et al., 2002; Elshami et al., 2021). Three major categories influence student satisfaction with e-learning: faculty, interactivity, and technology (Bolliger, 2004; Kurucay and Inan, 2017). Unlike students, faculty satisfaction is defined as the perception of efficiency, effectiveness, and benefit during the online teaching process. Students, instructors, and institutions are three key factors determining faculty satisfaction with online education (Bolliger and Wasilik, 2009; Bolliger et al., 2014). From parents' perspective, factors affecting their satisfaction are not limited to learning outcomes but also extra-learning elements such as children's screen time, exposure to harmful website content, and lack of time for physical exercise (Harjule et al., 2021). It indicates that only students' satisfaction is highly susceptible to interactivity in online education. After the outbreak of COVID-19, students were compelled to engage in isolated distance learning at home. Thus, they cannot interact with classmates or teachers as actively as before the pandemic, which diminishes their satisfaction with online study. Nonetheless, faculty and parent satisfaction are not strongly associated with interactivity and are thus unaffected by limiting interactions with other social members.

The second moderator analysis of "before or after the COVID-19 outbreak" also showed that only the number of students expressing satisfaction with online education significantly declined, but the

number of faculty remained stable. Apart from lower interactivity following the pandemic, there is a significant difference in mental health between students and faculty following the COVID-19 outbreak. The prevalence of anxiety, depression, and stress was high among students in the online learning context after the pandemic. For instance, 70.7, 64, and 48.3% of pharmacy students reported mild-to-severe anxiety, depression, and stress levels in Lebanon (Hammoudi Halat et al., 2022) and 51.3% (anxiety), 29.4% (depression), and 56.5% (stress) of university students in Malaysia (Moy and Ng, 2021). However, regarding the prevalence of mental disorders among lecturers, only 15.7, 17.6, and 21.6% of them showed anxious, depressive, and/or stress-related symptoms (Miguel et al., 2021), which was much less than that of students. According to studies that found that anxious people are less satisfied with doctor consultations, mental health problems could negatively influence related satisfaction (Tanis et al., 2016). Therefore, a significantly smaller number of students than faculty were satisfied with online education following the COVID-19 outbreak.

The variable "whether or not emergency online learning" showed that satisfaction in the context of emergency online learning was significantly different from that in the non-emergency circumstance among both students and faculty. As many as 62.3% of students and 79.5% of faculty in the non-emergency situation reported satisfaction, the rate decreased to 47.1 and 40.6%, respectively, when switching to an emergency pattern. Unlike traditional online education, emergency online learning refers to a temporary shift to an alternate delivery mode due to crisis circumstances (Ferri et al., 2020; Hodges et al., 2020; Fuchs, 2022). Due to the sudden transition, faculty usually prepare and design lessons insufficiently and lack professional training in technological support systems (O'Keefe et al., 2020). Therefore, emergency online education could passively impact many dimensions, including user satisfaction, academic performance, and mental health (Lu et al., 2003; El-Sakran et al., 2022). In addition, since student and faculty satisfaction are interrelated (Yildiz, 2018), it is reasonable to conclude that there is a significant difference in satisfaction with online education between emergency and non-emergency situations among both students and faculty.

Regarding the following variable, asynchronous or synchronous online education, the moderating effect of it was nonsignificant both for students and faculty. The current result is consistent with previous meta-analysis findings that showed satisfaction was higher, but negligibly so in a synchronous environment such as webinars than in asynchronous online instruction (Ebner and Gegenfurtner, 2019). It indicates that asynchronous or synchronous online education is not influencing learning or teacher satisfaction. Unlike emergency online education, educators can have adequate time to prepare lessons in an asynchronous or synchronous context, thus not affecting the satisfaction rate. Many scholars pointed out that asynchronous recording can be regarded as a necessary alternative and additional tool for students who cannot attend synchronous lessons (Bixler et al., 2021; Manou et al., 2022).

The learning phase is a moderator variable that also shows significant results among students rather than faculty. The present results found that a significantly higher number of adult education learners (91.0%) were satisfied with online study than K-12 (58.9%) or university students (54.8%). The term "adult learner" is defined as an individual above the age of 24 who is employed full-time, studies part-time, and usually needs to support dependents such as a spouse and parents at home (Forbus et al., 2011; Ng and Baharom, 2018). Hence, unlike full-time K-12 or university students, adult learners are swamped with balancing commitments such as job, family, and education (Bishop, 2002). The flexibility of online education exactly meets the need to pursue an academic degree while balancing career and family commitments for adult students (Alexander et al., 2009). For this reason, most adults are willing to participate in online educational programs and are highly motivated and task-oriented (Merriam and Caffarella, 1991; Cercone, 2008). Therefore, compared with K-12 or university students who attend online courses passively, more adult learners are satisfied with online study.

For majors, no significant difference was shown between students and faculty in medical and other diverse majors in satisfaction with online education before and after the COVID-19 outbreak. Many scholars believe that implementing online education in majors highly dependent on firsthand experiences, such as medical science, is much more challenging than other subjects (Patra et al., 2021; Nikas et al., 2022). Nevertheless, medical students and faculty satisfaction were not reported to be different from their counterparts in other majors, which is inseparable from technological support. Owing to the development of digital technology, operations and clinical skills traditionally learned and acquired in laboratories and hospitals are currently feasible in online education (Li et al., 2021), and most faculty (77%) regard virtual teaching applications as a convenient tool (Arain et al., 2022). Hence, students and faculty in medical science were roughly as satisfied as others who specialized in other majors with online education.

The last moderator variable in this meta-analysis is developed or developing countries, which shows that a significantly higher number of students in developed countries (72.8%) were satisfied with online education than their counterparts in developing countries (45.8%), but there was no significant difference between faculty in developed and developing countries. The reason for it also lies behind the different determining factors affecting students' and faculty's satisfaction with online education: faculty, interactivity, and technology for students (Bolliger, 2004; Kurucay and Inan, 2017), whereas students, instructors, and institutions for faculty (Bolliger and Wasilik, 2009; Bolliger et al., 2014). For developing countries, the quality and quantity of e-content and e-resources are far from enough, which is caused by a lack of digital infrastructure (Adnan and Anwar, 2020). Students in rural and underprivileged areas are particularly affected by technological issues such as poor Internet connections and the incompatibility of digital learning platforms with their electronic devices (Adedoyin and Soykan, 2020; Zarei and Mohammadi, 2021). Since student satisfaction is more likely to be influenced by technological issues, it is understandable that more students, not faculty, reported satisfaction with distance education than their counterparts in developing countries.

4.3. Limitations and future study

Despite being a pioneering study examining satisfaction with online education among students, faculty, and parents before and after the COVID-19 outbreak, this meta-analysis has several limitations. First, the number of studies and moderator variables on parent satisfaction is insufficient, which leads to the moderating effect of variables such as the COVID-19 outbreak, whether or not online learning is in an emergency, and the children's learning

phase being unable to be examined. Therefore, more studies related to parents' satisfaction can be collected and further analyzed in the future. Second, there are only two categories for major student variables, namely medical and diverse, since the number of studies on other major variables was less than three. The satisfaction of students in other majors, such as arts, literature, psychology, and business, should also be paid attention to by scholars, as distinct features characterize different disciplines. Third, this study only included published papers and papers written in English. Although publication bias in the meta-analysis is sometimes unavoidable, including unpublished papers and papers in other languages could reduce bias to some extent. Therefore, future follow-up studies could be conducted to explore satisfaction with online education based on more unpublished research and papers in other languages.

5. Conclusion

In this meta-analysis, by aggregating evidence from 52 studies conducted over time with 93,686 participants across 26 countries, it was found that the prevalence of satisfaction with online education among students, faculty, and parents before and after the COVID-19 outbreak was 59.5, 75.3, and 70.7%, respectively, with a significant difference between satisfaction rates of students and those of their faculty and parents. Regarding students, a significantly higher number of students in the pre-pandemic era, non-emergency online environment, and developed countries were more satisfied with online education than their counterparts in the post-pandemic era, emergency online environment and developing countries. Moreover, a significantly higher number of adult education learners were satisfied with online study than K-12 and university students. In terms of faculty, instructors in the non-emergency situation reported almost double the satisfaction rate of their counterparts in emergency circumstances. Therefore, student satisfaction was the lowest compared with faculty and parent satisfaction, and measures can be implemented from four perspectives. First, faculty should put more effort into preparing and designing online courses, which will benefit students and themselves. Second, students should be more encouraged to engage in virtual educational activities. Engaged, responsive, and motivated students tend to express satisfaction, which further contributes to an efficient academic atmosphere (Dziuban et al., 2015). Third, governments, especially in developing countries, should enhance the digital infrastructure to provide more stable internet connections and richer e-resources for students attending online courses. Fourth, e-learning digital platforms should emphasize making their platforms compatible with electronic devices used in developing countries. The result of this meta-analysis is expected to contribute to the field of online education. Educators who specialize in online education hope to understand satisfaction with online education from three standpoints and thus could improve student, faculty, and parent satisfaction constructively.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

TX is responsible for conceptualization, software, and writing original draft. LX is responsible for supervision, reviewing, and editing. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Generational differences in the relationship between media exposure and health behaviors during COVID-19 pandemic

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Based on a questionnaire survey (N=857), this study analyzed generational differences in the public health behaviors of COVID-19 and provided an explanation for generational differences from the perspective of media exposure. There are significant differences in media exposure and health behaviors between the Mesozoic generation (35–55) and the young generation (18–34) during the lull. The Mesozoic generation paid greater attention to information on pandemics. Consequently, their health behaviors surpass that of the young generation. On the basis of social cognitive theory and protection motivation theory, this study develops a mediating model of media exposure on health behaviors, demonstrating that media exposure can influence health behaviors through the mediating effects of perceived severity, self-efficacy, and response efficacy, but not *via* perceived susceptibility. Moreover, a moderated mediation study found that generation moderates the indirect effect of media exposure on health behaviors *via* perceived susceptibility. Media exposure influences Mesozoic healthy behaviors positively by decreasing their perceived susceptibility. The implication of this study is that the development of health communication theory must account for generational differences and disease-specific characteristics.

KEYWORDS

media exposure, social cognitive theory, protection motivation theory, health behaviors, generational differences

1. Introduction

The relentless invasion of the COVID-19 pandemic has drastically altered the spring of 2020, and China was the first nation to be affected. It is the most critical public health emergency since the formation of New China, with the quickest spread, the broadest infectious spectrum, and the most challenging prevention and management (Xinhuanet., 2020). A public health emergency is a situation in which a health threat causes an imminent risk or serious harm to a large population (Haffajee et al., 2014). The public receives a great deal of pertinent information, instructing them to wear masks, take temperature, wash their hands and disinfect more often, stay indoors, etc. Existing research on SARS and MERS has demonstrated that different demographic variables are associated with distinct prevention behaviors in infectious diseases (Brug et al., 2004; Glanz and Bishop, 2010).

At the start of the COVID-19 outbreak, however, "how to persuade parents to wear masks" topped the trending search terms on major social media platforms such like Weibo. Under this issue, many young people complained that their parents paid little attention to COVID-19 and related similar experiences. Some individuals remarked, "If it were not for this pandemic, we might not realize how challenging it is to connect with our parents. They still go out without wearing masks and even mock

us for making a fuss." In addition, research has indicated that during an outbreak of COVID-19, young people are more prone to adopt severe preventive measures and are more likely to express their thoughts on the Internet (Chu et al., 2020). Generational differences in health behaviors are prominent, which some scholars have called "intergenerational battles" (Tang, 2020). why are there generational differences in health behaviors? What are the characteristics and reasons for generational differences? These are the main issues that the study wants to explore.

When public health emergencies arise, people seek information through many channels, with media coverage of the events as the most crucial source (Holland et al., 2012). The Measurement of how people are "exposed" to media content is essential to understanding media use and its effects (De Vreese and Neijens, 2016). Media exposure influences people's perception of the threat, which may ultimately determine their response to the crisis (Coleman and Thorson, 2002). Several studies have shown generational differences in media exposure (Xue et al., 2018).

The literature on media exposure and health behaviors focuses primarily on nonurgent risks, with few studies examining protective actions during a public health emergency (Slater et al., 2007; Siu, 2008). the media exposure of the public during public health emergencies was ignored. Consequently, our study attempts to fill this gap. In addition, media exposure encompasses the audience's contact frequency and substance. However, most relevant studies (Coleman, 1993; Dougall et al., 2005) only examined the frequency of exposure. Therefore, this study will analyze the effects of media exposure from the perspectives of exposure frequency and exposure extensity, which refers to the amount of information the audience is exposed to, enabling them to get a more comprehensive understanding of pandemics (Li, 2018). Besides, the majority of studies mainly relied on legacy media while excluding interpersonal communication (Zhang et al., 2020). This investigation will focus on media exposure at the mass, group organization, and interpersonal levels.

Dutta and Zoller (2009) classify health communication research as post-positivistic, interpretative, critical, and cultural. Based on the tradition of social psychology, the post-positivistic approach emphasizes the analysis of communication and social and psychological variables to explain and predict health behaviors (Dutta and Zoller, 2009; Thompson, 2011). This approach holds a prominent position in the field of health communication research. Under the post-positivistic approach, health communication extensively uses behavioral science theories, such as social cognitive theory and protection motivation theory. And these two theories focus on the effects of communication on the four Social-Cognitive variables of perceived severity, perceived susceptibility, self-efficacy, and response efficacy.

In summary, this research concludes by examining generational differences in health behaviors concerning media exposure and individual psychological and cognitive aspects. The conclusion describes the characteristics of generational differences in health behaviors as well as the mechanisms that provide an impact. It can further illuminate theories on the influence mechanisms between media exposure and health behaviors and improve future health communication effects.

2. Literature review

2.1. Social-cognitive predictors of health behaviors

Various theories of health behavior, including social cognitive theory, protective motivation theory, the extended parallel process model, the health belief model, and the theory of planned behavior, all suggest that socio-cognitive psychology substantially affects health behavior.

Bandura (1986) proposed, from the standpoint of individual cognition, the social cognitive theory, which held that health behaviors are influenced by two cognitive variables: self-efficacy and outcome expectations. Self-efficacy, a central notion of social cognitive theory, relates to a person's perception of their capacity to engage in essential health activities (Bandura, 1997). This idea proposes that strengthening an individual's self-efficacy can effectively enhance health practices (Bandura, 2004). Schunk and Usher (2019) suggest that cognitive elements should incorporate beliefs, perceptions, and emotions. However, previous empirical research has frequently just examined self-efficacy and outcome expectations (Boateng et al., 2016). According to Glanz and Bishop (2010), the social cognitive theory is the most often utilized theory in health behavior research.

Protection motivation theory proposes, based on social cognitive theory, that the intention to conduct a protective behavior is determined by two concurrent cognitive and partially emotional processes: one is threat appraisal, which refers to an individual's evaluation of the potential risk. The threat appraisal consisted of two variables: perceived severity and perceived susceptibility. The coping appraisal refers to an individual's evaluation of his or her ability to deal with danger and typically consists of the variables self-efficacy and response efficacy (Milne et al., 2000). According to the hypothesis, perceived susceptibility, perceived severity, response efficacy, and self-efficacy might favorably influence health behavior (Prentice-Dunn and Rogers, 1986). In addition, empirical research has demonstrated that the protection motivation theory is frequently applied to preventive health behaviors such as physical activity, cancer screening, and substance addiction and possesses superior predictive value (Witte, 1994; Roberto et al., 2007; Gaston and Prapavessis, 2014).

Regarding risk perception and health behaviors, perceived severity refers to the assumption that the consequences of contracting the disease are severe for the individual and others. And perceived susceptibility is a person's perception of their likelihood of experiencing a risk or contracting an ailment or sickness (Tanner et al., 1991). Previous research has demonstrated that both factors significantly influence health behavior adoption (Kasmaei et al., 2014). Regarding efficacy and health practices, Since Bandura (1986) established self-efficacy, numerous empirical researches have demonstrated that self-efficacy positively predicts preventative disease practices (McCann et al., 1995). Response efficacy is related to self-efficacy and refers to an individual's conviction in the success of steps to lower health risks (Witte, 1994). The greater a person's perception of a preventive measure's efficacy, the more likely they are to adopt the practice (Floyd et al., 2000). Numerous studies have demonstrated that response efficacy increases the propensity to protect oneself and others (Lwin et al., 2010).

The study, therefore, focuses primarily on the public's preventive health activities during the COVID-19 pandemic and suggests the following hypothesis:

H1: Perceived susceptibility affects health behaviors positively.

H2: Perceived severity affects health behaviors positively.

H3: Self-efficacy affects health behaviors positively.

H4: response efficacy affects health behaviors positively.

2.2. Media exposure and health behavior

The social cognitive theory proposed a "triadic interaction model" including personal factors, behavior, and the environment (Bandura, 1998). The consideration of environmental factors in social cognitive theory includes both the physical and social environment (Casper, 2001). Additionally, someone pointed out that the protection motivation theory focuses primarily on the influence of personal factors on health behavior and disregards environmental elements (Lebek et al., 2014). Media exposure is a critical socio-environmental factor (Narayan, 2013). The media significantly alter public health perceptions and encourage health behavior (Mullins et al., 2008). Studies demonstrate that mass media health messages can have favorable behavioral impacts (Wakefield et al., 2010). Through meta-analysis, Laranjo et al. (2015) determined that social media use can encourage individual behavior change. Consequently, this study integrates social cognitive theory and protection motivation theory to examine how media exposure influences health behavior by working on intrinsic cognitive mechanisms.

On the one hand, the media is the primary source of risk perception (Keown, 1989). Researchers have discovered that exposure to the news media influences the impression of influenza H1N1 risk (Lin and Lagoe, 2013; Oh et al., 2015). Other research has demonstrated that exposure to health-related news influences people's perceptions of health threats and induces behavioral responses (Wei et al., 2008). In addition, El-Toukhy (2015) found that social media exposure to disease information altered the perception of disease severity and susceptibility. Exposure to COVID-19 material from both mass media and social media enhances perceived severity, perceived susceptibility, and COVID-19 preventative behaviors (Ranjit et al., 2021; Truong et al., 2022).

However, on the other hand, Bandura (1977) believes four key sources produce self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and physiological and affective states. Vicarious experiences and verbal persuasion highlight the impact of external factors on self-efficacy. Undoubtedly, the media may contribute to disseminating vicarious experiences and implementing verbal persuasion (Gibbons et al., 2010). Several studies have demonstrated that media exposure to health-related information can increase an individual's self-efficacy. For instance, Bass et al. (2006) discovered a statistically significant positive association between Internet usage and self-efficacy. Two months of exposure to health information resulted in a considerable rise in self-efficacy among cancer patients, according to Lee et al. (2008). Response efficacy, which relates to the effectiveness of protective behaviors, is also influenced by external factors, including vicarious experience and verbal persuasion. Therefore, it is plausible to hypothesize that media exposure is also an external factor influencing response efficacy. In addition, a study confirms that during the COVID-19 pandemic, media exposure can indirectly influence public health behaviors *via* the mediation effects of self-efficacy and response efficacy (Ma, 2022).

The paper primarily proposes the following hypotheses:

> *H5*: media exposure influences health behaviors positively through the mediation of perceived susceptibility.
>
> *H6*: media exposure influences health behaviors positively via the moderating effect of perceived severity.
>
> *H7*: media exposure influences health behaviors positively via the mediating effect of response efficacy.
>
> *H8*: media exposure influences health behaviors positively through the mediation of self-efficacy.

2.3. Generational differences

A generation is a recognizable group that shares birth years, age range, and critical life experiences throughout crucial developmental phases (Kupperschmidt, 2000). Due to their similar location, people share comparable experiences and hence generate similar thoughts, experiences, and behavior patterns (Mannheim, 2002). Additionally, these unique life experiences distinguish one generation from the next (Jurkiewicz and Brown, 1998). Consequently, generational differences refer to the differences in cognition, attitude, and behavior choice across various generations.

According to research in the field of communication, there are discernible generational differences in media exposure. Regarding media types, the old choose newspapers and television to receive information (Lauf, 2001), while the young prefer the Internet and other electronic media (Pierce et al., 1990). In terms of media content, a study (Dou et al., 2006) reveals that the Chinese × generation pays more attention to television series and other amusement programs and less attention to economic news and other information programs than prior generations.

In addition, scholars consider the consequences of media exposure on various generations' cognition, attitudes, and actions. Putnam (2000) discovered that young heavy Internet users in the United States were more separated from public life, less engaged in social activities, and less trustworthy of their peers. Some research, focusing on health behaviors has shown that the digital divide created by generational differences has a significant impact on people's health levels (Viswanath and Kreuter, 2007; Hong et al., 2017). Moreover, researchers have demonstrated that the influence of media on risk perception varies between populations (Sussman et al., 1989; Snyder and Rouse, 1995). According to Zhou and Yang (2020), the generational gap in the adoption and use of digital media influences the generational gap in "knowing, believing, and doing" regarding health. However, previous research on health behavior mostly tended to consider respondents as a whole, neglecting the diverse effects on distinct populations.

Therefore, it is impossible to generalize whether media exposure to risk information about the COVID-19 pandemic influences relevant preventive health behaviors across generations. Consequently, this study expects that the mediating role of the aforementioned intrinsic cognitive factors in media exposure and health behaviors varies between generations as shown in Figure 1, and asks the following research questions:

> RQ1: Are there significant generational differences in COVID-19 media exposure?
>
> RQ2: Are there significant generational differences in COVID-19-preventive health behaviors?
>
> RQ3: Are the mediating roles of intrinsic cognitive factors (perceived severity, perceived susceptibility, self-efficacy, response efficacy) in

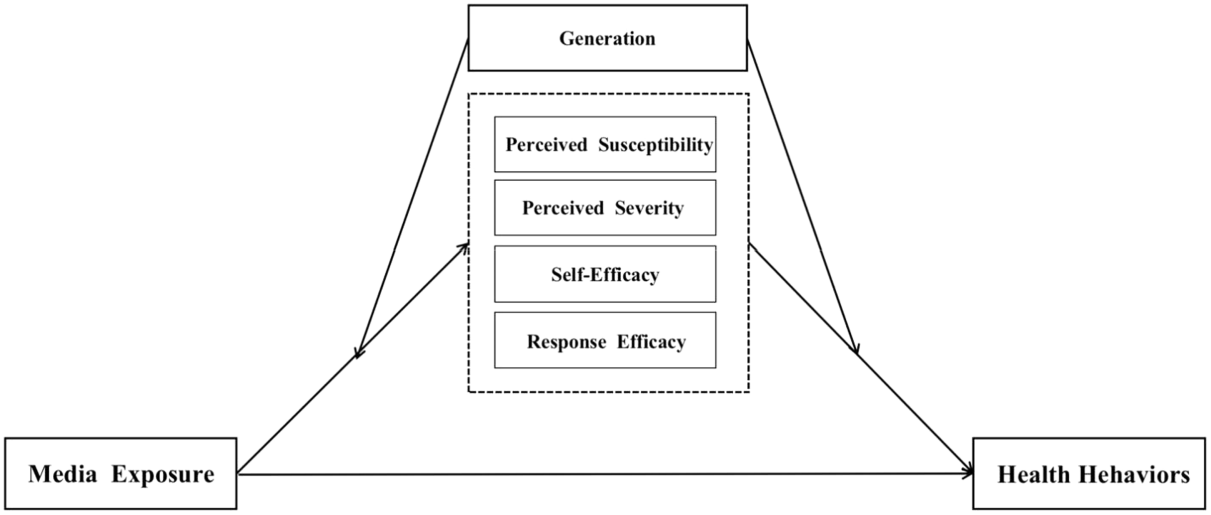

FIGURE 1
The Moderated mediation model to test the influence of generation on the mediated relationship between media exposure and health behaviors.

media exposure and health behaviors moderated varies between generations?

3. Method

3.1. Participants and procedures

From June 28 to July 4, 2020, we conducted a survey using the Tencent questionnaire platform[1] to evaluate the hypotheses. The total sample consisted of 857 Chinese citizens. In the pre-test phase, ambiguous and difficult-to-understand questions were altered based on audience comments. In addition, it is important to note that people's psychological cognition and health behaviors fluctuate at various pandemic stages. When the questionnaire was issued, the pandemic in China had entered a lull. A June outbreak in Beijing raised anxiety, but the situation is again under control. Wenhong Zhang stated in an interview on July 9 that, based on the epidemiological history, the occasional confirmed case is typical and does not result in a rapid spread.

In terms of the procedures, First, an independent sample t-test was adopted for analyzing the health behaviors and media exposure of the young and Mesozoic generations. We then test the association between variables using multiple regression analysis. In addition, to verify the hypotheses proposed, we built a moderated mediation model. an indirect effects analysis was performed with Hayes's (2009) method, testing standard errors *via* bootstrapping using Preacher and Hayes's SPSS macro. And finally, the moderating effect of generations, for both paths of mediating effects, is examined utilizing model 58 in PROCESS.

The general characteristics of the study participants are shown in Table 1. Males made up 47.3% of the sample (405) while females made up 52.7% (452). The majority (73.3%) lived in urban regions, with 71 (8.3%) in junior high school or lower, 149 (17.4%) in high school and technical secondary school, 232 (27.1%) in college, 39.3% (337) having earned a university degree, and others with master's and doctoral degrees. Participants were questioned about any recently confirmed instances in their home. 28% of respondents indicated yes.

3.2. Measurements

Media exposure: frequency of access to news about the COVID-19 pandemic and extensity of news messages accessed from the COVID-19 pandemic (Li, 2018).

In accordance with Li (2018), the extensity of media exposure during a pandemic was determined by how comprehensively one accessed the following news messages: (a) international pandemic situation; (b) domestic pandemic situation; (c) the severe impact of the pandemic (e.g., on individuals, regions, and countries); (d) government prevention and control measures; and (e) knowledge of pandemic prevention and popularization ($\alpha = 0.819$).

The frequency of media exposure was measured by the number of times individuals accessed news about the COVID-19 pandemic *via* the following media channels: (a) Channels of mass communication; (b) Interpersonal channels; (c) Organizational channels; and (d) Social media channels ($\alpha = 0.734$). The frequency and extensity of media exposure were measured using a 5-point Likert scale (1 = never, 5 = frequently). After calculating the scale's weight by principal component analysis, the total score was then determined.

Threat appraisal and Coping appraisal: Refer to the scale created and validated by Witte (1994) and use principal component analysis to derive factors for 12 items. There was a total of four components, the KMO value was 0.763, Bartlett's sphericity test level was 0.000, and the explainable variance was 70.75%. The four factors are as follows: perceived susceptibility, a total of three items, including "I am at risk of contracting Covid-19" ($\alpha = 0.897$); perceived severity, a total of three items, including "I believe once I have Covid-19 it may be life-threatening" ($\alpha = 0.709$); self-efficacy, a total of two items, including "I think my physical fitness can resist the virus" ($\alpha = 0.674$); response efficacy, a total four items in all, including "I believe wearing masks and engaging in other preventive actions can effectively contain the pandemic" ($\alpha = 0.788$).

1 https://wj.qq.com

TABLE 1 Descriptive statistical analysis of samples.

Category	Variable	*N* (%)	
Gender	Male	405	47.3
	Female	452	52.7
	Total	857	100
Education level	Junior high school or lower	71	8.3
	High school, technical secondary school	149	17.4
	College	232	27.1
	Undergraduate	337	39.3
	Postgraduate	68	7.9
	Total	857	100
Residence	Urban	628	73.3
	Rural	229	26.7
	Total	857	100
Exist any newly confirmed cases in your region?	Yes	247	28.8
	No	610	71.2
	Total	857	100

Health behaviors: During the pandemic, the media promotes preventative health behaviors including wearing masks, frequent hand washing, frequent disinfection, and avoiding gatherings. After the incident, some experts reiterated the significance of using public chopsticks or serving chopsticks. In addition, the media widely publicized the advantages of using public chopsticks. Respondents scored their self-assessment on preventive behavior measures, such as wearing masks, washing hands, disinfecting furnishings or workspaces, avoiding gathering activities, and utilizing public chopsticks (1–5 points for each item, $\alpha = 0.819$).

Generation is the central variable in our investigation. The division of generations occurs in various ways. This study refers fully to Xue et al.'s (2018) practice of dividing generations based on variations in media use and the practice of separating generations based on differences in preventive behaviors (Kim and Crimmins, 2020), dividing the interviewees into two generations: the young generation, inhabitants under the age of 34, and the Mesozoic generation, residents between the ages of 35 and 55. Due to the limits of online questionnaires, it is not possible to collect data on a large number of inhabitants beyond the age of 55. Hence this study focuses on the young generation (18–34) and Mesozoic generation (35–55).

4. Results

4.1. Descriptive statistics and variance analysis

Table 2 reveals that the content of media exposure ($M = 4.16$; SD = 0.68) is extensive and the frequency of media exposure is high, indicating that people continue to pay close attention to the COVID-19 pandemic during the calm phase. In addition, public health behaviors have a high score ($M = 4.11$; SD = 0.80), which demonstrates their voluntary adherence to healthy behavior norms. Moreover, response efficacy ($M = 4.25$; SD = 0.73) was the highest perception of the pandemic, followed by perceived severity ($M = 3.62$; SD = 0.97), self-efficacy ($M = 3.33$; SD = 0.97) and perceived susceptibility ($M = 1.84$; SD = 1.01). With the pandemic effectively under control, the number of confirmed cases in all but a few regions have been reduced to zero. Therefore, the perceived susceptibility of individuals is not high. And The analysis of correlation between variables also gives conditions for further regression and mediation analyses. According to Table 2, in addition to perceived susceptibility, perceived severity, self-efficacy, and response efficacy are positively related to the frequency ($r = 0.18$; $r = 0.44$; $r = 0.36$) and the extensity ($r = 0.27$; $r = 0.20$; $r = 0.42$) of media exposure and health behaviors ($r = 0.23$; $r = 0.23$; $r = 0.47$). However, there is a negative correlation between perceived susceptibility and self-efficacy ($r = -0.07$), response efficacy ($r = -0.07$), which will be discussed further in the subsequent analysis.

The independent sample *t*-tests were then used to assess the generational differences in media exposure and health behaviors between the young and Mesozoic generations. Regarding media exposure frequency, there were no discernible changes between the two generations. Specifically, as indicated in Table 3, there is a significant difference between the Mesozoic and young generations in terms of interpersonal media exposure channels ($t\,(857) = -1.97$, $p = 0.05$). Mesozoic exposure frequency on interpersonal channels ($M = 3.66$; SD = 1.05) is substantially greater than that of young individuals ($M = 3.53$; SD = 0.97). The average difference in score is −0.138 (d = −0.13), 95%CI = [−0.275.0.000]. Moreover, there is a significant difference between these two generations on organizational channels ($t\,(857) = -3.22$, $p = 0.001$). The frequency of Mesozoic exposure to organizational channels ($M = 3.62$; SD = 1.12) is substantially more than that of the young ($M = 3.37$; SD = 1.11). The average difference in score is −0.249 ($d = -0.22$), 95 percent CI = [−0.401, −0.097]. And there is a substantial difference between the two generations in terms of media exposure intensity ($t\,(857) = -4.14$, $p < 0.001$). The score of the Mesozoic public ($M = 4.27$; SD = 0.68) is higher than that of the young ($M = 4.08$; SD = 0.67), The average score difference is −0.19 ($d = -0.28$). 95%CI = [−0.287, −0.102]. During the pandemic pause, the Mesozoic generation was substantially more interested in pandemic-related news than the young generation.

In addition, the results reveal noteworthy changes in health behaviors between the two generations ($t\,(777.95) = -2.08$, $p = 0.004$). The behavior score of the Mesozoic ($M = 4.24$; SD = 0.72) is significantly higher than that of the young ($M = 4.09$; SD = 0.79) The average difference in scores is −0.15 ($d = -0.20$). 95% CI = [−0.283, −0.070]. Specifically, as demonstrated in Table 4, the Mesozoic outperformed the young regarding frequent hand washing, avoidance of gathering activities, and use of public chopsticks. This conclusion is opposite to the mockery made at the onset of the pandemic by the younger generation, who complained that their parents and elders were unwilling to take preventative precautions. It also suggests that there are still generational differences in health behaviors during the relative calm after the pandemic.

4.2. The mediating effects of cognitive factors

The first four hypotheses predicted that health behaviors would be positively related to perceived severity, perceived susceptibility, self-efficacy, and response efficacy. These hypotheses were tested using multiple linear regression while controlling for participant gender, education level, area, and regional risk. An F-test of the model, $F\,(8, 948) = 36.17$, $p < 0.001$, Adjusted $R^2 = 0.247$ was significant. See Table 5 for full information. Perceived severity ($\beta = 0.12$, $p < 0.001$), self-efficacy ($\beta = 0.12$, $p < 0.001$) and

TABLE 2 Mean value, standard deviation and correlation coefficient of each variable.

Variables	*M*	SD	1	2	3	4	5	6	7	8	9	10	11
1. Frequency	3.88	0.74	/	0.56**	0.30**	−0.17	0.18**	0.18**	0.36**	0.12	0.44	−0.52	−0.03
2. Extensity	4.16	0.68		/	0.41**	0.03	0.27**	0.20**	0.42**	0.66	0.38	−0.14**	−0.04
3. Behaviors	4.11	0.80			/	−0.06	0.23**	0.23**	0.47**	0.95**	−0.04	−0.05	−0.03
4. Susceptibility	1.84	1.01				/	0.31**	−0.07*	−0.07*	−0.07*	−0.05	−0.06	−0.74*
5. Severity	3.62	0.97					/	−0.05	0.32**	−0.01	−0.08*	−0.05	−0.05
6. Self-efficacy	3.33	0.97						/	0.28**	0.06	0.04	−0.11**	−0.02
7. Response efficacy	4.25	0.73							/	0.02	0.05	−0.10**	0.02
8. Gender	/	/								/	−0.04	−0.04	−0.02
9. Education level	/	/									/	−0.21**	−0.19**
10. Residence	/	/										/	0.15**
11. Regional risk	/	/											/

*$p<0.05$, **$p<0.01$.

TABLE 3 An analysis of differences in media exposure between generations.

	Young generation	Mesozoic generation	Sig.
Mass communication channels	4.22 ± 0.93	4.25 ± 0.89	0.64
Interpersonal channels	3.53 ± 0.97	3.66 ± 1.05	0.05
Organizational channels	3.37 ± 1.11	3.62 ± 1.12	0.001
Social media channels	4.28 ± 0.84	4.19 ± 0.95	0.13

TABLE 4 An analysis of differences in health behaviors between generations.

	Young generation	Mesozoic generation	Sig.
Wearing masks	4.22 ± 0.93	4.25 ± 0.89	0.46
Frequent hand washing	4.33 ± 0.87	4.53 ± 0.76	0.001
Frequent disinfection	3.86 ± 1.13	3.96 ± 1.06	0.18
Avoiding gathering activities	4.21 ± 0.96	4.38 ± 0.88	0.008
Using public chopsticks	3.77 ± 1.22	4.01 ± 1.14	0.003

response efficacy ($\beta=0.40$, $p<0.001$) all exhibit substantial beneficial effects on health behaviors, however perceived susceptibility has a negative influence on health behaviors ($\beta=-0.07$, $p=0.039<0.05$). Thus, hypotheses 2, 3, and 4 are supported, while hypothesis 1 is not. Regarding the control variables, multiple linear regression analysis reveals that gender substantially influences health behaviors ($\beta=0.15$, $p=0.015<0.05$). This indicates that women's health behaviors are superior to men's. In addition, education level has a marginally significant negative effect on health behaviors ($\beta=-0.05$, $p=0.072$), meaning that the health behaviors performance of the public with a higher education background is not as excellent as that of the public with a lower education background. Lastly, the data indicates that regional risk and whether a location is urban or rural have no meaningful effect on health behaviors.

Furthermore, bootstrapped confidence intervals (at the 0.05 level with 1,000 re-samples) were examined to check the indirect effect. If the confidence interval does not contain zero, it indicates a significant indirect effect. Indirect effects of media exposure and health behavior accounted for 47%. The results showed that media exposure indirectly influenced health behaviors by perceived severity (H6; 95% CI [0.002, 0.028]), self-efficacy (H7; 95% CI [0.01, 0.03]), response efficacy (H8; 95% CI [0.08, 0.14]), but not by perceived susceptibility (H5). In addition, the path represented by H8 has the most substantial mediation impact. Thus, through increasing response efficacy, media exposure can better improve the health behaviors of individuals (Table 6).

4.3. The moderating effect of generation

Model 58 in PROCESS was utilized to evaluate the moderated mediation model to answer RQ3. The findings revealed that generation moderated both of the routes represented by H8. The results are shown in Table 7. Interaction of media exposure and generation predicts perceived susceptibility, $\beta=-0.10$, SE = 0.05, $p=0.05$. Interaction between perceived susceptibility and generation predicts health behaviors considerably, $\beta=-0.13$, SE = 0.06, $p<0.05$. The mediated conditional effect on perceived susceptibility was negative for the Mesozoic generation, $\beta=-0.09$, SE = 0.04, 95%CI [−0.17, −0.004], whereas it was not significant for the young generation. Additionally, the conditional effect of perceived susceptibility on health behavior was negative for the Mesozoic generation, $\beta=-0.15$, SE = 0.05, 95%CI [−0.24, −0.05], but insignificant for the young generation.

Moreover, the indices of moderated mediation differed from zero for health behaviors (coefficients were 0.01). This indicated that the indirect effects of media exposure through perceived susceptibility on health behaviors differed for young and Mesozoic generations. For the Mesozoic generation, the indirect effect of media exposure on health behavior was positive, coefficient = 0.01, SE = 0.01, 95%CI [0.0009, 0.0284]. However, For the young generation, the indirect effect of media exposure on health behavior was insignificant. The above reflects the differential effect of the applicability of protection motivation theory among generations in public health events.

5. Conclusion and discussion

Firstly, for RQ1 and RQ2 provided in this study, the independent sample *t*-test results revealed that the young and Mesozoic had substantial generational differences in media exposure extensity and health behaviors. After the virus is controlled, the young generation's media attention swiftly moves to other issues, while the Mesozoic continues to pay close attention to pandemic-related information. In addition, the Mesozoic generation is more likely to get the relevant information through organizational and interpersonal channels. Therefore, they are more likely to use knowledge about the pandemic in dinner conversations. In addition, research has demonstrated that interpersonal pathways are crucial for encouraging beneficial behavior changes (Yang and Chao, 2021). As a result of the Mesozoic's heightened media attention, their health behaviors were superior to those of the young. As wearing a mask is a mandatory code of conduct in many public places, there is no evident age difference in this regard. However, there are significant generational differences in avoiding gathering activities, washing hands and disinfection, and using public chopsticks. In addition, how can it be explained that young people will complain online about their parents and elders not adopting the appropriate preventive measures in the early stages of the pandemic, when the virus is very contagious, in contrast to the study's findings? On the one hand, generational differences in health behaviors may show up in a variety of ways depending on the stage of the outbreak. However, as was already indicated, research has shown that during the pandemic, young people expressed their thoughts on contentious subjects more frequently online. The Mesozoic generation may suffer from widespread aphasia, and conclusions drawn from Internet public opinion may not be accurate reflections of reality.

Then, based on social cognitive theory and protection motivation theory, this research examines the impact of social-cognitive predictors on health behaviors and then develops a mediating model of media exposure on health behaviors. Multiple regression analysis indicated that perceived severity (H2), self-efficacy (H3), and response efficacy (H4) all had favorable effects on health behaviors, but contrary to expectations, perceived susceptibility (H1) had an adverse impact on health behaviors. And media exposure can influence health behaviors *via* the mediating effects of perceived severity (H6), self-efficacy (H7), and response efficacy (H8), but not *via* perceived susceptibility (H5), of which the path (H8) is the most influential. This indicates that media exposure is most effective at influencing health behaviors by improving their response efficacy during flattening periods. In addition, for RQ3, moderated mediation analysis revealed that generation moderates the indirect influence of media exposure on health behaviors *via* perceived susceptibility. Media exposure had a positive indirect effect on the health behavior of the Mesozoic generation. However, this indirect effect was not substantial for the young population. Specifically, media exposure adversely affected the Mesozoic's perceived susceptibility, which has a negative effect on their health behaviors. Thus, media exposure positively affects Mesozoic health behaviors by reducing their perceived susceptibility.

At the time of the study, the pandemic in China had reached a plateau, and except for sporadic confirmed cases, most areas had been cleared of confirmed cases. Therefore, the media is no longer a source of risk information but instead emphasizes the pandemic's positive status and prevention knowledge. During this period, the Mesozoic continues to pay close attention to information on the pandemic, thereby decreasing their susceptibility. What 's more, the relationship between risk perception and health behaviors is complex. Previous studies have inconsistent conclusions on the effects of perceived susceptibility and perceived severity on health behaviors. Both negative and positive associations were found in the studies investigating the relationship between risk perceptions and behaviors. Through meta-analysis, the researchers believe that a considerable part of these inconsistent conclusions is methodological issues, such as replacing behavior with behavior intentions, not setting risk conditions, etc. (Brewer et al., 2007). Some experts have also indicated that optimism bias influences respondents' evaluations of health threats (Weinstein, 1987). The

TABLE 5 Results of multivariate linear analysis for perceived susceptibility, perceived severity, self-efficacy and response efficacy on preventative health behaviors.

Variables	β	SE	t	p	Adjusted R^2
Regional risk	−0.09	0.07	−1.35	0.176	
Area	0.01	0.07	0.10	0.921	
Education level	−0.05	0.03	−1.80	0.072	
Gender	0.15	0.06	2.45	0.015	
Perceived susceptibility	−0.07	0.03	−2.06	0.039	
Perceived severity	0.12	0.03	3.59	<0.001	
Self-efficacy	0.12	0.03	3.71	<0.001	
Response efficacy	0.40	0.03	11.75	<0.001	0.247

The figures are standard coefficients.

TABLE 6 Testing the mediation effect of media exposure on health behavior through response efficacy, self-efficacy, perceived severity, and perceived susceptibility.

	Effect	BootSE	BootLLCI	BootULCI	Relative effect ratio
TOTAL	0.14	0.02	0.11	0.18	47%
A1	0.11	0.02	0.08	0.14	37%
A2	0.02	0.01	0.01	0.03	7%
A3	0.01	0.01	0.002	0.028	2%
A4	0.001	0.002	−0.002	0.005	
(C1 = A1–A2)	0.09	0.02	0.06	0.13	
(C1 = A1–A3)	0.09	0.02	0.06	0.12	

The figures are standard coefficients; A1 = response efficacy; A2 = self-efficacy; A3 = perceived severity; A4 = perceived susceptibility.

TABLE 7 Moderated mediation analysis.

Predictors	Mediator=perceived susceptibility		DV=health behaviors	
	β	SE	β	SE
Intercept	−0.05	0.11	−0.02	0.09
Response efficacy	−0.18***	0.04	0.32***	0.03
Self-efficacy	0.0001	0.03	0.10***	0.03
Perceived severity	0.38***	0.03	0.11***	0.03
Media exposure	0.11	0.08	0.15***	0.03
Generation	0.03	0.07	0.07	0.06
Media exposure * Generation	−0.10*	0.05	–	–
Perceived susceptibility	–	–	0.12	0.09
Perceived susceptibility * Generation	–	–	−0.13*	0.06
Direct and indirect effects	Coefficient	95% CI	Coefficient	95% CI
Conditional effects				
Young generation	0.01	−0.06, 0.08	−0.01	−0.09, 0.06
Mesozoic generation	−0.09*	−0.17, −0.004	−0.15**	−0.24, −0.05
Conditional indirect effects				
Young generation			−0.0002	−0.003, 0.003
Mesozoic generation			0.01	0.0009, 0.0284
Index of moderated mediation			0.01	0.0005, 0.0286

Coefficients presented are standardized estimates. *$p<0.05$, **$p<0.01$, ***$p<0.001$.

optimism bias may lessen the perceived need to avoid unfavorable outcomes by engaging in healthy practices (Larsman et al., 2012). Druică et al. (2020) define optimism bias as the tendency to estimate a lower likelihood of experiencing negative health events than others. COVID-19 is a pandemic with a long incubation period, highly contagious, and highly dependent on crowd interaction for transmission, making all members of society universally susceptible compared to other health topics such as skin cancer (Yi et al., 2020). However, the perceived susceptibility measure in the study centered on the evaluation of oneself being infected with the virus, and the findings revealed a low perceived susceptibility ($M=1.84$; SD = 1.01). And new research has confirmed the optimism bias of the COVID-19 instance in China (Today.uconn.edu, 2020). In light of this, it is feasible to speculate that there is an optimism bias in the public's perception of the current risk. Both Druică et al. (2020) and Chowdhury et al. (2014) found that optimism bias increases with age. Hence, the effect of susceptibility on health behaviors may be more strongly adversely moderated by optimism bias in the Mesozoic generation, reducing their intention to engage in health behaviors.

In addition, a multiple regression study revealed that education level has a marginally significant negative influence on health behaviors. And the variables' correlation analysis (shown in Table 2) revealed that education level was adversely associated with perceived severity. This indicates that those with higher levels of education are more hopeful about the pandemic situation in the country, hence decreasing their willingness to engage in health activities. A comparable study (Zhang et al., 2020) also revealed that persons with relatively low levels of education exhibited increased anxiety and concern for themselves during the pandemic. This may have a convincing explanation according to the extended parallel process model. In line with protective motivation theory, the extended parallel process model validates the positive impacts of perceived severity, perceived susceptibility, self-efficacy, and response efficacy on health behaviors (Witte and Allen, 2000). Nonetheless, it claims that individuals do not develop additional cognitive or affective responses when the perceived threat is low and that people's preventative behaviors are only driven when they perceive a sufficient level of threat in response to risk information.

Furthermore, the implication of this study is that the development of health communication theory must take into account the different effects of generations and the disease-specific characteristics. Future study can build and enhance the existing theory by testing the applicability of each variable in specific situations. And when the current pandemic enters a lull and the Chinese government continues to stress the importance of maintaining healthy preventative behaviors, effective health communication is crucial. In this sense, we propose that positive information about the pandemic should be shared alongside risk information in order to heighten the public's risk perception and encourage preventive behaviors. Moreover, in future health communication, due to systematic differences between generations in terms of external environmental exposure and cognitive-psychological factors, risk communication should focus on refined and precise services, and differentiated measures should be taken for various groups in terms of media channels and media content. For instance, to persuade the Mesozoic generation, the interpersonal and organizational channels should be emphasized, whereas, for the young generation, government officials can use social media to widely disseminate information about the pandemic and adopt novel content forms to attract their attention. Since optimism bias is one of the primary barriers to engaging in risk reduction practices, future risk communication programs should explore ways to correct this misunderstanding.

In conclusion, the main limitations of this article are reflected in: First, because of the use of cross-sectional data, the causal effect relationship cannot be adequately tested. Meanwhile, the actual behavior data cannot be obtained through self-assessment questionnaire. The

behavior measurement in the questionnaire actually measures attitudes and concepts toward health behaviors. Additionally, due to the limitations of online surveys, it was impossible to pay attention to the old generation, that is, the public above 55, and only compared the Mesozoic and the young generation. As marginalized groups utilizing new media, their media exposure and health behaviors in public health events deserve consideration; Lastly, generation is a topic worthy of consideration, and explaining generational differences in health behavior due to media exposure is only one perspective. To attempt a fuller understanding of generational difference in health behavior, it will be important to do additional qualitative research on topics such as generational differences in culture. Some researchers suggest cultural differences may exist in the association between risk perception and health behavior (Lau et al., 2010).

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

RH contributed to the conception, data analysis, and manuscript writing of the study. JH contributed to parts of the conception, data analysis, and manuscript writing of the study. HZ contributed to the literature obtaining and analysis, manuscript writing, and performed the analysis with constructive discussions of the study. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Teachers' post-pandemic outlook on the role of Technological and Pedagogical Content Knowledge in coping with burnout under adverse conditions: How a job demand transformed into a job resource

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Introduction: The sudden change of instructional mode from face-to-face to online teaching during the COVID-19 pandemic forced teachers to develop their ICT skills and knowledge to cope with newly imposed job pressures. The imbalance between job demands and resources in this context led to teachers' severe burnout. This retrospective study utilized a mixed methods approach to examine teachers' coping mechanisms, Technological and Pedagogical Content Knowledge (TPACK), and job burnout amid the COVID-19 pandemic.

Methods: Data were gathered from 307 teachers on their experience of emergency remote teaching (ERT) at the time they returned to school in the Spring of 2022. Structural Equation Modeling was used to investigate the mediating role of TPACK in the relationship between coping strategies and burnout.

Results: The results revealed direct effects in the pathways of avoidant, active positive, and evasive coping to burnout highlighting the role of avoidant strategies in harming teachers' well-being and problem-focused strategies in promoting teachers' mental health. Also, indirect effects of active positive coping to burnout through TPACK, as a constructive approach to fighting back the crisis, were verified. Further, the direct effect of TPACK on burnout as a hindrance was significant, showing that higher levels of TPACK guaranteed lower job burnout and emotional drain. Analyzing interviews with 31 teachers revealed that TPACK functioned as a stressor at the outset of the pandemic and a resource for overcoming the strain and resolving the challenges in the midst of the crisis till schools reopened.

Discussion: The findings underscore the significant role of teachers' updated knowledge base in reducing their job pressure and taking proper decisions to cope well with unforeseen circumstances. The study has practical implications for policymakers, teacher educators, and school administrators to pay immediate attention to collective wisdom, organizational support, and technological infrastructures for improving teachers' well-being and professional success.

KEYWORDS

burnout, coping strategies, COVID-19, post-pandemic, TPACK

1. Introduction

The prolonged crisis of the COVID-19 pandemic imposed adverse living and working conditions on people from all walks of life and particularly placed intolerable burdens on teaching professionals who have already been evidenced to suffer from severe job burnout in normal conditions. The imbalance between the excessive job demands and insufficient resources that took some time to be redressed caused considerable stress, fatigue, and strain and eventually high levels of job burnout among teachers and educators (Padmanabhanunni et al., 2022).

Job-related causes of burnout during the pandemic have been extensively researched during the last 2 years. While the origins of job burnout like workload and role conflict and ambiguity have already been documented prior to the pandemic (Bakker et al., 2007), their influence on teachers' job burnout in this period seems to be more profound. The possible justification for this could be the crucial role of technology in sustaining education during lockdowns and the way technology was inextricably interwoven with all educational activities of the teachers, students, and school staff. In normal situations, change on a massive scale like this takes place as "a process through which people and organizations move as they gradually come to understand and become skilled and competent in the use of new ways" (Hall and Hord, 2006, p. 4). *Time* as a key element in the diffusion of new ideas underscores the importance of gradual adoption of change as a process through which an innovation is diffused and normalized within a social system through communication channels (Rogers and Scott, 1997). As a result of this deficient and sudden change, key members of the education sector were pressed into managing a variety of educational technology challenges (Oyedotun, 2020).

In this stressful situation, the teachers continuously appraise and reappraise their troubled relationship with the environment (Lazarus and Folkman, 1984) trying to find the answer to "What can I do" (Lazarus and Folkman, 1984, p. 142) to alleviate the concomitant sufferings of the pandemic. Personal resources such as resilience (e.g., Padmanabhanunni et al., 2022), attitudes (e.g., Daumiller et al., 2021), efficacy (Sokal et al., 2020), and adoption of coping strategies (e.g., Wang et al., 2022) are among the documented efforts to deal with the stressors.

Considering the central role of ICTs in the unprecedented change of face-to-face instruction to online teaching, some technology-related variables including attitudes toward change (Daumiller et al., 2021), previous ICT training (Stang-Rabrig et al., 2022), and Internet/device access and connection quality (Kamal and Illiyan, 2021) have been sparingly examined to shed more light on their contribution to the status of teachers' mental health during the pandemic. In this framework, very few researchers have shown interest in the interdependence of teachers' ICT skills and knowledge, job burnout, and coping mechanisms (e.g., Stan, 2022), in spite of the fact that technological and pedagogical content knowledge (TPACK) has been documented to be related to teachers' technostress in pre-pandemic studies (Kay, 2008; Joo et al., 2016). To address this lacuna in research, the current study assumes a key role for TPACK as one essential resource that can assist teachers in adopting coping strategies to manage their job burnout during the pandemic.

2. Review of literature

2.1. Teachers' burnout during the COVID-19 pandemic

Teachers feel emotionally exhausted and extremely drained as a result of the unrelenting pressures of their working condition that has been exacerbated during the pandemic. The sudden shift from face-to-face instruction to online teaching, or emergency remote teaching (ERT) as it is called, generated unprecedented job demands for which the teachers were unprepared and untrained (Etchells et al., 2021). Looking carefully into the lived experiences of teachers during this time is indicative of teachers' deterioration of mental and physical health (Wakui et al., 2022) exhibiting the symptoms of moderate to high job burnout (Sokal et al., 2020).

Burnout is "a psychological syndrome emerging as a prolonged response to chronic interpersonal stressors on the job" (Maslach and Leiter, 2016, p. 103). Burnout consists of three dimensions of emotional exhaustion, i.e., the feeling of being drained of emotional and physical resources; depersonalization of others, i.e., emotional or cognitive disconnection from work; and loss of personal accomplishment, i.e., the feeling of lacking efficacy, attainment, and productivity in work (Maslach, 2015).

Teachers' burnout during the pandemic has been examined in relation to two sets of working conditions, that is demands and resources, based on the assumption that "burnout results from high job demands and poor job resources" (Schaufeli and Taris, 2014, p. 46). Adopting new approaches to planning lessons and instructional practices (Honigsfeld and Nordmeyer, 2020), learning to work with new platforms and introducing them to students (Etchells et al., 2021), longer working hours (Kaufman and Diliberti, 2021), and keeping students engaged in online classes (Kaup et al., 2020) are among the job demands teachers faced unexpectedly while organizational resources such as support from the school staff or colleagues were not widely available.

What is most noteworthy here is that both Job-Demands-Resources (JD-R) model (Demerouti et al., 2001) and the three-dimensional view of burnout (Maslach, 2015) offer liberal interpretations of how job burnout and coping strategies are associated. Leiter (1989), presumably backed by Maslach (2015), put forward the proposal that the three dimensions of burnout can be viewed in terms of the stress–strain-coping framework of Lazarus and Folkman (1984). In this way, emotional exhaustion is associated with strain (Leiter, 1989; Maslach, 2015); depersonalization is linked to the notion of coping (Lee and Ashforth, 1990) and personal distancing; and personal accomplishment represents self-evaluation and inefficacy (Maslach, 2015) that is "an outcome of the stress–strain-coping sequence" (Leiter, 1989, as cited in Lee and Ashforth, 1990, p. 744).

In the same vein, in trying to propose a multilevel model of burnout, Bakker and de Vries (2021) elaborate more on how avoidant coping strategies within the framework of self-regulation are maladaptive, and as individuals' levels of job strain and burnout raise, they become less capable of selecting a coping strategy that suitably matches the demands of the situation. They further underscore the role of coping flexibility as the ability to use diverse coping strategies so that the adjustment to situational demands is fostered to cope with job stress.

2.2. Teachers' coping with job burnout during the COVID-19 pandemic

Coping strategies are "constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person" (Lazarus and Folkman, 1984, p. 141). Coping strategies compose different distinctions and groupings as a result of alternative interpretations of coping theoretical underpinnings, psychometric research, or different labeling of the same strategies. Within the appraisal model, coping strategies are of two types: problem-focused coping strategies used to alter the pressure by doing something about it; and emotion-focused used to regulate the negative feelings toward the source of stress. With the rationale that coping strategies are of a more complex nature than identified in the appraisal model, the multidimensional model of coping strategies has identified distinct aspects of problem-focused and emotion-focused coping strategies (Carver et al., 1989). Coping strategies can be grouped into engagement (approach) and disengagement (avoidant) strategies as well (Carver and Connor-Smith, 2010). Approach coping strategies assist in dealing with the stressor and related emotions (e.g., acceptance, positive reframing, active coping), whereas avoidant strategies are used to escape from the threat or related emotions (e.g., denial, self-distraction, and venting).

The association between coping strategies and job burnout, stress, or well-being among healthcare workers has been extensively researched during the pandemic, but empirical work in this regard is scant in the domain of education. The findings of a few studies done on the subject support positive correlations of psychological outcomes (well-being, health, happiness, resilience, and growth during trauma) with approach coping and their negative correlations with avoidant coping among an international sample of teachers (MacIntyre et al., 2020). Nigerian teachers' burnout is reported to be positively related to their emotion-focused, problem-focused, and dysfunctional coping strategies (Ozoemena et al., 2021), while Iranian teachers' apprehension has been found to be negatively influenced by approach coping strategies and positively by avoidant coping strategies (Nazari et al., 2022). In their study of Canadian practicing teachers, Wang et al. (2022) reported that teachers who are classified as adaptive copers have shown the highest levels of enjoyment in teaching and job satisfaction, the lowest levels of negative emotions in teaching (anxiety, anger), and the lowest levels of burnout (emotional exhaustion) and quitting intentions. Examining the coping strategies and mental health across three groups of distressed, moderately stressed, and self-efficacious South African teachers, Marais-Opperman et al. (2021) reported a significant difference among them: teachers with a distressed profile who used self-blame as a coping strategy had poor mental health, while those with a self-efficacious profile and religion as a coping strategy had better mental health.

What seems to be neglected in this research arena is the role of teachers' technological skills and knowledge in their job burnout during the pandemic and its relation to adopting coping strategies. It is assumed that the knowledge of ICTs assisted teachers in coping with their stress and depression and enabled them to maintain their well-being and sustain their students' education in the midst of the crisis.

2.3. Emergency remote teaching and teachers' ICT knowledge and skills

Unarguably, *technology* is the crux of the issues educationalists, students, and parents dealt with during the COVID-19 pandemic. Central to this recurrent theme of research is teachers' way of handling online classes by demonstrating their technological knowledge and skills. In the condition that all educational services were given and received through the screen of computers or mobile phones, the quality of education was largely judged through the lens of teachers' mastery of holding and managing online classes.

Teachers' body of knowledge, competencies, and skills of integrating technology within teaching is framed in TPACK scheme (Koehler and Mishra, 2009). Being built on Shulman's (1986) construct of pedagogical content knowledge (PCK), TPACK is a complex interaction of three layers of knowledge, i.e., technology, pedagogy, and content (Yurdakul et al., 2012); and the creation of the knowledge that goes beyond these three separate knowledge bases (Koehler et al., 2013). There are seven components in the TPACK framework including technological knowledge (TK), pedagogical knowledge (PK), content knowledge (CK), pedagogical content knowledge (PCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and TPACK. TPACK is a practical framework for both describing the type of knowledge the teachers are required to have to integrate technology into teaching a given content using appropriate instructional approaches and technologies, and delineating how they can develop this knowledge base (Schmidt et al., 2009).

Technological and Pedagogical Content Knowledge is one of the widely researched areas of educational technology. The main themes of related research include model evolution, TPACK for specific subject domains, teachers' beliefs about TPACK, TPACK measures (Voogt et al., 2013), and the association between TPACK and teachers' personal characteristics (Cheng and Xie, 2018). In this framework, the reciprocal relationship between TPACK and technostress seems to have a wider sphere of influence on technology use in teachers' instructional practices as technostress has been reported to be inversely linked to teachers' TPACK (Ozgür, 2020) and notably, TPACK has significant effects on teachers' technostress (Joo et al., 2016).

Technological and Pedagogical Content Knowledge as an internal resource (Joo et al., 2016) and one of the key factors to cope with technology-induced psychological stress (Ozgür, 2020) is expected to reduce job burnout, a part of which is constructed by technostress. Technostress is a strong sense of anxiety created as a result of the "inability to cope with the new computer technologies in a healthy manner" (Brod, 1984, p. 16). This negative feeling about technology use is reported to be inversely associated with teachers' job satisfaction and efficacy (Lee and Lim, 2020), ICT integration (Rahimi and Yadollahi, 2011), and intention to use technology (Joo et al., 2016).

A few studies that have examined the role of teachers' technological self-efficacy and skills in their job well-being or burnout have yielded mixed findings. Stang-Rabrig et al. (2022), for instance, investigated the relations of teachers' occupational well-being (stress, exhaustion, job satisfaction) with job resources (e.g., support from colleagues), job demands (e.g., technical difficulties), and personal resources (e.g., self-efficacy with digital media). Surprisingly, the findings revealed positive relations between teachers' previous ICT

usage and perceived stress and exhaustion. In another study, Stan (2022) examined the additional value of TPACK in explaining the relation between job burnout and job-related affective well-being over and above personality traits. The result showed that teachers' TPACK was negatively related to job burnout and positively related to well-being.

This puzzling paradox puts teachers' TPACK under the spotlight as having either a facilitative or a debilitative role in the relationship between teachers' coping mechanisms and job burnout during the pandemic. Day et al. (2019) have earlier noted the potential paradox of ICTs and worker well-being in terms of ICT autonomy, social connectivity, and productivity within iParadox Triad scheme. This means that ICTs can be both a job demand and resource depending on teachers' appraisal of the strain, the construal of job burnout in the context of stress, and the deployed coping strategies. Given the scarcity of research in this domain, the current study examines the role of TPACK in the relationship between teachers' coping mechanisms and their job burnout during the pandemic. The originality of this study is reflected in its design and the way the variables are studied and measured. The retrospective nature of the study demands the participants' contemplation of how they went through the crisis and sustained their professional success amid adverse conditions. The mixed methods approach urges both quantitative and qualitative data gathering and analysis and thus leads to a more in-depth understanding of the interrelationship among the variables.

3. The structural model

In the current study, the role of TPACK in teachers' coping strategies with job burnout amid the COVID-19 pandemic is given careful scrutiny by conducting Structural Equation Modeling (SEM). The structured model and the direct and indirect pathways are depicted in Figure 1.

Quantitative data would be gathered and analyzed to verify the proposed model and answer the following research questions:

1. Is there any significant relationship between teachers' coping strategies, TPACK, and job burnout?
2. Does teachers' TPACK function as a mediator in the relationship between their coping strategies and job burnout?

To triangulate the quantitative data, teachers' post-pandemic outlook would be recorded and analyzed to qualitatively answer a third research question:

3. What are teachers' perceptions of the role of TPACK in coping with job burnout at the time of the COVID-19 pandemic?

4. Method

4.1. Participants

Three hundred and fourteen Iranian teachers who were teaching full-time during the COVID-19 crisis participated in the current study. The sample was recruited based on convenience sampling and teachers participated in the study voluntarily. All participants signed the consent form before completing the scales. They were informed of the content of the questionnaires and the goal of the research before going through the scales. The data were gathered in the Spring 2022 when the schools reopened and the teachers had already begun face-to-face teaching.

Upon checking the data, seven participants were removed due to their incomplete answers. The sample included both male ($n = 119$, 38.8%) and female ($n = 188$, 61.2%) teachers who ranged in age from 22 to 66 and had an average experience of 14 years.

4.2. Instruments

The following instruments were used to gather the quantitative data for the current study:

- Maslach Burnout Inventory-Educator's Survey
- TPACK-deep scale
- Brief-COPE scale

Maslach Burnout Inventory-Educator's Survey (MBI-ES): Teachers' burnout during the COVID-19 crises was assessed by

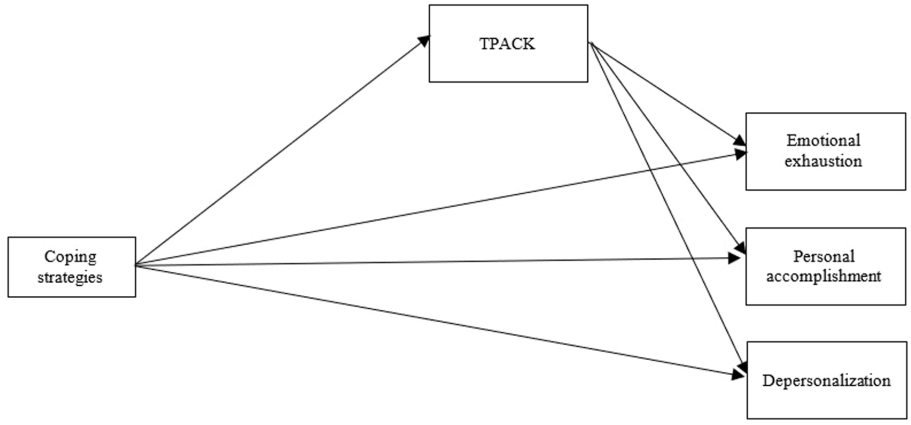

FIGURE 1
The model of the study.

MBI-ES (Maslach et al., 1996). MBI-ES has 22 items and evaluates teachers' job burnout with respect to three aspects of burnout syndrome including emotional exhaustion (9 items), personal accomplishment (8 items), and depersonalization (5 items). The items are anchored on a 7-point Likert scale from 0 (never) to 6 (every day).

The reliability of the scale has been reported by several studies since its development across different research contexts with participants of diverse ethnicity. MBI-ES has been validated with Persian samples and its psychometric characteristics were reported to be satisfactory (Pourshahbaz, 2016).

Minor modifications were made to the wording of the scale to make it suitable for the goal of the study that is probing into teachers' job burnout during ERT when schools were closed as a result of the COVID-19 national lockdown. The factor structure of the scale was put to test and the results confirmed the presence of three components with eigenvalues exceeding 1.0 explaining a total of 54.763% of the variance. The item loadings on each component were exactly similar to the original MBI-ES (Appendix 1). The reliability indices of the three dimensions of MBI-ES for this study are reported in Table 1.

Technological and Pedagogical Content Knowledge-deep: In order to assess the participants' TPACK, the TPACK-deep scale (Yurdakul et al., 2012) was used. The original TPACK-deep has four subscales including design (10 items), exertion (12 items), ethics (6 items), and proficiency (5 items). The questionnaire anchors on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

Technological and Pedagogical Content Knowledge-deep was examined for its factor structure and the result approved a 5-factor model that explained 61.7% of the variance of the construct. All items loaded exactly on the same factors reported by the developers of the TPACK-deep, with one difference. Three items of factor exertion loaded on a fifth factor and due to their common theme and similarities, the factor was labeled "knowledge empowerment" (Appendix 2). The reliability indices of TPACK-deep and its five components for this study are reported in Table 1.

TABLE 1 Reliability indices of the scales.

Variable	Number of items	Cronbach's alpha (α)
Job burnout	22	–
Emotional exhaustion	9	0.91
Personal accomplishment	8	0.85
Depersonalization	5	0.75
TPACK	33	0.96
Design	10	0.91
Exertion	9	0.90
Knowledge empowerment	3	0.87
Ethics	6	0.85
Proficiency	5	0.84
Brief-COPE	28	–
Avoidant	6	0.78
Active positive	6	0.76
Support	4	0.74
Acceptance	2	0.70
Religion	2	0.71
Humor	2	0.70
Self-blame	2	0.73
Evasive	4	0.66

Brief-COPE: Brief-COPE is the brief form of COPE inventory (Carver et al., 1989). This version of the scale was developed because the original scale was long and redundant (Carver, 1997). The Brief-COPE includes 28 items with 14 factors that measure "conceptually differentiable coping reactions" (Carver, 1997, p. 98). The scale can be used in many different ways for retrospective/concurrent situational goals by changing the phrasing of response options (Carver, 1997). The participants were asked to complete the scale expressing the ways they had managed their job burnout during the COVID-19 pandemic.

The result of factor analysis of the scale yielded eight factors that explained a total of 61.54% of the variance (Appendix 3). Similar to the original scale, acceptance, religion, humor, and self-blame remained as two-item factors with the same items of the original scale loading on each factor. Four higher-order factors emerged that had remarkable consistency with the original scales (Carver et al., 1989; Carver, 1997) including avoidant coping (subscales: denial, substance use, and behavioral disengagement), active positive coping (subscales: active coping, positive reframing, planning), support (subscales: emotional support, instrumental support), and evasive coping (self-distraction, venting). The reliability indices of the factors of Brief-COPE are reported in Table 1.

The interviews: With the intention of triangulating, 31 teachers were asked to take part in a structured interview. The questions of the interview targeted the personal stress and professional challenges the teachers faced during online teaching amid the COVID-19 pandemic; how they managed those problems; and if they received any support from colleagues or administrators to do so.

4.3. Procedure

Upon reviewing the literature and understanding the gaps, the hypothetical model of the study was devised and suitable instruments were selected. All instruments were piloted and their validity and factor structure were examined (See Appendices 1–3). The scales were then distributed among 314 teachers who experienced working under adverse conditions during the COVID-19 pandemic when the schools were closed from February 2020 to March 2022. Before completing the scales, a written and brief description of the research project and the scales were given to the participants. A consent form was also provided and upon signing the agreement, the teachers were asked to fill in the scales.

The quantitative data were checked and incomplete questionnaires were removed. The data then were inserted into the data analysis software programs. Suitable quantitative data analysis techniques were applied and the obtained results were interpreted.

To have a deeper insight into the relationship between the variables of the study, the teachers were asked for voluntary participation in the interviews. Thirty-one teachers agreed to take part in the interviews and their answers to five questions were analyzed by content analysis, both manually and using computer software.

4.4. Data analysis

Adopting a mixed methods approach, two sets of data analyses were used to attain the goals of the study and shed light on the interplay between TPACK, coping strategies, and job burnout.

Quantitative data analysis including descriptive and inferential statistics was used to answer research questions number 1 and 2. Descriptive statistics provided an understanding of the data in terms of characteristics and distribution of the values. SEM was used to scrutinize the mediating role of TPACK in the relationship between coping strategies and job burnout. SEM "is a statistical method that examines the relationships among numerous variables in a simultaneous way" (Collier, 2020, p. 1) and thus a suitable data analysis to test the hypothesized model of this study (Figure 1). For quantitative data analysis, IBM SPSS Statistics and Analysis of Moment Structures (AMOS) software were used.

Qualitative data analysis included content analysis of teachers' answers to the interview questions. Both manual and computer-assisted coding were used to analyze the data. Computer-assisted coding was done with NVivo12 Pro.

TABLE 2 Descriptive statistics of the variables of the study.

Variable	Mean	SD
Coping strategies	–	–
Avoidant coping	0.849	0.646
Active positive coping	2.089	0.551
Support	1.734	0.680
Acceptance	2.094	0.687
Religion	1.812	0.861
Humor	1.345	0.844
Self-blame	1.377	0.850
Evasive	1.614	0.586
TPACK	3.780	0.679
Design	3.830	0.750
Exertion	3.747	0.788
Knowledge empowerment	4.293	0.787
Ethics	3.675	0.797
Proficiency	3.556	0.830
Job burnout	–	–
Emotional exhaustion	27.873	10.175
Personal accomplishment	18.384	7.709
Depersonalization	13.589	4.971

5. Results

5.1. Quantitative data analysis

Descriptive statistics of the variables: Descriptive statistics of the variables of the study are presented in Table 2. Examining the descriptive statistics of the coping strategies shows that teachers' most frequently used coping strategies to manage burnout during COVID-19 were acceptance (Mean = 2.094, SD = 0.687) and active positive coping (Mean = 2.089, SD = 0.551) on a scale of 0–3. The teachers reported that they were not fond of avoidant strategies (Mean = 0.849, SD = 0.646).

On average, the participants reported being well capable of using technology to empower themselves during the COVID-19 pandemic (Mean = 4.293, SD = 0.787) and planning online classes relying on their technological and pedagogical knowledge (Mean = 3.83, SD = 0.75) on a scale of 1–5.

Based on the MBI-ES scoring guideline (Schaufeli et al., 1996), the participants displayed a high level of burnout on emotional exhaustion (Mean = 27.873, SD = 10.175) and depersonalization (Mean = 13.589, SD = 4.971) but a low level of burnout on personal accomplishment (Mean = 18.384, SD = 7.709) during the COVID-19 pandemic and ERT.

Inter-correlations between the variables: Table 3 shows the correlations between the variables of the study including coping strategies, TPACK, and burnout dimensions.

Considering the association between coping strategies and burnout dimensions, it is found that avoidant and self-blame strategies

TABLE 3 Inter-correlations between the variables of the study.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Avoidant	1											
2. Active	−0.013	1										
3. Support	0.209**	0.499**	1									
4. Acceptance	−0.066	0.502**	0.302**	1								
5. Religion	0.145*	0.473**	0.428**	0.373**	1							
6. Humor	0.345**	0.240**	0.273**	0.207**	0.255**	1						
7. Self-blame	0.404**	0.065	0.276**	−0.038	0.146*	0.217**	1					
8. Evasive	0.350**	0.439**	0.488**	0.239**	0.372**	0.306**	0.302**	1				
9. TPACK	−0.098	0.330**	0.140*	0.255**	0.140*	0.133*	−0.073	0.102	1			
10. EE	0.274**	−0.103	0.130*	0.001	0.067	0.080	0.153**	0.211**	−0.242**	1		
11. PA	0.129*	−0.249**	−0.082	−0.179**	−0.097	−0.099	0.144*	0.031	−0.536**	0.296**	1	
12. DP	0.593**	−0.054	0.130*	−0.062	0.109	0.270**	0.286**	0.322**	−0.196**	0.472**	0.243**	1

are positively related to all dimensions of burnout; while support and evasive coping strategies are positively related to two dimensions of burnout, that is, emotional exhaustion and depersonalization. Active coping and acceptance are negatively related to personal accomplishment; and humor is positively related to depersonalization.

As for the relationship between coping strategies and TPACK, it is revealed that active positive, support, acceptance, religion, and humor are positively related to TPACK. TPACK was found to be negatively related to all dimensions of burnout.

The measured model: AMOS software and the maximum likelihood estimation (MLE) procedure were used to do the required data analyses and test the model. Table 4 illustrates the fit indices of the hypothesized model including chi-square (χ^2), root-mean-square error of approximation (RMSEA), root-mean-square residuals (RMR), standardized root-mean-square residuals (SRMR) comparative fit index (CFI), the goodness-of-fit index (GFI), and adjusted goodness-of-fit index (AGFI); and their acceptable fit indices (Schermelleh-Engel et al., 2003). As Table 4 shows, all model fit statistics were within the acceptable ranges (χ^2/sd = 2.97, RMSEA = 0.066, RMR = 0.033, SRMR = 0.039, NFI = 0.93, CFI = 0.95, GFI = 0.94, and AGFI = 0.85).

Table 5 shows the direct effects between the variables of the study. Examining the direct paths from eight coping strategies to TPACK shows that the only significant effect is observed in the path active positive strategies-TPACK ($\beta = 0.285$, $t = 3.722$, $p < 0.001$).

TABLE 4 Evaluation of the fit indices for model testing.

Index	Model	Perfect fit	Good or acceptable fit	Decision
χ^2/sd	2.97	χ^2/sd ≤ 3	χ^2/sd ≤ 3	Good fit
RMSEA	0.066	RMSEA ≤ 0.05	RMSEA ≤ 0.08	Good fit
RMR	0.033	RMR ≤ 0.05	RMR ≤ 0.08	Perfect fit
SRMR	0.039	SRMR ≤ 0.05	SRMR ≤ 0.08	Perfect fit
NFI	0.93	NFI ≥ 0.95	NFI ≥ 0.90	Good fit
CFI	0.95	CFI ≥ 0.95	CFI ≥ 0.90	Perfect fit
GFI	0.94	GFI ≥ 0.95	GFI ≥ 0.90	Good fit
AGFI	0.85	AGFI ≥ 0.90	AGFI ≥ 0.85	Good fit

Examining the direct paths from eight coping strategies to emotional exhaustion shows that three paths are significant including avoidant-emotional exhaustion ($\beta = 0.163$, $t = 2.609$, $p < 0.01$), active positive-emotional exhaustion ($\beta = -0.217$, $t = 2.980$, $p < 0.01$), and evasive-emotional exhaustion ($\beta = 0.191$, $t = 2.894$, $p < 0.01$). Examining the direct paths from eight strategies to personal accomplishment shows that the only significant path is evasive-personal accomplishment ($\beta = 0.134$, $t = 2.230$, $p < 0.05$). Examining the direct paths from eight strategies to depersonalization shows that two paths are significant including avoidant-depersonalization ($\beta = 0.474$, $t = 2.609$, $p < 0.001$) and evasive-depersonalization ($\beta = 0.187$, $t = 3.318$, $p < 0.001$).

Examining the direct paths from TPACK to dimensions of burnout displays that all paths including TPACK-emotional exhaustion ($\beta = -0.244$, $t = 4.124$, $p < 0.001$), TPACK-personal accomplishment ($\beta = -0.52$, $t = 9.083$, $p < 0.001$), and TPACK-depersonalization ($\beta = -0.164$, $t = 3.275$, $p < 0.001$) are significant.

In Table 6, the regression coefficients that resulted from the mediation analysis are presented. The results revealed that active positive coping strategies had a significant indirect influence on all three dimensions of job burnout, that is emotional exhaustion ($\beta = -0.142$, $p < 0.001$), personal accomplishment ($\beta = -0.259$, $p < 0.01$), and depersonalization ($\beta = -0.084$, $p < 0.001$) via TPACK.

The direct and indirect pathways of the tested model are shown in Figure 2. Only the significant paths are depicted.

5.2. Qualitative data analysis

The data gained from the interviews were first analyzed manually and then inserted into the software NVivo12 Pro for establishing the themes and sub-themes. The coding was done in three steps of pre-coding, first-cycle coding, and second-cycle coding (Saldana, 2016).

In pre-coding, both researchers read the transcripts meticulously several times contemplating the issues the respondents raised. In the first-cycle coding, the texts were coded by the two researchers. Then the codes were compared and contrasted and in case of any disagreements, the issues were discussed and resolved. The intercoder Kappa was calculated to ascertain reliability. In the second-cycle

TABLE 5 Regression coefficients and standard errors for the pathways of the model.

Relationships with	TPACK				Emotional exhaustion				Personal accomplishment				Depersonalization			
Variables	*B*	*β*	S.E	*p*	*B*	*β*	S.E.	*p*	*B*	*β*	S.E	*p*	*B*	*β*	S.E	*p*
Avoidant	−0.087	−0.088	0.066	0.187	0.285	0.163	0.109	**	0.037	0.025	0.085	0.258	0.729	0.474	0.082	***
Active positive	0.330	0.285	0.089	***	−0.444	−0.217	0.149	**	−0.185	−0.106	0.115	0.108	−0.166	−0.092	0.112	0.061
Support	−0.002	−0.002	0.066	0.975	0.176	0.106	0.110	0.071	−0.041	−0.029	0.085	0.814	−0.045	−0.031	0.082	0.609
Acceptance	0.087	0.094	0.061	0.154	0.154	0.094	0.102	0.311	0.006	0.004	0.079	0.514	−0.010	−0.007	0.076	0.590
Religion	−0.011	−0.015	0.049	0.823	0.044	0.033	0.082	0.522	−0.007	−0.006	0.063	0.973	0.107	0.029	0.061	0.579
Humor	0.068	0.091	0.047	0.146	−0.012	−0.009	0.078	0.689	−0.078	−0.068	0.060	0.087	0.018	0.091	0.059	0.060
Self-blame	−0.059	−0.077	0.048	0.217	−0.008	−0.006	0.079	0.842	0.092	0.081	0.061	0.058	0.033	0.015	0.059	0.565
Evasive	−0.015	−0.013	0.077	0.849	0.369	0.191	0.127	**	0.220	0.134	0.099	*	0.317	0.187	0.095	***
TPACK	–	–	–	–	−0.432	−0.244	0.105	***	−0.786	−0.520	0.087	***	−0.255	−0.164	0.078	***

*$p < 0.05$; **$p < 0.01$; and *** < 0.001.

TABLE 6 Direct, indirect, and total effects for the mediation using a Bootstrap Analysis with 95% Confidence Interval.

Relationships with	Emotional exhaustion					Personal accomplishment					Depersonalization				
Variables	Direct effect	Indirect effect through TPACK	Confidence interval		Total effect	Direct effect	Indirect effect through TPACK	Confidence interval		Total effect	Direct effect	Indirect effect through TPACK	Confidence interval		Total effect
			Low	High				Low	High				Low	High	
Avoidant	0.285**	0.037	−0.014	0.115	0.323**	0.037	0.068	−0.039	0.199	0.105	0.729**	0.022	−0.006	0.085	0.751**
Active positive	−0.444**	−0.142***	−0.311	−0.052	−0.587**	−0.185	−0.259**	−0.424	−0.105	−0.444**	−0.166	−0.084**	−0.206	−0.030	−0.250
Support	0.176	0.001	−0.053	0.069	0.177	−0.041	0.002	−0.100	0.111	−0.040	−0.045	0.001	−0.036	0.043	−0.045
Acceptance	0.154	−0.038	−0.127	0.014	0.117	0.006	−0.069	−0.202	0.030	−0.063	−0.010	−0.022	−0.087	0.007	−0.032
Religion	0.044	0.005	−0.034	0.058	0.049	−0.007	0.009	−0.067	0.096	0.002	0.033	0.003	−0.017	0.045	0.036
Humor	−0.012	−0.030	−0.093	0.005	−0.041	−0.078	−0.054	−0.144	0.020	−0.131	0.107	−0.017	−0.064	0.004	0.090
Self-blame	−0.008	0.025	−0.013	0.079	0.017	0.092	0.046	−0.029	0.123	0.139	0.018	0.015	−0.007	0.051	0.033
Evasive	0.369**	0.006	−0.048	0.074	0.375**	0.220*	0.011	−0.091	0.123	0.231*	0.317**	0.004	−0.028	0.047	0.320*
TPACK	−0.432**	---	–	–	−0.432**	−0.786**	–	–	–	−0.786**	−0.255**	–	–	–	−0.255**

*$p<0.05$; **$p<0.01$; and ***$p<0.001$.

coding, the themes and subthemes were developed based on the first coding cycle. The data then were inserted into NVivo12 Pro and the hierarchy of codes, themes, and subthemes was established (Table 7).

The result of the analysis of the interviews regarding theme 1, i.e., burnout, revealed four subthemes including students, technology, workload, and personal issues. The subtheme "students" had eight categories, the theme "workload" and "technology" had two categories each, and the theme "personal issues" had three categories (Table 8).

Within theme 2, i.e., coping mechanism, two subthemes of students and technology emerged. The subtheme "students" had eight categories and the subtheme "technology" had two categories (Table 9).

With respect to theme 3, i.e., support, three subthemes of administrative, social, and technological support emerged. The subthemes "administrative support" and "technological support" did not include any categories, yet the subtheme "social support" had two categories (Table 10).

6. Discussion

6.1. Coping strategies and job burnout

The findings of the study primarily revealed that avoidant strategies with the subscales of denial, substance use, and behavioral disengagement were predictors of two dimensions of job burnout, that is, emotional exhaustion and depersonalization. In other words, teachers who pushed the reality of the pandemic away, used substances to feel better about the crisis or get through it, and reduced or gave up the effort to accomplish their educational goals the pandemic was interfering with, experienced higher emotional fatigue and depersonalization. The use of avoidant strategies is a sign of teachers' incapability to get along with the stressful situation of the pandemic that inevitably led to a higher level of emotional drain and defensive behavior. The overwhelming nature of the strain and the multifaceted challenge the teachers faced affected both their personal lives (Spadafora et al., 2022) and professional career (Kupers et al., 2022) and caused a sense of emotional distress and detachment from work for those who could not cope well with these stressors.

Evasive strategies with the subscales of self-distraction and venting were the significant predictors of all three dimensions of burnout and contributed to increased teachers' emotional drain, depersonalization of others at work, and low sense of accomplishment during the crisis. This suggests that neither ventilating one's negative feelings nor focusing away from them were conducive to having healthy work conditions during the pandemic. Emotion-focused coping strategies are used when people think they cannot do anything with the situation and they have to endure the stressor. Maladaptive strategies and teachers' sense of negative emotions and burnout are related (Ozoemena et al., 2021) because these strategies are associated with poorer mental health (Burker et al., 2005) and depression (Pavlov and Limbers, 2022); and their use over time may hinder adjustment to stress situation (Carver et al., 1989).

Active positive strategies with subscales planning, positive reframing, and active coping were found to prevent emotional exhaustion. These strategies are problem-focused and let people evaluate the stressful situation and think about what they want to do by looking at the problem from a positive perspective, and then implementing their constructive plans to manage the stress. As found in previous studies, the use of active coping strategies leads to more well-being and mental health while low coping mechanisms cause prolonged burnout (Eddy et al., 2019).

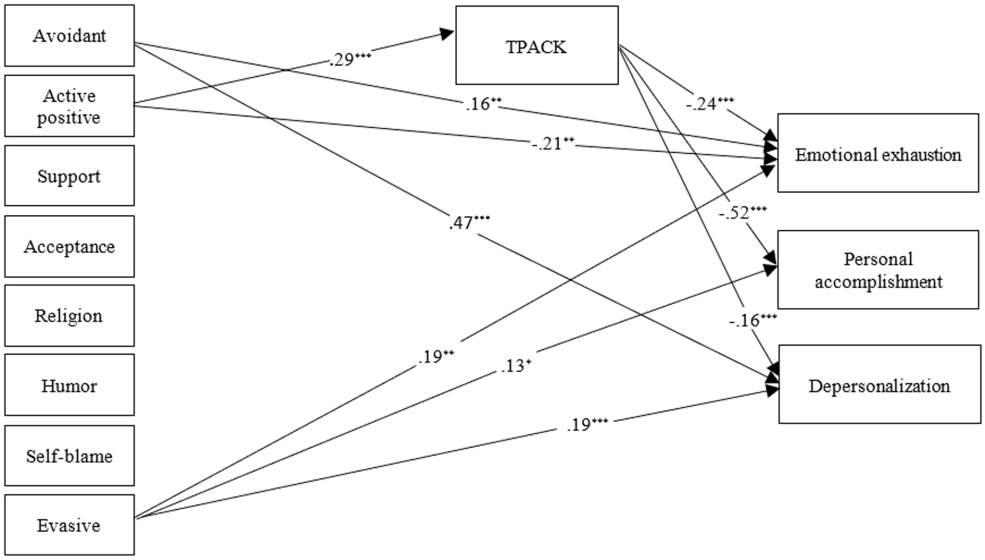

FIGURE 2
The structural equation modeling (SEM) of the interrelationship between the variables (Regression coefficients are standardized).

TABLE 7 Themes and subthemes.

Themes	Rank	Word	Count	Weighted percentage (%)	Subthemes	Meaning
Sources of burnout	1	students	97	5.50	Students, Technology, Workload, Personal issues	Causes of teachers' burnout during the pandemic
	2	teaching	46	2.61		
	3	Internet	27	1.53		
	4	work	20	1.13		
	5	communication	19	1.08		
	6	content	19	1.08		
Coping mechanisms	1	students	34	3.47	Students, Technology	Teachers' ways of coping with the main stressors
	2	tried	20	2.04		
	3	teaching	18	1.83		
	4	knowledge	15	1.53		
	5	content	13	1.33		
	6	software	12	1.22		
Support	1	teaching	36	2.41	Administrative, Social, Technological	The available resources
	2	Internet	34	2.27		
	3	provide	32	2.14		
	4	students	28	1.87		
	5	support	27	1.80		
	6	colleagues	26	1.74		

6.2. Coping strategies, TPACK, and burnout

The predictive power of active positive coping strategies over TPACK shows that during the crisis, teachers have used these strategies to alter the source of the stress and adopt a more constructive approach to solve the existing problems (Carver et al., 1989). When people believe that they can do something productive to change the stressful condition, they choose problem-focused strategies, otherwise, they deploy emotion-based strategies (Lazarus and Folkman, 1984). As a result, these strategies have been found to be among the most popular coping strategies used by teachers during the pandemic (Nazari et al., 2022; Rajesh et al., 2022).

Principally, deploying problem-solving strategies is dependent on the resources that are at the disposal of the person or the limitations

TABLE 8 Theme 1 sources of burnout: Subthemes, categories, and example quotations.

Subtheme	Example quote
Students	
• Motivation	"The students, even though I appeared in the classroom with a high level of energy and I also tried to explain the subject matter perfectly, used to attend the classroom only to announce their presence and without any interest and motivation."
• Engagement and interaction	"The biggest challenge was trying to engage students in classroom activities when using SHAD or WhatsApp. Almost half of the students would vanish as soon as the class started and it seemed like you were teaching in an empty classroom."
• Attention and learning	"I saw my students did not learn much from these online classes because they were not present in the class while simultaneously acing their tests; and I was worried about their next year when the pandemic was finally over and they had not learned anything."
• Class management/discipline	"Students, knowing that the teacher does not have physical supervision during the class, were doing various things during the class."
• Cheating	"In virtual space, students could easily communicate with each other and this communication did not allow the teacher to assess the real level of students' knowledge."
Technology	
• TPACK	"We were under a lot of pressure, and many times we felt that we were burnt out because we could not find a practical way to solve students' problems." "I can boldly claim that my biggest challenge was my lack of distance teaching knowledge because we were not taught how to teach in such conditions."
• Technological infrastructures	"The weak Internet in the places where my students lived caused the class process to be cut off and they did not attend the class on time or did not send the assignments on time."
Workload	
• e-Leaning content	"Creating content for virtual classes could be time-consuming and sometimes you would spend so many hours creating a clip but when you look back at it you see that it does not have any sound because your headphone was broken and you did not know it, it happened to me once and I instantly burst into tears."
• Time	"It seemed that I could find no more free time for myself. I had to spend all my day doing school stuff like creating video clips or designing an online test."
Personal issues	
• Financial issues	"The teachers had to pay the related expenses themselves."
• Privacy violation	"All parents and students had access to the teacher's phone number, and many times they disturbed the teacher with occasional calls and made unusual requests."
• Physical health damage	"My eyesight became very poor and suffered a lot because I had to constantly look at the phone and follow the teaching and learning process of the students."

they face when they decide to use these resources (Lazarus and Folkman, 1984). At the outset of the pandemic, the teachers realized that neither the technological infrastructures of the country nor the teachers themselves were ready for this huge and sudden change. Yet, their attitudes to this change evolved and gradually altered from negative to positive; and from somewhere during the crisis, they perceived this change as a positive challenge that could be exploited for their professional empowerment and development (Daumiller et al., 2021).

Being able to use technologies to manage instructional practices guaranteed more sense of professional efficacy (Abbitt, 2011) and thus lowered teachers' burnout associated with personal accomplishment. The higher their TPACK became, the more they used technologies (Davaasuren et al., 2021), and the more they felt capable of managing the demands of their job. This is actually reflected in the role of TPACK as a hindrance to all three dimensions of burnout in the current study. In line with a few earlier works, this suggests that teachers with higher levels of TPACK were more confident in online classes and experienced less stress and emotional drain (Stan, 2022). Conversely, lack of knowledge and incapability of working with technological devices raised teachers' technostress (Arslan et al., 2022), because negative feelings toward technology are the result of the constant pressure of acquiring new technological knowledge and skills (Tarafdar et al., 2007). This anxiety impacted their job burnout (Dahabiyeh et al., 2022) and job satisfaction (Aktan and Toraman, 2022) and in a repeating cycle, teachers activated their appraisal mechanism and turned to their resources including TPACK to be able to cope with that strain (Lazarus and Folkman, 1984).

6.3. The mediating role of TPACK in the relationship between coping and burnout

TPACK strengthens the effect of active coping on reducing job burnout meaning that the teachers who used more active positive coping and felt they could manage online teaching, experienced less job burnout because they had higher TPACK. This supports the argument for the interconnectedness of coping and TPACK and how these two variables can explain job burnout altogether.

The finding can be backed by iParadox Triad assumption as it confirms the view that ICTs can be located on a job demand-resource continuum that have both positive and negative effects on work well-being based on individuals' appraisal system (Day et al., 2019). "On the one hand, they can serve as a useful tool to help achieve

TABLE 9 Theme 2 coping mechanisms: Subthemes, categories, and example quotations.

Subtheme	Example quote
Students	
• Motivation	"Motivating the students by making them participate in activities and also creating competition between them, for example, I asked them to prepare podcasts and videos or audio files and send them to the lesson group."
• Engagement and interaction	"Asking questions from my students constantly during teaching was the best way to conquer the challenge of not knowing if they are present in my classroom."
• Attention and learning	"In the second semester of the pandemic, I decided to get students more involved in class time. Near the end of each session, I gave them some assignments to do at home and send their answers to my Telegram or WhatsApp account.
• Class management and discipline	"Creating diverse activities to attract more students' attention and prevent disorder in the classroom. For example, using different pictures, animations, and clips to teach each part of the lesson, as well as asking various questions related to the previous lesson to start the new lesson and increase the participation of students."
• Cheating	"I designed different tests with different answers so that not every question would be the same for every student." "I used online tests to reduce student cheating during the exam."
Technology	
•TPACK	"The first months of my job was like a trial-and-error process. I tried to search and update myself by taking part in workshops, watching videos in YouTube." "I have tried a lot of software for making videos to increase their quality and decrease their size." "I learned from my colleagues about how to manage online classes."
• Technological infrastructures	"I bought a modem with higher performance and speed as well as a smartphone with a higher memory at my own expense." "I also tried to prepare course content in advance and send it to student groups when the Internet speed problems were less."

TABLE 10 Theme 3 support: Subthemes, categories, and example quotations.

Subtheme	Example quote
Administrative	
	"Unfortunately, training classes for teachers were not held at all." "There was no special support from the school and the MOE. They were just checking if the classes were held."
Social	
Helpful	"They created some kind of WhatsApp group and channels, in which there were lots of instructional materials regarding for example how to reduce the size of your videos and how to upload them into SHAD and some materials like this." "The interaction between the teachers made us share our experiences in different fields and this was a basic help in some cases."
Not helpful	"The teachers I worked with did not even know how to manage virtual teaching and use new technologies. They could probably work with SHAD at most. Therefore, they had no special experience to share with others."
Technological	
	"There was no financial or non-financial support, and only two or three limited Internet packages were given to the teachers, which did not meet the needs of the teachers and their workload." "No tools such as smartphones and tablets or accessories such as microphones or phone holders were provided to the teacher. Many students did not even have television at home or lived in villages where there was no Internet coverage at all, and unfortunately, the government could not support any of these cases."

work-related (and non-work-related) goals. On the other hand, they appear to introduce new stressors that can negatively affect well-being" (Day et al., 2019, p. 583).

Within this framework and based on the stress–strain-coping scheme (Lazarus and Folkman, 1984; Lee and Ashforth, 1990), TPACK could be a stressor, a positive challenge, or irrelevant in the primary appraisals. Logically, TPACK as a stress reducer is of more value for those teachers who had been trained technologically. This is expected because TPACK development courses are reported to affect teachers' self-efficacy and ability to overcome barriers against classroom technology integration (Knapp, 2017) and choose suitable teaching methods and classroom management (Aktaş and Özmen, 2020).

In the secondary appraisals, based on teachers' available resources and support, the TPACK could be a threat to work well-being (i.e., a stressor). In case the demand taxed the resources of the teachers (i.e., their TPACK), it was a stressor (as was for most teachers) that might have resulted in job burnout that demanded a response. Thus, TPACK could have been a negative job demand for those teachers who did not have much training and experience in teaching online or hybrid classes before the pandemic. These teachers were forced to redouble their sustained cognitive effort for integrating technology into their

instruction without being provided with worthwhile organizational resources and support. Paradoxically, this can also be a job demand for those teachers who had past experience with educational technology but whose prior ICT skills were not enough or helpful for handling a variety of technological challenges they faced in the ERT. The response of both groups, that is empowering one's TPACK by spending time and effort, could lower the negative effects of the lack of TPACK (e.g., technostress) and thus contributed to less job burnout.

6.4. Teachers' experiences of the ERT

Sources of burnout: One main source of teachers' burnout was students' low motivation and interest in remote learning. Students' low motivation in virtual learning is mainly related to technological infrastructures and social support from teachers and peers (Tan, 2021). As mentioned in interviews, technological infrastructures were linked to lack or insufficient technology access and availability of technological devices as well as students' low computer skills. Unfortunately, around a quarter of Iranian students (4 million students) did not own a smartphone or did not have good-quality Internet access to be a member of student network known as SHAD during the pandemic (Khabaronline, 2020). Further, due to the flaws of the educational platform, students' interaction with the teacher, peers, and the content did not lead to the construction of a good learning atmosphere to improve students' participation in classes (Sun et al., 2022). The instruction was mostly teacher-fronted and content-centered planned, directed, and delivered by the teacher without prioritizing attitudinal goals in the designed activities (Echeverría et al., 2022).

Another source of teachers' burnout was their concerns about students' learning due to their absences, low class participation, and cheating. This emotional drain can be viewed from two perspectives: students' learning outcomes and teachers' inefficacy. Teachers were fearful of their students' low learning gains as they could not have a fair evaluation of their learning. One main reason for this was climbed chances of academic dishonesty in remote learning such as contract cheating in doing the assignments or getting help from others (the Internet or peers) in exams (Erguvan, 2021). Hence, some teachers had a sense of inefficacy, as they were not sure if their efforts were enough, their teachings were influential, and the materials they prepared were useful. This uncertainty and skepticism about "what they do is right," significantly influenced the rise of teachers' inefficacy in comparison to the pre-pandemic condition (Weißenfels et al., 2022).

Technology was the dominant theme in teachers' discussion of burnout during the pandemic. As a matter of fact, all other themes and subthemes had direct or indirect links to technology and its pivotal role in distressing teachers or helping them out of the stressful condition of the ERT. Without a doubt, the Internet speed and its penetration in less privileged areas and villages were stressors number one. Following the Internet, the teachers have raised the issue of the local platform, SHAD, and its inadequacies. The overburdened teachers who had to manage extra works felt even more exhausted because they had to work with an application that could not fulfill the educational needs of teachers or students. In addition to teachers, SHAD was not perceived to be a useful educational network by either the students (Rastegar and Rahimi, 2021) or their parents (IRNA, 2021) and was the main source of fatigue for all.

Related to technology, TPACK was one of the most complicated issues teachers talked about during their interviews. The topics of interest associated with the TPACK-burnout included TPACK as a stressor, particularly in the early months of the pandemic, a job demand that has not been addressed appropriately before the pandemic and not well supported during the pandemic, and a disincentive to the sense of self-efficacy. In the first half of the pandemic, most teachers were very confused about the ERT, its trajectory, how it would proceed, and when it would come to an end. They felt incapacitated by lacking TK, TPK, and TCK to be able to successfully teach in this new condition. The shortage of ICT skills and knowledge for teaching raised teachers' negative feelings and anxiety to a certain extent (Ozgür, 2020). Without much organizational support, the teachers had to empower themselves technologically by spending their time, energy, and money and this led to even more emotional exhaustion and fatigue (Bakker et al., 2007).

As they repeatedly mentioned, teachers spent much of their time preparing e-content because the national platform did not support synchronous communication. While this asynchronous teaching seemed to be more flexible and more adjustable for those who did not have technological support (Etchells et al., 2021), it had its own flaws. Considering teachers' TPACK level and computer skills, and the organizational support they could receive, teachers' emotional exhaustion raised because they became physically and psychologically fatigued in the process of e-content production and sharing (Minihan et al., 2022). Additionally, the teachers were required to spend a lot of time correcting students' homework, designing online tests, and finding appropriate teaching materials on the Internet that increased their workload significantly in comparison to the pre-pandemic situation (Kaufman and Diliberti, 2021). Iranian teachers' escalated exhaustion as a result of workload seems to be experienced by other teachers during the pandemic worldwide. This includes work–family conflicts (Sokal et al., 2020), sleep reduction or disorder (Barbosa et al., 2022), and health problems such as poor eyesight (Dossari et al., 2022) or backache (Barbosa et al., 2022).

Coping mechanisms: As can be supported by the descriptive statistics, the use of two types of coping strategies, that is active positive coping and acceptance, was prevalent among teachers during the pandemic. These strategies were mainly deployed to cope with challenges the teachers had with their students and technological issues.

Teachers' frequent use of problem-based coping strategies is a sign of their concern about their students' learning (Pogere et al., 2019) and how determined they were to find a way to manage their issues. The use of acceptance as a functional strategy also helped them to accept the reality of the pandemic and become engaged in the attempt to deal with this stressful situation (Carver et al., 1989). As a result of that, they performed different courses of action from empowering their knowledge base and mastery of working with technology to implementing efficacious teaching methods and designing good-quality contents and tests. This upskilling raised teachers' confidence and expertise in online teaching and thus generated a more positive classroom atmosphere that affected students' learning (Almerich et al., 2016) and acceptance of technology-enhanced instruction (Bostan and Şener, 2021).

Teachers' concerted efforts and perseverance to empower themselves technologically and develop their TPACK show how cleverly these teachers employed their active positive coping from planning, to positive

reframing to active coping strategies. Teachers in the very first weeks of the pandemic realized that pre-pandemic ICT skills and knowledge were one of the most reliable sources of coping with the challenges of the pandemic (Stang-Rabrig et al., 2022). Those who lacked that proficiency or felt less updated in their ICT skills, showed more clear thinking and extra energy (Allen et al., 2020) and acquired or developed their TPACK first by trial and error and searching the Internet, then more systematically by taking part in online classes or seeking help from their more proficient colleagues. Teachers' talking about their technostress, TPACK, efficacy, and burnout shows that the more they had the experience of working with technology confidently, the more efficacious they became, and thus the more they felt satisfied and happy (Lee and Lim, 2020). As a result, in the second half of the pandemic, the role of TPACK changed from a job stressor to a job resource that could buffer the impact of other demands on burnout itself (Bakker et al., 2005).

Teachers' adoption of approach coping shows that Iranian teachers had enough determination and capacity to perform their job duties despite the disastrous effects of the pandemic on their life and work conditions. Teachers' perceptions of the way they could adapt to the change successfully are indicative of their internal and interpersonal resilience as they upskilled themselves in both technology and pedagogy to guarantee efficient teaching and learning processes (Raghunathan et al., 2022). Teachers' sustained effort to have a better ERT is also indicative of their intrinsic motivation and a strong sense of responsibility that in spite of their high job burnout and dissatisfaction documented in pre-pandemic studies (e.g., Pourshahbaz, 2016), they did not walk away from their jobs and fulfilled their duties even more than what was expected from them.

Support: Despite teachers' high sense of commitment to their job and concerns for their students' learning, they were deprived of organizational support and strong leadership in coping with the stressors. They had just their colleagues' assistance and guidance to acquire essential skills and knowledge to be able to continue teaching under adverse circumstances. They shared e-contents, links to useful websites, clips of their teachings, and their experience of working with helpful applications, platforms, and software. For many, this was a valuable source of gaining and developing the TPACK.

It is logical to say that teachers' internal resources and the community's support lowered their job burnout and inspired them to adapt to the situation instead of abandoning their attempts (Bakker et al., 2005). However, inevitably working in a non-supportive environment had a significant role in increasing job burnout (Collie et al., 2012). The teachers were frustrated because they did not feel any organizational care about their well-being, appreciation of their hard work, and support for their socio-emotional needs (Eder and Eisenberger, 2008). In contrast to some previous studies, lack of organizational support did not signify low work commitment; however, low organizational support had certainly influenced teachers' job satisfaction (Oubibi et al., 2022).

7. Conclusion

The conflicting role of teachers' ICT skills and knowledge during the pandemic as a job resource or demand has been untouched by education researchers. Inspired to fill this gap, the current study examined the interrelationship between teachers' coping mechanisms, TPACK, and their job burnout by gathering and analyzing both quantitative and qualitative data.

The result of SEM revealed a mediating role for TPACK in the relationship between active positive coping strategies and job burnout, indicating that those teachers who used more problem-focused coping strategies had lower job burnout because they had higher TPACK. What can be induced from the results is a restorative power of TPACK on teachers' working conditions during the pandemic on one hand, and its constructive role in assisting teachers to manage their job-related distress in that stressful condition on the other hand. From teachers' discussion of the sources of burnout, it is concluded that technology and its associated variables, i.e., infrastructure and knowledge base, constructed the core of job burnout that in its own turn influenced students' motivation, engagement, and learning as well as teachers' workload and well-being. TPACK, developed by blood, sweat, and tears, was found to be the main support for teachers' strength and resilience to hold the ERT. It is inferred that despite being deprived of organizational support, the social support from the community of teachers assisted them in achieving their work goals and professional development to some extent.

Based on the gained results, the study contributes to the literature in four ways. First, it affirms that teachers' well-being and job security are critically interwoven with job resources and demands and strongly impacted by organizational support. Second, it reflects the fact that technology can function as a double-edged sword in teachers' professional success and health, and incuriosity to educational technology would bring about serious consequences for educational professionals. Third, it displays that teachers' dissatisfaction with their job conditions and the way they face and overcome their frustrations can be perceived through the strength of the link between their own and their colleagues' technological competence and knowledge base and the availability of necessary technological infrastructures and devices. Fourth, it provides evidence of the fact that job resource is equally established in individual empowerment and organizational support and valuably co-constructed by the close and active collaboration of a professional community.

The practical implications and applications of the findings of the study for policymakers, teacher educators, and school administrators are evident. Primarily, wise and effective leadership from the MOE on formulation and execution of IT policy for technology integration into primary and secondary education is essentially required. Sequentially, the implementation of these plans should be accompanied by creating and improving technological infrastructures at schools and reinforced by suitable and continual access to technological devices for teachers, students, and parents. As for pre-service teachers, more attention should be given to TPACK courses across the syllabus of different subjects to train more technologically competent teachers. As for in-service teachers, workshops and in-service courses on useful technologies considering teachers' needs should be offered to lessen the negative impact of technological knowledge/skill deficiency on teachers' professional well-being and health. The value of collective wisdom in resolving the crisis in adverse conditions and events demands school administrators and principals establish teachers networks for professional support and cooperation.

8. Limitations and future scope

The findings of the study should be interpreted considering the limitations the researchers faced in the course of carrying out the work. First and foremost, because of the length of the

questionnaires, recruiting a very large sample was impossible. Second, the data were gathered at the end of the pandemic, and the teachers were asked to complete the scales based on their whole experience of the ERT from February 2020 through a retrospective lens. Third, the context of teaching (public vs. private schools) was not a variable due to the unavailability of enough participants. Further, as the study utilized a cross-sectional design no manipulation of the variables took place. Moreover, the subjects of the study were limited to Iranian high-school teachers, and thus extrapolating the results should be done with caution. Last but not least, the study used self-report measures and due to practicality issues observational data could not be gathered.

Despite the insightful findings of this study, some research domains remain open for further investigation regarding the issue of TPACK, burnout, and coping strategies. Utilizing experimental designs or observational studies to probe into the impact of TPACK on teachers' coping mechanisms and their job burnout is recommended. Reflecting on the results of this study, manipulating TPACK through interventions and examining the impact of TPACK instruction on teachers' well-being and mental health as well as coping mechanisms is desired. Examining more complex relations by incorporating teachers' individual variations (e.g., age, experience, gender, etc.) into the model is also encouraged. It would be revealing if researchers across different contexts and nations can cooperate and examine the role of TPACK in assisting teachers, of different backgrounds and cultures, to experience healthier work conditions and organizational commitment. To gain a deeper understanding of the interplay of the variables of the current study, the use of other types of qualitative data-gathering techniques such as think-aloud protocols or ethnography is suggested.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

NR carried out the study, gathered the data, and helped in writing the manuscript. MR conceptualized, designed, and supervised the research, and drafted, wrote, reviewed and edited the manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1129910/full#supplementary-material

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The impact of career expectation on employment anxiety of art students in higher vocational colleges during the COVID-19: A chain mediating role of social support and psychological capital

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Objective: In the process of college students' employment, psychological capital, and social support play a vital role.

Methods: This study examined the relationship between career expectation and employment anxiety of Chinese vocational art college students (N=634). Participants completed the Career Expectation Scale (CES), Employment Anxiety Scale (EAS), Psychological Capital Scale (PCS), and Social Support Scale (SSS).

Results: (1) Vocational art students' career expectation has a positive predictive effect on employment anxiety, social support, and psychological capital; Social support and psychological capital have negative predictive effects on employment anxiety. (2) Social support and psychological capital play a significant chain intermediary role between career expectation and employment anxiety, and there is a masking effect.

Conclusion: These results are of guiding significance to the improvement of the employment quality of art students in higher vocational colleges and the employment consulting work in colleges.

KEYWORDS

higher vocational art students, career expectations, employment anxiety, social support, psychological capital

Introduction

The Chinese government proposed to speed up the construction of a modern vocational education system (Xue and Li, 2022), build a skilled society to promote employment, and let more young people realize their life value with their skills in 2021 (Li et al., 2021). With the slowdown of China's economic growth, economic transformation and upgrading, the impact of COVID-19 on the economy and many other reasons (Han, 2022; Yu et al., 2022), the survival and development of various industries in China are facing great pressure, which also poses severe challenges to the employment of college graduates who are still expanding, especially the employment of vocational college graduates (Yang et al., 2022). At present, a lot of the public and some enterprises and institutions have low recognition of vocational education, they believe that the higher vocational students' education is lower than that of undergraduate students,

which means that the ability of higher vocational students is also lower than that of undergraduate students (Li, 2021). Meantime, the phenomenon of "emphasizing academic qualifications over technology" is common, which makes many vocational college graduates at a disadvantage or even suffer discrimination when seeking jobs (Zhang X., 2022). This kind of unfair treatment will make vocational students disappointed with their academic background, and repeated employment failures will also make them doubt their personal abilities, which, in turn, will produce anxiety and even dissatisfaction with society. As the cradle of the cultivation of practical technical talents in art, the employment situation faced by the graduates of higher vocational art majors is not optimistic. Due to the strong self-esteem of higher vocational art students, they have a high self-esteem, and they have higher expectations for the popularity of the recruitment company and the salary and treatment of the job. However, the actual situation is that the recruitment unit has high requirements for the work skills of higher vocational art students, but the salary is low; many recruiters are small or micro companies, with poor job stability and lack of promotion space. This gap between ideal and reality has caused nervousness, irritability, and other uneasiness in the employment process of higher vocational art students. This unease will grow as their graduation time approaches (Bolton, 2022; Li et al., 2022; Shi et al., 2022).

Employment anxiety refers to a kind of intense and persistent state anxiety caused by the uncertainty of employment results in the process of employment, which may cause a series of adverse physical and mental reactions (Unguren and Huseyinli, 2020; Chen and Zeng, 2021). The research shows that moderate employment anxiety can stimulate individual potential, promote self-ability, and actively participate in employment competition (Jang and Jin, 2020); However, high levels of employment anxiety can make individuals feel uneasy, fearful of helplessness, and even psychological barriers, which can affect physical and mental health and lead to employment failure (Joo, 2019). Previous studies on employment anxiety mostly started from specific methods such as alleviating employment pressure and psychological adjustment (Jeong, 2019; Lee and Ko, 2019), and rarely discussed the internal psychological mechanisms affecting employment anxiety. Research on employment anxiety is also mainly focused on undergraduate students, poor students, medical students, etc., and there is a lack of research on the group of art students in vocational colleges. In 2022, the number of students graduating from Chinese universities exceeded 10 million, a record high. At the same time, the downturn of China's economy has made it difficult for many small and micro enterprises to survive, and even a wave of bankruptcy, and these small and micro enterprises are the main work of vocational college students. In addition, the normalization of the domestic epidemic and prevention and control measures have had a great impact on the social practice activities of students in vocational colleges. It can be seen that the record number of graduates and the pressure of China's economic slowdown, coupled with the continuation of the epidemic, have aggravated the severe and complex employment situation of college students, bringing great anxiety and pressure to graduating college students, especially for graduates of vocational colleges with low educational levels. Based on this, this study relies on the relationship between vocational expectations, social support, psychological capital, and employment anxiety of students in vocational colleges, and whether the influence of social support and psychological capital on employment anxiety has a chain mediating effect. It is of great practical significance to prevent and alleviate the employment anxiety of art students in vocational colleges and universities under the state of large-scale public health emergencies and improve the mental health level.

Literature review

Career expectation refers to the willingness and expectation of an individual to engage in a career in the future before entering the labor market. It emphasizes the internal motivation of individual career choice, and is also the external embodiment of individual occupational values (Hong et al., 2022). The study found that career expectation has a significant predictive effect on college students' employment pressure, employment satisfaction, and employment quality (Bruthers and Matyas, 2020; Mcleod et al., 2021). At the same time, career expectation can affect employment anxiety by adjusting the positive coping style in college students' employment activities (Seong and Francesca, 2020; Wu et al., 2020). College students who attach importance to internal value will feel the sense of urgency and anxiety to improve their ability, while college students who attach importance to external value will rely more on external forces (So and Ha, 2019; Choi and Jung, 2020). However, higher professional expectations will lead to more anxiety (Aydinli et al., 2019; Yang and Yang, 2022). This study therefore proposed the following hypothesis:

> *H1*: The career expectation of art students in higher vocational colleges can positively predict employment anxiety.

As an extension of positive psychological ideas in the field of organizational behavior, psychological capital has received extensive attention from researchers in many disciplines. It is a positive psychological state or psychological energy displayed by individuals in the process of growth and development (Min and Minte, 2022; Xu and Wang, 2022). Psychological capital is closely related to the employment activities of college students, which can stimulate the internal employment potential of individuals, and change the cognition and attitude toward employment, thus increasing employment opportunities and enhancing employment success (Nimmi et al., 2021). Therefore, psychological capital plays a positive role in employment involving individual competence competition (Daniel et al., 2019; Lupsa and VÎrgĂ, 2020). In addition, the related research on psychological capital and employment anxiety shows that psychological capital has a positive impact on college students' employment anxiety, that is, the higher the psychological capital, the lower the level of employment anxiety (Belle et al., 2022; Yang et al., 2022). Therefore, the second hypothesis was proposed:

> *H2*: Psychological capital plays a mediating role in the process of the influence of career expectation on employment anxiety of vocational art students.

Social support refers to the resources provided by others to help individuals cope with the pressure they face (Lubis et al., 2022). Because social support comes from many aspects, including material support, spiritual inspiration, and help from relatives and friends. For art students in higher vocational colleges, the choice of occupation, where to obtain employment, how to obtain

employment and how to realize their self-value after employment should be carefully considered, and more importantly, they need to rely on relevant social support resources to complete (Zhang Y.Z., 2022). It can be seen that social support plays a very important role in college students' employment. Research on social support and employment anxiety shows that there is a significant negative correlation between social support and employment anxiety of college students (Kautish et al., 2021; Noman et al., 2021); In the face of employment pressure or employment choices, the more abundant social support resources for college students, the lower the level of employment anxiety (Yamashita and Kazama, 2018; Jang and Jin, 2019). In addition, the social support buffer theory points out that, on the one hand, social support can directly reduce individual pressure and improve social adaptability (Yang et al., 2020; Wang and Li, 2022), and on the other hand, it can improve anxiety and tension and promote physical and mental health through mediation effect (Unguren and Huseyinli, 2020; Chen and Zeng, 2021). Therefore, individuals with higher levels of social support have higher levels of mental health. Based on the above research results, the third and the fourth hypothesis were proposed:

> *H3*: Social support plays a mediating role in the influence of career expectation on employment anxiety of vocational art students.
>
> *H4*: Social support and psychological capital play a chain intermediary role in the impact of career expectations on employment anxiety of vocational art students.

Materials and methods

According to the literature review and research purpose of this study, a hypothesis model was proposed (Figure 1). Social support and psychological capital were important influencing factors between career expectation and employment anxiety, and there was a chain relationship between social support and psychological capital.

Participants

With the informed consent of the survey participants, the questionnaire was distributed online through the professional survey platform Questionnaire Star from March 10 to 20, 2022, and effective screening sampling was conducted. The survey object of this online questionnaire is the recent graduates of five vocational colleges in Jiangsu Province who have not signed formal employment contracts (age = 22–24, mean age = 23.35, SD = 1.316 years). A total of 634 questionnaires were distributed. After excluding the questionnaires with missing answers and repeated answers, 619 graduates were finally selected as research participants. The effective rate of the questionnaire was 97.63%. Due to the gender structure of art students, there were more female participants than male participants in this study, 388 female students (62.70%) and 231 male students (37.30%).

Research tools

Career expectation

The Career Expectation Scale (CES; Wu et al., 2020) was used to measure the status of Career expectations in three dimensions. There are eight items in the prestige position and stability dimension, eight items in the internal value dimension, and five items in the external value dimension. This version of the scale has been proved to have good reliability and validity among college students in Chinese Mainland (Wang et al., 2022). It uses a five-point Likert-type response mode with 5 = strongest and 1 = not strong. The higher the total score and subscale score, the higher the level of professional expectation. The Cronbach' alphas of three subscales ranged from 0.87 to 0.91. The results of confirmatory factor analysis were $\chi^2/df = 2.69$, RMSEA = 0.05, CFI = 0.93, NFI = 0.92, GFI = 0.90.

Employment anxiety

The Employment Anxiety Scale (EAS; Zhang X., 2022) was used to measure the individual employment anxiety in four dimensions. Among them, there are seven items in the dimension of employment

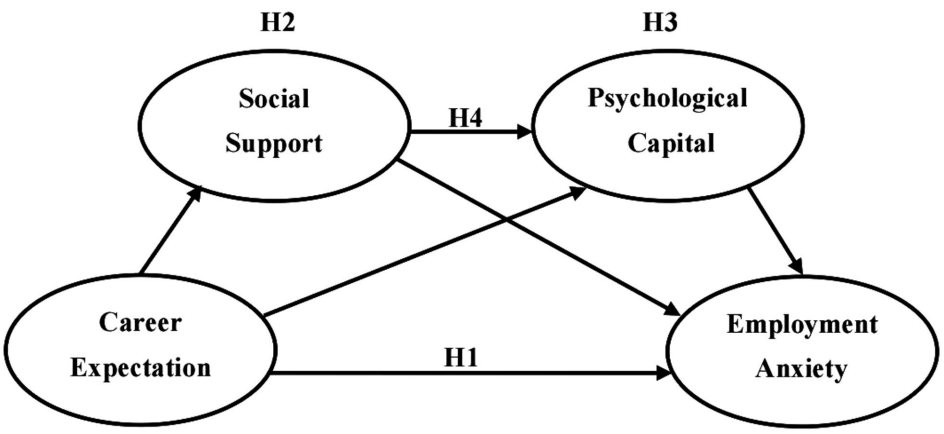

FIGURE 1
Hypothetical model.

competition pressure, seven items in the dimension of lack of employment support, six items in the dimension of lack of self-confidence, and six items in the dimension of worry about employment prospects. This version of the scale has been proved to have good reliability and validity among college students in Chinese Mainland (Wang et al., 2022). It uses a five-point Likert-type response model with 5 = strongest, 1 = not strong. The higher the total score and subscale score, the higher the level of employment anxiety. The Cronbach' alphas of four subscales ranged from 0.82 and 0.89. The results of confirmatory factor analysis were $\chi^2/df = 2.17$, RMSEA = 0.04, CFI = 0.97, NFI = 0.96, GFI = 0.96.

Psychological capital

The Psychological Capital Scale (PCS; Luthans and Broad, 2020) was used to measure the individual's psychological state in four dimensions (resilience, optimism, self-efficacy, and hope), with five items in each dimension. This version of the scale has been proved to have good reliability and validity among college students in Chinese Mainland (Liu et al., 2022). It uses a seven-point Liker-type response model with 7 = very strong, 1 = very not strong. The higher the total score and subscale score, the higher the level of psychological capital. The Cronbach' alphas of four subscales ranged from 0.84 and 0.90. The results of confirmatory factor analysis were $\chi^2/df = 2.36$, RMSEA = 0.07, CFI = 0.92, NFI = 0.91, GFI = 0.91.

Social support

The Social Support Scale (SSS; Costa et al., 2022) was used to measure the individual's social support level in three dimensions (family support, friend support, and other support), with four items in each dimension. This version of the scale has been proved to have good reliability and validity among college students in Chinese Mainland (Tian and Shi, 2022). It uses a seven-point Liker-type response model with 7 = very strong, 1 = very not strong. The higher the total score and subscale score, the higher the level of psychological capital. The Cronbach' alphas of three subscales ranged from 0.85 and 0.92. The results of confirmatory factor analysis were $\chi^2/df = 2.55$, RMSEA = 0.03, CFI = 0.97, NFI = 0.96, GFI = 0.96.

Data analysis

SPSS 26.0 and its plug-in program were used to input, process, and statistically analyze the relevant data of this study. Methods include descriptive statistics, Pearson's correlation analysis, and PROCESS macroanalysis (Model 6) to assess the chain mediating role of social support and psychological capital. The data were normalized by Z-score in this study. Since the data collected are mainly derived from participants' self-reports, which may lead to common methodological biases, in order to further improve the rigor of the study, Harman univariate tests were used to test for biases in common methods before data analysis. The mediation effect test in this study adopts the bootstrapping method, according to BootLLCI, BootULCI to determine whether the interval contains 0, if it does not contain 0, the mediation effect is significant, and vice versa. The model sample size is set to 5,000 and the confidence interval (CI) is set to 95%.

Results

Common method deviation test

In this study, Harman's single-factor was used to test the common method bias since we assessed career expectations, employment anxiety, social support, and psychological capital using measuring scale. The analysis results showed that there were 14 common factors with eigenvalues greater than 1, among which the explained variance of the first factor was 24.56%, which was less than the critical standard of 40%, indicating that there was no problematic common method bias (Podsakoff and Organ, 1986).

Descriptive statistics

Table 1 presents the mean, standard deviation, and correlation coefficients for the study variables. Career expectation correlated moderately with employment anxiety ($r = 0.574$, $p < 0.01$), and social support ($r = 0.392$, $p < 0.01$), and slightly with psychological capital ($r = 0.293$, $p < 0.01$). Employment anxiety negatively correlated with social support ($r = -0.331$, $p < 0.01$), and psychological capital ($r = -0.413$, $p < 0.01$). Social support correlated moderately with psychological capital ($r = -0.413$, $p < 0.01$), so this result meets the requirements of intermediary effect analysis. Meanwhile, all correlation coefficients are below 0.700, indicating that there is no multicollinearity in the data.

Main effect

When the main effect path was tested using SEM, the standardized regression coefficients of the main effect were between 0.27 and 0.54. The model demonstrated by the main effect path was suitable for the sample data: $\chi^2 = 26.568$, $\chi^2/df = 2.214$ (Schumacker and Lomax, 2004), RMSEA = 0.034 (Steiger, 1989; McDonald and Ho, 2002; Schumacker and Lomax, 2004), CFI = 0.982 and NFI = 0.973 (Bentler and Bonett, 1980; Hu and Bentler, 1999), GFI = 0.982, TLI = 0.972 (Doll et al., 1994; Schumacker and Lomax, 2004), and SRMR = 0.021 (<0.05; Jöreskog and Sörbom, 1989; Hu and Bentler, 1999). Career expectation explained 40.03% of the variance in employment anxiety levels ($\gamma = 0.54$, $p < 0.001$), thus supporting Hypothesis 1 (Figure 2).

Structural model

The standardized regression coefficients of the main effect were between 0.25 and 0.45 in the SEM. The model demonstrated by the main effect path was a fit for the sample data: $\chi^2 = 329.640$, $\chi^2/df = 2.658$ (Schumacker and Lomax, 2004), RMSEA = 0.047 (<0.05; Steiger, 1989; Browne and Mels, 1990; McDonald and Ho, 2002; Schumacker and Lomax, 2004), CFI = 0.936 and NFI = 0.932 (Hu and Bentler, 1999), GFI = 0.925, TLI = 0.919 (Doll et al., 1994), and SRMR = 0.037 (< 0.05; Jöreskog and Sörbom, 1989; Hu and Bentler, 1999). Hypotheses 2–4, which involved mediating factors, constituted a structural model, as illustrated in Figure 3.

Mediating effect

In order to test the hypothesis, bootstrapping was used to test the chain mediation model of the path between social support and psychological resources in occupational expectation and employment anxiety (Hayes, 2009). Table 2 shows the analysis results of bootstrap 95% confidence intervals (5,000 times), excluding 0 (Mackinnon et al., 2004); the direct impact of career expectation on employment anxiety was significant ($\gamma = 0.253$, $p < 0.001$). For the career expectation→social support→employment anxiety path, the bootstrap 95% confidence intervals (5,000 times) exclude 0 ($\gamma = -0.111$, $p < 0.001$). For the career expectation→psychological capital→employment anxiety path, the bootstrap 95% confidence intervals (5,000 times) also exclude 0 ($\gamma = -0.105$, $p < 0.001$). For the career expectation→social support→psychological capital→employment anxiety path, the bootstrap 95% confidence intervals (5,000 times) again exclude 0 ($\gamma = -0.007$, $p < 0.001$), with the chain mediated effect discovered to be significant.

TABLE 1 Descriptive statistics and correlations of study variable.

	1	2	3	4
1. Career Expectations	—			
2. Social support	0.392**	—		
3. Psychological capital	0.293**	0.471**	—	
4. Employment anxiety	0.574**	−0.331**	−0.413**	—
Mean	3.919	4.772	3.773	6.682
SD	0.701	0.863	0.778	1.816

$N = 634$. **$p < 0.01$.

Discussion

The impact of career expectations on employment anxiety

This study explores the influence of career expectations on employment anxiety of vocational art students and its internal mechanism. The results show that the career expectations of vocational art students have a significant positive predictive effect on employment anxiety, that is, the higher the level of career expectations of art students, the higher the degree of employment anxiety caused by this, which is completely consistent with previous research results and validates the first hypothesis of this study (Scholes and McDonald, 2021; Walters et al., 2022). In contrast, the human, material, and financial costs that art students need to spend in the process of growth and training are much higher than those of other majors, such as: art specialty training fees, learning equipment purchase fees (cameras, computers, painting tools, etc.), going out to collect style or visit exhibitions, etc. Influenced by the concept of "high investment will have high returns," higher vocational art students have relatively high requirements for job salaries. At the same time, influenced by the idea that art is an elegant culture, art students often show a high self-esteem personality, and they have high expectations for the popularity or reputation of the employment unit, especially the salary and working

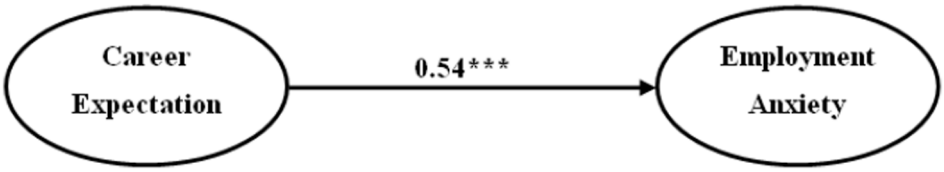

FIGURE 2
Main effect of career expectation to employment anxiety. ***p <0.001.

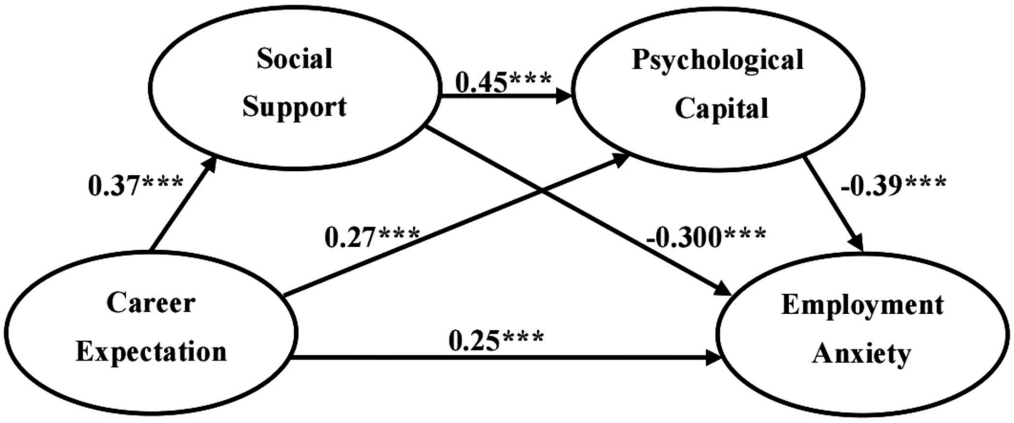

FIGURE 3
Structural model. ***p<0.001.

TABLE 2 Bootstrapping test result for chain mediating effects.

Total, direct, and indirect effect	Effect	Se	Boot95% CI	
			LLCI	ULCI
CE → SS → EA	−0.111	0.036	−0.216	−0.063
CE → PC → EA	−0.105	0.025	−0.221	−0.057
CE → SS → PC → EA	−0.007	0.011	−0.184	−0.039
Direct effects: CE → EA	0.253	0.049	0.301	0.395
Total indirect effect	−0.223	0.034	−0.278	−0.199
Total effect	0.476	0.068	0.397	0.522

CE, Career Expectation; SS, Social Support; PC, Psychological Capital; EA, Employment Anxiety.

environment. However, the actual level of positions, remuneration packages, and career development space that the job market (Watts et al., 2019; Mostafa et al., 2020) can provide is far from the initial psychological expectations of senior vocational art students (Maurud et al., 2022). The huge gap between ideal and reality should be one of the reasons for the employment anxiety of vocational art students.

The independent mediating role of social support and psychological capital

This study explores that social support and psychological capital play a mediating role in the influence of career expectation on employment anxiety of art students in higher vocational colleges, which verifies the second and third hypotheses of this study, but both of these two mediating processes have a masking effect. First, career expectation can affect employment anxiety through psychological capital. The research results show that career expectation can significantly and positively predict psychological capital, which is completely consistent with the existing research results (Daswati et al., 2022; Obschonka et al., 2023). At present, many employers lack sufficient social recognition for art students in higher vocational colleges, which makes some excellent art students not be treated fairly and missed employment opportunities, affecting their future career development and life trend. At the same time, many art students in higher vocational colleges are not confident about their academic qualifications and professional abilities, and think they will lose in the employment competition with undergraduates (Hanife and Nazmiye, 2021). The internal and external dual pressure easily causes the graduates to have negative emotions such as tension and anxiety, which leads to a significant reduction in the internal confidence level of individuals, and even self-doubt. While career expectation has a positive impact on psychological capital (Collignon and Sajuria, 2021; Mei et al., 2022). When higher vocational art students show higher levels of psychological capital, they will have more confidence in their own professional abilities. They can maintain a positive attitude toward the unfair treatment of employers in the process of job hunting, constantly seek for deficiencies from their own aspects and strive to achieve employment, which greatly reduces the emergence of employment anxiety of vocational art students (Tatarko and Rodionov, 2017; Amy and Tony, 2020; Johnston and Cassidy, 2020). Therefore, this study confirms that psychological capital can alleviate employment anxiety. Secondly, career expectation can also affect employment anxiety through social support. The research results show that career expectation can significantly and positively predict social support, which is completely consistent with previous research results (Jia et al., 2018; Wu et al., 2019). Because most art students in higher vocational colleges lack clear goals and effective plans for their future career development, they will seek more social support resources to achieve successful employment if they have high expectations for their careers in the process of seeking employment. According to the theory of socialization, family is an important part of individual social support resources. Before art students in higher vocational colleges entered the employment market, their families were the earliest places for their socialization. The social class where their families lived, their parents' professional background and interpersonal resources were important guarantees for their children's successful employment (Baluku et al., 2020; Lowery and Cassidy, 2022; Zhao et al., 2022). Therefore, the ardent expectation of vocational art students will expand their social support system, improve the utilization of social support resources, and thus achieve successful employment. The impact of social support on employment anxiety is negative, which is completely consistent with previous research results (Amy and Tony, 2020; Yang et al., 2022), indicating that the higher the level of social support, the lower the degree of employment anxiety. When art students in vocational colleges encounter problems or difficulties in the process of employment, they are prone to mood swings that cause tension, anxiety, and worry. At this time, the support of society, family, friends, and other channels will help them improve their self-coping ability, face problems positively, alleviate anxiety, and effectively reduce employment anxiety.

Chain mediating effect of social support and psychological capital

The study finds that social support and psychological capital play a chain intermediary role between career expectation and employment anxiety, which is basically consistent with previous research results (Kerksieck et al., 2019; Ren et al., 2019; Hye and Yeongmi, 2020), and also verifies the fourth hypothesis of this study. The main effect model of social support proposes that social support can not only alleviate the potential harm caused by stress events to individuals, but also have a positive impact on individual emotional experience and behavior patterns, so that individuals can enhance their sense of self-control, and even improve their physical and mental health by providing social support for individuals (Bruthers and Matyas, 2020; Martin et al., 2021). Therefore, the more abundant the social support resources are, the more positive the individual's psychological state will be. It can be seen that social support can affect the individual's emotional experience of stress and the way of coping with stress. High level of social support can promote the positive state of psychological capital.

Conclusion

This study preliminarily reveals the relationship between career expectation and employment anxiety of art students in vocational colleges, and the role played by social support and psychological capital between them. Among them, career expectation has a positive predictive effect on employment anxiety, while social support and

psychological capital have a masking effect here. This research result has important practical value for improving the employment quality of art students in higher vocational colleges. This requires higher vocational art students to make long-term plans for their careers in advance during their studies, not to focus on employment positions, but to use the employment platform to display their talents and continuously accumulate experience to improve themselves. Therefore, higher vocational art students should reasonably position their career expectations, overcome employment psychological barriers with the help of diversified social support, and actively face employment pressure by adjusting employment mentality, so as to reduce employment anxiety and promote employment quality. For example, vocational art students can find as many positions suitable for their career development as possible through the Internet, relatives and friends, and the talent market, and appropriately reduce the expectation of job salary. Higher vocational art studies also need to learn some employment interview skills, and show their professional expertise in the application process. At the same time, higher vocational art students should maintain a stable mood in the fierce competition for employment, by reducing the impact on themselves due to discrimination by recruiters. Of course, flexible employment is also another way out for higher vocational art students to find employment. In addition, university administrators, as student service providers, should provide scientific and effective employment guidance for students in the employment process. First of all, vocational colleges and universities should seek recruitment information from various relevant enterprises through multiple channels and provide it to students in a timely manner. Second, it is necessary to strengthen the professional concept of higher vocational art students and form the concept of "employment first, then career choice." Third, for students with employment difficulties, schools should also provide assistance based on the student's personal situation. In addition, due to the strong support of Chinese governments at all levels for college students in innovation and entrepreneurship policies and economy, vocational colleges and universities can also cultivate and support some potential innovation and entrepreneurship projects of higher vocational art students.

There are still several limitations in this study: (1) In terms of sample selection, the research subjects of this study are art graduates from five vocational colleges in Jiangsu. Due to the difference in the level of socio-economic development with the rest of the country and the uniqueness of the art profession, the scope of promotion of research results is limited, and the source of future research samples and professional types can be further expanded. (2) Due to the many factors affecting the employment anxiety of higher vocational art students, this study only explores the relationship between vocational expectations, social support, psychological capital, and employment anxiety of higher vocational art students, and can be further explored from the direction of personal ability and family socioeconomic status in the future.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

AZ: study concept and design, statistical analysis, and manuscript revise.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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When COVID-19 strikes mental health: a measurement analysis of reassurance seeking behavior scale in Peruvian population

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Background: The long-lasting impact of the COVID-19 pandemic cannot be overstated. To combat its dire consequences, some screening measures have been hastily developed and require robust verification to explore their adequacy across different groups. The present research study aimed to analyze measurement invariance by sociodemographic characteristics of the Coronavirus Reassurance Seeking Behavior Scale (CRSB) in Peruvian adults.

Methods: A total of 661 participants completed The Coronavirus Reassurance Seeking Behavior Scale (CRSB), the Coronavirus Anxiety Scale (CAS), and sociodemographic information a subgroup filled in the Patient Health Questionnaire (PHQ-9). Reliability and measurement invariance across sociodemographic characteristics were analyzed. Likewise, associations with depression and dysfunctional coronavirus anxiety were examined.

Results: Results showed that the single factor structure of the CRSB with correlated errors fitted the data adequately and the instrument was invariant across gender, age, and loss of a significant relative to COVID-19. In addition, significant associations with depressive symptoms and dysfunctional anxiety were found.

Conclusion: The findings of the present study suggest that the Coronavirus Reassurance Seeking Behaviors Scale is invariant across different sociodemographic characteristics.

KEYWORDS

measurement invariance, Peru, COVID-19, anxiety, depression, reassurance seeking behavior

1. Introduction

Since the beginning of the coronavirus disease (COVID-19) outbreak, more than 3.5 million lives have been claimed, and the number of those infected has surpassed the 168 million mark worldwide (Center for Systems Science and Engineering, 2020), reaching almost every country in the globe.

Latin America is one of the regions hit the hardest by the COVID-19 pandemic, according to estimates by international organizations such as the Economic Commission for Latin America (ECLA), the World Bank and the World Health Organization (WHO). It has resulted in the worst economic, social and productive crisis in the region of the last 120 years, in which unemployment, poverty, and inequality have increased (Economic Commission for Latin America [ECLA], 2021).

Although Latin America had sufficient time to prepare and face the pandemic, its structural conditions in the economy, housing, and health ended up making the continent a propitious place for the spread of COVID-19 (Peñafiel-Chang et al., 2020). A health system that was not prepared for such crisis, with high hospital occupancy that in some cases has reached the limit of emergency (Agencia EFE, 2020), and a difficult economic situation in the most unequal region in the world (Martí i Puig and Alcántara Sáez, 2020), are part of an explosive cocktail.

In this context, Peru made world news. In August 2020, the southern country reached its maximum peak of deaths per day from COVID-19, becoming the one with the highest mortality rate in the entire planet, according to the ranking prepared by the Coronavirus Resource Center of the Johns Hopkins University (CNN Español, 2020). With the arrival of 2021, and despite the devastating second wave in Europe, it still continues among the top ten places on that fatality podium and second in Latin America after Mexico (Alayo Orbegozo, 2021).

Among the restraint measures that some governments have adopted in order to stop or prevent the spread of the virus are: social distancing, isolation, quarantine, lockdown (Alfano and Ercolano, 2020; Lau et al., 2020; Sánchez-Villena and de La Fuente-Figuerola, 2020), banning of social, productive and economic activities, as well as the closure of borders. Some countries have even implemented a strict nationwide curfew. These measures have a detrimental impact on mental health (Yao et al., 2020; Msherghi et al., 2021; López Steinmetz et al., 2022), increasing levels of stress, depression symptomatology and anxiety (Elmer et al., 2020; Galea et al., 2020; Lima et al., 2020; Zhang and Ma, 2020; Mendoza-Ruvalcaba et al., 2022).

1.1. Impact of the pandemic on mental health

Quarantine and isolation increase the occurrence of psychological and mental problems, mainly originating from the absence of interpersonal communication. Depressive and anxiety disorders are more likely to develop or aggravate (Xiao, 2020; Zandifar and Badrfam, 2020). This propensity to display difficulties ranges from isolated symptoms to the development of a mental ailment such as insomnia, anxiety, depression, and post-traumatic stress disorder (Huremović, 2019). Likewise, in the social withdrawal in which people have been forced to restrict their mobility and reduce their social contacts to a minimum, the availability of timely psychosocial interventions and routine psychotherapeutic counseling have been drastically cutdown (Xiao, 2020).

In the context of a pandemic, it is important to consider the loss of function that can accompany the acquired disease. This in turn represents demoralization and helplessness, reaching a state of mourning (Huremović, 2019). Likewise, people subjected to the stress of the outbreak may present marked anguish and a significant deterioration in social or occupational functioning, and if they persist with a sad mood, a major depressive disorder may arise. It has been postulated that the combined effect of loss and threat may explain the frequent occurrence of depression (Styra et al., 2008).

The paralyzing fear that this disease triggers could be explained by its novelty and the uncertainty it generates (Asmundson and Taylor, 2020). The substantial number of patients and suspected infected cases raised public concern about becoming infected. This situation preconditions, to some extent, people to seek reassurance by excessive searching for news and information on COVID-19.

1.2. Reassurance seeking behavior as a vulnerable emotional distress factor

Excessive reassurance seeking is a relevant mechanism associated with the management of psychological distress. Empirical research studies have linked it to the prolongation of anxiety including generalized anxiety disorders (Beesdo-Baum et al., 2012), obsessive-compulsive disorder (Salkovskis, 1996; Salkovskis et al., 1998) and health anxiety or hypochondriasis (Taylor and Asmundson, 2004; Halldorsson and Salkovskis, 2017). It has been conceptualized as the "repeated solicitation of safety-related information from others about a threatening object, situation or interpersonal characteristic despite having already received this information" (Parrish and Radomsky, 2010).

Reassurance seeking behavior has been appointed as a vulnerability factor that enhances emotional distress during a pandemic (Lee and Crunk, 2020). Recurrent verification and reassurance seeking can ensue as a reaction to an infection risk (Taylor and Asmundson, 2004).

People with an overly excessive concern over their health are characterized by frequent medical redundant checking and reassurance seeking (Asmundson and Taylor, 2020).

One possible explanation of why people engage in excessive reassurance seeking is their lack of tolerance toward uncertainty (Taylor, 2019). In fact, some disorders are associated to high intolerance of uncertainty (Fergus et al., 2015). Those with high levels of intolerance address their uncertainty through reassurance seeking and behaviors checking (Dugas and Robichaud, 2007). One of the ways in which they do this is by searching for medical information online or asking a professional.

Continual reassurance can also be explained under the lens of maladaptive coping (Taylor, 2019). Although the pandemic has mobilized everyone to use different ways of coping to deal with this stressful situation (Voronin et al., 2020), some people may resort to use maladaptive safety behaviors (i.e., excessive hand washing, repeatedly and unnecessarily seeking reassurance in social media

or from health professionals) in an attempt to relieve their stress in the short term, but failing to resolve the underlying fears and concerns, which allows the anxiety to prevail in the long term (Wheaton et al., 2012).

1.3. CRSB and associated variables

In order to understand the causes of excessive distress, reassurance seeking behaviors play an important role as a vulnerable factor to emotional distress (Taylor, 2019). As a response to the pandemic, Lee et al. (2020) have developed the Coronavirus Reassurance-Seeking Behavior Scale (CRSB) which aims to measure the recurrence of engagement in coronavirus-related reassurance seeking behaviors. The CRSB is a short 5 item scale with good psychometric properties. It has good internal consistency ($\alpha = 0.90$) and a solid single factorial structure (Lee et al., 2020). Although it has been translated into some other languages like Turkish, Persian, Greek and Italian, there is no formal evaluation of its equivalence across different groups.

Its original version had a high correlation with dysfunctional coronavirus anxiety, depression, among others (Lee et al., 2020). Previous research studies have mentioned that excessive reassurance-seeking is a hallmark feature in developing and perpetuating anxiety and specifically been associated to corona phobia and health anxiety (Lee et al., 2020).

Likewise, people that are prone to have a high intolerance to uncertainty and use excessive reassurance safety behaviors are likely to have high levels of depression (Thompson et al., 2010; Taylor, 2019).

1.4. The present study

Based on the aforementioned and in response to the pandemic situation, the aim of the present study was to evaluate whether the CRSB is equivalent across some sociodemographic variables in a sample of Peruvian adults. In addition, reliability indices were inspected, and it was hypothesized that CRSB had a positive and direct relationship with depression by means of the Patient Health Questionnaire (PHQ-9) and with dysfunctional anxiety measured by the Coronavirus Anxiety Scale (CAS).

2. Materials and methods

2.1. Participants

The sample comprised 661 Peruvian adults for which cross-sectional data was collected using a snowball sampling technique mainly in urban zones of the capital, Metropolitan Lima. Participants that did not meet the inclusion criteria were filtered out. The final sample consisted of 661 participants (59% women), their age ranged from 18 to 45 ($M_{age} = 23.5$, $SD = 6.2$). **Table 1** includes the complete sociodemographic characteristics of the participants. Some variables were re-categorized for the sake of simplicity. Additionally, some categories had very few cases. In the case of age, and following some developmental theorists (Arnett, 2000, 2015; Mehta et al., 2020) two very well distinguished groups were formed, emerging adults, which ages ranged from 18 to 29 years (Arnett, 2000) and established adults, which ages ranged from 30 to 45 years (Mehta et al., 2020). Likewise, original educational level categories were collapsed to basic education (primary and secondary) and higher education (university studies onward) supported by the Peruvian educational structure and the Peruvian General Education Law (2003).

TABLE 1 Sociodemographic characteristics of the Peruvian sample ($n = 661$).

	n	%
Gender		
Female	392	59
Male	269	41
Age		
Emerging adults (18–29)	554	84
Established adults (30–45)	107	16
Marital status		
Single	573	86.7
Cohabiting or married	67	10.1
Divorced or separated	21	3.2
Number of children		
No children	573	87
Has children	88	13
Education level		
Basic education	407	62
Higher education	254	38
You know people with COVID-19		
Yes	481	73
No	180	27
COVID-19 diagnosis		
No	509	77
Diagnosed or convalescent	152	23
Loss of a significant relative to COVID-19		
Yes	237	36
No	424	64
Levels of depressive symptoms*		
None	60	34.9
Mild	31	18
Moderate	32	18.6
Moderately severe	35	20.3
Severe depression	14	8.1

*Variable depression has a sample of $n = 172$.

2.2. Measures

2.2.1. Sociodemographic information

Participants were requested to state a number of background variables among the most important: gender, age, number of

children, educational level, whether the participant have or have had the diagnosis of COVID-19 and whether they have lost a significant relative due to COVID-19.

2.2.2. Coronavirus reassurance-seeking behavior scale

The CRBS (Lee et al., 2020) is a self-reported scale that looks to evaluate reassurance-seeking behaviors related to preoccupations over coronavirus infection. It consists of 5 items through which participants indicate how often they got engaged in reassurance-seeking behaviors (e.g., "I spoke with a medical professional about my symptoms to see if I was infected with the coronavirus disease") in the last 2 weeks. Items are rated on a five-point Likert scale, ranging from "not at all" (0 scores) to nearly every day over the last 2 weeks (4 scores). The total score of the CRBS can range from 0 to 20. In the present study, internal consistency coefficients were adequate ($\alpha = 0.89$, $\omega = 0.9$).

2.2.3. Patient health questionnaire

The PHQ-9 (Spitzer, 1999) is a brief self-administered questionnaire and consists of nine items assessing depressive symptoms (e.g., "Thought that you would be better off dead, or of hurting yourself"). Participants rated the frequency of their answers in the last 2 weeks on a 4-point Likert scale ranging from "not at all" (0 scores) to "nearly every day" (3 scores). The adapted Peruvian version of the PHQ-9 (Calderón et al., 2012) was used, and has good evidence of validity supporting one dimension factor structure (Villarreal-Zegarra et al., 2019). The total score of the PHQ-9 can range from 0 to 27. Cut-off points of 0–4 (none), 5–9 (mild), 10–14 (moderate), 15–19 (moderately severe), and 20 to more (severe depression) (Kroenke et al., 2001). In the present study, internal consistency Cronbach's alpha coefficient was excellent ($\alpha = 0.92$).

2.2.4. Coronavirus anxiety scale

The CAS (Lee, 2020) is a self-rated instrument and consists of five items evaluating dysfunctional anxiety over the coronavirus. Participants indicated how frequently they experience each activity over the last 2 weeks on a five-point Likert scale, ranging from "not at all" (0) to "nearly every day over the last 2 weeks" (4). Previous empirical studies have demonstrated good psychometric properties of this brief tool in different languages: Korean (Choi et al., 2020), Turkish (Evren et al., 2020), Bangla (Ahmed et al., 2020). The validated Peruvian version of the CAS was used with satisfactory evidence of validity (Caycho-Rodríguez et al., 2020). In the present study, the internal consistency Cronbach's alpha coefficient was adequate ($\alpha = 0.85$).

2.3. Procedure

An institutional review board (i.e., The Research Committee of San Pedro University), provided ethical approval for conducting the research study. Participants gave their consent virtually before starting the evaluation. The evaluation was anonymous, voluntary and confidential, so the study did not represent any ethical risk to the participants. Moreover, contact information from the research team was provided in case of questions, doubts, or any additional information the participants required, during or at the end of the study.

For some instruments, the validated local versions were used and for foreign tools a translation from English to Spanish was made, followed by a back translation to assure linguistic equivalence of the instruments.

A set of self-rated questionnaires and socio-demographic information was completed by Peruvians from the general population. Participants completed the survey remotely (i.e., through an online platform) in which a link was enabled and disseminated on different social media sites. Informed consent was required. Participants were told about the anonymous nature of the research, that they could withdraw from the survey at any time without further explanation and that the information would be treated as confidential as possible for research purposes.

2.4. Data analysis

Evidence of internal structure validity was evaluated using confirmatory factor analysis. Maximum Likelihood with Robust standard errors (MLR) method was used, which is suitable when the number of response categories for each item is equal to or greater than five (Rigdon, 1998; Raykov, 2012). Accordingly, a set of goodness-of-fit indices were used: Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI), which define adequate values as those > 0.90; the Standardized Root Mean-Square (SRMR); and the Root Mean Square Error of Approximation (RMSEA), where values <0.080 are considered adequate (Keith, 2014). Likewise, goodness-of-fit indices of the model with correlated errors were evaluated.

Additionally, a stepwise Multi-Group Confirmatory Factor Analysis (MGCFA) was used to assess nested models with progressive restrictions in the gender group. Initially, we set a base or configural model. Based on this, we added restrictions at the level of factor loadings (weak model). A non-substantial discrepancy between the two models indicates weak invariance (configural model vs. weak model). We then evaluate the strong model with restrictions at the level of factor loadings and intercepts. We then, compare both models (weak model vs. strong model). We considered a non-substantial variation in each of the previous steps described if the difference was $\Delta CFI < 0.010$ and $\Delta RMSEA < 0.015$ or $\Delta SRMR < 0.005$ (Chen, 2007; Putnick and Bornstein, 2016). Associations between the CRBS and the PHQ-9 and CAS were conducted by means of Pearson's correlation analysis. We expected a positive correlation of the CRBS with the two variables. Finally, omega (ω) internal consistency coefficients were calculated. Values greater than 0.80 were considered optimal (McDonald, 1999).

All analyses were performed using Lavaan package, Version 0.6-12 (Rosseel, 2012) in R program (Version 4.2.1). The R script is attached as **Supplementary material**.

3. Results

3.1. Factor structure

A confirmatory factor analysis was conducted to assess the original single factor structure in a sample of Peruvian adults. The original factor structure (model 1) yielded a poor fit. Modification

TABLE 2 Goodness-of-fit indices for the models evaluated of CRSB.

Model	χ^2 (*df*)	CFI	TLI	RMSEA	SRMR
Model 1	44.7 (5)	0.942	0.884	0.110	0.049
Model 2	14.8 (4)	0.984	0.960	0.064	0.025

Model 1 = Model with five-items; Model 2 = Adjusted model with covariance error between item 2 and item 3.

indices suggested adding covariance error variance for item 2 and item 3. Therefore, model 2 was run following an adjusted model that considered these correlated errors. Optimal values for the fit indices were identified, and an adequate fit for the RMSEA index value were found (see Table 2). Theoretically, items 2 and 3 are closely related to each other and both refer to the search for information on COVID-19. Subsequent analyses were performed using this model. The standardized factor loadings of model 2 are presented in Table 3.

3.2. Measurement invariance

We conducted a multi-group factor analysis, imposing progressive restrictions on structure (configural), factor loadings (weak), intercepts (strong), and residuals (strict) for all models. We found good fit indices in all cases, except in the educational level group for the configural model, which presented RMSEA somewhat above the cutoff. Measurement invariance was analyzed by gender (women and men), age (emerging adults, established adults), educational level (basic education, higher education) and loss of a significant relative (yes, no) (see Table 4). Our study found that the difference in CFI between models (configural vs weak, and weak vs strong) for all groups tested was small, ΔCFI < 0.010, and at least ΔRMSEA or ΔSRMR satisfying the cutoff for measurement invariance, with the exception of educational level. In the case of the male and female groups, the difference between strong and strict invariance was significant. On account of no straightforward interpretation for strict invariance, it was considered that there was a satisfying level of invariance to allow comparisons between males and females. So, measurement invariance was found by gender at the strong level. Similarly, results show measurement invariance by age and loss of significant relative to COVID-19 groups at the strict level.

3.3. Relationship with other variables

Correlation analyses was conducted with latent variables in the model. Results showed that the Coronavirus Reassurance-Seeking Behaviors latent factor correlated directly and significantly with the Coronavirus Anxiety latent factor, $r = 0.66$, $p < 0.001$. Furthermore, the CRSB correlated directly and significantly with the Depression symptoms latent factor, $r = 0.23$, $p = 0.019$.

3.4. Reliability

Internal consistency by means of omega coefficient were calculated for the best fitting model (model 2). Thus, coefficient presented optimal levels of internal consistency, $\omega = 0.86$.

TABLE 3 Standardized factor loadings of the confirmatory factor analysis for the final model.

Item	F1
01. I took my temperature to see if I was infected with the coronavirus disease.	0.69
02. I read information on the internet to see if I had symptoms of the coronavirus disease.	0.78
03. I read or watched videos to see if I was infected with the coronavirus disease.	0.81
04. I spoke with other people about my symptoms to see if I was infected with the coronavirus disease.	0.85
05. I spoke with a medical professional about my symptoms to see if I was infected with the coronavirus disease.	0.75

4. Discussion

We have increasing evidence that the COVID-19 pandemic eroded the mental health of millions of individuals. Different stressors associated to the outbreak such as lockdown, isolation, financial anguish, physical and social distancing, fear of contagion, concern for family and friends, and uncertainty increase the levels of maladaptive behaviors, as well as the onset of mental disorders such as anxiety, post-traumatic stress, or depression (Huremović, 2019; Taylor, 2019). The main objective of the present research study was to evaluate the measurement invariance of the Coronavirus Reassurance Seeking Behavior Scale (CRSB) across different sociodemographic variables in a sample of Peruvian adults. First, we tested the internal structure of the CRSB. Results shed light on a single factor structure of the CRSB from the original English version developed by Lee et al. (2020) in which it was necessary to add an item error covariance. Thus, two models were evaluated to better understand the factorial structure of the CRSB. The complete 5 item- scale model, and the model with correlated errors in items 2 and 3. Reliability was calculated by means of omega's coefficient guaranteeing adequate levels of internal consistency.

In evaluating the model fit, the modification indices suggest establishing the covariance between the errors of item 2 ("I read information on the internet to see if I had coronavirus symptoms") and item 3 ("I read or watched videos to see if was infected with the coronavirus"). The content analysis of these two items represents for the individual the emphasis on evaluating their information seeking activity on the coronavirus issue. The first item analyses the individual's exploration on the Internet, while the second item inspects the action of reading or watching videos. In the foregoing, it is important to realize that currently the reading and watching at audiovisual material is carried out primarily through the Internet. This would result in a redundancy of these two indicators. Consequently, in this study we also present and explore the error covariance model, which in future studies or replications could motivate an adjustment in the content of any of these items.

Secondly, although previous research studies have examined the importance of the psychometric properties of the scale, it has not yet been investigated whether the scale might vary in

TABLE 4 Measurement invariance of the Coronavirus Reassurance Seeking Behavior Scale across groups.

Group	Invariance	X^2 (gl)	CFI	TLI	RMSEA	SRMR	Δ CFI	Δ RMSEA	Δ SRMR
Sex	Configural	16.4 (8)	0.988	0.971	0.057	0.023	–	–	–
	Weak	22.9 (12)	0.985	0.975	0.052	0.040	0.002	0.005	0.017
	Strong	27.4 (16)	0.984	0.980	0.047	0.041	0.001	0.005	0.001
	Strict	49.3 (21)	0.961	0.963	0.064	0.047	0.017	0.017	0.006
Age	Configural	21.5 (8)	0.982	0.955	0.072	0.024	–	–	–
	Weak	24.2 (12)	0.984	0.973	0.056	0.029	0.002	0.016	0.005
	Strong	28.1 (16)	0.984	0.980	0.048	0.029	0.001	0.008	0.000
	Strict	29.3 (21)	0.989	0.989	0.035	0.030	0.003	0.013	0.001
Educational Level	Configural	25.8 (8)	0.975	0.939	0.082	0.024	–	–	–
	Weak	28.8 (12)	0.977	0.961	0.065	0.033	0.002	0.017	0.009
	Strong	37.9 (16)	0.970	0.962	0.064	0.035	0.002	0.001	0.002
	Strict	37.3 (21)	0.977	0.978	0.049	0.036	0.004	0.015	0.001
Loss of significant relative to COVID-19	Configural	19.9 (8)	0.983	0.957	0.067	0.023	–	–	–
	Weak	27.2 (12)	0.978	0.964	0.062	0.048	0.002	0.005	0.025
	Strong	34.0 (16)	0.974	0.968	0.058	0.050	0.000	0.004	0.002
	Strict	36.9 (21)	0.977	0.978	0.048	0.049	0.001	0.010	0.001

different groups. In this sense, measurement invariance across gender was supported. This shows the first evidence of the absence of measurement bias of the CRSB, as being equally accurate for both men and women (Dimitrov, 2010). The study confirmed, through configural, weak and strong invariance, that the one-dimensional structure in both subsamples shows acceptable fit values, concluding that it provided the bare minimum necessary for a meaningful interpretation of group mean contrasts.

Moreover, results suggest the equivalence of measurement of the scale across age groups. The models (emerging adults and established adults) are equivalent in their factorial loads and intercepts. Thus, the evidence indicates that the one-dimensional model with correlated errors has attributes that make it solid and robust to differences between young and established adults, showing that the reassurance seeking behavior construct is understood in the same way across groups. Similar results were obtained regarding the group that had lost someone important through COVID-19 and those who had not. In general, our results lead to establish that population-based norms are applicable to various subgroups (i.e., gender, age, loss of significant other, etc.).

Third, regarding associations with other variables, reassurance seeking behavior was positively related to anxiety. According to previous research studies (Taylor, 2019), many people are susceptible to develop anxiety and responses such as compulsive checking and reassurance-seeking regarding potential threats.

Excessive reassurance seeking behavior has been characterized as a mechanism that plays a core role in managing psychological distress. It has been associated to anxiety and perceived general threats. In this scenario, reassurance seeking behaviors sought to immediately reduce anxiety and avoid hazardous perceived situations, episodes, or stimuli. However, it is paradoxically followed by a compulsive checking seeking response over time, perpetuating anxiety (Abramowitz et al., 2002). The study of Lee et al. (2020) revealed that reassurance seeking was highly associated to anxiety related to the COVID-19 pandemic. People that have an excessive triggered response of fear of becoming infected with the virus are prone to look for reassurance that they are not afflicted.

People with anxiety indulge in reassurance seeking behavior, hoping to minimize their feelings of uncertainty. Reassurance seeking behavior is recognized as a form of intolerance toward uncertainty, leading to higher levels of worry. This behavior is associated with pathological anxiety and has contributed to the field of generalized anxiety disorders (Dugas et al., 2001).

Concerning the depression variable, it was significantly related to reassurance seeking behavior. Although reassurance-seeking alleviates worry and uncertainty in the short term, it also prolongs depression in the long term (Joiner et al., 1999). It has been reported that if highly reassurance-seeking people perceive a negative valuation of themselves, they will begin to show depressive symptomatology.

Reassurance seeking behavior has been coined as a vulnerable factor for psychopathology, with anxiety and depression as its most common manifestations (Taylor, 2019).

Contradictory to the previous literature and foregoing research studies, Lee and Cruck (Lee and Crunk, 2020) could not find significant results of reassurance seeking as a predictor of depression. It is more likely that the PHQ-4 used with only two items measuring depression may not be sensitive enough to find significant results. However, in the present study, we can confirm a significant relationship between reassurance seeking behavior and depression, albeit with a small effect. It is important to address this issue because the prevalence of depression has increased sevenfold since the COVID-19 outbreak (Bueno-Notivol et al., 2021; Villarreal-Zegarra et al., 2023).

National, as well as international Public Health institutions are advised to address the state of general public mental health, in order to improve the wellbeing of citizens.

5. Limitations and conclusion

Although these findings are promising, there are some limitations worth mentioning. First, the sampling method was chosen by convenience in an effort to deal with time constraints and limited resources. In this sense, as the sample selection is not random, it is not possible to reach generalizations of the results. Future studies should use a probabilistic sample involving different regions of the country to have more accurate and categorical conclusions. Second, the study was based on self-report measures which might have some bias associated to social desirability or memory- related effects. It is recommended that studies also use other methodological strategies such as a qualitative approach (i.e., in depth interviews). Third, for the depression variable, we obtained a smaller sample size since not all participants chose to respond to this scale, possibly because it was located at the end of the survey and the answer option was left free due to the length of the entire survey. Although results yielded a significant relationship with reassurance seeking behavior, a small effect size was found.

Regardless of the shortcomings of the present study, the Coronavirus Reassurance Seeking Behaviors Scale has good psychometric properties. It can be used as a potential screening tool to identify people vulnerable to experience anxiety related to the novel coronavirus disease.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Research Committee of San Pedro University. The participants provided their written informed consent to participate in this study.

Author contributions

DM-M conceptualized the study, did the project administration, and study design. DM-M, DV-Z, RC-B, and JG-S prepared the methodology and formal analysis. DM-M, NF-R, DL-A, and GP-Q collected the data. DV-Z and JG-S did data curation. DM-M wrote the first draft of the manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1132804/full#supplementary-material

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Mental health and academic experiences among U.S. college students during the COVID-19 pandemic

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When the COVID-19 pandemic began, U.S. college students reported increased anxiety and depression. This study examines mental health among U.S college students during the subsequent 2020–2021 academic year by surveying students at the end of the fall 2020 and the spring 2021 semesters. Our data provide cross-sectional snapshots and longitudinal changes. Both surveys included the PSS, GAD-7, PHQ-8, questions about students' academic experiences and sense of belonging in online, in-person, and hybrid classes, and additional questions regarding behaviors, living circumstances, and demographics. The spring 2021 study included a larger, stratified sample of eight demographic groups, and we added scales to examine relationships between mental health and students' perceptions of their universities' COVID-19 policies. Our results show higher-than-normal frequencies of mental health struggles throughout the 2020–2021 academic year, and these were substantially higher for female college students, but by spring 2021, the levels did not vary substantially by race/ethnicity, living circumstances, vaccination status, or perceptions of university COVID-19 policies. Mental health struggles inversely correlated with scales of academic and non-academic experiences, but the struggles positively correlated with time on social media. In both semesters, students reported more positive experiences with in-person classes, though all class types were rated higher in the spring semester, indicating improvements in college students' course experiences as the pandemic continued. Furthermore, our longitudinal data indicate the persistence of mental health struggles across semesters. Overall, these studies show factors that contributed to mental health challenges among college students as the pandemic continued.

KEYWORDS

mental health, college students, COVID-19, academic performance, remote learning, perceived stress, anxiety, depression

Introduction

Before the COVID-19 pandemic, 1 in 5 U.S. college students reported "overwhelming anxiety," and 1 in 6 reported depression severe enough to impact daily functioning (American College Health Association, 2018), but the pandemic led to worse mental health among this cohort. For example, Wang et al. (2020b) surveyed over 2000 U.S. college students in May 2020, and found that 48% reported moderate-to-severe depression and 38% reported moderate-to-severe anxiety. A longitudinal study at Dartmouth (Huckins et al., 2020) conducted before and during the first academic term of the pandemic found higher depression, anxiety, and sedentary time, and the anxiety and depression were correlated with more COVID-19 news. Furthermore,

pandemic-related stressors may have exacerbated symptoms for students who were already experiencing depression (Greaney et al., 2021).

These pandemic-related mental health impacts among college students appear to be a global phenomenon. A survey of French college students in April and May of 2020 indicated that 16% had severe depression, 28% had a high level of anxiety, 22% had severe distress, and 11% had suicidal thoughts (Wathelet et al., 2020). In May, 2020, 15% of college students in Bangladesh reported high levels of severe depression, and 18% reported severe anxiety (Islam et al., 2020). In a sample of college students in Saudi Arabia between March and June of 2020, 35% reported moderate to extreme levels of anxiety (Khoshaim et al., 2020). A survey of Chinese college students in February and March 2020 found that 44% reported increased stress levels, 17% had anxiety symptoms, and both measures of mental health were correlated with more frequent reading of the news during that time period (Wang et al., 2020a). A meta-analysis by Li et al. (2021) found high levels of depression and anxiety among college students across 27 studies, and percentages of symptoms were higher among non-Chinese students and higher after March 1, 2020.

Studies have identified several factors correlated with pandemic mental health impacts. Females have generally reported higher levels of psychological distress (e.g., Li et al., 2021), more time on news was correlated with negative mental health outcomes in Wathelet et al. (2020) and Huckins et al. (2020), and social media usage was correlated with greater stress for female and male college students (Prowse et al., 2021). A change to living at home with family correlated with worse mental health among samples of college students in some studies (e.g., Islam et al., 2020), but living with family was a protective factor in another study (Cao et al., 2020), and some findings suggest that negative effects may be due to financial pressures placed on families during the pandemic (Islam et al., 2020).

College students' anxiety and depression levels may have remained high throughout the 2020–2021 academic year because their academic and social experiences were still disrupted in myriad ways. For example, a follow-up (Mack et al., 2021) to the longitudinal Dartmouth study found that as the pandemic continued in spring 2020, anxiety and depression among college students were still higher than previous academic terms and were correlated with the internet search term "COVID fatigue." The transition to remote learning was challenging for many students (e.g., Aristovnik et al., 2020; Wang et al., 2020b; Prowse et al., 2021), and many universities continued to predominantly offer remote and hybrid classes during subsequent semesters and adopted campus policies that reduced the number and perhaps quality of in-person interactions among students.

Our research objective was to better ascertain the mental health of U.S. college students as the pandemic continued, and we sought to determine potential differentiating factors of depression, anxiety, and perceived stress among students. During the fall 2020 semester, we conducted a survey study of U.S. college students. We hypothesized that students living on-campus would have better mental health scores than students living off-campus, and we hypothesized that participants who spent more time on social media platforms such as Facebook, Instagram, Twitter, and Tiktok would have worse mental health scores. In regards to academic experiences, we hypothesized that participants taking in-person classes would have a higher sense of belonging to their class community than participants taking online classes. During spring 2021, we conducted a follow-up study for further cross-sectional as well as longitudinal examinations of mental health among college students. We believed that factors such as universities' COVID-19 mitigation policies as well as individuals' perceived risks of contracting COVID may influence mental health changes as the pandemic continued, so we added questions to assess these factors. With the new cross-sectional data, we revisited the hypotheses from the fall study, and we also hypothesized that mental health scores would improve for the longitudinal participants from Survey 1 to Survey 2, that those scores would correlate with perceived risk of contracting COVID-19 and with vaccination status, and that those scores and the quality of students' social lives would correlate with universities' COVID-19 mitigation policies.

Method

Using Prolific[1] for a U.S. nationwide sample, we conducted a mental health survey of 279 college students in the fall 2020 semester and then, in the spring 2021 semester, conducted a second survey of 399 students, including 120 participants from the fall sample. Both surveys collected measures of perceived stress, anxiety, depression, academic and non-academic experiences, living situation, and extent of news and social media usage. Our surveys also asked about students' academic experiences and sense of belonging in three respective class formats – in-person, virtual, and hybrid. In the spring 2021 study, we refined the questions regarding students' academic and non-academic experiences, and we intentionally collected a stratified sample with equal representation in several race/ethnicity and gender categories.

Survey 1 (fall 2020)

Participants

Participants were recruited via Prolific (see footnote 1), an international survey site that pays participants to partake in the surveys. The site is similar to Amazon Mechanical Turk (Palan and Schitter, 2018) but has additional filtering mechanisms, ethical compensation, and has been repeatedly shown to provide higher quality data (Peer et al., 2021; Douglas et al., 2023) and recommended as a better source for collecting data from participants online (Newman et al., 2021). Like Mechanical Turk, Prolific provides access to convenience samples that are likely more diverse than laboratory studies, and it has been used to collect diverse samples in studies with the same mental health measures during the pandemic (e.g., Groarke et al., 2020; Armour et al., 2021; Sams et al., 2021). Table 1 presents the participant demographics. Compared to the demographics by race of U.S. undergraduate enrollment (American Council on Education, n.d.), the proportion of participants identifying as Asian appeared to be over-represented, while the proportions of participants identifying as Black and Hispanic were underrepresented. Our recruitment posting included filters to only allow participants who were pursuing a Bachelor's Degree in the United States and were 18 years of age or older. The survey took about 7.5 min to complete, and participants were awarded $1.30 upon completion. Of the 279 responses, 10 participants were excluded for failing one or more of the random attention checks, and 10 participants were excluded because they were not currently pursuing a Bachelor's degree, despite the Prolific filter.

1 https://www.prolific.co/

TABLE 1 Sample size and means/SDs for key scales and sociodemographic characteristics.

Variable	Category	Fall 2020	Spring 2021
Gender	Women	135	205
	Men	114	169
	Other	10	4
Race/ethnicity	Caucasian	136	101
	Black/African American	17	64
	Hispanic/Latino	16	57
	Asian/Asian-American	53	94
PSS	Women	23.79(7.23)	23.01(7.49)
	Men	20.29(8.36)	19.94(8.41)
	White/Caucasian	23.15(7.54)	20.99(7.13)
	Black/African American	21.89(8.74)	21.40(9.78)
	Hispanic/Latino	24.39(6.75)	19.10(9.49)
	Asian/Asian-American	21.15(8.23)	21.14(8.15)
GAD	Women	11.30(5.50)	9.47(5.76)
	Men	8.07(5.31)	7.93(5.41)
	White/Caucasian	10.76(5.39)	9.11(5.35)
	Black/African American	7.44(6.14)	8.02(5.38)
	Hispanic/Latino	10.67(5.26)	9.25(6.25)
	Asian/Asian-American	8.72(5.60)	8.20(5.54)
PHQ	Women	10.87(6.14)	11.10(6.41)
	Men	8.54(6.11)	8.69(6.19)
	White/Caucasian	10.41(6.10)	9.67(6.17)
	Black/African American	9.44(6.35)	10.28(6.47)
	Hispanic/Latino	11.78(5.68)	11.28(6.97)
	Asian/Asian-American	9.00(6.39)	9.05(6.31)
Place of residence	Within Commuting Distance	147	199
	Outside of Commuting Distance	58	81
	On Campus	40	98
Socioeconomic status	Low (less than $25,000)	-	58
	Medium-Low ($25,000-50,000)	-	83
	Medium ($50,000-100,000)	-	134
	Medium-high ($100,000-200,000)	-	70
	High (More than $200,000)	-	32
Working status	Not-working	80	157
	Part-Time	83	111
	Full-Time	43	40
Class-year	First Year	30	56
	Sophomore	58	84
	Junior	85	123
	Senior	62	98
	Fifth-Year	13	16
School type	Private (Less than 5,000 students)	–	36
	Private (5,000–15,000 students)	–	31
	Private (More than 15,000 students)	–	20
	Public (Less than 5,000 students)	–	12
	Public (5,000–15,000 students)	–	90
	Public (More than 15,000 students)	–	187

Materials

Perceived stress scale

This consists of 11 questions on 5-point Likert scales ranging from *never* to *very often*, where higher scores indicate higher feelings of stress (Cohen et al., 1983).

Generalized anxiety disorder test

This consists of seven questions on 4-point Likert scales ranging from not at all to *nearly every day*, where higher scores indicate higher feelings of anxiety (Spitzer et al., 2006).

Patient health questionnaire

This consists of nine questions on 4-point Likert scales ranging from *not at all* to *nearly every day*, where higher scores indicate higher feelings of depression (Kroenke et al., 2009).

Additional questions

Additional Likert scale questions asked about perceived support levels, amount of time spent on social media and news media, and academic experiences and sense of community in in-person, remote, and hybrid college classes during the fall 2020 semester. There were also four attention check questions that were Likert-scale based and distributed throughout the survey. Additional forced-choice questions asked about gender identity, job status, location, etc. When we created the survey, we included a wide variety of questions based on students' expressed interests for data analyses in an undergraduate course on Research Methods in Psychology. However, the three authors examined a constrained set of hypotheses for this survey and in conducting the follow up study. A full set of the survey questions can be found in the Supplementary material.

Procedure

Data were collected with a Google Forms survey[2]. This study was reviewed and approved by the DePauw University IRB Board. Participants were recruited on the Prolific website (see footnote 1) and provided informed consent *via* the Google Form after they were told the purpose of the study. Responses were received between November 3, 2020 and November 11, 2020.

Survey 2 (spring 2021)

Participants

For the spring survey we received 399 total responses with 120 of them being the same participants from the fall. The Prolific restrictions were the same as the fall survey with the addition of an age restriction of 18–22 years old, and we posted the survey eight times with separate demographic restrictions to obtain nearly 50 participants from each demographic combination of two gender categories (Female and Male) and four race/ethnicity categories (Black/African American, Asian/Asian-American, Hispanic/Latino, White). Survey completion averaged 9.13 min. Most participants received $1.43 upon completion of the survey, but in an attempt to recruit a representative sample after low initial group participation rates, we re-posted surveys with appropriate filters to collect data from additional Hispanic females, Black males, and Black females with $2.00 in compensation. Twenty-one participants were excluded for failing one or more attention checks. Table 1 shows the participant demographics. For analyses that compared demographic groups, we excluded participants who did not fit into our two gender categories or four race/ethnicity categories, leaving 313 participants.

Materials

A full set of the survey questions can be found in the Supplementary material. A major addition to this follow-up study was an examination of the effects of different university COVID-19 policies on student mental health and academic success. We conducted informal interviews with students at several colleges and used recurring themes to create the subscales below with high face validity, and our analyses in the Results sections suggest high reliability for all but one of the scales.

COVID-19 monitoring scale

This assessed the extent to which participants' universities were monitoring their COVID-related behaviors during the spring 2021 semester. It included three questions on 5-point Likert scales.

Social quality on campus scale

This assessed the perceived social quality of a participant's campus experience during the spring 2021 semester. It included five questions on 5-point Likert scales.

Perceived effectiveness of COVID-19 policies scale

This assessed the perceived effectiveness of their university's handling of COVID-19 on campus during the spring 2021 semester. It included three questions on 5-point Likert scales.

Academic experience scale

This assessed how participants felt about their academic experience as a whole during the spring 2021 semester. It included three questions on 5-point Likert scales.

Non-academic experience scale

This assessed how participants felt about their non-academic experiences during the spring 2021 semester. It included four questions on 5-point Likert scales.

Additional questions

Additional Likert scale questions asked about perceived support levels, how much time participants spend on social media and news media, whether they had received a COVID-19 vaccination, and, if not, their enthusiasm about receiving a vaccination. There were also four attention check questions that were Likert-scale based and distributed throughout the survey. Additional forced-choice questions asked about gender identity, job status, etc. We also used the PSS, GAD-7, and PHQ-8 surveys described in the Study 1 materials.

Procedure

The data were collected with a Google Forms survey (see footnote 2) with Likert scales and forced-choice questions when appropriate. This study was reviewed and approved by the DePauw University IRB Board. Participants were recruited on the Prolific website (see footnote 1) and provided informed consent via the Google Form after they were told the purpose of the study. Responses were received between April 22, 2021 and May 13, 2021.

2 https://docs.google.com/forms

Results

Fall 2020 mental health among college students

Table 1 presents demographic data as well as the means and standard deviations for the PHQ-8, GAD-7, and PSS. Cronbach's α scores indicate reliability for these samples (fall PHQ-8 = 0.90; fall GAD-7 = 0.91; fall PSS = 0.91). We note that normality assumptions were not met in some cases (e.g., PHQ-8, GAD-7, PSS scores), but we report parametric tests, which are considered appropriate with large sample sizes and provide more direct comparison with most of the published literature in this area; however, nonparametric tests of these data show similar results (e.g., regarding statistical significance for the mental health score comparisons). Female students (n = 135) scored higher than males (n = 114) on all three measures (PHQ-8: $t(247) = 2.98$, $p = 0.003$, $d = 0.38$; GAD-7: $t(247) = 4.70$, $p < 0.001$, $d = 0.60$; PSS: $t(247) = 3.54$, $p < 0.001$, $d = 0.45$). These scores were near clinical thresholds. Between groups ANOVAs showed that students' living situations – on-campus, off-campus within commuting distance, and off-campus beyond commuting distance – did not correspond to significant differences on the PHQ-8 ($p = 0.70$), GAD-7 ($p = 0.44$), or PSS ($p = 0.92$). Amount of time spent on social media correlated with PHQ-8 [$r(257) = 0.18$], GAD-7 [$r(257) = 0.28$], and PSS [$r(257) = 0.24$]. Amount of time spent on news media correlated with PHQ-8 [$r(257) = 0.17$] and GAD-7 [$r(257) = 0.14$] but not with PSS [$r(257) = 0.09$].

Fall 2020 academic experiences among college students

Table 2 shows participants' reported academic experiences and sense of belonging for three class formats. For the subset of 95 participants who reported experiences in all three class formats, a repeated measures ANOVA comparing Academic Experience by class format did not show a difference, $F(2, 188) = 1.96$, $p = 0.14$. However, for the subset of 96 participants who reported their sense of community in all class formats, a repeated measures ANOVA showed a difference, $F(2, 190) = 17.99$, $p < 0.001$, with LSD post-hoc tests indicating that in-person classes (M = 2.71, SD = 1.06) led to a significantly more belonging than hybrid classes (M = 2.29, SD = 0.94), which was significantly more than fully online classes (M = 2.01, SD = 1.09). The subsample's means and standard deviations across conditions were consistent with the full sample in Table 2.

Spring 2021 and longitudinal mental health among college students

Table 1 presents demographics and the means and standard deviations for the PHQ-8, GAD-7, and PSS. Cronbach's α scores indicate reliability for these samples (spring PHQ-8 = 0.89; spring GAD-7 = 0.92; spring PSS = 0.90). Female students scored higher than males on all three measures (PHQ-8: $t(372) = 3.67$, $p < 0.001$, $d = 0.38$; GAD-7: $t(372) = 2.63$, $p = 0.009$, $d = 0.27$; PSS: $t(372) = 3.62$, $p < 0.001$, $d = 0.39$). There was a similar count of vaccinated (n = 180) and not vaccinated (n = 197) participants, but independent samples t-tests showed no differences in their scores on the PHQ-8 ($p = 0.87$), GAD-7 ($p = 0.26$), or PSS ($p = 0.63$); however, the question did not differentiate between partly and fully vaccinated, and given the timing of the survey and the age group, it is possible that many of the "vaccinated" individuals had recently received only their first of two doses. Between groups ANOVAs showed that students' living situations – on-campus, off-campus within commuting distance, and off-campus beyond commuting distance – did not correspond to differences on the PHQ-8 ($p = 0.60$), GAD-7 ($p = 0.99$), or PSS ($p = 0.48$). For the subset of 120 participants with longitudinal data, repeated measures ANOVAs showed no differences in PHQ-8 or GAD-7 across semesters, but there was mixed evidence for a decrease among PSS scores ($p = 0.07$ for a two-way paired-samples t; $p = 0.01$ for a Wilcoxon signed rank test). Cronbach's α scores also indicate reliability for these longitudinal samples (fall PHQ-8 = 0.89; spring PHQ-8 = 0.88; fall GAD-7 = 0.89; spring GAD-7 = 0.92; fall PSS = 0.88; spring PSS = 0.90).

Reliable responses were obtained for the Monitoring (Cronbach's α=0.66), Academic Experience (Cronbach's α=0.75), and Non-Academic Experience (Cronbach's α=0.74) scales. The Perceived Effectiveness scale was reliable (Cronbach's α=0.55) after removing the question about university COVID-19 policies affecting stress (Cronbach's α=0.35 with the item included), but responses to the Social Quality scale were surprisingly inconsistent (Cronbach's α=0.27) across the five items; therefore, we did not include the Social Quality scale in analyses.

The perceived effectiveness of university COVID-19 policies was positively correlated with Academic Experience, $r(376) = 0.15$, $p = 0.004$, and Non-Academic experience, $r(376) = 0.18$, $p < 0.001$. As shown in Table 3, the Academic and Non-Academic Experience scales

TABLE 2 Participants' sense of community and academic experience by semester and class format.

Variable	Fall		Spring	
	M (SD)	*n*	*M* (SD)	*n*
Sense of community:				
In person	2.74 (1.06)	106	3.47 (1.22)	163
Hybrid	2.28 (0.99)	130	2.83 (1.08)	185
Online	1.88 (1.14)	248	2.28 (1.20)	365
Academic experience:				
In Person	2.55 (0.95)	105	3.56 (1.19)	159
Hybrid	2.63 (0.98)	130	3.32 (1.01)	185
Online	2.63 (1.25)	248	3.06 (1.27)	365

TABLE 3 Mental health and COVID-19 policies Spring 2021.

COVID-19 Policy (*N*=378)	Pearson correlations		
	PSS	GAD	PHQ
Monitoring$_1$	0.001	−0.01	−0.03
Perceived effectiveness$_3$	0.003	−0.03	−0.04
Academic experience$_4$	−0.42**	−0.30**	−0.28**
Academic workload$_1$	0.18**	0.11*	0.08
Non-academic experience$_1$	−0.45**	−0.29**	−0.33**
Perceived risk of COVID$_1$	0.07	0.03	0.03
Time on social media$_2$	0.15**	0.12*	0.17**
Time on news$_1$	−0.06	0.02	−0.04

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
$N = 378_1, 377_2, 376_3, 375_4$.

were inversely correlated with PHQ-8, GAD-7, and PSS scores, whereas academic workload was positively correlated with the GAD-7 and PSS. Time on social media was positively correlated with the PHQ-8, GAD-7, and PSS, whereas time on news media and the perceived risk of COVID-19 were not correlated with any mental health measures.

Spring 2021 and longitudinal academic experiences among college students

Table 2 shows the means and standard deviations for academic experience and sense of belonging in respective class formats (in-person, remote, and hybrid). For the 140 participants who reported experiences in all three class formats, a repeated measures ANOVA comparing Academic Experience by class format was significant, $F(2, 278) = 10.83$, $p = 0.001$, with LSD post-hoc tests indicating that in-person classes (M = 3.51, SD = 1.22) led to a significantly better experience than hybrid classes (M = 3.26, SD = 1.05), which were significantly better than fully online classes (M = 2.91, SD = 1.21). The respective means and standard deviations across conditions were consistent with the full sample in Table 2. Sense of community effects were even more pronounced for the 146 participants who reported scores for all three class formats, $F(2, 290) = 62.47$, $p < 0.001$, with LSD post-hoc tests indicating that in-person classes (M = 3.45, SD = 1.25) led to a significantly better sense of community than hybrid classes (M = 2.74, SD = 1.04) which were significantly better than fully online classes (M = 2.18, SD = 1.18). Again, this subset was consistent with the overall sample in Table 2.

For the subset of 120 participants with longitudinal data, repeated measures ANOVAs showed increases in class experience and sense of belonging for all class formats (all at $p = 0.001$ or below). A comprehensive 2 (fall or spring semester) X 3 (Class Format: In-person, Online, or Hybrid) repeated measures ANOVA, which only included 29 participants who experienced all three class formats in both semesters, showed a comparable main effect for semester for both measures and a main effect for class format in which in-person participants reported higher sense of belonging than hybrid, which was higher than online.

Spring 2021 subset analyses by race/ethnicity and school type

After filtering to participants who chose one designation for race/ethnicity, between groups ANOVAs indicated no differences by race/ethnicity for PSS ($p = 0.85$), GAD-7 ($p = 0.43$), or PHQ-8 ($p = 0.20$). Table 4 reports the means for these demographic subsets in the longitudinal data. There were no differences by race/ethnicity for the Academic Experience ($p = 0.40$) and Non-Academic Experience ($p = 0.22$) scales. There was a significant difference in time spent on social media, $F(3, 311) = 9.53$, $p < 0.001$, with Black and Hispanic participants tending to spend more time than Asian and White participants, but there was no difference in time spent on news ($p = 0.88$). There were no differences in ratings on the Monitoring scale ($p = 0.39$), Perceived Effectiveness scale ($p = 0.39$), or satisfaction with their college's COVID-19 handling for the spring ($p = 0.17$).

After filtering to participants who attended private (n = 87) or public colleges (n = 289), between groups ANOVAs indicated no differences by college type for PSS ($p = 0.40$), GAD-7 ($p = 0.66$), PHQ-8 ($p = 0.25$), the Academic Experience ($p = 0.18$) and Non-Academic Experience ($p = 0.12$) scales, and the time spent on social media ($p = 0.73$) and news ($p = 0.08$). Students at private colleges reported higher ratings on the Monitoring scale ($F(1, 374) = 9.37$, $p = 0.002$) and marginally higher ratings on the Perceived Effectiveness scale ($F(1, 374) = 3.79$, $p = 0.052$); however, there was no difference in satisfaction with their college's COVID-19 handling ($p = 0.36$).

Longitudinal relationships between mental health and academic experience

We conducted three hierarchical regression analyses. The first evaluated the effects of several factors on spring academic experience and academic confidence, respectively. We added fall academic confidence in the first block (Model I), fall PHQ-8, GAD-7, and PSS in the second block (Model II), and spring PHQ-8, GAD-7, PSS, and Non-Academic Experience scores in the third block (Model III). The respective models explained 13, 14, and 47% of the variance for spring academic experience, and 26, 27, and 46% of the variance for spring academic confidence. In both analyses, among the mental health scores, only the fall PSS scores were a significant predictor ($\beta = 0.25$, $p = 0.04$ for academic experience; $\beta = 0.26$, $p = 0.03$ for academic confidence; however, these positive β values compare to negative β values for the other non-significant mental health measures, including spring PSS), but spring Non-Academic Experience was a critical predictor ($\beta = 0.57$, $p < 0.001$ for academic experience; $\beta = 0.40$, $p < 0.001$ for academic confidence).

TABLE 4 Longitudinal participants' mental health Fall 2020 to Spring 2021.

Category		Fall 2020				Spring 2021			
			Mean Scores				Mean Scores		
		n	PSS	GAD-7	PHQ-8	n	PSS	GAD-7	PHQ-8
Women (*n* = 58)	White/Caucasian	31	24.3 (5.95)	12.52 (4.90)	11.19 (5.91)	31	22.39 (4.80)	11.13 (5.50)	10.84 (5.56)
	Black/African American	4	20.2 (4.35)	3.75 (1.50)	6.75 (2.06)	4	16.25 (2.50)	2.75 (1.71)	3.75 (2.06)
	Hispanic/Latino	3	27.6 (9.45)	8.00 (2.65)	12.00 (7.94)	3	22.33 (4.16)	7.00 (4.36)	10.00 (7.00)
	Asian/Asian-American	20	20.8 (7.29)	9.10 (5.04)	8.90 (6.32)	20	20.40 (6.64)	8.55 (5.72)	9.75 (7.08)
Men (*n* = 46)	White/Caucasian	32	19.9 (6.29)	8.56 (3.94)	7.69 (5.32)	32	18.59 (5.24)	7.28 (4.56)	7.47 (5.66)
	Black/African American	4	24.0 (10.86)	5.75 (6.65)	8.75 (7.63)	4	18.00 (8.98)	4.75 (5.74)	7.00 (7.44)
	Hispanic/Latino	1	28.0 ()	10.00 ()	14.00 ()	1	17.00 ()	4.00 ()	7.00 ()
	Asian/Asian-American	9	20.8 (10.59)	6.56 (4.93)	8.89 (6.11)	9	23.89 (4.96)	13.00 (4.09)	13.00 (5.63)

The second regression analysis predicted spring Non-Academic Experience. We added fall academic confidence in the first block (Model I), fall PHQ-8, GAD-7, and PSS in the second block (Model II), and spring PHQ-8, GAD-7, and PSS in the third block (Model III). The respective models explained 5, 14, and 20% of the variance. Fall PSS scores were the only significant predictor among the mental health measures ($\beta = -0.34$, $p = 0.02$).

Discussion

Numerous studies have shown that mental health among college students and young adults has been negatively impacted during the early months of the COVID-19 pandemic (e.g., Huckins et al., 2020; Wang et al., 2020b). By surveying students during the fall 2020 and spring 2021 semesters, we assessed whether those effects persisted, and we tested associations with academic and non-academic factors. Our fall data indicated near-clinical levels of depression, anxiety, and perceived stress as measured by the PHQ-8, GAD-7, and PSS, and the spring cross-sectional and longitudinal data show that high levels of depression and anxiety persisted, while there was mixed evidence for a decrease in PSS scores. In contrast, Zheng et al. (2022) found reduced PSS and PHQ-9 scores by spring 2021, but their study compared to an earlier spring 2020 timepoint. Consistent with our hypotheses and previous research (e.g., Li et al., 2021; Rettie and Daniels, 2021), female college students had significantly worse mental health during these time periods. No differences in mental health measures were found between race/ethnicity groups. We also found support for our hypotheses that more time on social media would correlate with worse mental health; in contrast, time spent on news media correlated with mental health impacts in the fall 2020 sample but not the spring 2021 sample.

Our research also assessed college students' academic experiences during the pandemic and the extent to which those experiences and universities' COVID-19 mitigation policies correlated with mental health measures. As we hypothesized, the fall 2020 sample indicated a clear rank order for sense of belonging in college classes, with the highest for in-person, then hybrid, then remote. There was no significant difference in the reported quality of class experience across these formats; however, the larger spring 2021 sample showed significant differences in sense of belonging and academic experience across class formats, with the same ordering as in the fall. The subset of participants with longitudinal data showed the same pattern, though their ratings for both sense of belonging and class experiences improved from the fall 2020 to spring 2021 semester. Unfortunately, those improvements were clearly insufficient by themselves to address the pandemic mental health impacts among college students. A regression analysis indicated that spring academic experience was significantly influenced by spring non-academic experiences but not by measures of mental health in the fall or spring. However, spring non-academic experiences were partly predicted by fall perceived stress scores, indicating some potential indirect roles for how mental health impacted subsequent academic experiences. Follow-up research may help to delineate the most impactful components of that non-academic experience. Related work by Cahuas et al. (2023) used a detailed assessment of perceived social support and found that support from family was a strong predictor of quality of life among college students during the pandemic. Our non-academic experiences scale only had one item about social support, but it had the possible benefit of including several items about satisfaction with the campus living situation and community.

Aside from large gender differences, we found few differentiators of mental health impacts from demographics or living circumstances. Across race/ethnicity groups, there were no significant differences in levels of anxiety, depression, and perceived stress, or in academic experiences or perceptions of university's handling of COVID-19 pandemic. This appears consistent with Charles et al. (2021), who found that White students reported larger mental health impacts than Black students in the early weeks of the pandemic but showed similar impacts at a later timepoint, and it is also consistent with Liu et al. (2022) who found no differences in PSS responses by ethnicity in late fall 2020. Similarly, in our spring 2021 sample, there were no significant differences between students at private and public universities in terms of mental health impacts or reported levels of academic and non-academic experiences, though students at private colleges reported higher levels of monitoring and marginally higher levels of effectiveness. Contrary to our hypotheses, students who lived on campus did not have higher mental health scores than those living off campus. Additionally, perceived differences in campus COVID-19 policies did not correlate with mental health scores, and neither vaccination status nor students' perceived risk of contracting COVID-19 correlated with mental health scores.

Some of our results may reflect survey limitations. The fall 2020 survey was conducted shortly before the U.S. presidential election, which may have impacted mental health scores as well as news media coverage. In the spring 2021 sample, our question about vaccination status did not differentiate between students who were fully vaccinated and students who had recently had a first dose, and there may have been a large number of college students in that latter group due to the timing of vaccine availability for different demographics. The demographically stratified sample is a clear strength of our spring 2021 data, but its representativeness is nonetheless limited by comparatively fewer numbers of Black male participants. Finally, the social quality scale in the spring 2021 sample did not show internal reliability, so our results could not address whether that was a differentiating factor in students' mental health across colleges.

We believe our research makes a valuable contribution toward understanding the trajectory of college students' mental health at different timepoints of the COVID-19 pandemic Our findings suggest that under circumstances like a pandemic that may greatly disrupt universities' normal functioning, universities should nonetheless prioritize in-person learning as much as possible, as sense of belonging was much higher in that class format, and such non-academic experiences significantly inversely correlated with scores of depression, anxiety, and perceived stress. Moreover, non-academic experience was a significant predictor of academic experience and academic confidence in the current semester. Even if a university can continue with in-person classes in such circumstances, it should also provide options for students to take leaves of absence or pursue remediation among increased responsibilities (e.g., Lv et al., 2022), as a study by Brown et al. (2023) suggests that many students' educational plans changed during the pandemic, and results by Lee et al. (2021) suggest first generation students were especially likely to take time off. It is worth noting that some universities have continued to provide online-learning options since the pandemic, and the seemingly negative implications of this on social connection might be something to consider with future courses offered. Our findings also have a *potential*

recommendation for individual college students: consider decreasing your social media usage to see if there are mental health benefits. Of course, the consistent association that we find between social media and mental health across semesters is only correlational, much like related research that shows associations between internet addiction and mental health among Czech students (Gavurova et al., 2022), but it may be worth trying habit changes as well as practicing effective coping strategies (Awoke et al., 2021).

Overall, our results show a persistent mental health decline among U.S. college students during the 2020–2021 academic year. According to students, the overall academic experience improved during that time period, but even in spring 2021, in-person classes were significantly better than hybrid and remote classes. The qualities of academic and non-academic experiences were inversely correlated with mental health scores, and our longitudinal analyses indicate some connections between these constructs across semesters, with perceived stress in fall 2020 associated with non-academic experiences in spring 2021, which were in turn associated with academic experiences during that semester. We anticipate that the strength of these relationships will change in subsequent academic years as universities return to many of their pre-pandemic norms in terms of academic and social experiences.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by DePauw University Institutional Review Board. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MR, EB, and JM contributed to the conception and design of the fall and spring studies. MR performed the statistical analyses. EB and JM created the tables. MR wrote the first draft of the manuscript and performed the statistical analyses. All authors contributed to the manuscript revision and read and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1166960/full#supplementary-material

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Chronic pain and problematic substance use for veterans during COVID-19: the moderating role of psychological flexibility

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Background: Chronic pain and problematic substance use are commonly co-occurring and highly detrimental issues that are especially prevalent in U.S. veteran populations. Although COVID-19 made clinical management of these conditions potentially difficult, some research suggests that certain veterans with these conditions did not experience this period as negatively as others. It is thus important to consider whether resilience factors, such as the increasingly-studied process of psychological flexibility, might have led to better outcomes for veterans managing pain and problematic substance use during this time of global crisis.

Methods: This planned sub-analysis of a larger cross-sectional, anonymous, and nationally-distributed survey (N=409) was collected during the first year of the COVID-19 pandemic. Veteran participants completed a short screener and battery of online surveys assessing pain severity and interference, substance use, psychological flexibility, mental health functioning, and pandemic-related quality of life.

Results: For veterans with chronic pain and problematic substance use, the pandemic resulted in a significant lowering of their quality of life related to meeting basic needs, emotional health, and physical health compared to veterans with problematic substance use but no chronic pain diagnosis. However, moderation analyses revealed that veterans with these comorbid conditions experienced less negative impacts from the pandemic on quality of life and mental health when they reported greater psychological flexibility. For veterans with problematic substance use only, psychological flexibility was also related to better mental health functioning, but did not significantly correlate with their quality of life.

Conclusion: Results highlight how COVID-19 differentially impacted veterans with both problematic substance use and chronic pain, such that this group reported particularly negative impacts of the pandemic on multiple areas of quality of life. However, our findings further emphasize that psychological flexibility, a modifiable resiliency process, also buffered against some of the negative impacts of the pandemic on mental health and quality of life. Given this, future research into the impact of natural crises and healthcare management should investigate

how psychological flexibility can be targeted to help increase resiliency for veterans with chronic pain and problematic substance use.

KEYWORDS

chronic pain, substance use, resilience, veterans, pandemic, mental health

1. Introduction

Chronic pain and problematic substance use are two frequently co-occurring and significant health problems in the United States. On its own, chronic pain (e.g., pain lasting longer than 3–6 months and persisting beyond the healing of an initial injury or disease) is very complicated to treat (Qaseem et al., 2017; Dowell et al., 2022) and associated with a multitude of negative health problems and functional issues (Kerns et al., 2003; Rice et al., 2016; Hadi et al., 2019). In an effort to alleviate pain, many individuals turn to substances such as alcohol, tobacco, and opioids (Blanco et al., 2016; Ditre et al., 2019), leading to a higher prevalence of comorbid chronic pain and substance use concerns (Manhapra and Becker, 2018). The resulting interaction between chronic pain and substance use is complex. For instance, although frequent use of substances can have short-term analgesic impacts, pain is often exacerbated during subsequent abstinence periods (Jochum et al., 2010; Ditre et al., 2018), and repeated opioid misuse can also induce hyperalgesia (e.g., increased pain sensitivity; Benyamin et al., 2008; Compton et al., 2012; Hooten et al., 2015). When chronic pain prompts self-medication through substances, this in turn contributes to escalating problematic substance use and poorer pain-treatment outcomes, resulting in a positive feedback loop maintaining both issues (Ditre et al., 2019). Even in the absence of a formal substance use diagnosis, individuals with chronic pain can experience greater levels of pain due to problematic substance use or drinking and drug use that does not meet full substance use disorder criteria but is linked to personal distress, physical health issues, or legal or social concerns (e.g., Alford et al., 2016; Bello et al., 2018).

Comorbid chronic pain and problematic substance use are especially prevalent in veteran populations (Oliva et al., 2017; Hoggatt et al., 2021). Compared to their civilian adult counterparts, veterans regularly demonstrate a higher prevalence of both chronic pain (e.g., past 6-month prevalence: 29.1% vs. 19.5%; Dahlhamer et al., 2018) and substance use disorders (past 12-month prevalence: 12.8%; Hoggatt et al., 2021 vs. 3.0% National Survey on Drug Use and Health (NSDUH), 2019). Veterans with chronic pain are also at an increased risk for developing substance use issues (Morasco et al., 2011a). This comorbid chronic pain and substance misuse, including prescribed opioid misuse as well as other substances such as tobacco and alcohol, can result in multiple severe negative impacts such as mental and physical health issues (Ward et al., 2022), difficulties maintaining employment (Wyse et al., 2021), and lack of stable housing (Dunne et al., 2015).

Veterans with both chronic pain and problematic substance use may have found it particularly challenging to effectively manage their health and well-being during the COVID-19 pandemic. Many patients with chronic pain, including those treated with prescribed opioids, faced cancelled or postponed pain treatment due to the pandemic (Eccleston et al., 2020) even though research has shown that COVID-19 prompted worsening pain, depression symptoms, stress, social isolation, and decreased quality of life (e.g., Purcell et al., 2021; Compton and Marie, 2022). At the same time, studies conducted during the pandemic also identified resilient subsets of veterans who maintained high functioning despite their pain symptoms. For example, Lazar et al. (2022) found that despite COVID-related disruptions in care, many veterans with chronic pain saw the pandemic as an opportunity to enact positive lifestyle changes (e.g., working on work-life balance, joining a community bike ride) that increased their quality of life. Qualitative studies have also reported positive changes for veterans during COVID-19, such as allowing them more time at home to focus on beneficial health behaviors and re-engage with family members (Mohamed Ali et al., 2022).

Understanding what factors may have helped veterans adopt positive behaviors to improve their pain experience and quality of life during COVID-19 could help inform future pain and substance use treatment. One such protective factor shown to buffer against negative mental health and functional impacts for individuals facing challenging life circumstances is psychological flexibility (Gentili et al., 2019; Meyer et al., 2019). Psychological flexibility is characterized by an ability to remain present-focused and fully aware of emotions, sensations, and thoughts, be willing to accept them, and choose to act in ways that align with individual values (Hayes et al., 2004). Psychological flexibility fundamentally reflects how an individual adapts to difficult situations and stressful life events and how they cope with their internal experiences in those moments (Kashdan and Rottenberg, 2010). Such characteristics are, in turn, associated with improved mental health functioning and quality of life (Block and Block, 2006; Smeekens et al., 2007; Rüsch et al., 2008; Berking et al., 2009) and have led many researchers to view it as a transdiagnostic protective factor (e.g., Kashdan and Rottenberg, 2010; Levin et al., 2014; Kroska et al., 2020; Pakenham et al., 2020).

The protective qualities of psychological flexibility may be of particular importance when considering the coping of individuals with chronic pain and problematic substance use (e.g., Li et al., 2019; Gloster et al., 2021; Mallik et al., 2021). Notably, psychological flexibility supports self-efficacy for both pain and addiction management by increasing perceived power to enact positive change in one's life and promoting values-oriented, goal-directed action (Hayes et al., 2004). Understanding the benefit of increased psychological flexibility during this time may also be key to assisting these veterans, as psychological flexibility is a potentially modifiable factor through therapeutic interventions such as Acceptance and Commitment Therapy (ACT) and other mindfulness and acceptance-based interventions (Rash et al., 2019). Among individuals with chronic pain, psychological flexibility has been associated with less pain-related physical impairment (Vowles and McCracken, 2008), increased quality of life (Duarte et al., 2022), and reduced substance misuse (Gentili et al., 2019; Li et al., 2019). Thus, psychological

flexibility may be an important factor in understanding how veterans with both chronic pain and substance use concerns managed the COVID-19 pandemic and can continue to manage symptoms in the everchanging public health landscape.

1.1. The current study

The present study examined the relationship between chronic pain and psychological flexibility on mental health and pandemic-related functioning for veterans reporting problematic substance use. Advancing our understanding of factors that can buffer against pandemic-induced deteriorations in functioning is especially important for promoting the well-being of veterans with co-occurring chronic pain and substance use concerns. We investigated the following hypotheses:

> *Hypothesis 1*: Veterans reporting problematic substance use and a prior chronic pain diagnosis (vs. no chronic pain diagnosis) would report greater perceived deterioration in major areas for quality of life (i.e., finances, ability to meet basic needs, emotional health, concentration, and physical health).
>
> *Hypothesis 2*: That psychological flexibility would be positively correlated with mental health functioning, and negatively correlated with problematic substance use, self-reported pain, and pandemic-related worsening of quality of life for all veterans.
>
> *Hypothesis 3*: That psychological flexibility would moderate the relationship between chronic pain diagnosis and mental health functioning, such that lower levels of psychological flexibility will be associated with significantly poorer mental health functioning for veterans with chronic pain and problematic substance use. In addition, at higher levels of psychological flexibility, all veterans (i.e., with and without chronic pain diagnosis) would report greater mental health functioning.
>
> *Hypothesis 4*: That the same interaction pattern proposed in Hypothesis 3 between psychological flexibility and chronic pain diagnosis would be found for self-reported pandemic-related quality of life, such that greater psychological flexibility would be associated with better quality of life during COVID-19 for veterans with chronic pain and problematic substance use. We also hypothesized that, at higher levels of psychological flexibility, all veterans would report less negative impact of COVID-19 on quality of life.

2. Materials and methods

2.1. Participants and procedure

This study was an *a priori* planned sub-analysis of an online survey of the effect of COVID-19 on physical and mental health of veterans with self-reported problematic drug and alcohol use administered using the Qualtrics federal platform between November 24, 2020, and February 2, 2021 (results of the primary study published elsewhere: Reilly et al., 2022). Procedures and methods for collecting this data were approved by the Institutional Review Board at the VA Bedford Healthcare System. Survey participants were recruited and identified through the Qualtrics federally-approved survey platform using their panel-aggregator system. Participants had previously signed-up for specific online survey panels available through Qualtrics and were provided *via* the panel aggregator system with basic information about the survey and a hyperlink. Subsequently, potential participants provided informed consent and then completed items assessing inclusion/exclusion criteria. Eligible participants were at least 18 years old and reported being a U.S. military veteran, which was confirmed through the review of multiple items related to age, service years, and DD214 information. Eligible participants reported problematic substance use as defined by a minimum score of 1 on the CAGE Adapted to Include Drugs (CAGE-AID; Brown and Rounds, 1995). This procedure has been recommended by the Consensus Panel for sufficient breadth in identifying veterans with potential SUDs (Sullivan and Fleming, 2008). Participants were then provided access to the survey, which was estimated to take approximately 25 min to complete. Respondents were paid $4.80 to complete the survey.

A total of 436 participants completed the survey. Twenty-seven respondents (6.2%) were removed for not meeting pre-determined quality review standards (see primary data Reilly et al., 2022 for more information on the quality review process). The final data set consisted of 409 participants. Across the full sample, most respondents were male (76.5%), not Hispanic/Latino (91.9%), heterosexual (91.4%), and served after 1990 (61.6%), with a mean age of 54.96 (SD = 16.44). Similar to prior studies (Dahlhamer et al., 2018), a total of 31.5% (129/409) of participants self-reported receiving a chronic pain diagnosis from a health provider.

2.2. Study measures

Survey-collected demographics included self-reported age, gender, sexual orientation, race, ethnicity, income, armed service era, use of VHA services, and relationship status. Participants also self-reported whether they had received a diagnosis of chronic pain or substance use disorder (defined for survey participants as a formal diagnosis received from a doctor or healthcare provider). Participants' self-reported diagnosis of chronic pain was used to group respondents into chronic and non-chronic pain categories for analysis.

The three-item Pain, Enjoyment, General Activity scale (PEG-3) was used to assess (1) pain intensity, (2) pain-related interference with enjoyment of life, and (3) pain-related interference with daily activities over the prior week (Krebs et al., 2009). The PEG-3 has been found to be sensitive to change and differentiate between individuals with and without pain improvement over time (Krebs et al., 2010). The PEG-3 items differentiate levels of pain severity continuously from a zero to ten scale. The composite PEG score, created by summing all items and dividing by three, can be viewed as a measure of total pain impact. For the current sample, internal consistency was high for the PEG-3 ($\alpha = 0.90$).

The Cut Down, Annoyed, Guilty, Eye Opener (CAGE) Adapted to Include Drugs (CAGE-AID; Brown and Rounds, 1995) was used to

screen for problematic substance use. This is a validated 4-item measure that assesses the impact of participants' use of alcohol and other drugs and its severity. Per the CAGE-AID protocol, the questionnaire was only given to participants who reported current alcohol or drug use. It consists of four yes/no questions, "Have you ever felt you ought to cut down on your drinking or drug use," "Have people annoyed you by criticizing your drinking or drug use," "Have you ever felt bad or guilty about your drinking or drug use," and "Have you ever had a drink or used drugs first thing in the morning to steady your nerves or to get rid of a hangover." The CAGE-AID has demonstrated both high internal consistency and high sensitivity and specificity to screen for problematic substance use (McIntyre et al., 2021). It is not intended as a diagnostic tool.

Psychological flexibility was measured using the Psyflex Measure (Gloster et al., 2021), which assesses the major aspects of psychological flexibility: acceptance, mindfulness, and values-oriented actions in daily living. Items are rated on a Likert scale from 1 = very seldom to 5 = very often and summed. The six-item measure aims to measure psychological flexibility by capturing each domain of the ACT Hexaflex (Hayes et al., 1999, 2011) including present moment-centeredness, acceptance, cognitive defusion, self-as-context, values, and committed action. Higher scores represent higher psychological flexibility. According to Constantinou et al. (2021), the Psyflex supported a one-factor solution across four clinical and non-clinical samples and demonstrated good psychometric properties (Cronbach's alpha = 0.81; Gloster et al., 2021). For the current study, the Psyflex was found to be highly reliable ($\alpha = 0.88$).

The Pain Management Collaboratory Coronavirus Pandemic COVID-19 5-Item Measure (PMC-5; Coleman et al., 2021) was created early in the pandemic to assess the potential negative impact of COVID-19 on quality of life. The developers of this measure suggest individualized adaptation as appropriate of this scale by clinical research teams to survey the effects of the COVID-19 pandemic on study participants, leading to the inclusion of three of the original items five domains of pandemic impact in the current study: finances, ability to meet basic needs, and emotional health. Two additional areas were added to the scale, physical health and ability to concentrate, to assess physical and cognitive functioning changes, respectively. These domains were chosen based on nascent COVID-19 literature suggesting these social determinants of health management—financial, physical, and emotional - might be particularly impacted during the pandemic (e.g., Ryan et al., 2020). Each quality of life domain was assessed on a Likert scale from 1 = improved to 4 = a lot worse. Items were assessed both individually and as a total score reflecting pandemic-related quality of life for veterans. In the current sample, internal validity was satisfactory (Cronbach's alpha = 0.82).

Mental health functioning was measured using the Short-Form Health Survey-12 (SF-12; Ware et al., 1996), a 12-item measure that assesses global areas functioning. The SF-12 has been validated for predicting populations' mental health and functioning without targeting specific health outcomes and has high reliability, including with U.S. veterans (Salyers et al., 2000). The current study utilized only the mental health composite score (MCS-12) of the SF-12 as a measure of global mental health functioning, in line with past research using the SF-12 subscale specifically for mental health measurement (e.g., McAlpine et al., 2018). Scoring involves using a norm-based algorithm that produces a self-reported MCS-12 between 0 and 100 (Jones et al., 2001), with lower scores associated with lower mental health functioning. Previous studies have indicated acceptable 2-week test–retest reliability of 0.76 for the MCS-12 in the general U.S. population (Ware et al., 1996).

2.3. Data analysis

Initial descriptive statistics were examined using frequencies (n) and percentages (%), with independent sample t-tests and Chi-square tests used to assess for potential differences in sociodemographic variables (e.g., age, gender, use of VHA services), average pain level (PEG-3), and problematic substance (CAGE-AID) use by chronic pain diagnosis status. Statistical analysis for Hypothesis 1 then consisted of a comparative analysis of participants with and without a self-reported diagnosis of chronic pain on quality of life using independent samples t-tests for each categorical variable on the PMC-5 (i.e., finances, basic needs, concentration and focus, mental health, and physical health). To analyze initial relationships between variables of interest, Pearson Product correlations were conducted for continuous variables to investigate indications of multicollinearity in the planned hierarchical multiple regression analysis for Hypotheses 3 and 4. Multicollinearity among predictor variables was set at zero-order correlations greater than 0.70, and continuous variables scores and errors were inspected for normalcy of distribution and residuals. Continuous predictor variables were mean-centered prior to computing an interaction term for the regression model. Hierarchical linear regression was utilized to investigate Hypothesis 3, the relationship between chronic pain diagnosis and mental health functioning, as potentially moderated by psychological flexibility, and Hypothesis 4, the relationship between chronic pain diagnosis and pandemic-related quality of life as moderated by psychological flexibility. To correct for multiple tests, a Bonferroni adjusted alpha level of 0.05/k, where k was set at 6 (the number of predictors in the model) was used and partial regression coefficients were set to an adjusted alpha of 0.008. Survey participants were required to answer all survey questions, and thus the data set included no missing data.

Preliminary data analyses demonstrated that key assumptions for multiple regression analysis were met. Simple slopes analyses were conducted for significant interactions. In the first step, regression estimates controlled for age, self-reported problematic substance use behaviors, and total pain impact. In the second step, hypothesized predictors of psychological flexibility and chronic pain diagnosis were added to the model to assess for main effects. In the third step, the cross-product of psychological flexibility and chronic pain diagnosis was added to evaluate for the predicted interaction. These steps were repeated to test the same interaction model for Hypothesis 4 with the dependent variable of pandemic-related quality of life. All analyses were performed using IBM SPSS v26.

3. Results

3.1. Chronic pain diagnosis and pandemic-related quality of life

For respondents with a self-reported chronic pain diagnosis, the mean composite PEG-3 score over the prior week was 5.95 (SD = 2.29), which was significantly higher than those not reporting

a chronic pain diagnosis (M = 3.30, SD = 2.64), $t(407) = -2.81$, $p < 0.001$, $d = -1.04$. A Chi-squared test revealed that compared to participants with problematic substance use and no chronic pain diagnosis, participants with both substance use concerns and a chronic pain diagnosis were more likely to have received clinical care from the VA, $\chi 2$ (1, N = 409) = 13.60, $p < 0.01$ and identify as a race other than Caucasian, χ^2 (1, N = 409) = 5.89, $p = 0.02$. Veterans with or without chronic pain were equally likely to self-report having a formal substance use disorder diagnosis. Sociodemographic characteristics are presented for the full sample and by chronic pain diagnosis in Table 1.

To test Hypothesis 1, independent-samples t-tests were conducted to compare veterans reporting problematic substance use with and without comorbid chronic pain across five self-reported areas of quality of life measured by the PMC-5, including finances, ability to meet basic needs, emotional health, concentration, and physical health (see Figure 1). There was a significant difference in the scores for perceived worsening of ability to meet basic needs by diagnosis for veterans with chronic pain and problematic substance use ($M = 2.43$, SD = 0.76) and those with problematic substance use but without chronic pain ($M = 2.22$, SD = 0.67) conditions; $t(407) = -2.81$, $p = 0.008$, $d = -0.30$; self-reported emotional health for veterans with chronic pain ($M = 2.88$, SD = 0.85) and without chronic pain ($M = 2.65$, SD = 0.75) conditions; $t(406) = -2.63$, $p = 0.006$, $d = -0.30$; and perceived physical health for veterans with chronic pain ($M = 2.28$, SD = 0.66) and without chronic pain ($M = 2.57$, SD = 0.79) conditions; $t(404) = -3.61$, $p < 0.001$, $d = -0.41$. No significant differences were found for finances ($p = 0.08$) or ability to concentrate and focus ($p = 0.12$).

3.2. Regression analyses

Preliminary comparison tests for planned regression analyses were conducted to investigate possible differences by primary variables of interest (chronic pain diagnosis, mental health functioning, and psychological flexibility), potential control variables (overall pain score, problematic substance use), and demographics (age) on outcome variables. Younger age, higher levels of problematic substance use (CAGE-AID), and greater self-reported pain (PEG-3) were significantly related to poorer mental health functioning (MCS-12) and greater pandemic-related stressors (PMC-5; see Table 2). Consequently, age, CAGE-AID, and PEG-3 were controlled for when conducting the subsequent hierarchical multiple regression to explain the variance in mental health and pandemic-related functioning. Additionally, correlation analyses (see Table 2) were reviewed to assess Hypothesis 2. Mental health functioning was negatively correlated with pain and substance use concerns, and positively correlated with psychological flexibility for veterans with and without a formal chronic pain diagnosis. All continuous variables had an approximate normal distribution with no significant outliers, and statistically significant relationships among variables did not suggest multicollinearity (absolute correlation coefficient greater than 0.70).

Hierarchical multiple regression was used to investigate Hypothesis 3, that the relationship between chronic pain and mental health functioning during COVID-19 would be moderated by an individual's self-reported psychological flexibility (see Table 3). Preliminary data analyses were conducted and assured that key assumptions for multiple regression analysis were met. The interaction between chronic pain and psychological flexibility emerged as a significant predictor of mental health functioning ($\beta = 0.15$, SE = 0.07, $p = 0.007$).

Simple slopes analysis was consequently conducted to probe the interaction. Findings indicate that for veterans without chronic pain, higher levels (1 SD above the mean) of psychological flexibility were associated with greater mental health functioning, $B = 0.16$, $\beta = 0.20$, SE = 0.05, $p < 0.001$ (see Figure 2). This relationship was even stronger for veterans with chronic pain, such that those who reported greater psychological flexibility also reported better mental health functioning, $B = 0.36$, $\beta = 0.45$, SE = 0.06, $p < 0.001$. This indicates that psychological flexibility was a predictor for greater mental health functioning for veterans with substance use concerns, with or without chronic pain—though the veterans with chronic pain showed particularly positive mental health impacts related to greater psychological flexibility. The overall model explained 21% of the variance in mental health functioning, total $R^2 = 0.21$, $F(6, 402)$ 17.34, $p < 001$.

Per Hypothesis 4, we also expected the pattern of interaction found for mental health functioning would hold for pandemic-related quality of life (Table 4). The interaction between chronic pain and psychological flexibility emerged as a significant predictor of pandemic-related quality of life ($\beta = -0.16$, $p = 0.003$). Simple slopes analysis revealed that for veterans without chronic pain, higher levels (1 SD above the mean) of psychological flexibility was not significantly associated with better pandemic-related quality of life, $B = -0.01$, $\beta = 0.12$, SE = 0.00, $p = 0.03$ (see Figure 3). This relationship was, however, significant for veterans with chronic pain, such that those reporting greater psychological flexibility also reported decreased negative impacts to quality of life due to the pandemic, $B = -0.03$, $\beta = 0.39$, SE = 0.00, $p < 0.001$. This indicates that psychological flexibility was a significant predictor for pandemic-related quality of life, with veterans with chronic pain showing less perceived negative impact of the pandemic on their quality of life when they reported greater psychological flexibility. The overall model explained 26% of the variance in mental health functioning, total $R^2 = 0.26$, $F(6, 402) = 23.73$, $p < 001$.

4. Discussion

The current cross-sectional study of veterans with problematic substance use found that psychological flexibility appeared to buffer negative outcomes in mental health functioning and pandemic-related quality of life among veterans with co-occurring chronic pain. This buffering effect was also present among veterans with only problematic substance use (but without chronic pain) in relation to their mental health functioning, but not for their pandemic-related quality of life. Finally, although both groups reported decrements in quality of life due to the pandemic, those with comorbid chronic pain and problematic substance use reported reduced functioning across multiple discrete areas of quality of life that they specifically attributed to the pandemic, including meeting basic needs, emotional health, and physical health relative to those without chronic pain.

Our finding of the moderating effect of psychological flexibility on well-being aligns with international research suggesting that psychological flexibility may have served as a potential resiliency factor for adults during the first wave of COVID-19 (McCracken et al., 2021). Consistent with other COVID-19 studies (e.g., Crasta et al.,

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TABLE 1 Sample demographics by chronic pain diagnosis category (N=409).

Variable	All respondents	Chronic pain diagnosis	No chronic pain diagnosis
	N =409	*n* =129	*n* =290
Gender			
Male	313 (76.5%)	92 (71.3%)	221 (78.9%)
Female	94 (23%)	36 (27.9%)	58 (20.7%)
Transgender Male	1 (0.2%)	0 (0.0%)	1 (0.4%)
Preferred not to answer	1 (0.2%)	1 (0.8%)	0 (0.0%)
Age (M, SD)	54.96 (16.44)	54.96 (15.09)	54.80 (17.05)
CAGE-AID	2.37 (1.12)	2.48 (1.17)	2.31 (1.10)
PEG-3**	4.14 (2.82)	5.94 (2.29)	3.30 (2.64)
Race*			
White	370 (90.5%)	110 (85.3%)	260 (92.9%)
Black/African American	22 (5.4%)	10 (7.8%)	12 (4.3%)
Other	7 (1.7%)	2 (1.6%)	5 (1.8%)
Asian	5 (1.2%)	3 (2.3%)	2 (0.7%)
Native Hawaiian/Pacific Islander	5 (1.2%)	4 (3.1%)	1 (0.4%)
American Indian/Alaska Native	5 (1.2%)	1 (0.8%)	4 (1.4%)
Ethnicity			
Not Hispanic/Latino	376 (91.9%)	117 (90.7%)	259 (92.5%)
Hispanic/Latino	33 (8.1%)	12 (9.3%)	21 (7.5%)
Sexual orientation			
Heterosexual (straight)	374 (91.4%)	120 (93%)	254 (90.7%)
Bisexual	19 (4.6%)	7 (5.4%)	12 (4.3%)
Gay/lesbian	13 (3.2%)	2 (1.6%)	11 (3.9%)
Prefer not to say	3 (0.7%)	0 (0.0%)	3 (1.1%)
Service era			
September 2001 or later	156 (38.1%)	48 (37.2%)	108 (38.6%)
August 1990 to August 2001	96 (23.5%)	39 (30.2%)	57 (20.4%)
May 1975 to July 1990	99 (24.2%)	41 (31.8%)	58 (20.7%)
Vietnam Era (1964–1975)	150 (36.7%)	46 (35.7%)	104 (37.1%)
February 1955 to July 1964	24 (5.9%)	3 (2.3%)	21 (7.5%)
Korean War (1950 to 1955)	3 (0.7%)	1 (0.8%)	2 (0.7%)
Income			
Less than $19,999	31 (7.60%)	13 (10.1%)	18 (6.4%)
$20,000–$39,999	70 (17.11%)	25 (19.4%)	45 (16.1%)
$40,000–$59,999	66 (16.14%)	25 (19.4%)	41 (14.6%)
$60,000–$79,999	53 (12.96%)	19 (14.8%)	34 (12.1%)
$80,000–$99,999	48 (11.74%)	14 (10.9%)	34 (12.1%)
$100,000–$149,999	87 (21.30%)	18 (14.0%)	69 (24.6%)
$150,000 +	54 (13.20%)	15 (11.6%)	39 (13.9%)
Comorbid substance use disorder	84 (20.5%)	28 (21.0%)	56 (19.3%)
Received VHA care**	268 (65.5%)	101 (78.3%)	167 (59.6%)

Participants could choose multiple race and service era categories.
Differences between diagnostic groups denoted with *$p < 0.05$; **$p < 0.001$.

2020; Chong et al., 2021), we found that veterans with higher levels of psychological flexibility reported fewer negative impacts during COVID-19 related to substance use, mental health, and pandemic-related quality of life. These findings add to the increasing evidence,

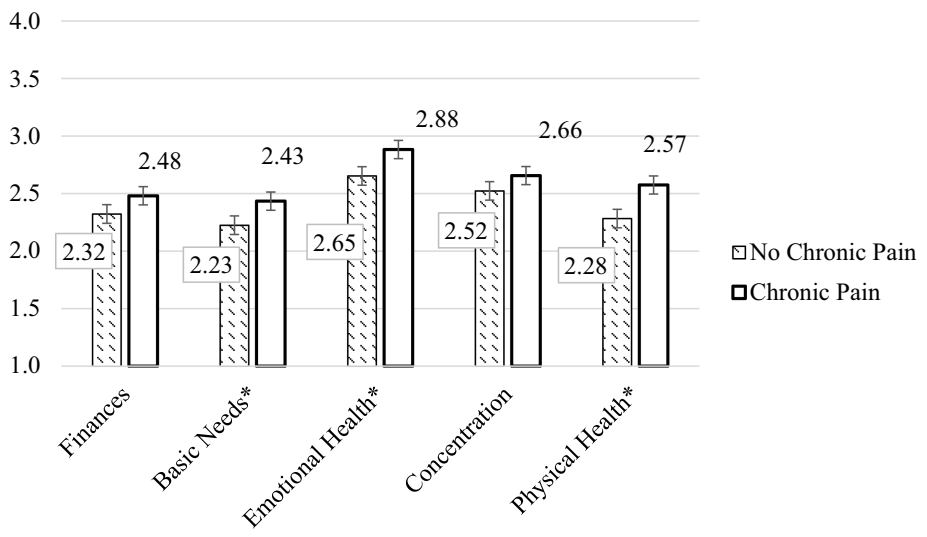

FIGURE 1
Decline in major areas of quality of life during COVID-19. *indicates significant difference between groups.

TABLE 2 Correlations among continuous predictor variables.

Measure	1	2	3	4	5	6
1. Age	–					
2. PEG-3	−0.30***	–				
3. CAGE-AID	−0.33***	0.26***	–			
4. Psyflex	0.21***	−0.12*	−0.14**	–		
5. MCS-12	0.28***	−0.16**	−0.24***	0.35***	–	
6. PMC-5	−0.31***	0.34***	0.31***	−0.30***	−0.33***	
M	54.84	4.14	2.37	38.75	42.43	2.47
SD	16.44	2.82	1.12	8.56	6.78	0.57
Range	19–88	0–10	1–4	11–55	20–64	1–4

PEG-3, The Pain, Enjoyment of Life and General Activity Scale; CAGE-AID, The CAGE Adapted to Include Drugs Questionnaire; Psyflex, Psychological flexibility scale; MCS-12, Short-Form 12 Health Survey Mental Component Score; PMC-5, Pandemic-Related Quality of Life.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

with differences across populations, underlying conditions, and waves of the pandemic, that psychological flexibility is an important component of resiliency, protecting against worsening quality of life and psychological concerns within the context of COVID-19.

Notably, the positive association between psychological flexibility and study outcomes appeared strongest for veterans self-reporting a chronic pain diagnosis. Specifically, psychological flexibility demonstrated the greatest benefits for increased mental health functioning and limiting deleterious pandemic-related effects for those with a chronic pain diagnosis. This partially supported our hypothesis and is consistent with evidence that psychological flexibility is associated with increased functioning for those with chronic pain and may be protective against pandemic-specific stress (Yu et al., 2021).

Our findings also add important nuance to the apparent benefit of psychological flexibility as a protective factor, suggesting it is increasingly beneficial for veterans with more significant clinical profiles (e.g., those with both SUDs and chronic pain). This is consistent with the theory of psychological flexibility that people who are more willing to experience difficult thoughts and feelings in the service of committed action guided by their values would potentially experience less pandemic-related quality of life changes and mental health issues. Psychological flexibility may be an especially important protective factor for veterans with chronic pain, who are more likely to have multiple functional and psychological conditions that could be impacted by the pandemic. As psychological flexibility is considered a transdiagnostic mental health resiliency process, its potentially potent effects for veterans with chronic pain underscores its importance as a protective factor.

Unlike veterans with chronic pain, those without chronic pain did not show differences in the impact of COVID-19 on quality of life based on their psychological flexibility. Veterans with problematic substance use but no chronic pain reported similar levels of COVID-19 impacts on quality of life, regardless of their level of psychological flexibility. This could be because for veterans who were managing specifically problematic substance use, quality of life was less impacted by the secondary difficulties

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TABLE 3 Hierarchical multiple regression testing interaction model on mental health.

Step and predictors	Mental health functioning					
	ΔR^2	β	*B*	SE	sr2	95% CI for *B*
Step 1	0.11					
Age		0.22***	0.09	0.02	0.20	[0.05, 0.13]
CAGE-AID		−0.16**	−0.93	0.31	−0.14	[−1.53, −0.33]
PEG-3		−0.05	−0.12	0.12	−0.05	[−0.36, 0.12]
Step 2	0.09					
Age		0.18***	0.18	0.02	0.16	[0.03, 0.11]
CAGE-AID		−0.14**	−0.14	0.29	−0.13	[−1.39, −0.25]
PEG-3		0.01	0.01	0.13	0.00	[−0.24, 0.27]
Psyflex		0.29***	0.29	0.04	0.29	[0.16, 0.30]
Chronic Pain Diagnosis		−0.08	−0.08	0.74	−0.07	[−2.61, 0.28]
Step 3	0.01					
Age		0.17***	0.07	0.02	0.16	[0.03, 0.11]
CAGE-AID		−0.14**	−0.83	0.29	−0.13	[−1.39, −0.26]
PEG-3		−0.01	−0.02	0.13	−0.01	[−0.27, 0.23]
Psyflex		0.20***	0.16	0.05	0.16	[0.07, 0.25]
Chronic Pain Diagnosis		−0.08	−1.10	0.73	−0.07	[−2.55, 0.32]
Psyflex X Chronic Pain		0.15**	0.20	0.07	0.12	[0.05, 0.35]

PEG-3, The Pain, Enjoyment of Life and General Activity Scale; CAGE-AID, The CAGE Adapted to Include Drugs Questionnaire; Psyflex, Psychological flexibility scale.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

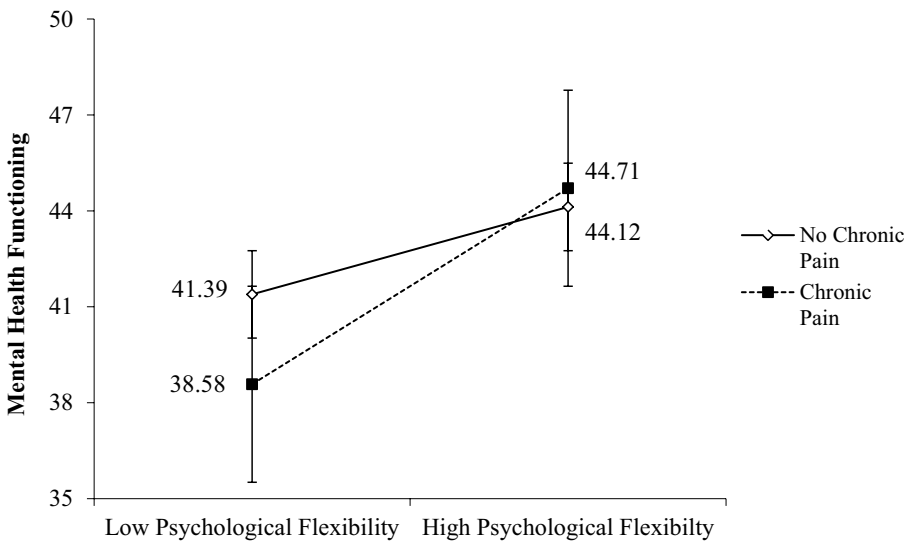

FIGURE 2
Interaction of psychological flexibility and chronic pain on mental health functioning.

that veterans with comorbid chronic pain also cope with, such as clinic closures, physical health concerns, depression, and anxiety (Morasco et al., 2011b; Burke et al., 2015). It is also possible that veterans with chronic pain and substance use issues faced the double disadvantage of managing both substance use issues and pain during COVID-19. Specifically, these veterans may have experienced the reciprocal and negative cycle that occurs when pain is treated with recreational substances, which negatively impacts long-term pain outcomes and results in further mood issues due to the added impact of problematic substance use (Ditre et al., 2019). Higher levels of psychological flexibility may have buffered against this "double disadvantage," as it can be particularly useful when external challenges arise that require re-evaluating values, health goals, and viable activities (Roux et al., 2022). Thus, psychological flexibility may be more strongly beneficial for quality of life for veterans actively managing chronic

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TABLE 4 Hierarchical multiple regression testing interaction model on pandemic-related quality of life.

Step and predictors	Pandemic-related quality of life					
	ΔR^2	β	*B*	SE	sr2	95% CI for *B*
Step 1	0.20					
Age		−0.18***	−0.01	0.00	−0.17	[−0.01, −0.01]
CAGE-AID		0.18***	0.09	0.02	0.17	[0.05, 0.14]
PEG-3		0.24***	0.05	0.01	0.23	[0.03, 0.07]
Step 2	0.05					
Age		−0.16**	−0.01	0.00	−0.14	[−0.01, −0.01]
CAGE-AID		0.17***	0.09	0.02	0.16	[0.04, 0.13]
PEG-3		0.19***	0.04	0.01	0.16	[0.02, 0.06]
Psyflex		−0.22***	−0.02	0.00	−0.24	[−0.02, −0.01]
Chronic Pain Diagnosis		0.08	0.10	0.06	0.08	[−0.02, 0.22]
Step 3	0.02					
Age		−0.15**	−0.01	0.00	−0.17	[−0.01, −0.01]
CAGE-AID		0.17***	0.09	0.02	0.18	[0.04, 0.13]
PEG-3		0.21***	0.04	0.01	0.18	[0.02, 0.06]
Psyflex		−0.12*	−0.01	0.00	−0.23	[−0.02, −0.01]
Chronic Pain Diagnosis		0.08	0.09	0.06	0.07	[−0.03, 0.20]
Psyflex X Chronic Pain		−0.16**	−0.02	0.01	−0.13	[−0.02, −0.01]

PEG-3, The Pain, Enjoyment of Life and General Activity Scale; CAGE-AID, The CAGE Adapted to Include Drugs Questionnaire; Psyflex, Psychological flexibility scale.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

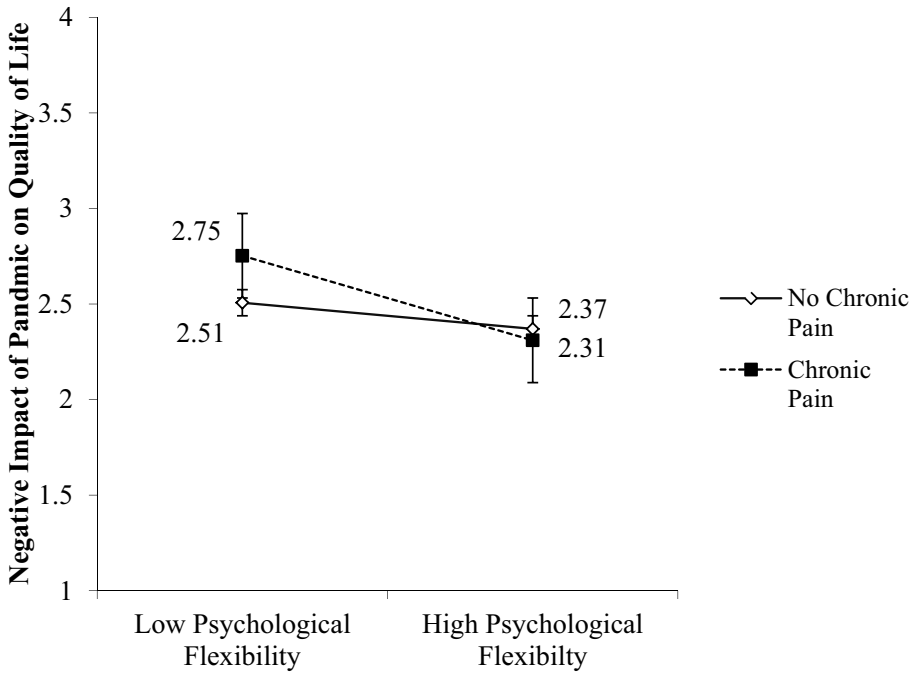

FIGURE 3
Interaction of psychological flexibility and chronic pain on pandemic-related quality of life.

pain and its subsequent health issues during the pandemic. Overall, our results provide additional support for the relevance of psychological flexibility in supporting mental health functioning and quality of life (notably for veterans with co-occurring pain and problematic substance use) during the pandemic, meriting further work in this area.

4.1. Limitations

Several limitations to this study exist. It is important to note that this is cross-sectional data, so these results identify important associations as foundations for further research hypotheses, but should not be construed as causal findings. Additionally, as the purpose of this survey was to assess the experiences of veterans in the community during COVID-19, and thus we utilized an online, anonymous survey unlinked to medical records, we were unable to verify self-reported diagnostic information related to chronic pain (though veterans in our sample reporting a chronic pain diagnosis also demonstrated significantly higher PEG-3 scores, compared to veterans not reporting a chronic pain diagnosis). Second, our participant sample was not diverse in terms of race, ethnicity, or gender, potentially limiting generalizability. As the presence of pain and substance use comorbidities significantly affect multiple aspects of life, and this impact can differ for veterans with different racial, gender, and ethnic identities, future work in this area should include more diversity within their sample. Third, as the aim of our primary study was to assess veterans reporting problematic substance use, we did not have a comparative veteran sample with chronic pain but without self-reported substance use concerns to include in our analyses. Finally, given that we used a measure for the overall construct of psychological flexibility, the individual components of this construct (e.g., acceptance, mindfulness, valued living) could not be evaluated and represent an important area for future research.

5. Conclusion

Co-occurring problematic substance use and chronic pain are common, and our results provide evidence that a modifiable resiliency process (i.e., psychological flexibility) can be targeted to improve quality of life and mental health functioning. Given the transdiagnostic nature of psychological flexibility, these benefits may be generalizable to other conditions and warrant further study to explore the clinical applications of these results. Lastly, focusing on only chronic pain or substance use concerns when treating veterans with both issues may not adequately address the interrelationship between both conditions, which may be especially detrimental during moments of challenge, both personally and globally. Future research should continue to investigate the interaction between pain and substance use issues and protective factors such as psychological flexibility.

Data availability statement

The datasets presented in this article are not readily available because owing to privacy and ethical considerations, the final data sets underlying publications resulting from this research will not be publicly shared outside of the Department of Veterans Affairs. On request and with principal investigator (EDR) permission, a deidentified, anonymized data set will be created and shared pursuant to a data use agreement, appropriately limiting the use of the data set. Requests to access the datasets should be directed to ER, Erin.Reilly@va.gov

Ethics statement

The studies involving human participants were reviewed and approved by VA Bedford Healthcare System R&D Committee. The ethics committee waived the requirement of written informed consent for participation.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Sport and academic engagement of 1,387 Slovenian dual-career athletes before and during COVID-19 lockdown—what did we learn?

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Introduction: Since the coronavirus disease outbreak in 2019, there have been several preventive measures and restrictions applied to minimize the transmission of the virus. While lockdown has affected our everyday lives, it has negatively impacted sport and athletes as well.

Methods: 1,387 Slovenian dual-career (DC) athletes (47.4% females, 52.6% males) participated in the 22-item questionnaire to gather information on their sports and academic engagement before and during COVID-19 lockdown period. Half of the athletes were enrolled in education at the secondary level (n=819, aged 15–18 years), while the others were enrolled in primary (n=301, 8–14 years) and tertiary (n=267, 19–36 years) education. All participants in the current study have a valid athlete categorization by the Slovenian Olympic Committee and are competing at either junior (31.7%), national (26.9%), prospective (29.5%), international (8.5%), world (2.3%) or Olympic (1.2%) level.

Results: DC athletes spent less time on training (–4.7h; p<0.001), learning (–1.0h; p<0.001), exams (–0.9h; p<0.001), laboratory work (–0.6h; p<0.001), and other educational activities (–0.3h; p<0.001) during COVID-19 lockdown compared to period before the lockdown. Their training environment was changed so they trained either at home or outdoors. Results showed that indoor (–3.7h; p<0.001) and team sport athletes (–1.3h; p<0.001) trained less than outdoor and individual sports. Male athletes spent more time on training both before (1.3h; p<0.001) and during lockdown (1.3h; p<0.001) and other sport-related activities (1.3h; p<0.001). On the other hand, female athletes spent more time on studying both before (1.5h; p<0.001) and during lockdown (2.6h; p<0.001). Both sport and educational activities were influenced by athletes' age ($p \leq 0.017$).

Conclusion: Indoor and team sport athletes were more affected by the governmental measures than outdoor and individual sport athletes. Male athletes experienced a greater decline in learning time compared to female athletes. DC is shown to be beneficial for athletes even in times of COVID-19 lockdown, as DC athletes report smaller decline in motivation, shifting attention from sport to study and having fewer mental problems due to uncertain sports future. The feedback of the preventive measures could serve to assist policy makers and athlete's support staff to form and apply preventive measures that are more effective for DC athletes' training and education.

KEYWORDS

COVID-19 pandemic, education, sport policy, student-athlete, training load, academic load, behavioral changes

Introduction

Beginning in 2020, we faced a new virus without knowledge of its severity and consequences. In response, several preventive measures were applied by the government. Coronavirus disease (COVID-19) greatly influenced all aspects our lives during 2020 and 2021 (Fedyk et al., 2022). During the first few days of the disease occurrence in the beginning of March, the epidemiological situation did not dictate emergency measures, therefore there were no special restrictions of the daily activities both in the work environment and in everyday life. At that time, the only recommended preventive measures included washing hands, sanitizing, not touching eyes and mouth, and restricting contacts with people showing any symptoms of a respiratory disease. Yet, the COVID-19 disease spread faster than anyone anticipated, which caused most countries, including Slovenia, to apply a strict lockdown by closing educational institutions and non-essential industry, and restricting sports-training (Zhang et al., 2020).

In the light of COVID-19 lockdown, schools and universities closed their doors, resulting in students spending more time at home and meeting their study obligations there. This changed family daily routines and sleeping habits (López-Bueno et al., 2020; Moore et al., 2020; Fasano et al., 2021; Segre et al., 2021). The earliest works investigating the consequences of COVID-19 induced lockdown on physical and mental wellbeing showed changes in people's emotional state. These included feelings of worry, fear and longing due to lack of social contact (Fasano et al., 2021), along with increased screen time and lack of physical activity (LeBlanc et al., 2015; Ammar et al., 2020; Clemente-Suárez et al., 2020; López-Bueno et al., 2020; Moore et al., 2020). These negative consequences were also observed in athletes (Mehrsafar et al., 2021; Paravlic et al., 2022). However, a special subgroup of athletes are dual-career (DC) athletes who coordinate regular study obligations with their sports-related obligations. Even before the COVID-19 pandemic occurred, balancing the academic and sports career was a challenging task for DC athletes. Their training and competition schedule usually includes 20–30 h of training per week (Aquilina, 2013), along with frequent international travel (Kerštajn and Topič, 2017) and the same amount of study-related obligations.

Article 35 of the Sports Act (2017) stipulates that athletes are entitled to the adjustment of school and study obligations, and their scope and manner of adjustment are determined by regulations governing the field of education. In the field of secondary education, DC athletes have the opportunity to adapt their education to more effectively coordinate their sports and school obligations. However, the adjustments for DC athletes are still not well resolved at the university level, where the Higher Education Act stipulates that higher education institutions determine the study regime, forms and periods of knowledge testing by themselves. Therefore, the adjustments for DC athletes at tertiary (university) level of education are still very heterogeneous, so that students from different study programs at the same level of competition still lack the same conditions for studying. However, DC has several positive benefits and is strongly recommended for athletes, as it may add to both future career opportunities and easier transition to the labor market (Barriopedro et al., 2018). A study on 15 former Olympic athletes found that athletes with dual-career adjusted better and had less difficulty reintegrating into society after sport's career termination than athletes who solely prioritized sport (Torregrosa et al., 2015). Athletes from two previous studies (Price et al., 2010; Torregrosa et al., 2015) claim that DC helped them to achieve well-being and a well-rounded life during their athletic career. Furthermore, changing from a mostly mental activity (study) to a physical one (sport) can act as a form of recovery from the other activity, and benefits athletes in the course of their dual-careers (Stambulova et al., 2015).

Due to a possibility of increased risk of disease transmission associated with high-intensity physical activity, national governments and international sporting committees implemented COVID-19 measures, canceling sport participation and events (Parnell et al., 2022). This caused several alterations in the training regimes, such as training frequency, duration, intensity and training environment change. As a result, changes in training and study regimes impacted the physical and mental well-being of athletes (Mehrsafar et al., 2021; Paravlic et al., 2022). However, DC athletes might respond differently to the pandemic due to the added stressors of their dual careers. Therefore, variations in these study and training alterations by DC athletes with different socio-demographic and sports-related characteristics remain unknown and should be investigated.

As COVID and other virus outbreaks remain ongoing, a detailed analysis of the current well-being of athletes is needed to provide policy makers and athletes' support staff with information about the impact of preventive measures. Understanding how they have adapted their training and competition plans, and the impact of these, can help inform strategies for future disruptions. Therefore, the aim of this study was to (i) investigate the effects of COVID-19 lockdown on DC athletes' training and education, (ii) identify whether the sports-related and socio-demographic characteristics of the athletes influenced differences in their training and educational activities at various times during the pandemic, and (iii) investigate the benefits of dual-career for coping with the COVID-19 pandemic.

Materials and methods

Currently, there is no available questionnaire used to collect relevant data on how DC athletes coped during the COVID-19 lockdown period and how they adapted their daily activities to maintain their athletic and educational competitiveness. Based on previous studies available (Izzicupo et al., 2021), a questionnaire was developed.

Procedures

This longitudinal observational cohort study was conducted to investigate differences in sports and academic engagement between the time before (PRE_{LD}) and during COVID-19 lockdown (DUR_{LD}) (starting on 13.3.2020) in DC athletes. To identify variations among the athletes, a group of researchers developed a questionnaire customized for a Slovenian speaking population. For the primary purpose of the study, the initial administration of the questionnaire occurred during the first week of September 2020 (Time 1). However, to investigate the reliability of the questionnaire, it was administered again one week later (Time 2). At both time points, the questionnaires were administered through the online platform 1 ka.[1]

Study sample

To be included in the current study, participants were required to fulfil the following inclusion criteria: (a) to be an active athlete, categorized by the Slovenian Olympic Committee (SOC) regulations; (b) to be simultaneously involved in some form of organized education. Athletes were included regardless of age, sex, education level, type of sport, and competition environment. SOC categorization is based on the results achieved by an athlete and his/her level of competition. Thus, athletes are categorized to either junior, national, prospective, international, world or Olympic level. Currently, there are 7,780 athletes in Slovenia with valid SOC categorization (Slovenian Olympic Committee, 2023). All participants were informed about the aims of the study and were asked to provide a written consent. This study was approved by the Ethics Committee of the Faculty of Sport (University of Ljubljana), number: 033-52/2022-4, and all procedures were carried out in agreement with the Declaration of Helsinki.

The instrument—questionnaire

The questionnaire was designed to gather information from the athletes about their sports and academic engagement before and during COVID-19 lockdown period.

The questionnaire was constructed by a group of researchers (KD, AP, and MD) to elicit answers for the current research question. In the first phase, each researcher prepared several potential questions. In the second phase, each question was thoroughly reviewed and checked for understanding by all group members. The third phase consisted of a pilot study, in which 15 randomly selected subjects (researchers, students and athletes) completed a test version of the questionnaire. After developing consensus on the final version of the questionnaire, MD developed an online version of the questionnaire and sent it to the participants.

The questionnaire consists of 22 questions in each of the following categories:

Sociodemographic (Q1–Q5);

Sport and academic engagement before and during COVID-19 lockdown period (Q6–Q14);

Support and benefits of dual-career (Q15–Q22).

The sociodemographic characteristics section includes the following questions: sex, age, current level of education, sport and level of sport competition by the SOC ranking. The sport and academic engagement section consisted of nine questions related to hours of sport and educational activities before and during COVID-19 lockdown. They were asked if they trained/went to school, how was their training/education changed and the reasons for not participating in the training process during the lockdown. The support and benefits of dual-career section includes questions about DC athletes' perceptions and response to the pandemic, including why they think DC helped/did not help them to cope with the pandemic. The questions were mostly closed-ended, while in some cases the athletes could write their own answer if it wasn't provided among the choices.

Statistical analysis

All data were presented as means (±SD) with 95% confidence intervals and mean difference (MD) where applicable. The statistical analyses were conducted using SPSS statistical software (version 27.0, IBM Inc., Chicago, United States). Normality of data distribution was confirmed by the Shapiro–Wilk test, while the homogeneity of variances was tested using the Levene's test for all dependent variables. To investigate the reliability of the questionnaire, the relative reliability of all dependent variables between Time 1 and Time 2 was estimated using the intra-class correlation coefficient (ICC), two-way random model (consistency type). ICC values were considered as very high if >0.90, high if between 0.70 and 0.89, and moderate if between 0.50 and 0.69. Additionally, a standard error of estimate (SEM) followed by the coefficient of variation (CV) were calculated as measures of absolute reliability, which indicates within subject variation, as previously suggested (Hopkins, 2000). Results showed that average ICC values ranged from 0.787 (Q13) to 1.000 (Q2).

To answer our primary objective and assess the influence of independent variables such as type of sport (indoor vs. outdoor), categorization (junior vs. national vs. prospective vs. international vs. world class vs. Olympic), sex (males vs. females) and age (8 to 14 years of age vs. 15 to 18 years of age vs. 19 to 36 years of age) on DC athletes' engagement in sports and educational activities at PRE_{LD} and DUR_{LD}, a Kruskal–Wallis test followed by Mann–Whitney test was applied. Additionally, to compare differences in observed changes (Δ) in sports and academic engagement between PRE_{LD} and DUR_{LD}, a Mann–Whitney test was applied. For the post-hoc analysis, a Bonferroni adjustment for value of p interpretation was used. For all analysis conducted, the statistical significance was accepted at $p < 0.05$.

Results

Athletes' socio-demographic characteristics

Athletes' socio-demographic characteristics are presented in Table 1. A total of 1,387 Slovenian DC athletes (47.4% females, 52.6% males; 8–36 years of age; mean age = 17 ± 5.14 years) participated in the study. Approximately half of the athletes are enrolled in education at the secondary level ($n = 819$, 15–18 years of age), while the other

1 https://www.1ka.si/

10.3389/fpsyg.2023.1173261

TABLE 1 Sociodemographic characteristics of participants (*N*=1,387).

Characteristics		*N*	Percent (%)
Sex			
	Female	657	47.4
	Male	730	52.6
Current level of education			
	Not in the education process	0	0.0
	Primary school	301	21.7
	High school	698	50.3
	Vocational school	121	8.7
	Bachelor's study	216	15.6
	Master's study	47	3.4
	Doctoral study	4	0.3
Ranking by the SOC			
	Junior	402	31.7
	National	341	26.9
	Prospective	375	29.5
	International	108	8.5
	World	29	2.3
	Olympic	15	1.2
Type of sport			
	Individual	961	69.3
	Team	426	30.7
Competition environment			
	Indoor	906	65.4
	Outdoor	480	34.6

half is participating in primary ($n=301$, 6–14 years of age), and tertiary ($n=267$, from 19 years of age on) education. All athletes in the current study have a valid categorization by the SOC which is the basis for obtaining the status rights of athletes, and are therefore competing at either junior (31.7%), national (26.9%), prospective (29.5%), international (8.5%), world (2.3%) or Olympic (1.2%) level. For the purpose of this study, we split the cohort of athletes in subcategories according to type of sport (individual = 69.3%, or team = 30.7% sport), competition environment (outdoor = 34.6% or indoor = 65.4% sport) and three age groups: first age group (8–14 years), second age group (15–18 years) and third age group (19–36 years).

DC athletes' engagement in sports and educational activities before and during the COVID-19 lockdown

When compared to PRE_{LD}, DC athletes spent less total time on training (−4.7 h; $Z=-23.464$; $p<0.001$), learning (−1.0 h; $Z=-4.806$; $p<0.001$), exams (−0.9 h; $Z=-11.737$; $p<0.001$), laboratory work (−0.6 h; $Z=-11.742$; $p<0.001$), and other educational activities (−0.3 h; $Z=-5.888$; $p<0.001$) (Figure 1) DUR_{LD}.

Differences in DC athletes' engagement in sports and educational activities before and during the COVID-19 lockdown considering athletes' age

Both sport and educational activities were influenced by athletes' age [H ranging from 8.119 (learning hours, $p=0.017$) to 114.345 (training hours, $p<0.001$)] (Figure 2). The results showed that athletes in the first age group (8–14 years) spent significantly less time on all activities before and during lockdown, compared to other age groups ($p<0.001$ for all analyes), except in learning time both before and during lockdown as well as other educational activities that did not differ compared to the other two groups. When differences between two older groups were considered, a third age group (19–36 years) spent more time in training, competing, physiotherapy, other physical activities, learning, laboratory work and other educational activities, compared to the second age group (15–18 years) (Figure 2).

Moreover, when difference in time spent on different activities from PRE_{LD} to DUR_{LD} were considered, results reached a significance for training time ($H=20.739$, $p<0.001$), time used on exams ($H=5.981$, $p=0.016$), laboratory work ($H=52.975$, $p<0.001$) and other educational activities ($H=12.977$, $p=0.002$). In detail, the second age

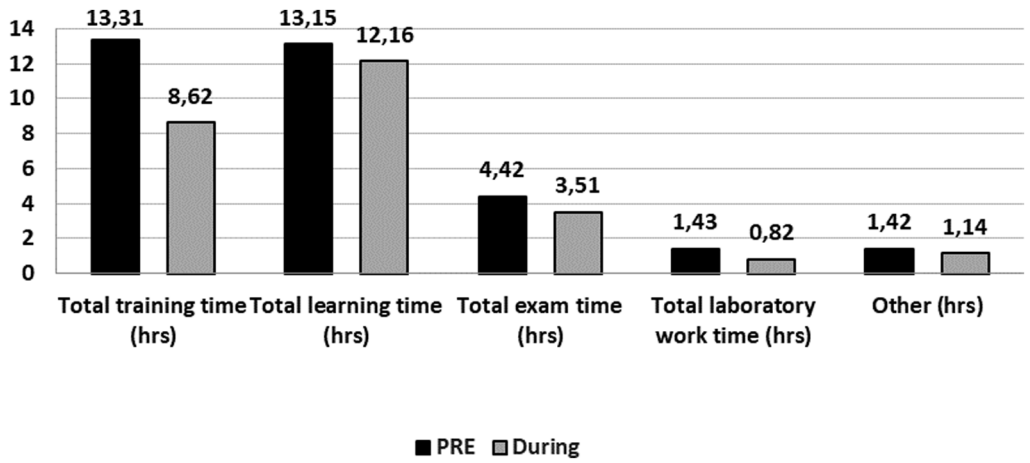

FIGURE 1
Comparisons of sports and educational activities before (PRE_{LD}) and during (DUR_{LD}) lockdown.

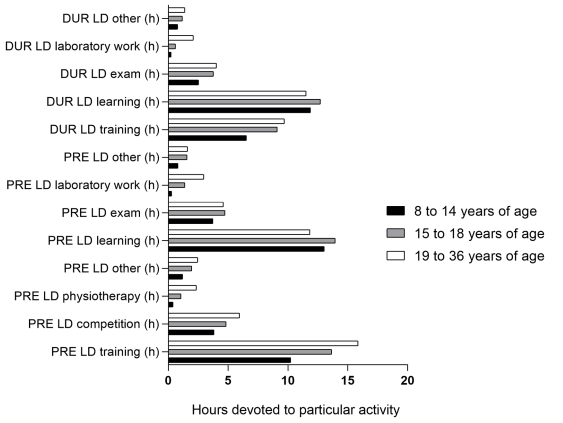

FIGURE 2
Comparisons of sports and educational activities before (PRE_{LD}) and during (DUR_{LD}) lockdown according to age.

group (15–18 years) experienced greater reduction in laboratory work hours (percent difference [PD] = 181.5%; $Z = -7.502$; $p < 0.001$) and hours of other educational activities (PD = 166.3%; $Z = -3.728$; $p < 0.001$), compared to the first age group. Also, when compared to the third age group, the first age group experienced greater reduction in time spent on tests (PD = 70.1%; $Z = -2.838$; $p = 0.005$). In contrary, they experienced lower decrease in training hours (PD = 50%; $Z = -4.480$; $p < 0.001$) and laboratory work (PD = 183.7%; $Z = -3.561$; $p < 0.001$) from PRE_{LD} to DUR_{LD} when compared to the third age group. Finally, compared to second age group, third age group showed a greater reduction in time spent in training (PD = −30.5%; $Z = -3.212$; $p = 0.001$) and laboratory work (PD = −13.1%; $Z = -2.457$; $p = 0.014$) from PRE_{LD} to DUR_{LD}. In contrary, they showed a lower decrease in time spent in learning (PD = 117.2%; $Z = -2.431$; $p = 0.015$) and tests (PD = 47.6%; $Z = -2.517$; $p = 0.012$) compared to the second age group, from PRE_{LD} to DUR_{LD} (Figure 3A).

Differences in DC athletes' engagement in sports and educational activities before and during the COVID-19 lockdown considering athletes' sex

Both sport and educational activities were influenced by athletes' sex. The results showed that compared to females, male athletes spent more time on training before lockdown (1.3 h; $Z = 11.742$; $p < 0.001$), other sport-related activities (1.3 h; $Z = 11.742$; $p < 0.001$) and training during lockdown (1.3 h; $Z = 11.742$; $p < 0.001$). On the other hand, male athletes spent less time on studying both before (−1.5 h; $Z = -3.602$; $p < 0.001$) and during lockdown (−2.6 h; $Z = -5.358$; $p < 0.001$), total laboratory work before lockdown (−0.4 h; $Z = -2.049$; $p = 0.040$), and exams before (−0.6 h; $Z = -3.558$; $p < 0.001$) and during lockdown (−0.7 h; $Z = -2.627$; $p = 0.009$) (Figure 4). Compared to female athletes, male athletes experienced significantly greater decline in learning activities [percent difference (PD) = 123.9%; $Z = -2.785$; $p = 0.005$] from PRE_{LD} to DUR_{LD} (males $\Delta = -1.58 \pm 7.79$ h. vs. females $\Delta = -0.37 \pm 7.80$ h) (Figure 3B).

Differences in DC athletes' engagement in sports and educational activities before and during the COVID-19 lockdown considering level of competition

Total training time both before and during a lockdown differed between athletes who participated in different levels of competition

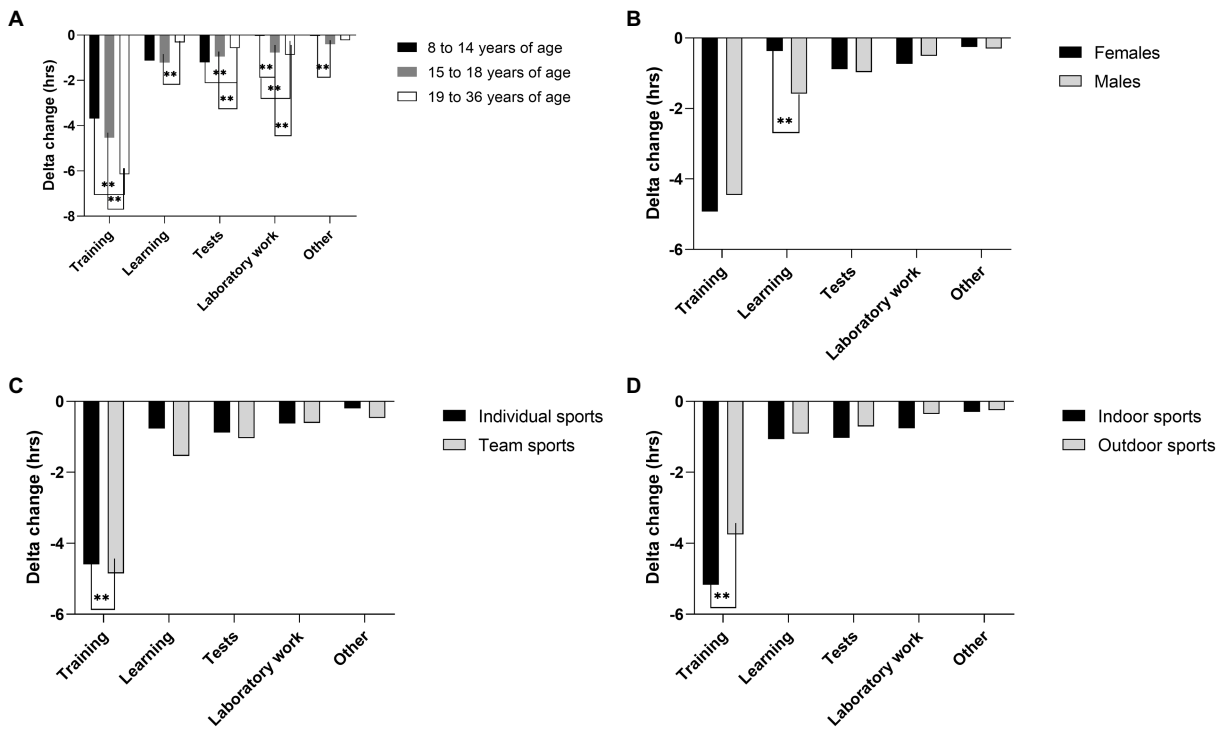

FIGURE 3
Before (PRE_{LD}) to during (DUR_{LD}) lockdown changes in athletes' engagement in sport and academic activities according to **(A)** age, **(B)** sex, **(C)** type of sport and **(D)** competition environment.

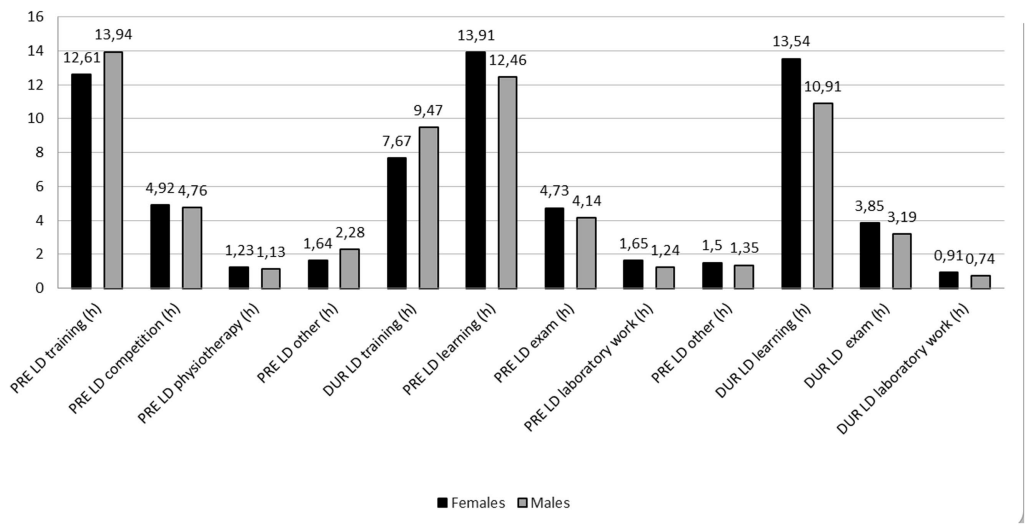

FIGURE 4
Comparisons of sports and educational activities before (PRE_{LD}) and during (DUR_{LD}) lockdown between sex.

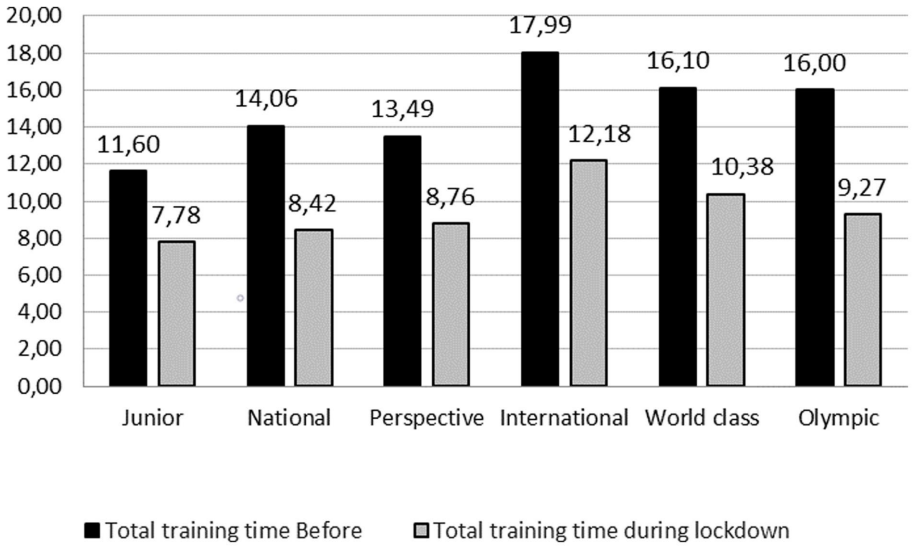

FIGURE 5
Comparisons of average weekly training time before (PRE_{LD}) and during (DUR_{LD}) lockdown between athletes competing at different levels.

($H = 83.157$; $p < 0.001$) (Figure 5). Thus, results showed that junior athletes spent less time on training before lockdown (−2.5 h; $Z = -4.920$; $p < 0.001$) compared to National level athletes. Also, when compared to prospective athletes, junior athletes spent less time on training both before (−1.9 h; $Z = -4.257$; $p < 0.001$), and during lockdown (−1.0 h; $Z = -2.512$; $p = 0.012$). As it is seen from the figure, all the athletes trained less DUR_{LD} compared to PRE_{LD} regardless of their competition level. Furthermore, when differences in time spent on different activities from PRE_{LD} to DUR_{LD} were considered, results reached a significance for training time only ($H = 21.229$, $p = 0.001$). Post-hoc analysis showed that junior athletes experienced less decline in training time from PRE_{LD} to DUR_{LD} compared to national level athletes (PD = −38.2%; $p < 0.001$), but not other groups of athletes. There were no significant differences between other groups (Figure 6).

Differences in DC athletes' engagement in sport and education-related activities before and during the COVID-19 lockdown considering type of sport

When looking at individual and team sport athletes, the results showed that athletes in individual sports spent more time on sport and educational activities compared to team athletes, both before (training, 1.0 h; $Z = 2.606$; $p = 0.009$, learning, 1.8 h; $Z = 2.863$; $p = 0.004$) and during lockdown (training, 1.3 h; $Z = 3.577$; $p < 0.001$; learning, 2.5 h;

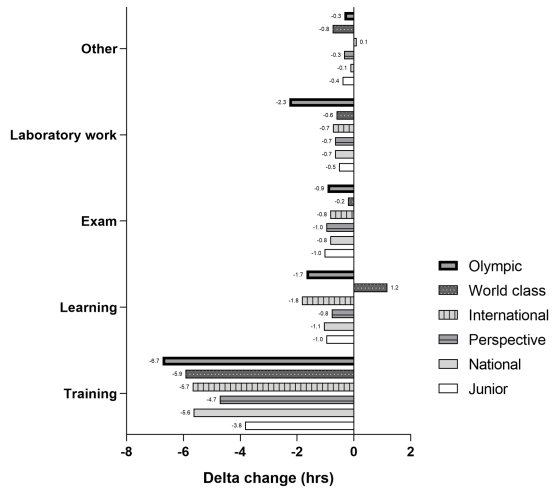

FIGURE 6
Comparisons of sports and educational activities before (PRE_{LD}) and during (DUR_{LD}) lockdown according to level of competition.

$Z = 4.374$; $p < 0.001$). There were no statistically significant differences for other variables assessed (Figure 7). Finally, when compared to athletes engaged in individual sports, athletes training and competing in team sports experienced significantly greater decline in training exposure (PD = 5.3%; $Z = -2.349$; $p = 0.019$) from PRE_{LD} and DUR_{LD} (individual sports $\Delta = -4.60 \pm 6.11$ h. vs. team sports $\Delta = -4.85 \pm 6.30$ h.) (Figure 3C).

When comparing differences between athletes engaged in indoor and outdoor sports, the results showed that athletes training and competing indoors spent less time training both before (2.2 h; $Z = -6.382$; $p < 0.001$) and during lockdown (3.7 h; $Z = -10.847$; $p < 0.001$) (Figure 8). Compared to athletes engaged in outdoor sports, athletes training and competing indoors experienced significantly greater decline in training exposure (PD = 31.7%; $Z = -4.993$; $p < 0.001$) from PRE_{LD} and DUR_{LD} (outdoor sports $\Delta = -3.75 \pm 5.49$ h. vs. indoor sports $\Delta = -5.17 \pm 6.45$ h.) (Figure 3D).

Alterations in DC athletes' training

Table 2 shows athletes' training changes due to COVID-19 lockdown. Most of the athletes (92.9%) trained at home during the COVID-19 pandemic. Other changes included training outdoors, training at home with online support, or other changes, which were combinations of the above-mentioned alterations. Among athletes who did not train during the pandemic, nearly a third stated they lacked motivation, while others claimed they did not have adequate training conditions or listed other reasons. Most of the DC athletes (63.3%) felt they responded better to the COVID-19 pandemic than non-student athletes. Their responses indicated a smaller decline in motivation (44.8%), shifting attention from sport to study (31.3%), fewer mental problems due to uncertain sports future (15.9%) and other (8%). The DC athletes who indicated that they did not respond better during the COVID-19 pandemic ($n = 568$) listed the following reasons: failed to focus on either school or sports (28.2%), feeling bad psychologically (16.5%) and other (18.3%), while 37% trained the same as before the lockdown (Table 2).

Discussion

Dual career athletes, who are pursuing both athletic and academic careers simultaneously, faced unique challenges during the pandemic. They had to balance training and competition schedules with academic responsibilities that have been disrupted by the pandemic and also faced logistical challenges related to travel and the use of

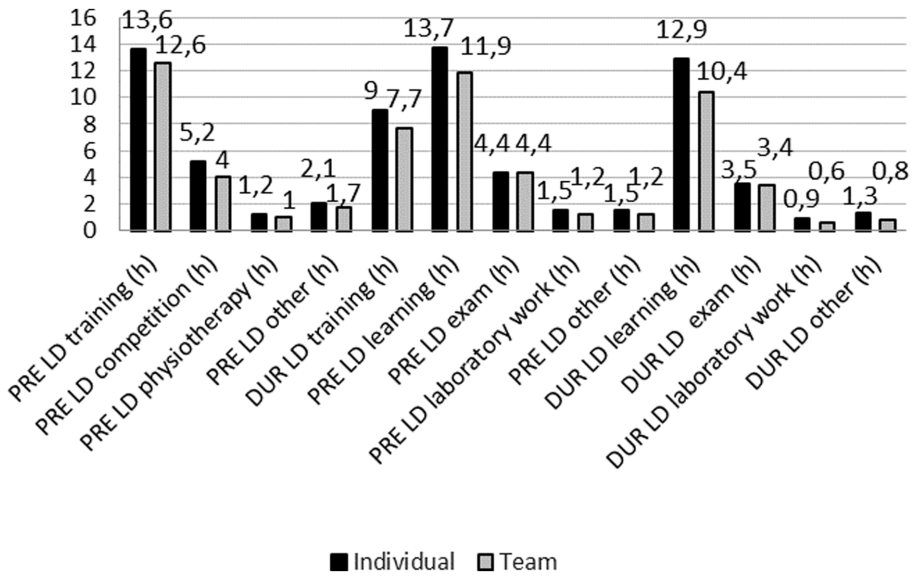

FIGURE 7
Comparisons of time spent on sport and educational activities before (PRE_{LD}) and during (DUR_{LD}) lockdown between athletes competing in individual and team sports.

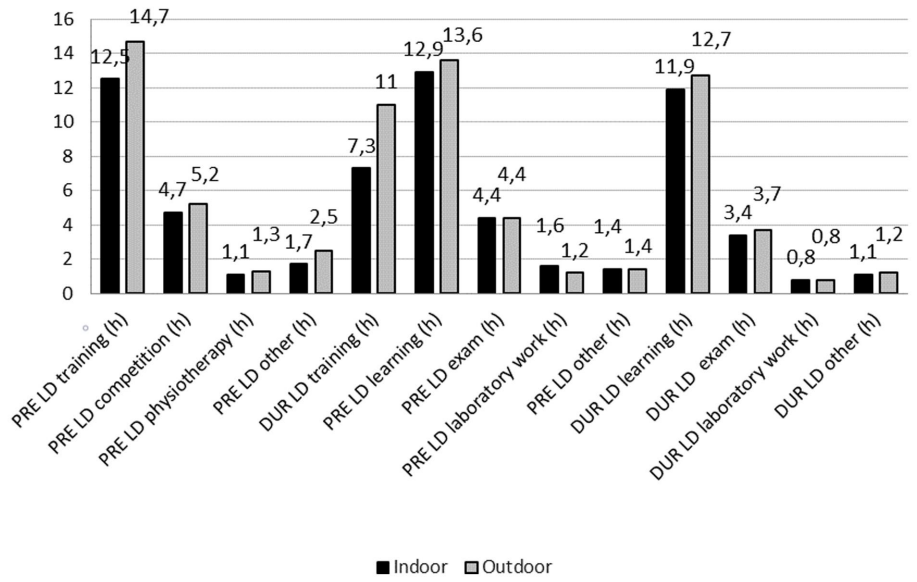

FIGURE 8
Comparisons of time spent on sport and educational activities before (PRE_{LD}) and during (DUR_{LD}) lockdown between athletes competing in indoor and outdoor sports.

training facilities. Our research showed that the COVID-19 lockdown had a major impact on DC athletes' lives due to several governmental measures. Compared with time spent on training and study before the lockdown, DC athletes spent less time on both during the lockdown. The biggest decline was observed in training as athletes trained 4.7 h less than before the lockdown, which is approximately a third less than usual. In relation to training and competition environment, data in our study showed that outdoor-sport athletes spent more time training before (2.2 h), but even more during the lockdown, compared to indoor-sport athletes. Those results indicate that indoor sports were definitely more influenced by governmental measures, as indoor athletes trained 3.7 h less than outdoor athletes. Both indoor and team sport athletes experienced a greater decline in training hours due to the preventive measures applied.

The preventive measures taken in Slovenia during the pandemic included limiting the number of people in indoor spaces (including gyms) and a prescribed space in m^2 per individual, meaning that many sport clubs were unable to provide the appropriate space while conforming with the preventive measures. Therefore, they were forced to cancel, reduce, or adapt their trainings. Latter was confirmed by our results, showing that as many as 93% of athletes trained at home during the lockdown. Among athletes who claimed their training was changed, 40% of them trained at home, 36% trained outside, while others trained with online support or the combination of the mentioned options. The most common reason for not training was lack of motivation (32%), while 27% of the athletes also stated they did not have adequate conditions for training. These changes could contribute to a higher risk of injury, as the lack of sport-specific training (Verrall et al., 2005) and a low number of training sessions (Ekstrand et al., 2020) are already known to contribute to higher injury rates.

Furthermore, we found that study and training alterations were varied with the socio-demographic and sports-related characteristics of DC athletes. Males spent more time on training and sports-related activities both before and during lockdown compared to females, whereas females spent more time than males on educational activities both before and during the lockdown. This is supported by the evidence from The Organization for Economic Cooperation and Development report from 2017, which showed that completion rate in upper secondary education and both participation and completion in tertiary education is higher in female athletes than in males (Education at a Glance, 2017). Even though female sport is becoming more popular, there is still a gender gap in elite sports; for example, most female athletes around the world cannot live solely from their athletic careers (Capranica et al., 2013). Moreover, Barriopedro and colleagues found that female athletes from their study took more time than male athletes to find their first job after terminating their sports career (Barriopedro et al., 2018). Despite all that, there is also an existing gender pay gap, which is reported to be 12.7% in the European Union, in favor of men (Eurostat, 2023).

All the athletes trained less during the lockdown regardless of their competition level. Yet the governmental measures applied differently to different competition levels. Athletes competing at the prospective, international, world and Olympic levels were allowed to train the whole time, with an exception of a period when they were only allowed to conduct training sessions using a "bubble strategy." This was shown to be a promising non-pharmaceutical intervention when coping with emerging infectious diseases (Shen et al., 2022). Sports teams intentionally established a "protective bubble" through which they restricted physical closeness with those outside of the bubble, thereby minimizing the risk of infection (Shen et al., 2022). The sub-analysis showed that individual-sport athletes spent more time training and studying both before and during the lockdown compared to team-sport athletes—a difference influenced by governmental measures. With respect to the training and competition environment, the data indicated that outdoor-sport athletes spent more time training before (2.2 h), but even more during the lockdown, compared to indoor-sport athletes. This indicates that indoor sports

TABLE 2 Alterations in DC athletes' training due to COVID-19 lockdown.

		Count	%
Did you train at home during quarantine due to the COVID-19 pandemic?	Yes	1,288	92.9%
	No	99	7.1%
If yes: How was your training changed? If no: go to the next question	I trained at home	520	39.8%
	I trained outside	471	36.1%
	I trained at home with "online" support	221	16.9%
	Other	93	7.1%
If not: why you did not train:	I did not have adequate conditions for training	36	27.3%
	Lack of motivation	42	31.8%
	I felt bad physically	1	0.8%
	I felt bad psychologically	7	5.3%
	Other	46	34.8%
Do you think you responded to COVID-19 pandemic better than non-student athletes due to the combination of education and sport?	Yes	878	63.3%
	No	509	36.7%
Why has the combination of education and sports helped you cope better with the COVID-19 pandemic compared to non-student athletes?	Smaller decline in motivation	418	44.8%
	Shifting attention from sport to study	292	31.3%
	Less mental problems due to uncertain sports future	148	15.9%
	Other	75	8.0%
If no: Why the combination of education and sports has not helped you cope better with the COVID-19 pandemic compared to non-student athletes?	I failed to focus on either school or sports	160	28.2%
	I felt bad psychologically	94	16.5%
	I trained the same as before the lockdown	210	37.0%
	Other	104	18.3%

were more directly influenced by governmental measures about indoor containment, as indoor athletes trained 3.7 h less than outdoor athletes. However, research also shows that despite close proximity interactions in team sports, SARS-CoV-2 transmission is limited during team sport activities played outdoors (Jones et al., 2020; Dixon et al., 2021; Egger et al., 2021; Faude et al., 2022). Interestingly, research on transmission in indoor sports is inconclusive. For example, a study of 1825 water polo athletes found that transmission of the disease was minimal in indoor sports settings as well (Kreienkamp et al., 2022), but other research suggests that viral transmission in indoor sports is higher compared to outdoor sports and those sports in which preventive hygiene measures could be maintained (Pauser et al., 2021).

The pandemic had a significant impact on mental health, and athletes were no exception (Mehrsafar et al., 2021; Jia et al., 2022). DC athletes may be particularly vulnerable to psychological effects of the pandemic due to the added stressors of their dual careers (Drole et al., 2023). Understanding their responses to the pandemic can help identify risk factors for mental health issues and inform interventions to support their well-being. Most of the DC athletes think they responded better to the pandemic situation compared to non-student athletes, because they experienced less decline in motivation. It is well-known that participation in organized sport has many benefits, not only physical, but also social and psychological (Bartko and Eccles, 2003; Holt et al., 2011; Eime et al., 2013; Piepiora, 2021; Piepiora et al., 2022). Sport allows students to acquire many transferable skills, such as better self-esteem, organizational and interpersonal social skills. Athletes are known by extreme resilience, which is a characteristic that allows them to persevere motivation and bounce back faster and easier (Bartko and Eccles, 2003; Fletcher and Sarkar, 2012). They build this skill throughout their sports career, as a result of winning and losing at the competitions. Losing is an essential part of sport, as it teaches athletes to overcome disappointment, adapt to challenges and cope with unpleasant events. Playing sport can in fact help students to control their emotions and channel negative feelings in a positive way (Holt et al., 2011). All those skills can be later transferred to other areas of their life, including the times of pandemic. The DC athletes from our study felt they could also shift their focus from sport to education and felt less insecure about their future, knowing they are pursuing higher education. Overall, studying the response of DC athletes to the COVID-19 pandemic can provide valuable insights into the unique challenges they face and inform interventions to support their well-being and performance during and beyond the pandemic. DC was shown to benefit athletes even when they decide to retire from sport or get injured (Stambulova et al., 2009, 2021; Barriopedro et al., 2018; Ivarsson et al., 2018). Pursuing a DC allows athletes to diversify their interests and skills beyond their sport, which can help maintain motivation and a sense of identity outside of their athletic environment. This can be particularly important during a traumatic injury that may prevent them from participating in their sport for an extended period (Ivarsson et al., 2018). DC allows athletes to continue working towards meaningful goals despite not being able to participate in their sport. Pursuing a DC can provide athletes with socio-economic stability, which can help reduce stress and anxiety related to their injury and at the same time maintain motivation and focus on recovery and rehabilitation.

However, the lockdown measures were not only concerning during the period of pandemic, but also after the athletes transitioned to normal training and competition. Reduced training hours could have caused detraining, which is particularly concerning when athletes return to a pre-lockdown training schedule. The return to normal training could increase their training and competition load, exposing athletes to a greater risk of injury (Eirale et al., 2020; Sarto et al., 2020). Additionally, we found that the psychological state of the DC athletes was altered during the lockdown period, as some of them reported poor psychological health and that they could not focus on either sport or school. Yet it is not known how many athletes ended their sports-career during that period due to lack of motivation, financial/material support for training, or other reasons. This issue requires further research.

Limitations

Although this study presents data from a large sample, it has a few limitations, which we have acknowledged during the implementation of the questionnaire. Firstly, the questionnaire only collected limited data, therefore it lacks details about the psychological impact and injury occurrence prior and during the lockdown period, which could provide us more valuable results. To provide even more context, it would be useful to have the post-lockdown data of the same individuals. Additionally, the pre-lockdown data relied on recall and athletes' personal diaries, which might have impacted the results.

Conclusion

During the COVID-19 lockdown, athletes training experienced detrimental changes in the frequency/duration domain, environment and type of training. In general, athletes trained a third less time than usual, and most athletes changed their training environment to at home or outdoors. Indoor and team sports were more affected by the governmental measures than outdoor and individual sports. DC is shown to be beneficial for athletes even in times of COVID-19 lockdown, as DC athletes reported a smaller decline in motivation by shifting attention from sport to study and they felt fewer mental problems due to the uncertainty of their sports future. Considering the health crises induced by COVID-19 outbreak, that will most likely have a long-lasting effect, our findings provide policy makers and athletes' support staff useful information when forming and applying preventive measures that improve DC athletes' training and education. Also, the promotion of higher education among athletes and their greater involvement in the learning processes, may serve as a potential tool for maintaining motivation and mental health among athletes in future pandemics or situations like traumatic injury or retirement from sports.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of the Faculty of Sport (University of Ljubljana). The patients/participants provided their written informed consent to participate in this study.

Author contributions

KD drafted the manuscript and contributed to the conceptualization. AP contributed to conceptualization, design, and data analysis. JC critically revised the manuscript, while MD contributed to the idea and critically revised the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Big Five personality traits and coping strategies of Italian university students during the COVID-19 pandemic first wave

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Introduction: Little is known about the role personality traits may have played for university students in diminishing and compensating for the negative impact of COVID-19 in its early phases, promoting adaptive coping. University students represent a population which was consistently obliged to follow social distance rules due to the early shift of many organizations from face-to-face to online learning. Therefore, it is worth exploring whether the Big Five traits acted as risk or protective factors after the outbreak of a disaster such as the COVID-19 pandemic for Italian university students.

Methods: We involved a sample of 2,995 university students who completed an online survey in March 2020. We measured the Big Five personality traits through the Big Five Inventory-2-XS and their coping strategies through the Robust—Pandemic Coping Scale. The latter assessed four COVID-19-related coping dimensions, namely Despair (e.g., including helplessness and feeling lack of control), Aversion (e.g., referring to oppositive strategies), Proactivity (e.g., comprising problem solving and information seeking), and Adjustment (e.g., concerning reappraisal and assertiveness).

Results: Preliminarily, two Linear Mixed Models indicated that university students had higher scores in Conscientiousness, followed by Open-Mindedness, and then Agreeableness. These three traits were, in turn, higher than Extraversion and Negative Emotionality, which did not differ among them. Concerning coping, university students reacted more frequently utilizing adaptive strategies (with Proactivity used more frequently than Adjustment) rather than maladaptive strategies (with Despair higher than Aversion). A Path Analysis examining the relations between the Big Five traits and the four coping dimensions showed that Negative Emotionality can be considered as a risk factor, and that Agreeableness, Conscientiousness, and Open-Mindedness can be conceptualized as protective factors. More interestingly, we found that Extraversion entailed both a risk and a protective role for Italian university students after the outbreak of the COVID-19 pandemic.

Discussion: Notwithstanding limitations, these findings can be the basis for developing disaster preparation and prevention actions, aiming at promoting students' positive coping towards current and future disasters.

KEYWORDS

personality traits, COVID-19, coping, university students, Big Five, resilience, disaster preparation

1. Introduction

On 11 March, 2020, the WHO (2020) declared the COVID-19 pandemic. As all natural disasters (EM-DAT, n.d.), pandemics have potentially traumatic consequences for people of all ages and for a plethora of fields (Kumar et al., 2021). The consequences of the COVID-19 spreading have heavily affected everyday life in the social, economic, health, and education domains for millions of individuals (Kumar et al., 2021). In turn, the negative effects on physical health and the dramatic changes to which people were forced to comply with the restrictions that, worldwide, were imposed to limit the diffusion of the SARS-CoV-2 virus, have caused an increase of psychopathological symptoms and disturbances such as depression, anxiety, post-traumatic stress disorder, and others (e.g., Fitzpatrick et al., 2020; Gallagher et al., 2020; Nicomedes and Avila, 2020; Rodríguez-Rey et al., 2020; Arslan et al., 2021; Dozois and Mental Health Research Canada, 2021; García-Portilla et al., 2021). As a result of the state of emergency and the corresponding safety measures, there were a variety of disruptions in everyday routines (Ellis et al., 2020; Holmes et al., 2020). For education systems, they comprised school and university closures, with a particular emphasis on social distance, from the beginning of the outbreak of the pandemic. However, thanks to the technological and educational resources of many universities, for higher education students the interruptions of formal learning were generally very brief, given the prompt responses of many organizations to shift lessons from onsite to online learning in rapid times (Aristovnik et al., 2020). A survey which involved 424 universities and other higher education institutions based in more than 100 countries, revealed that in 2020 at least two-thirds of such organizations moved from onsite to online lessons (Marinoni and Jensen, 2020). Moreover, during 2020 there was a marked increase in the number of licenses of platforms such as Zoom (2020), which is one of the learning systems used by many universities (including the one in which this research was conducted).

In parallel with a growth of the interest in some of the psychological consequences of the outbreak of the pandemic for university students (e.g., on students' expectations and experiences, Aucejo et al., 2020; on adjustment to online courses, Audet et al., 2021; on e-learning achievement emotions, Raccanello et al., 2022a), researchers are paying increasing attention to university students' characteristics of personality that could have played a role in diminishing and compensating the negative impact of the diffusion of the COVID-19, promoting adaptive coping (Anglim and Horwood, 2021; Audet et al., 2021; Sahinidis and Tsaknis, 2021; Staller et al., 2021; Quigley et al., 2022; Wang et al., 2022; Weiß et al., 2022; Zolotareva et al., 2022). In line with this tendency, we explored whether the Big Five traits (i.e., Extraversion, Agreeableness, Conscientiousness, Open-Mindedness, and Negative Emotionality or Neuroticism) acted as risk or protective factors after the outbreak of a disaster such as the COVID-19 pandemic for a sample of Italian university students, taking into account a large variety of coping strategies.

In this work we focused on the Five-Factor Model (Costa and McCrae, 2006), given that this personality approach is one of the most widely used (Bacon et al., 2022). Being a universal and cross-cultural model, its use makes it easy for researchers to collaborate and compare the results from different studies; moreover, the usability of the corresponding questionnaires and scoring systems makes the model practical for a variety of professionals, and this can help particularly for dissemination of research findings (McCrae and Costa, 1997; Montag and Elhai, 2019; Marengo et al., 2021). Recent studies document also the Big Five factors' specificity from a neurobiological perspective (DeYoung, 2015; Davis and Panksepp, 2018; Marengo et al., 2021). In the literature, there are also other models conceptualizing personality traits (e.g., Anglim and O'connor, 2019; Bacon et al., 2022). Among them, a viable alternative option to the Big Five model is offered by the HEXACO model, distinguishing Honesty-Humility, Emotionality, EXtraversion, Agreeableness, Conscientiousness, and Openness to Experience (Ashton and Lee, 2007, 2020). This model extends the Big Five model considering a sixth factor, Honesty-Humility, which corresponds to individuals' tendency to be fair and authentic in social interactions (Bacon et al., 2022). Rather than being a mere addition, the sixth factor derives from differently portioning the variance which related to Big Five Agreeableness and Negative Emotionality to HEXACO Agreeableness, Negative Emotionality, and Honesty-Humility (Bacon et al., 2022). The HEXACO model was used to study behavioral and emotional responses in relation to risk situations, also during the pandemic (Modersitzki et al., 2020; Volk et al., 2021). However, some authors argue that this model has not been demonstrated to be universal and that the contents of the sixth factor partially overlaps with facets already included in the Big Five Agreeableness factor (Anglim and O'connor, 2019). Acknowledging the strengths and constraints of the HEXACO model, we nevertheless decided to focus on a model including the five main factors comprised by the most known models (i.e., the Big Five model), both for parsimony and for the need to rapidly assess personality traits, given the sudden and unpredictable outbreak of the pandemic (it is worth noting that the time interval between the declaration of the pandemic and the date in which we presented the project for this research to the Ethical Committee was quite short—see the Procedure section). Moreover, we needed brief instruments suitable for online administration and already available in Italian in that specific historical moment. The choice of focusing on the Big Five model was also in line with most research about personality traits and the pandemic published during 2020, as indicated by Bacon et al. (2022), who for example identified a higher number of works based on the Big Five model rather than the HEXACO model. However, the results regarding the HEXACO model tend to replicate those concerning the Big Five model (Bacon et al., 2022). Advancing research on the relation between personality traits and coping is of paramount relevance to extend our knowledge on how to support students after a disaster occurs, and also to plan in advance interventions regarding disaster preparedness and prevention. All these actions are essential to promote university students' resilience, as the capacity to adapt positively after having experienced traumatic events (Masten, 2021).

2. Literature review

2.1. Coping strategies

The outbreak of a disease usually provokes a variety of psychological reactions (Kohút et al., 2021). The cognitive, emotional, and behavioral responses that individuals display when facing stressful events are classically defined as coping strategies (Lazarus and Folkman, 1984; Lazarus, 2000). Such strategies are activated when

people perceive that the requests of an event exceed individuals' resources for responding. Coping strategies are still relevant today to take into account the processes through which people react to stress, in particular with reference to their maladaptive or adaptive function (Ewert et al., 2021). Nevertheless, it is worth anticipating that there is a wide variety of strategies that people can use and that a key factor associated with their efficacy is the ability to flexibly choose the most adequate strategy in relation to the characteristics of both individuals and specific contexts (Ewert et al., 2021; Zimmer-Gembeck, 2021). Aiming to elaborate an extended taxonomy that could comprise most of the coping strategies studied within the psychological literature, Skinner and Zimmer-Gembeck (Zimmer-Gembeck and Skinner, 2011; Skinner and Zimmer-Gembeck, 2016; Zimmer-Gembeck, 2021—for adaptation of this categorization to natural disasters, see Raccanello et al., 2020, 2021, 2023; to the pandemic, see Burro et al., 2021; to wars, see Vicentini et al., 2022) proposed a classification based on the concept that an uncertain or stressful event can be perceived as a threat or as a challenge towards the three basic human needs for competence, relatedness, and autonomy (Deci and Ryan, 1985). These three needs are at the core of the Self-Determination Theory, according to which individuals' wellbeing and psychological functioning is associated with the satisfaction (and the absence of frustration) of such needs (Deci and Ryan, 1985). The need for autonomy concerns the human tendency towards autonomous choices and critical thinking; the need for competence regards people's need for mastering the contextual requests and perceiving oneself as competent; and the need for relatedness refers to the tendency of experiencing positive relations in which people care one another (Šakan et al., 2020). Coherently with the Self-Determination Theory, recent findings suggested that, also during the pandemic, satisfaction and frustration of the three basic psychological needs is relevant for influencing individuals' wellbeing (Šakan et al., 2020). This has been investigated also involving university students during the first wave of the pandemic, for example indicating that Conscientiousness is related to low levels of frustration and high levels of satisfaction of the competence need (Staller et al., 2021).

When an event is perceived as a challenge, it is likely that the individuals' responses would be adaptive; when it is perceived as a threat, the probability of them being maladaptive would raise. For each of the six intersections between these two aspects (threat vs. challenge perception; type of need) there would be four families of coping strategies, two maladaptive and two adaptive. For example, at the outbreak of the pandemic people lacked knowledge on how to face it, both because authorities needed some time to implement the first rules to limit the diffusion of the virus, and because vaccines were not available yet. According to how individuals perceived this as a threat or a challenge to their competence, respectively, they could have reacted in maladaptive ways, e.g., thinking that no solution was possible or trying to cognitively escape from the reality denying it, or in adaptive ways, e.g., trying to behave according to the prevention guidelines or to search for information. When a stressful event regards the need for:

- Competence, the two maladaptive reactions can be classified within the families, respectively, of *helplessness* and *escape*, while the two adaptive reactions within the families of *problem solving* and *information seeking*.
- Relatedness, the maladaptive families include *delegation* (e.g., feeling of being out of control) and *social isolation* (e.g., withdrawing from social interactions), and the adaptive families *self-reliance* (e.g., focusing on emotion awareness and regulation) and *support seeking* (e.g., giving or looking for social support).
- Autonomy, the maladaptive families comprise *submission* (e.g., ruminating) and *opposition* (e.g., refusing to cooperate), and the adaptive families *accommodation* (e.g., using reappraisal) and *negotiation* (e.g., being assertive and contracting, identifying priorities).

Based on this taxonomy, we developed a 20-item scale to assess maladaptive and adaptive coping strategies related to pandemics using the Rasch modeling, i.e., the Robust—Pandemic Coping Scale (R-PCS; Burro et al., 2021). Through a dual approach combining an exploratory and a confirmatory analysis, we identified the four dimensions of the scale, called Despair, Aversion, Proactivity, and Adjustment. The first two dimensions focused on threats while the other two on challenges. Based on previous literature (Zimmer-Gembeck and Skinner, 2011; Skinner and Zimmer-Gembeck, 2016) and on their relations with positive (i.e., enjoyment) and negative (i.e., anger) emotions, we could argue that the first two are maladaptive while the other two are adaptive. To help clarity, we report in Table 1 the items of the four dimensions of the R-PCS, distinguishing them according to their reference to threats or challenges; to the needs for competence, relatedness, or autonomy; and to the family of coping strategies (helplessness, delegation, submission, opposition, problem solving, information seeking/giving, social support, accommodation, and negotiation). In particular:

- *Despair* included items referred to threats towards the three needs, i.e., competence, relatedness, and autonomy; they concerned the families of helplessness, delegation, and submission.
- *Aversion* comprised only items about threats to autonomy, and specifically pertaining to the family of opposition.
- *Proactivity* included items related to challenges towards competence, about problem solving and information seeking/giving, and only one item about relatedness (which was however focused on an active way to solve problems).
- *Adjustment* included items pertaining to challenges towards autonomy, concerning accommodation and negotiation, and one item about relatedness (focused on relations but referred also to contracting with others).

2.2. Personality traits

Students' cognitive, emotional, and behavioral reactions at the outbreak of the COVID-19 pandemic may have been associated with different risk or protective factors. Risk factors have a negative impact on psychological development and functioning, worsening them, while protective factors are those contributing to their amelioration (Luthar et al., 2015). Could personality traits have played a role as risk or protective factors in such period for Italian university students' coping?

TABLE 1 Items of the four dimensions of the R-PCS (in italics), distinguished according to their reference to threats vs. challenges; competence, relatedness, or autonomy needs; and family of coping strategies (helplessness, delegation, submission, opposition, problem solving, information seeking/giving, social support, accommodation, and negotiation).

	Pandemic perceived as a threat		Pandemic perceived as a challenge	
R-PCS Dimension	Despair	Aversion	Proactivity	Adjustment
Need for competence	Helplessness: - *Thinking that nobody can help me*		Problem solving: - *Behaving in safe ways (for example washing my hands frequently)* Information seeking/giving: - *Giving correct, clear, and comprehensible information* - *Looking for information from reliable sources* - *In case of doubts, asking for information on appropriate behaviors*	
Need for relatedness	Delegation: - *Panicking*		Social support: - *Helping and reassuring those around me*	Social support: - *Collaborating with others*
Need for autonomy	Submission: - *Overthinking about the emergency* - *Thinking that things will never get better*	Opposition: - *Remembering that following the rules protects everybody's health* (reversed) - *Thinking that safety measures are not useful* - *Following advice from experts* (reversed) - *Ignoring the regulations from the Ministry of Health*		Accommodation: - *Taking the opportunity to cultivate hobbies* - *Keeping myself busy (for example playing or studying)* Negotiation: - *Creating new routines if usual ones cannot be followed* - *Focusing on things that are really important (for example family)*

The Big Five personality trait domains enabled the organization of individual differences according to typical patterns of thoughts, feelings, and behaviors (Soto and John, 2017). Some conceptualizations distinguish also specific facet-traits within each larger Big Five domain, with a hierarchical organization (McCrae and Costa, 2010; Soto and John, 2017). Within the so-called "person-situation debate" (Goldberg, 1993; Faulkner et al., 2004; Fink et al., 2021), personality traits have generally been recognized as stable within individuals and consistent across time and situations (Fink et al., 2021). However, data on adults seem to suggest that in the case of the pandemic the way in which individuals perceived the situation explained more variance related to adaptive reactions such as compliance with safety behaviors than their personality, for which it was usually quite low (Zajenkowski et al., 2020; Fink et al., 2021). Nevertheless, not much is known on the relation between personality traits and a wide range of pandemic-related coping strategies for the specific population of university students, which was obliged to abruptly diminish face-to-face social interactions due to the shift to online lessons at the COVID-19 outbreak (see paragraph 2.4. Big Five Traits and Coping Strategies in University Students During the Pandemic below for studies on this issue).

It is worth noting that personality traits could have different effects in the various phases of the disaster cycle (i.e., nondisaster phase, predisaster phase, impact phase, emergency phase, and reconstruction phase; Noji, 1997; other researchers refer to similar and partially overlapping phases such as mitigation, preparedness, response, and recovery phases; Alexander, 2019; Sawalha, 2020). We focused on the impact phase, corresponding to the moment of the occurrence of the disaster which can provoke serious damages for things and people. The relatively long duration of the impact phase for the COVID-19 pandemic gave the rare possibility to study the role of personality in a time frame which is generally under-investigated, due to its very short duration for many natural disasters (e.g., earthquakes, tsunamis, or volcanic eruptions).

On the basis of the literature about the Big Five, we generally expect Extraversion, Agreeableness, Conscientiousness, and Open-Mindedness to act as protective factors, and Negative Emotionality (or Neuroticism) to act as risk factors in a variety of situations.

- *Extraversion.* Considering the facet-traits distinction (McCrae and Costa, 2010; Soto and John, 2017), extraverted people can be described as sociable, assertive, and full of energy. They are usually expected to be actively engaged in social relations (McAdams, 2015). They cope with events through reappraisal (Balzarotti et al., 2010) and negotiate with others using an assertive rather than a passive or an aggressive style (Bagherian and Mojambari, 2016; Sims, 2017). Moreover, this trait is frequently associated with subjective wellbeing (Li et al., 2015; Anglim et al., 2020).
- *Agreeableness.* Agreeable people are characterized by compassion, are respectful, and think the best about other individuals. They are emphatic, care about others, and are prone to prosocial behaviors such as helping or donating (Habashi et al., 2016; Sims, 2017).
- *Conscientiousness.* Conscientious people are organized, persistent when engaged in a task, and reliable. They are used to respect rules and recommendations, positively valuing achievement, order, hard work, and efficiency (Barrick and Mount, 1991; Roberts et al., 2005), and also utilizing, especially when goal progress is threatened, an assertive style (Bagherian and Mojambari, 2016; Sims, 2017). They also tend to avoid germs (Costa and McCrae, 2006). Moreover, this trait is particularly relevant for school performance (Judge and Ilies, 2002).
- *Open-Mindedness.* People with high Open-Mindedness are fascinated by art, intellectually curious, and creative. Thus, they are open to new experiences and capable of adapting easily to them (Schmutte and Ryff, 1997; McAdams, 2015), also in relation to shifting to online learning (LePine et al., 2000). In addition, they are prone to prosocial behavior (Kline et al., 2019).
- *Negative Emotionality.* People with high Negative Emotionality are anxious, depressed, and easily change their mood. They are generally characterized by poor wellbeing, psychological distress, and high scores for indicators of negative psychological functioning (Anglim et al., 2020). Low Negative Emotionality, together with high Conscientiousness, has the strongest associations with both physical and mental health (Bogg and Roberts, 2013; Friedman and Kern, 2014; Strickhouser et al., 2017). Moreover, neurotic people tend to react through maladaptive coping (Costa and McCrae, 2006), rarely using reappraisal (Balzarotti et al., 2010). They are also seldom assertive (Bagherian and Mojambari, 2016; Sims, 2017).

Finally, Agreebleness, Conscientiousness, and Open-Mindedness are usually also associated with subjective wellbeing—even if less strongly compared to the other two traits—while the relations with negative indicators of psychological functioning are usually less consistent (Anglim et al., 2020).

2.3. Big Five traits and COVID-19 coping strategies

Which COVID-19 coping dimensions (conceptualized according to the R-PCS) could we expect in university students on the basis of the literature about Big Five factors and coping? Does pandemic-related research support previous findings about the risk and protective role of the Big Five traits? During the pandemic, most of the research on personality and coping focused on adults spanning from 18 years to older ages, and only rarely focused on university students (see paragraph 2.4. Big Five Traits and Coping Strategies in University Students During the Pandemic below for studies on this issue). It is also worth noting that, in general, the feeling of lack of control over the unknown threats due to the outbreak of the pandemic is generally associated with misinformation and conspiracy theories (Šrol et al., 2021), in turn increasing the intensity of the perceived danger and the probability to activate personality expressions (Bedford-Petersen and Saucier, 2021). We anticipate that most of the studies which are commented on within this paragraph were conducted with adults (and not specifically with university students) during the first wave of the pandemic (i.e., Bogg and Milad, 2020; Carvalho et al., 2020; Chan et al., 2020; Muto et al., 2020; Nofal et al., 2020; Qian and Yahara, 2020; Zajenkowski et al., 2020; Aschwanden et al., 2021; Blagov, 2021; Fink et al., 2021; Götz et al., 2021; Kocjan et al., 2021; Kohút et al., 2021; Nikčević et al., 2021; Schmiedeberg and Thönnissen, 2021; Zettler et al., 2021; Abdelrahman, 2022).

2.3.1. Despair

While no previous study examined the Big Five traits in relation to COVID-19 Despair as conceptualized by the R-PCS, we could gather some hints about possible links examining the COVID-19 literature assessing adults' emotional responses, wellbeing, stress, anxiety, depression, and other symptoms. These constructs are included in the three coping families within Despair, i.e., helplessness, implying the absence of hope about the future; delegation, typical of people overwhelmed by negative emotions; and submission, manifesting itself primarily through rumination. On the whole, the COVID-19-related literature reports that various indicators of negative distress are related positively with Extraversion and Negative Emotionality, and negatively with Agreeableness, Conscientiousness, and Open-Mindedness (studies documenting these findings are detailed as follows).

Data on adults indicated that Extraversion had a positive effect on subjective wellbeing (Kocjan et al., 2021) and it was negatively correlated with generalized anxiety and depressive symptoms (Nikčević et al., 2021), but it was also positively associated with stress (Kocjan et al., 2021), negative emotional responses (Kohút et al., 2021), and a more negative perception of the situation, but only for participants without a partner (Schmiedeberg and Thönnissen, 2021). A review on the role of personality in COVID-19-related emotions and behaviors indicated that Extraversion was associated with people's reluctance to socially distancing from others (Bacon et al., 2022). Agreeableness and Conscientiousness had a positive effect on subjective wellbeing (Kocjan et al., 2021) and were negatively correlated with generalized anxiety and depressive symptoms (Nikčević et al., 2021). Negative Emotionality was associated negatively with subjective wellbeing (Kocjan et al., 2021) and positively with negative emotions (Kohút et al., 2021), with a more negative perception of the restrictions to daily life (Schmiedeberg and Thönnissen, 2021), and with stress, anxiety, and depression (Qian and Yahara, 2020; Kocjan et al., 2021; Nikčević et al., 2021). Some studies also reveal that, among the five traits, Negative Emotionality was the strongest predictor of the worst psychological functioning (Kocjan et al., 2021) and was most related with a poor mental health (Bacon

et al., 2022). Open-Mindedness was negatively linked with generalized anxiety and depressive symptoms (Nikčević et al., 2021), but it also had negative effects on subjective wellbeing (specifically, when mediated by individuals' resilience) and positive effects on stress (Kocjan et al., 2021).

2.3.2. Aversion

If we focus on the oppositive coping strategies characterizing Aversion, it is useful to take into account research about adults' compliance with preventive measures during the COVID-19 pandemic. Considering samples of adults from a variety of countries, the current findings seem to suggest that, on the one hand, adherence to safety behaviors is higher for people with high Agreeableness, Conscientiousness, Negative Emotionality, and Open-Mindedness. On the other hand, it could be particularly difficult for extraverted individuals, especially for rules imposing social distancing.

Fink et al. (2021) found that scores in the scale Adherent Safety Behavior negatively correlated with Extraversion, while the other four traits were positively related, with the highest association for Negative Emotionality. Other findings indicated that preventive behavior was associated positively with Agreeableness (Chan et al., 2020; Muto et al., 2020; Qian and Yahara, 2020; Zajenkowski et al., 2020; Krupić et al., 2021; Pilch et al., 2021), Conscientiousness (Carvalho et al., 2020; Chan et al., 2020; Nofal et al., 2020; Qian and Yahara, 2020; Krupić et al., 2021; Abdelrahman, 2022), Negative Emotionality (Chan et al., 2020), and Open-Mindedness (Qian and Yahara, 2020; Pilch et al., 2021), and negatively with Extraversion (Krupić et al., 2021). Similar results were reported by Peters et al. (2023), commenting that, albeit with some exceptions, individual differences in the Big Five traits are linked with a range of COVID-19-related behaviors, like social distancing (Bogg and Milad, 2020; Aschwanden et al., 2021; Zettler et al., 2021), compliance with hygiene rules (Blagov, 2021; Zettler et al., 2021), and adherence to lockdown restrictions (Zajenkowski et al., 2020; Götz et al., 2021; Siritzky et al., 2022). However, the results are not always consistent. Some studies found no significant relations between the Big Five traits and compliance with recommendations (Kohút et al., 2021), or even negative relations between Negative Emotionality and adherence to recommendations (Bogg and Milad, 2020).

2.3.3. Proactivity

Considering information seeking (concerning the competence need)—which is one of the most representative families measured by Proactivity—research on COVID-19 found that in the first wave Negative Emotionality positively predicted search for information (Kohút et al., 2021). Given that Proactivity included also one item about problem solving, the same literature considered in relation to compliance with rules could be taken into account for formulating the hypotheses about the relation between the Big Five traits and this coping dimension, with the opposite direction.

2.3.4. Adjustment

Concerning Adjustment, Kohút et al. (2021) found that Conscientiousness negatively predicted relaxation and emotional improvement, a strategy similar to reappraisal (which is one of the coping strategies comprised by the family of accommodation), which however was positively predicted by Open-Mindedness. Schmiedeberg and Thönnissen (2021) found that Open-Mindedness was associated with a more positive perception of the situation, again an aspect that could be linked with reappraisal. As regards social support, Kohút et al. (2021) documented that Agreeableness predicted helping others.

2.4. Big Five traits and coping strategies in university students during the pandemic

University students constitute a population with some different characteristics from the adult population. In the period following the outbreak of the pandemic, they were generally deprived uniformly of their social interactions, in particular of those concerning learning-teaching contexts, including both peers and teachers (Aristovnik et al., 2020; Marinoni and Jensen, 2020). Using a sort of quasi-experimental design, involving university students during the pandemic in studies about personality traits and coping strategies, gave the rare possibility to focus on the effects of social deprivation on the relation between the two constructs.

Previous research involving university students has already in part examined the role of the Big Five traits concerning coping (i.e., Anglim and Horwood, 2021; Audet et al., 2021; Sahinidis and Tsaknis, 2021; Staller et al., 2021; Quigley et al., 2022; Wang et al., 2022; Weiß et al., 2022; Zolotareva et al., 2022).

For example, Anglim and Horwood (2021) involved a sample of more than 1,000 Australian undergraduates during July 2020. Their data indicate substantial similarities in the relation between the Big Five factors and wellbeing with the pre-pandemic phases, but they also revealed a reduced impact of Extraversion on positive affect, supporting the relevance of situation selection beyond temperament for explaining the impact of personality traits. Audet et al. (2021) indicated that Open-Mindedness was positively associated with subjective wellbeing and engagement towards online learning for 350 Canadian university students in the 2020 fall semester. Involving younger students (i.e., a sample of 347 Flemish secondary school students) in June 2020, Iterbeke and De Witte (2022) also found that more conscientious and open-minded students adjusted well to the changes induced by the pandemic, while more neurotic students showed higher levels of stress. In line with this, Quigley et al. (2022) reported positive correlations higher than 0.35 between Neuroticism and stress for a sample of about 300 first-year English undergraduate students in a survey from January to March 2021. Sahinidis and Tsaknis (2021) involved more than 500 Greek university students from March to April 2020, indicating that engagement with online learning was higher for more open-minded and conscientious students and lower for neurotic ones. Also vitality, regarding energy and enthusiasm, related positively to Conscientiousness and negatively to Neuroticism, in a sample of German bachelor/master students participating to an online survey in June 2020 (Staller et al., 2021). A study by Wang et al. (2022) indicated that perceived stress was related negatively with Extraversion, Agreeableness, Conscientiousness, and Open-Mindedness, and positively with Neuroticism, and there was an opposite pattern for social support. This was revealed involving a sample of almost 600 Chinese medical university students in November 2021.

Using a small sample ($N = 51$), Weiß et al. (2022) focused on how the Big Five personality traits related to coping with contact restrictions in May 2020 in Germany. Their findings confirmed the association between being extravert on the one hand, and suffering from constraints together with benefiting from their relaxation on the other hand. Finally, Zolotareva et al. (2022) investigated the relation between the Big Five traits and healthy life style in March and April 2021 in a sample of more than 1,200 university students in Russia. They found, for example, that stress management was related positively with Extraversion and Conscientiousness, and negatively with Neuroticism. Moreover, social support for healthy practices was positively related with Extraversion, Agreeableness, and Conscientiousness.

Overall, most of these studies focused on constructs that are related to the R-PCS Despair factor. However, the specific characteristics of the relation between the five factors and a wide range of coping strategies as those assessed through instruments such as the R-PCS has not been examined thoroughly yet. In addition, involving university students in the very first phases of the pandemic (in our case, the participants were Italian university students), we could investigate this relation in a phase of disasters, i.e., the impact phase (Noji, 1997; Alexander, 2019; Sawalha, 2020), which is generally under-investigated given its usual short duration. For example, for other natural disasters such as earthquakes or tsunamis it is both procedurally and ethically very difficult to involve people as study participants during such phase. Therefore, knowledge about the individuals' psychological reactions during the impact phase is frequently studied through retrospective reports (Raccanello et al., 2022b), which however can be biased by memory distortion processes.

To sum up, the recent literature about how adults, and in particular university students, coped with the threats and challenges of the pandemic in its early stages seems to give support to the well-established protective role of Agreeableness, Conscientiousness, and Open-Mindedness, and to the risk role of Negative Emotionality. Nevertheless, a great exception is played by Extraversion, whose typically protective role has been deeply questioned by the restrictions about social distancing. Whether this pattern also characterizes Italian university students in relation to a large variety of coping strategies has not been deeply investigated yet.

3. Aims of the current study

The current study aims at broadening the understanding of personality traits as key risk or protective factors in relation to how Italian university students coped with the challenges due to the outbreak of the COVID-19 pandemic in 2020. There are at least three gaps in the current literature that our research identified on the relations between the Big Five traits and coping with this population. To our knowledge, scarce attention has been paid at studying: (a) the Big Five traits in Italian university students during the pandemic; (b) the correlates of the Big Five traits regarding a wide range of coping strategies in Italian university students during the first wave of COVID-19; so, before generalizing suggestions concerning broader samples of adults and other countries' university students, it is necessary to test whether the underlying theoretical assumptions are confirmed with them; and (c) risk and protective factors playing a role in the very first period of a disaster such as a pandemic (using the first wave of the COVID-19 pandemic as an example), i.e., its impact phase, as a necessary step in implementing actions to support university students' resilience before, during, and after disasters.

Therefore, we had two main aims. The first aim was to explore how a sample of Italian university students was characterized in terms of the Big Five personality traits and COVID-19-related coping strategies assessed after the outbreak of the COVID-19 pandemic. The strategies were evaluated through the R-PCS, which measures four dimensions, namely Despair, Aversion, Proactivity, and Adjustment. The second aim was to test whether and how the Big Five personality traits were linked to the four types of COVID-19-related coping strategies. Based on previous research, we formulated four hypotheses.

> *Hypothesis 1*: For Despair, we hypothesized positive links with Extraversion and Negative Emotionality, and negative links with Agreeableness, Conscientiousness, and Open-Mindedness.
>
> *Hypothesis 2*: For Aversion, we hypothesized a positive link with Extraversion, and negative links with Agreeableness, Conscientiousness, Negative Emotionality, and Open-Mindedness.
>
> *Hypothesis 3*: For Proactivity, we hypothesized positive links with Extraversion, Agreeableness, Conscientiousness, and Open-Mindedness, and a negative link with Negative Emotionality.
>
> *Hypothesis 4*: For Adjustment, we hypothesized positive links with Extraversion, Agreeableness, Conscientiousness, and Open-Mindedness, and a negative link with Negative Emotionality.

To sum up, for Italian university students after the outbreak of the COVID-19 pandemic, we expected Negative Emotionality to act as a risk factor, and Agreeableness, Conscientiousness, and Open-Mindedness to act as protective factors. However, the question about the role of Extraversion remained unclear.

4. Method

4.1. Participants

We involved a sample of 2,995 participants ($M_{age} = 25.50$ years, SD = 6.61, 80% females) from a North-Eastern Italian university. Respectively, the 57.45% of them were bachelor's students, the 36.78% master's students, and the 5.77% attended a PhD or other post-lauream courses. As regards their area of study, they were studying human sciences (25.73%), medicine (18.16%), foreign languages (17.00%), economy (14.27%), science and engineering (8.36%), literature (7.58%), law (5.43%), or sport science (3.48%). At the time of the survey, 0.37% of participants had directly experienced COVID-19, having received a positive test result, 1.46% had been tested but had a negative result, and 98.17% had never been tested.

4.2. Procedure

This study is part of a larger longitudinal project that involved all the students from a North-Eastern Italian university from March 2020 to July 2022 with a total of 14 waves (Burro et al., 2021). It was approved by the Director of the Head Office General Management and by the Ethical Committee of the Department of Human Sciences of the same university (protocol n. 118,846/2020; the request was presented on 13 March 2020 and it was approved on 16 March 2020). We contacted about 25,000 students by email for the first time between March and April 2020. They were invited to take part to an online survey about COVID-19, personality, and coping strategies. Students that confirmed their participation had to sign an informed consent before filling in the questionnaire. All the questions were presented in Italian. The data considered in this study concern the first wave. We administered the questionnaire about 2 weeks after that the WHO had declared the COVID-19 pandemic (11 March 2020, World Health Organization, 2020), specifically between 23 March 2020 and 1 April 2020. In Italy, on 9 March a Decree of the President of the Council of Ministers (Decreto del Presidente del Consiglio dei Ministri, DPCM; Gazzetta Ufficiale della Repubblica Italiana, 2020) had already been applied to the whole country, containing strict regulations to mitigate the diffusion of the virus and limiting, in particular, people's mobility. At the university involved for this study, lessons shifted to completely online from the beginning of March 2020.

4.2.1. Measures

4.2.1.1. Big Five

For measuring the Big Five personality traits we used the Italian version of the Big Five Inventory-2-XS (BFI-2-XS; Soto and John, 2017). This instrument consists of 15 items to be rated on a five-point scale (1 = *not at all* and 5 = *very much*) according to how true each sentence is to describe the participant. It comprises five factors corresponding to the Big Five traits: Extraversion (e.g., *I am full of energy*; $\omega = 0.65$), Agreeableness (e.g., *I assume the best about people*; $\omega = 0.63$), Conscientiousness (e.g., *I am reliable, others can always count on me*; $\omega = 0.60$), Negative Emotionality (e.g., *I worry a lot*; $\omega = 0.69$), and Open-Mindedness (e.g., *I am original, I come up with new ideas*; $\omega = 0.62$). Each dimension includes three items, one for each facet of the personality traits: sociability, assertiveness, and energy level for Extraversion; compassion, respectfulness, and trust for Agreeableness; organization, productiveness, and responsibility for Conscientiousness; anxiety, depression, and emotional volatility for Negative Emotionality; aesthetic sensitivity, intellectual curiosity, and creative imagination for Open-Mindedness.

4.2.1.2. Pandemic-related coping strategies

We measured the strategies used to cope with the pandemic using the R-PCS (Burro et al., 2021). It comprises 20 items to be rated on a five-point scale (1 = *never* and 5 = *always*) according to how frequent each strategy is used. We asked to the participants to respond to thinking about the ways they had used to cope with emotions such as fear, sadness, and anger since the restriction measures were applied to the whole Italian territory (DPCM of 9 March 2020). The R-PCS evaluates two maladaptive, i.e., Despair ($\omega = 0.75$) and Aversion ($\omega = 0.61$), and two adaptive dimensions, i.e., Adjustment ($\omega = 0.68$) and Proactivity ($\omega = 0.68$), each including five items. The dimensions differ for how they refer to threats or challenges, and to competence, relatedness, and/or autonomy needs (Zimmer-Gembeck and Skinner, 2011; Skinner and Zimmer-Gembeck, 2016; Zimmer-Gembeck, 2021). Despair comprises negative strategies reflecting immobility and panicking reactions, with one item focused on threats towards competence (e.g., *Thinking that nobody can help me*), two towards relatedness (e.g., *Panicking*), and two towards autonomy (e.g., *Thinking that things will never get better*). Aversion regards the opposition to those rules and constraints developed by authorities to protect physical health, with five items focused on autonomy-related threats (e.g., *Ignoring the regulations from the Ministry of Health*). Adjustment concerns the positive and constructive ways that people use to face stressful situations, with one item focused on challenges towards relatedness (e.g., *Collaborating with others*) and four items towards autonomy (e.g., *Creating new routines if usual ones cannot be followed*). Proactivity refers to the efforts for finding solutions to problems, with five items focused on competence-related challenges (e.g., *Looking for information from reliable sources*). For each dimension, we transformed the scores into a Rasch-logit interval scale (ranging from 1 to 10), in line with the original scale (Burro et al., 2021).

4.3. Data analysis

We analyzed the data with the R software, version 4.2.2 (R Core Team, 2022), given its characteristics such as versatility, effectiveness of data visualization, community support, reproducibility, integration with other tools, and open-source characteristics (Kuhn and Johnson, 2019; Baumer et al., 2020; Peng and Matsui, 2021). We ran two Linear Mixed Models (LMM, using primarily lme4 R-package, version 1.1.31, Bates et al., 2015) and a Path Analysis (PA, using primarily lavaan R-package, version 0.6–13, Rosseel, 2012; Oberski, 2014; for applications see Raccanello et al., 2022a).

Preliminarily, we examined the descriptive statistics of all the variables that we assessed (see Table 2 for descriptive statistics and intercorrelations). We consider correlations between 0.10 and 0.30 as small, between 0.30 and 0.50 as moderate, and higher than 0.50 as large (Cohen, 1988; Baguley, 2009; Hayes, 2020). Then, we investigated whether the five factors of the BFI-2-XS differed among them through a first LMM, with participants as the random effect and factors of the scale as the categorical fixed effect; the scores of each factor were the dependent variables. We ran another LMM to study possible differences between the dimensions of the R-PCS, with participants as the random effect and dimensions of the R-PCS as the categorical fixed effect; the scores of each dimension of the R-PCS were the dependent variables. For each LMM, we performed a type III analysis of variance table with Satterthwaite's method (Baguley, 2012; Andreasen and McDonald, 2021). We used the Bonferroni correction for post-hoc tests (using primarily emmeans R-package, version 1.8.3, Lenth, 2022). The level of significance was $p < 0.05$. Finally, we conducted a PA (Hoyle, 2012; Schumacker and Lomax, 2016) in order to examine the relations between the variables based on the theoretical assumptions derived by the literature. PA can be used to test the validity of a model and to estimate the strength of the relations between the variables. Path modeling is currently a standard approach for

representing and studying direct and indirect effects of one or more independent variables on one or more dependent variables in the social sciences (Cook and Forzani, 2020). In our case, we tested a model in which the five factors of the BFI-2-XS related to the four dimensions of the R-PCS. We utilized the SEM function in the lavaan package, with the Maximum Likelihood with Robust Huber-White standard errors and scaled test statistic (MLR). For running a PA, the minimum ratio between number of observations and number of parameters should be 5:1 or more, and preferably 10:1 (Kline, 2016). In our case the ratio was 100:1, and therefore the sample size was adequate.

5. Results

5.1. Preliminary analyses

The descriptive statistics and the intercorrelations concerning the five factors of the BFI-2-XS and the four dimensions of the R-PCS are shown in Table 2. Examining the intercorrelations between the Big Five factors, we found that both Extraversion and Agreeableness had small positive correlations with Conscientiousness and Open-Mindedness, respectively. Moreover, Conscientiousness was linked to Open-Mindedness through a small positive correlation and to Negative Emotionality through a moderate negative correlation. Concerning the R-PCS, we found positive correlations, respectively, between the two maladaptive (i.e., Despair and Aversion) and the two adaptive (i.e., Adjustment and Proactivity) dimensions—the first small and the second moderate. In addition, all the correlations between a maladaptive and an adaptive dimension were small and negative, except the one between Aversion and Proactivity, which was moderate and negative.

5.2. Linear mixed models (Aim 1)

The first LMM revealed a significant effect of the Big Five factors, $F(4, 11{,}980) = 868.21$, $p < 0.001$, $\eta^2_p = 0.22$ (Figure 1A). The post-hoc tests indicated that the scores were higher for Conscientiousness ($M = 3.73$, $SD = 0.71$, 95% CI [3.71, 3.76]) compared to Open-Mindedness ($M = 3.57$, $SD = 0.74$, 95% CI [3.55, 3.60]; $t = 8.99$, $p < 0.001$), higher than Agreeableness $M = 3.50$, $SD = 0.69$, 95% CI [3.48, 3.53]; $t = 12.92$, $p < 0.001$). In turn, Agreeableness was higher than Extraversion ($M = 2.95$, $SD = 0.57$, 95% CI [2.92, 2.97]; $t = 30.62$, $p < 0.001$ and Negative Emotionality $M = 2.92$, $SD = 0.85$, 95% CI [2.89, 2.95]; $t = 32.25$, $p < 0.001$), which did not differ among them.

The second LMM indicated a significant effect of the R-PCS dimensions, $F(3, 11{,}980) = 7878.70$, $p < 0.001$, $\eta^2_p = 0.66$ (Figure 1B). The post-hoc tests revealed higher scores for Proactivity ($M = 6.84$, $SD = 1.47$, 95% CI [6.79, 6.89]) compared to Adjustment ($M = 6.47$, $SD = 1.38$, 95% CI [6.42, 6.51]; $t = 11.10$, $p < 0.001$), higher versus Despair ($M = 3.13$, $SD = 1.17$, 95% CI [3.09, 3.17]; $t = 98.36$, $p < 0.001$), in turn higher than Aversion ($M = 2.83$, $SD = 1.20$, 95% CI [2.79, 2.88]; $t = 8.70$, $p < 0.001$).

5.3. Path analysis (Aim 2)

The results of the PA are represented in Figure 2. Here we obtained a just-identified model, i.e., a model in which the degrees of freedom were tantamount to zero, resulting in a single,

TABLE 2 Intercorrelations and descriptive statistics (means, *M*; standard deviations, *SD*; 95% confidence intervals, CI) for the five factors of the BFI-2-XS and the four dimensions of the R-PCS.

Variable	1	2	3	4	5	6	7	8	9
1. BFI-2-XS—extraversion	-								
2. BFI-2-XS—agreeableness	−0.05**	-							
3. BFI-2-XS—conscientiousness	0.26***	0.16***	-						
4. BFI-2-XS—negative emotionality	0.06**	−0.06***	−0.27***	-					
5. BFI-2-XS—open-mindedness	0.19***	0.20***	0.11***	−0.02	-				
6. R-PCS—despair	0.14***	−0.07***	−0.11***	0.45***	−0.08***	-			
7. R-PCS—aversion	−0.01	−0.14***	−0.13***	0.02	−0.10***	0.11***	-		
8. R-PCS—proactivity	0.15***	0.18***	0.25***	−0.11***	0.23***	−0.15***	−0.31***	-	
9. R-PCS—adjustment	0.17***	0.24***	0.25***	−0.16***	0.30***	−0.22***	−0.19***	0.45***	-
M	2.95	3.50	3.73	2.92	3.57	3.13	2.84	6.84	6.47
SD	0.57	0.69	0.71	0.85	0.74	1.17	1.20	1.47	1.20
95% CI	[2.92, 2.97]	[3.48, 3.53]	[3.71, 3.76]	[2.89, 2.95]	[3.55, 3.60]	[3.09, 3.17]	[2.79, 2.88]	[6.79, 6.89]	[6.42, 6.51]

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

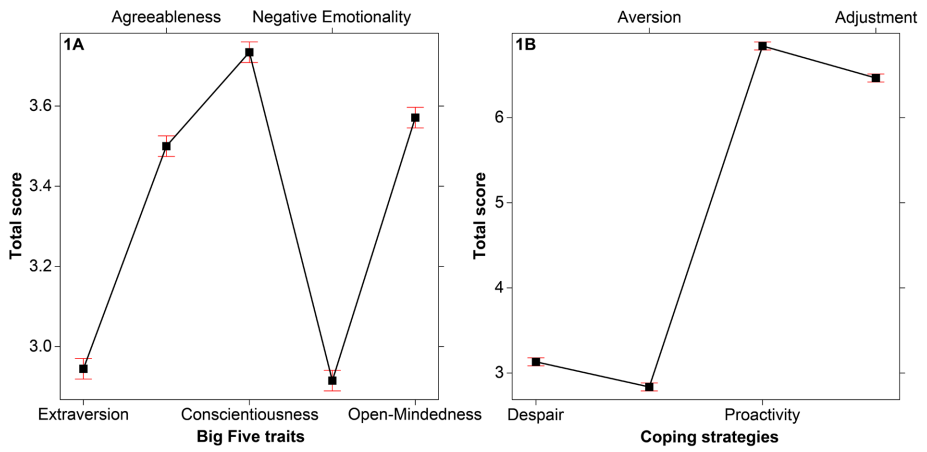

FIGURE 1
Total scores of **(A)** the five factors of the BFI-2-XS, and of **(B)** the four dimensions of the R-PCS. The bars represent the 95% CI.

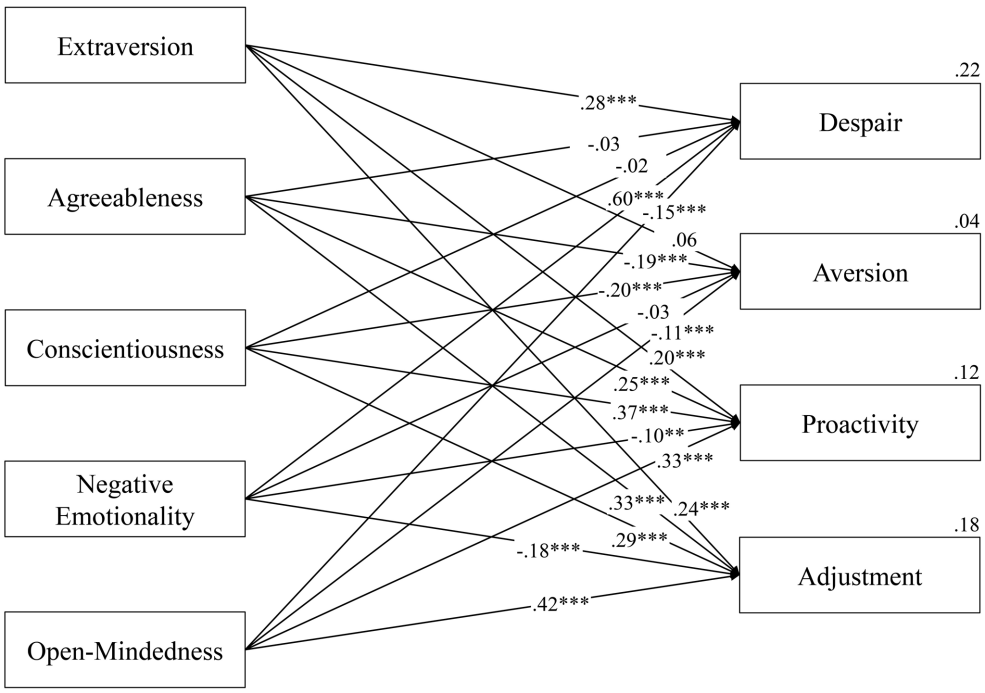

FIGURE 2
Path analysis for the relations between the five factors of the BFI-2-XS and the four dimensions of the R-PCS. The digits represent standardized factor loadings. We reported explained variances next to each dependent variable. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

unique solution where the model accurately reproduces the data. Therefore, indices such as the Comparative Fit Index (CFI—compares the fit of the data to the hypothesized model), the Tucker-Lewis Index (TLI—compares the fit of the hypothesized model to a null model), the Goodness of Fit Index (GFI—measures the compatibility of the observed covariance matrix with the hypothesized model), and the Adjusted Goodness of Fit Index (AGFI—corrected version of GFI that accounts for the number of indicators per latent variable) were all found to be equal to 1.000; additionally, the Root-Mean-Square Error of Approximation (RMSEA) and the Standardized Root Mean Residual (SRMR), which evaluate the difference between the hypothesized model and a perfect model, and the discrepancy between the sample covariance matrix and the model covariance matrix, respectively, were also found to be equal to 0.000 (Hu and Bentler, 1999; Marsh et al., 2004; Kline, 2016; Cook and Forzani, 2020).

Despair was significatively and positively linked with Extraversion, $\beta = 0.283$, $p < 0.001$, and with Negative Emotionality, $\beta = 0.600$, $p < 0.001$. It was also significatively and negatively related to

Open-Mindedness, $\beta = -0.148$, $p < 0.001$. For these three traits, our data fully supported Hypothesis 1. The links between Despair and, respectively, Agreeableness, $\beta = -0.030$, $p = 0.299$, and Conscientiousness, $\beta = -0.022$, $p = 0.455$, were not significant, but the negative direction was the one expected on the basis of Hypothesis 1. For Despair, the five traits explained on the whole the 22% of variance.

Aversion had significant negative links with Agreeableness, $\beta = -0.194$, $p < 0.001$, Conscientiousness, $\beta = -0.200$, $p < 0.001$, and Open-Mindedness, $\beta = -0.108$, $p < 0.001$, in line with Hypothesis 2. The relations with Extraversion, $\beta = 0.057$, $p = 0.162$, and Negative Emotionality, $\beta = -0.027$, $p = 0.315$, were not significant, but they were however in the expected direction. For this coping dimension the explained variance was 4%.

Proactivity was significantly related to each of the five traits, positively to Extraversion, $\beta = 0.197$, $p < 0.001$, Agreeableness, $\beta = 0.247$, $p < 0.001$, Conscientiousness, $\beta = 0.367$, $p < 0.001$, and Open-Mindedness, $\beta = 0.332$, $p < 0.001$, and negatively to Negative Emotionality, $\beta = -0.100$, $p = 0.001$. Explained variance was 12%. These findings confirmed Hypothesis 3.

Similarly, Adjustment was significantly linked with all the traits, positively with Extraversion, $\beta = 0.238$, $p < 0.001$, Agreeableness, $\beta = 0.334$, $p < 0.001$, Conscientiousness, $\beta = 0.288$, $p < 0.001$, and Open-Mindedness, $\beta = 0.418$, $p < 0.001$, and negatively with Negative Emotionality, $\beta = -0.180$, $p < 0.001$. Explained variance was 18%. Our results supported Hypothesis 4.

6. Discussion

Our first analyses enabled us to describe how our sample is characterized in terms of personality and COVID-19-related coping (Aim 1). The Italian university students involved in the study had higher scores in Conscientiousness, followed by Open-Mindedness, and then Agreeableness. These three traits were, in turn, higher than Extraversion and Negative Emotionality. Concerning coping strategies, they reacted more frequently using adaptive reactions (with Proactivity used more frequently than Adjustment) rather than maladaptive reactions (with Despair higher than Aversion).

Focusing on the relation between personality and coping (Aim 2), our findings revealed that Negative Emotionality can be considered as a risk factor, and that Agreeableness, Conscientiousness, and Open-Mindedness can be thought as protective factors. More interestingly, we also found that Extraversion can entail both a risk and a protective role for Italian university students after the outbreak of the COVID-19 pandemic.

On the one hand, our analysis showed that students' Negative Emotionality was significantly and positively related with Despair, a pattern of coping strategies focused on helplessness and negative emotional reactions, spanning from panicking to the complete absence of hope. This result confirms a very high number of previous findings documenting that neurotic people are prone to distress and psychopathology, both in a variety of situations (Bogg and Roberts, 2013; Friedman and Kern, 2014; Strickhouser et al., 2017; Anglim et al., 2020) and also during the COVID-19 pandemic (Qian and Yahara, 2020; Kocjan et al., 2021; Kohút et al., 2021; Nikčević et al., 2021; Schmiedeberg and Thönnissen, 2021). This is also in line with COVID-19 data about stress and wellbeing of secondary school and university students (Staller et al., 2021; Iterbeke and De Witte, 2022; Quigley et al., 2022; Wang et al., 2022; Zolotareva et al., 2022). Moreover, the relation between students' Negative Emotionality and Despair was very strong and it was higher compared to the relation with the other four traits, again supporting previous COVID-19-related findings (Kocjan et al., 2021; Bacon et al., 2022). Concerning Aversion, the link with Negative Emotionality was negative but not significant. The negative direction is in line with the hypothesis that neurotic people are particularly compliant with rules, based on previous COVID-19 research about adults (Chan et al., 2020; Fink et al., 2021; Peters et al., 2023). However, prior findings reported no significant or positive relations (Bogg and Milad, 2020; Kohút et al., 2021). Nevertheless, most of these studies focused on specific types of safety behaviors, such as social distancing, disinfecting, reducing mobility, etc. The absence of a significant relation in our data could be explained by the fact that the Aversion dimension lacked this specificity, rather focusing on oppositive behaviors towards any kind of protective measures proposed by the authorities. Concerning the two adaptive coping dimensions, Negative Emotionality was significantly and negatively linked with both of them. Even if neurotic people had demonstrated an active search for information during the pandemic (Kohút et al., 2021), their typical tendency to use maladaptive coping and low assertiveness (Costa and McCrae, 2006; Balzarotti et al., 2010;Bagherian and Mojambari, 2016; Sims, 2017) probably prevented students from adapting successfully during the outbreak of the pandemic. Therefore, our data confirmed that Negative Emotionality is a risk factor for Italian university students in the impact phase of a disaster such as the current pandemic, as it had been amply demonstrated previously for a variety of situations.

On the other hand, Agreeableness, Conscientiousness, and Open-Mindedness clearly revealed their protective role. In our database, they were generally significantly related with each of the four factors, negatively with Despair and Aversion (albeit with some exceptions, in which the direction of the links was in line with our hypotheses but the relations were not significant) and positively with Proactivity and Adjustment. Again, this is in line with both pre-pandemic literature and the COVID-19 studies. Concerning Despair, the negative links suggested an overall lower distress for agreeable, conscientious, and open-minded students. Even if the COVID-19 findings are not always consistent, they had suggested that these three traits were characterized by a good positive functioning in terms of wellbeing and mental health (Kocjan et al., 2021; Nikčević et al., 2021), and this had been in part documented also with secondary and university students (Audet et al., 2021; Staller et al., 2021; Iterbeke and De Witte, 2022; Wang et al., 2022; Zolotareva et al., 2022), confirming pre-pandemic data (Anglim et al., 2020). If we focus on Aversion, the tendency to care for others (Habashi et al., 2016; Sims, 2017), to respect rules (Barrick and Mount, 1991; Roberts et al., 2005), and to adapt smoothly to new situations (Schmutte and Ryff, 1997; LePine et al., 2000; McAdams, 2015) of people high in each of the three traits, respectively, could help explaining their low opposition towards protective measures. The same characteristics, together with the tendencies to be assertive (Bagherian and Mojambari, 2016; Sims, 2017) and to use reappraisal (Kohút et al., 2021), can justify the positive links between the three traits and the two adaptive coping dimensions.

Finally, our analysis showed that Extraversion can be both a risk and a protective factor in the impact phase of a disaster. Research had generally supported the potentialities of extraverted people as being characterized by subjective wellbeing (Li et al., 2015; Anglim et al., 2020), with this trait being protective for both wellbeing and mental health indicators also during the pandemic (Kocjan et al., 2021; Nikčević et al., 2021). However, for our sample of Italian university students there was a significant and positive relation between Extraversion and Despair, in line with some research involving adults during the COVID-19 pandemic (Kocjan et al., 2021; Kohút et al., 2021; Schmiedeberg and Thönnissen, 2021) and also university students (Anglim and Horwood, 2021; Wang et al., 2022; Weiß et al., 2022). Interestingly, similar findings did not emerge in a study with university students involved during the spring of 2021, for which there were positive relations between Extraversion and stress management (Zolotareva et al., 2022). Our result concerning Extraversion gives particular support to the relevance of the concepts of goodness-of-fit and person–situation interaction (Goldberg, 1993; Faulkner et al., 2004) when evaluating the advantages and disadvantages of people's dispositions. In other terms, individuals' characteristics are associated with a positive psychological functioning and adaptation whether they are matched in certain ways with specific characteristics of the situations. An ongoing question in personality research is the extent to which the positive or negative feelings of wellbeing experienced by extraverts are primarily determined by the person's own psychological constitution, or by the external interactions they have with other people (Audet et al., 2021). The COVID-19 pandemic had an undoubtedly devastating impact on human communities across the world. Nevertheless, it did provide a natural laboratory for exploring this question about personality. In many parts of the world (Acaps, n.d.), lockdown conditions imposed by governments meant that face-to-face interactions between people were at the very least, seriously limited. Our results seem to reveal that, for the specific group of university students for which most of the usual face-to-face social interactions were suddenly and abruptly denied, deprivation of social contact had the worst effects for extraverted people, tipping the balance of such debate towards the importance of interindividual processes. Their subjective wellbeing was thus proved to be highly dependent from external factors (Goryńska et al., 2015), in line with their reluctance to follow recommendations (Fink et al., 2021; Krupić et al., 2021; Peters et al., 2023), especially when concerning social distance from others (Bacon et al., 2022). The positive (even if not significant) link between Extraversion and Aversion, indeed, supported their difficulties in complying with the rules imposed by the authorities to reduce the spreading of the virus. We could speculate that the non-significance of this link could be due, again, to the non-specific characterization of Aversion: in other terms, it is probable that we would have found a significant relation if such dimension had only referred to social distancing. As for the relation between Extraversion and the two adaptive coping dimensions, the data fully confirmed previous literature, showing that extravert students reacted also in adaptive ways, through active problem solving, looking for information and adjusting positively to the challenges of the situation, capitalizing on key strengths such as their assertiveness (Balzarotti et al., 2010) or reappraisal use (Bagherian and Mojambari, 2016; Sims, 2017).

Referring again to the frequency with which our sample was characterized by the Big Five traits and the different coping strategies documented examining our first aim, we could speculate that, overall, the pattern which emerges seems to be adaptive. Beyond endorsing more frequently adaptive rather than maladaptive strategies, our university students were also characterized by higher scores for those personality traits which confirmed their protective role, i.e., Agreeableness, Conscientiousness, and Open-Mindedness.

6.1. Limitations and future directions

The current study has a number of limitations. First, our sample was characterized by gender imbalance and included students from one country, i.e., Italy. Researchers should try to examine cross-cultural data (e.g., Raccanello et al., 2022a) to support the generalizability of their findings. Second, we used self-report instruments, limited by constraints related to social desirability or memory biases. However, they are still the best ways to access inner states and their use was one of the few available ways to conduct research during the lockdown periods. Third, the scale utilized to assess the Big Five traits was only 15 items long, and this could have impacted its reliability (Soto and John, 2017). However, this measure enabled to minimize the assessment time, an essential feature for a large-scale survey with a within-subject design, and this limitation is common to most of the studies conducted during the COVID-19 pandemic. Future studies could generalize our findings using longer instruments. Fourth, we assessed also the specific facet traits within each of the broader Big Five domains, but given the short nature of the instrument we could not study them. Further research analyzing different facets could help to better disentangle some ambiguous findings highlighted in the literature about the relation between the Big Five traits and coping during the pandemic. Fifth, we did not examine how trait profiles were associated with coping, which could be considered in future research to better describe risk and protective factors. For example, extraverted people who are particularly conscientious could have suffered more compared to those with lower Conscientiousness, given their strong sense of responsibility soliciting them to respect rules, including those about social distancing. Sixth, we utilized a cross-sectional design, which is correlational in nature. Nevertheless, the on-course analysis of the data that we gathered longitudinally could help to draw causal conclusions about the relations between the examined variables. Seventh, we measured personality traits using one specific model, assessing the Big Five factors; future research could investigate the role of personality traits also using other models, such as the HEXACO model, in the subsequent phases of the pandemic, or in relation to other disasters.

6.2. Conclusion

Our findings shed light on the role of the Big Five traits towards Italian university students' coping at the outbreak of the COVID-19 pandemic. We found support for the risk role of Negative

Emotionality and the protective role of Agreeableness, Conscientiousness, and Open-Mindedness. However, in line with the person-situation perspective, this study revealed that Extraversion had both a risk and a protective role.

Knowledge on the nature of the association between personality traits and maladaptive or adaptive reactions when facing a completely unexpected traumatic event can be at the basis of the development of disaster preparedness and prevention actions (United Nations Office for Disaster Risk Reduction, UNDRR, n.d.). Supporting students to increase their awareness about which reactions are more probably associated with their personality, could be a way to improve their capacity to be better equipped to contrast the endorsement of maladaptive ones. In other terms, it could help to improve their resilience towards current or future disasters.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Ethical Committee of the Department of Human Sciences of the University of Verona (protocol n. 118846/2020). The patients/participants provided their written informed consent to participate in this study.

Author contributions

RB, DR, and GV contributed to conception and design of the study and organized the database. RB performed the statistical analysis. RB and DR wrote the first draft of the manuscript. GV wrote sections of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Nomophobia and smartphone addiction amidst COVID-19 home confinement: the parallel mediating role of digital gaming and social media tools usage across secondary school students

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Introduction: With the inevitable technological boom enforced by the COVID-19 lockdowns and online emergency remote teaching practices, the prevalence of nomophobia (NMP) and smartphone addiction (SA) among adolescents has become a pressing issue, which has come under scrutiny. However, the impact of social media tools usage (SMTU) and digital gaming behavior (DGB) on these phenomena remains unclear since there is little research focusing on the complex interplay among these variables. Regarding this context, the present study aimed to explore the parallel mediating role of secondary school students' SMTU and DGB in the relation between NMP and SA.

Methods: In line with this aim, we employed a cross-sectional design with a critical case sampling strategy and collected data through an online survey from a total of 427 secondary school students in Istanbul in the 2021-2022 academic year. In order to test the parallel mediation model, we employed multiple linear regression models by utilizing PROCESS models with 5000 BC bootstrap samples and 95% CI.

Results and discussion: Results illustrated that there was an increase in the prevalence of NMP and SA during the COVID-19 home confinement as consistent with the previous research. The results also indicated that among the multiple mediators, the mediating role of SMTU was significant in the relation between NMP and SA. This means NMP has direct and indirect significant impact on SA through SMTU. However, the mediating role of DGB was found nonsignificant in this relationship. Our results are robust and hold key contributions to both theoria and praxis in educational psychology research realm by disentangling the complex underlying mechanism between NMP, SMTU, DGB, and SA. On the practical side, our results provide insightful implications for school boards and researchers in the development of effective interventions.

KEYWORDS

digital gaming behavior, nomophobia, secondary school students, smartphone addiction, social media tools usage

1. Introduction

Digital technologies have become an integral part of the modern life, characterized by rapid technological advancements. Children, particularly school-age students, are susceptible to adopting new technologies into their daily lives (Männikkö et al., 2018). In conjunction with the technological boom, the COVID-19 pandemic has profoundly impacted global populations, resulting in home confinement and restricted activities to curb the virus's spread (Nilsson et al., 2022). Thus, the pandemic has substantially altered human behavior patterns worldwide with individuals compelled to remain at home. This has led to an upsurge in excessive technology use including overuse of smartphones and the internet along with increased digital gaming behavior (DGB) and social media tools usage (SMTU). Additionally, social isolation, financial difficulties, substance use, and poor mental health conditions such as depression, anxiety, and stress have contributed to this trend (Masaeli and Farhadi, 2021). Despite its suitability as an indoor activity, the increased use of technology has potential drawbacks. Excessive gaming and SMTU are some of these drawbacks. In particular with the pandemic period, excessive technology use has caused behavioral disorders and technological addiction including addictive SMTU and DGB. Previous research illustrated that a set of behavioral symptoms or disorders that are linked to the overuse of technology and the isolation caused by the pandemic comprise of social isolation, anxiety, depression, and insomnia (Huang and Zhao, 2020; Qiu et al., 2020). In a similar vein, the pandemic has limited adolescent socialization opportunities, leading to a considerable increase in SMTU, which may exacerbate addictive tendencies and negatively impact the well-being of adolescents (Marengo et al., 2022).

Over the past two decades, the proliferation of smartphones has made them the most important social media and digital gaming tool, particularly among adolescents. However, this has increased young people's susceptibility, leading to the emergence of nomophobia (NMP), or No Mobile Phone Phobia. NMP is a prevalent problem among younger generations and has become increasingly common more recently (Anshari et al., 2019). The concept of NMP can be explained by four basic components, such as *unable to communicate*, *lose connectedness*, *unable to access information* and *give up convenience* (Yildirim and Correia, 2015). Although smartphones provide convenience to students and teachers in the education process and offer the opportunity to access mobile learning, information resources, and educational materials promptly and on demand, they have potential downsides such as NMP (Almunawar et al., 2015). With an endeavor to address this problem, previous research aimed to explain the associations between NMP and SA (Tavolacci et al., 2015; Anshari et al., 2019; Durak, 2019; Semerci, 2019), NMP and social media addiction (Lin et al., 2021), SA and social media addiction (Marengo et al., 2022), DGB and SMTU (Paschke et al., 2021; Nilsson et al., 2022).

In regard to pandemic conditions, home confinement and the curfews implemented during the COVID-19 pandemic and the resulting online participation of students in their classes have exacerbated students' smartphone addiction (Serra et al., 2021; Marengo et al., 2022). In a similar vein, during lockdowns, smartphones, which became a source of entertainment and pastime apart from educational purposes. Likewise, this has contributed to an increase in students' NMP (Shahzad et al., 2021). Previous research findings illustrated that even before the pandemic, one out of every three students have a problem with NMP (Tavolacci et al., 2015). Research focusing on the pandemic period also acknowledged that the COVID-19 pandemic prevented students' social interactions, thus led to increased addictive use of smartphones (Pasquale et al., 2021; Serra et al., 2021), gaming behavior (Balhara et al., 2020), excessive internet use (Iyer and Sharma, 2020; Pasquale et al., 2021). Regarding the pandemic context, few studies focused on the SMTU profiles of adolescents during the pandemic (Muzi et al., 2021; Brailovskaia and Margraf, 2022; Marengo et al., 2022). Although all these studies have provided some significant contributions into a clear understanding of ABCs (Antecedents, Behaviors and Consequences) of addictive use of smartphones before and during the COVID-19 period, still there is a need for further studies to explore the complex interplay between NMP, SMTU, DGB, and SA since there are conflicting results. For example, previous research studies have asserted that playing digital games can offer potential advantages, including cognitive, emotional, and social benefits (Granic et al., 2014) and alleviation of isolation feeling (Carras et al., 2017). Furthermore, during the COVID-19 pandemic, digital gaming was found to be a helpful tool for managing stress and mitigating the negative effects of public health measures like lockdowns, quarantines, and social distancing (Balhara et al., 2020). Additionally, in some cases, playing digital games may function as a coping mechanism for addressing personal shortcomings or difficulties such as a lack of social support, relationship issues, or dissatisfaction with one's appearance (Griffiths and Beranuy, 2009).

In view of these conflicting results existing in the literature, there is a need for exploration of the complex interplay between adolescents' NMP and SA, SMTU and DGB as well as the underlying mechanism in this relation. Given this context, the present study aimed to investigate the mediating role of secondary school students' SMTU and DGB in the relationship between NMP and SA. The study employed a cross-sectional design with a critical case sampling strategy and collected data through an online survey of 427 students in a secondary school in Istanbul during the 2021–2022 academic year. In order to test the parallel mediation model, multiple linear regression models with PROCESS macro using 5,000 bias-corrected bootstrap samples and 95% confidence intervals were used. The study's findings present some invaluable implications for a better understanding of the role of SMTU and DGB in the relation between NMP and SA across secondary school students. More specifically, the present study holds key contributions to the existing literature in some respects. First, it discloses the complex interplay between the concepts of SMTU, DGB, NMP and SA. Additionally, it enables an increase in public awareness on digital media and the pandemic which have brought about behavioral disorders and technological addiction on secondary school students. The study adds to a better understanding of the mediating role of SMTU and DGB in the relation between NMP and SA. This study further highlights psychological implications of SMTU and DGB on psychosocial well-being and mental health. It also provides sociological implications of growing public concern about addictive SMTU and DGB. Additionally, the present study also provides some empirical originality regarding the critical case sampling since it is particularly useful in explaining phenomena of interest and it may provide unique insights into the relationship between NMP, SMTU, DGB, and SA among adolescents. Thus, we hypothesized a parallel multiple mediator model assuming that NMP impacts SA both directly and indirectly through SMTU and

DGB across secondary school students in a context of COVID-19 home confinement.

2. Theoretical background and hypotheses

2.1. Self-regulation theory

Social Cognitive Theory (SCT) provides an underpinning framework for Self-Regulation Theory (SRT). According to SCT individuals' behavior is shaped by their cognitive processes, as well as the social and environmental contexts in which they live. SCT describes how individuals can use their cognitive processes to control their behavior and attain their lifelong goals (Bandura, 1986). SRT was adopted as a theoretical foundation in the present study. SRT is a psychological theory that explains how individuals actively manage their cognitive, emotional, and behavioral resources to achieve their goals in different situations. SRT proposes that individuals can self-regulate their behavior and emotions through a series of cognitive and emotional processes. The underpinning idea lies behind SRT is that human beings are self-regulating organism who can actively adapt to their environment and set themselves goals and strategies to achieve those goals (Bandura, 1986). The control theory approach to self-regulation explains how goal-directed behavior is self-regulated that enable individuals to balance their own behavior. Self-regulation is a dynamic process that involves ongoing monitoring of one's thoughts, emotions, and behavior to attain desired outcomes (Carver and Scheier, 2011). Social cognitive perspective on self-regulation emphasizes the importance of metacognitive processes, such as goal setting, planning, and self-reflection. This perspective views self-regulation as a cyclical process that involves setting goals, monitoring progress, and adjusting strategies as needed to achieve desired outcomes. Self-monitoring, which involves observing one's own behavior, thoughts, and emotions, is one of the key components of SRT. Through self-monitoring, individuals can identify when their behavior or thoughts are not aligned with their goals and make necessary adjustments. SRT emphasizes the significance of self-efficacy, which refers to one's confidence in their ability to achieve objectives and complete tasks successfully. People with high levels of self-efficacy are more likely to take goal-oriented actions and persist through obstacles and setbacks (Bandura, 1986).

SRT refers to the process of translating personal goals into action, which involves planning and adapting one's thoughts, feelings, and behaviors to achieve desired outcomes (Kitsantas et al., 2000; Carver and Scheier, 2011). SRT can result in the potential benefit of avoiding distractions (Kopetz et al., 2013). Additionally, previous research indicated that SRT has been used as foundation in effective management of addictive behaviors such as internet addiction (Dawe et al., 2004), SA (Van Deursen et al., 2015), and addictive SMTU (Kitsantas et al., 2000). On the other hand, Jeong et al. (2016) asserted that a lack of self-regulation increases the risk of addictive SMTU and SA. Furthermore, depleted self-regulation capacity can have detrimental effects on healthy coping mechanisms, thereby increasing the likelihood of addictive smartphone and SMTU (Dijkhuis et al., 2017). To develop self-regulating skills, individuals need to manage competing demands for resources and time as well as aiming to achieve expected and planned outcomes while avoiding addictive SMTU (Neal et al., 2017). Individuals who lack self-regulating skills are thus more susceptible to addictive SMTU and SA. Overall, there is an established body of literature that explores the associations between these factors (Kuss and Griffiths, 2012; Kuss et al., 2014; Andreassen, 2015; Yildirim and Correia, 2015; Masaeli and Farhadi, 2021; Paschke et al., 2021; Pasquale et al., 2021; Marengo et al., 2022; Nilsson et al., 2022).

2.2. The associations between nomophobia and smartphone addiction, nomophobia and social media tools usage, nomophobia and digital gaming behavior

NMP is the anxiety and fear experienced by individuals when they are separated from or unable to use their mobile devices. It is increasingly prevalent as individuals get more reliant on their smartphones for social media and digital gaming. It is a real phenomenon which significantly impairs mental health and well-being causing symptoms of anxiety and depression (King et al., 2013). NMP has been explained as a problem derived from the inappropriate use of smartphone such as SMTU and DGB, which can be detrimental for the well-being of the user when used abusively and excessively (Viner et al., 2020). Smartphones can be considered as widely used and rapidly adopted tools throughout the evolution of ICTs and adolescents are the early adopters of them (Serra et al., 2021). In fact, the most important social media and digital gaming tool is the smartphone which makes adolescents susceptible to addictive behavior (Pasquale et al., 2021; Serra et al., 2021; Marengo et al., 2022). As a result of this vulnerability, one of the prevalent problems that adolescents face is NMP, which has emerged especially amongst the younger generation and has become increasingly common in recent years (Yildirim and Correia, 2015).

Social media tools have increasingly gained popularity amongst adolescents. Adolescents perceive social media as safe places to express themselves freely (Shah et al., 2019). Excessive use of social media can result in negative outcomes, including reduced self-esteem, social isolation, social anxiety, and NMP (Bergagna and Tartaglia, 2018). The widespread problematic SMTU among adolescents, which has increased during the pandemic, has been found to be positively associated with anxiety and negatively associated with self-esteem. In addition, excessive social media use by adolescents has been linked to higher levels of social isolation and loneliness (Ciacchini et al., 2023). Likewise, DGB is the habits and actions individuals display when playing games in a virtual environment. DGB can be explained as the state of deep engagement (Jennett et al., 2008). Thus, some individuals may become addicted to gaming, leading to negative consequences in their lives. These consequences can be attributed to excessive DGB, preoccupation with gaming, and withdrawal symptoms when unable to play (Griffiths, 2010). Excessive DGB during COVID-19 might cause psychological problems such as loneliness and depression (Sundaray and Galimotu, 2020). Previous research has identified depression, anxiety, social phobias, and poorer school performance as potential outcomes of pathological gaming (Gentile et al., 2011), indicating the need for further research.

The use of smartphones, while providing certain benefits, also brings about a number of associated problems. One such problem is the phenomenon of NMP, which can be defined as the fear of being

without mobile phone contact. Research illustrates that excessive use of smartphones for SMTU and DGB has been linked to the development of NMP (Sandeep, 2018). The widespread usage of smartphones among adolescents for the purposes of social media and digital gaming renders them susceptible to experiencing NMP (Lee, 2014). The manifestation of social, physiological, and physical symptoms can be attributed to the addiction to smartphones (Anshari et al., 2019). Although smartphones provide adolescents with constant connectivity to the outside world and offer a limitless platform for digital gaming and social media, this reliance may result in the development of addictive tendencies. Of these tendencies, the most significant one is the display of NMP and SA (Durak, 2019; Semerci, 2019).

Given this context, previous research has attempted to explain the association between SA and NMP (Anshari et al., 2019; Durak, 2019; Semerci, 2019). In addition to this reliance, adolescents are at risk of developing NMP, due to addictive behaviors related to SMTU and DGB (Lin et al., 2021). Thus, there is a complex interplay between NMP, SMTU, DGB (Ayar et al., 2018; Ortega-Barón et al., 2021). Based on the previous research, the following research hypotheses were posited:

> *H1.* NMP is positively associated with SA.
>
> *H2.1.* NMP is positively associated with SMTU.
> *H2.2.* NMP is positively associated with DGB.

2.3. The associations between social media tools usage and smartphone addiction, digital gaming behavior and smartphone addiction

Smartphone addiction is characterized by compulsive smartphone use that disrupts individuals' daily activities, such as their schooling and social interactions. Studies have shown that there is a positive correlation between the amount of time spent on smartphone use and the likelihood of developing smartphone addiction (Serra et al., 2021). Research also illustrated that DGB and SA significantly predict SMTU (Savcı and Aysan, 2017). Adolescents are more likely to use technology such as the social media, digital games, internet, and smartphones. These technologies can increase their susceptibility to developing technological addictions (Valkenburg and Peter, 2011). For many adolescents the issues that occur most frequently are SA, SMTU and DGB. They use digital games for the purposes of engaging in enjoyable activities that provide entertainment, pleasure, and mental stimulation. However, excessive usage of them can cause addiction (Yiğit and Günüç, 2020), resulting in digital gaming addiction in most cases. Digital gaming addiction refers to a condition where a person becomes unable to cease playing games for extended periods, linking the game to actual life, impeding the obligations imposed on them as a result of playing games, and prioritizing gaming over other pursuits (Horzum, 2011). Previous research has evidenced that individuals who play digital games may exhibit addictive behaviors (Grüsser et al., 2007; Griffiths, 2010; Kuss and Griffiths, 2012). Digital gaming has been found to have a significant impact on individuals in various ways. Studies have revealed that digital gaming is associated with reduced self-confidence (Jeong and Kim, 2011), increased anxiety (Caplan, 2007; Wei et al., 2012). Furthermore, digital gaming has been linked to several dimensions of psychophysical health, including sleep, fatigue, and concentration problems. Moreover, it has been associated with a higher likelihood of experiencing depression (Männikkö et al., 2018). These negative effects underscore the need for a balanced and moderate approach to digital gaming and the importance of promoting physical activity, social interaction, and other healthy behaviors.

Although DGB and SMTU differ in many aspects, the World Health Organization labels them as examples of excessive screen time (World Health Organization, 2019). Recently, there has been a growing scientific focus on examining how various types of screen activities, including DGB or SMTU, may impact health outcomes, school performance, physical activity, and social relationships (Reed et al., 2019). The impact of DGB on SA still remains unclear since there is little research. However, research illustrated that the lockdowns during the COVID-19 pandemic have led to an increase in problematic DGB (Balhara et al., 2020) and screen time use (Fernandes et al., 2020). These factors might have a contributing role in adolescents' development of SA. Thus, in the light of above arguments, the following hypotheses were set:

> *H3.1.* SMTU is positively associated with SA.
> *H3.2.* DGB is positively associated with SA.

2.4. The mediating role of social media tools usage and digital gaming behavior on nomophobia and smartphone addiction

Social media has become an essential aspect of adolescents' daily lives. The widespread usage of internet and social media among adolescents in OECD countries has reached on weekdays 2 hours after school while on weekends more than 3 hours per day (OECD, 2017). The increased dependence or addiction to social media platforms has raised concerns among parents, teachers, governments, and young individuals themselves. The excessive SMTU and DGB has been linked to heightened feelings of anxiety and depression, as well as disrupted sleep patterns (OECD, 2017). Given the continuing rapid adoption of digital gaming and SMTU among young people, it is essential to adopt a strategy that mitigates potential risks while still allowing for the substantial opportunities and benefits that these technologies offer (OECD, 2017). Using social media excessively is connected to lower sleep quality and a notable correlation has been observed between playing digital games in the evening and experiencing sleep deprivation (Billari et al., 2018). There is a connection between social media use and body image issues (Fardouly and Vartanian, 2016) as well as the development of disordered eating habits (Holland and Tiggemann, 2016).

Research studies have indicated increased DGB and addictive SMTU have been linked to adverse outcomes and perception of decreased well-being (Nilsson et al., 2022). There is also a connection amongst time spent on digital gaming and SMTU, NMP and negative emotional and psychological symptoms (Brunborg et al., 2014; Carey et al., 2021). Smartphones, which are the most important tools of social media and digital gaming, can cause NMP amongst adolescents (Yildirim and Correia, 2015). Individuals who exhibit high levels of

dependency on their smartphones are likely to experience a greater incidence of NMP (Azadmanesh et al., 2016). Studies have shown that individuals who exhibit high levels of dependency on their smartphones experience intense anxiety when they are separated from their devices or lose them (Volkmer and Lermer, 2019).

Moreover, the phenomenon of NMP results in various symptoms including feelings of isolation or loneliness, depression, social anxiety disorder, obsessive compulsive disorder, and other psychological disorders (Gezgin et al., 2018). A previous research study revealed that social media addiction was linked to poorer mental health and academic performance among students, and this association was mediated by self-esteem (Hou et al., 2019). Another study found that greater severity of depression was associated with increased problematic smartphone use (PSU) and symptoms of internet gaming disorder. Fear of missing out (FoMO) mediated the relationship between depression and PSU, and internet gaming disorder symptoms partially mediated the relationship between FoMO and PSU (Yuan et al., 2021). Similarly, a recent study indicated that peer exclusion, emotional symptoms, and FoMO were positively correlated, and FoMO mediated the association between peer exclusion and emotional symptoms (Marengo et al., 2021). Additionally, another study found that smartphone addiction played a mediating role in the relationship between NMP and aggression (Nuri et al., 2021). A recent research study examined the potential mediating effects of social network use, internet gaming disorder, and pathological internet use on the relationship between loneliness and depression. The results showed that loneliness was a positive predictor of depression. Moreover, the study found that the two mediators, internet gaming disorder and social network are parallel mediators in this relationship (Wang et al., 2021).

Our literature review reveals that most studies testing mediation models have focused on various factors such as internet addiction and psychological maltreatment, social media addiction, mental health, academic performance, FoMO, depression, PSU, SA, and internet gaming disorder (Fazeli et al., 2020; Marengo et al., 2021; Nuri et al., 2021; Wang et al., 2021; Yuan et al., 2021). These results may resonate the parallel mediating role of DGB and SMTU on the relation between NMP and SA. However, we have found an empirical research gap that, to our knowledge, no previous research examines the mediating role of SMTU and DGB on the association between NMP and SA. Thus, the underlying mechanism in this association and the extent to which NMP and SA are mediated by SMTU and DGB remains unclear. This necessitates further inquiry into this research area and highlights the empirical originality of the present study. Therefore, based on the above arguments and previous research gaps, the following hypotheses were proposed to test the parallel mediating role of SMTU and DGB in the relation between NMP and SA:

> *H4.1.* SMTU mediates the relation between NMP and SA.
> *H4.2.* DGB mediates the relation between NMP and SA.

3. Materials and methods

3.1. Research model

The present study employed a cross-sectional design with a multiple mediator approach in order to test parallel multiple mediator role of SMTU and DGB in the relation between NMP and SA during the COVID-19 pandemic lockdowns. The hypothetical conceptual model was presented in Figure 1.

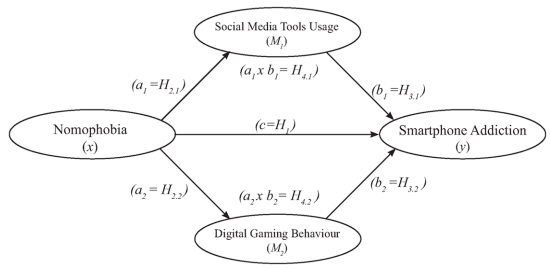

FIGURE 1
A conceptual model to test parallel multiple mediators' impact on NMP and SA.

3.2. Critical case and participants

The present study employed a critical case sampling strategy to determine the study group. Critical case sampling is a purposive sampling technique that is particularly beneficial in exploratory research as well as research with limited resources. It is also useful in situations where a single case or a small number of cases can provide decisive insights into the phenomenon under scrutiny. Thus, in the present study the rationale for employing critical case sampling is that the phenomena under investigation are regarded as in line with "it exists everywhere if it is here; if it is not here, it does not exist anywhere" (Patton, 2002, p. 237). Thus, the case selected in this study is embedded with rich resources, and it was considered that the phenomena under scrutiny exist everywhere if they exist at students in this top-notch secondary school in Istanbul. Therefore, data were collected from 427 secondary school students who attend one of the top three secondary schools in Türkiye, which accepts students with the highest score of 500 and those who are in the 0.01 percentile according to the 2021 Nationwide Central Placement Exam (LGS) results.

The critical case in this study is one of the most prestigious secondary schools in Türkiye. It offers an advanced level of education with tuition-free facilities and boarding possibilities. Its diverse student body is drawn from all around Türkiye. The academic and extracurricular activities provided by the school encourage students to become lifelong learners and develop self-regulating, creative and critical thinking skills that enable them to contribute to society in various areas. The academic program is trilingual (Turkish, German, English) with a university preparatory curriculum, spanning 5 years, including 1 year of German preparatory and 4 years of secondary school. Since 2000, the school has offered the German Abitur diploma, which allows successful students to attend almost any German, Austrian, or Swiss university in almost any major, and is recognized by several member states of the EU. The students in this school have consistently scored some of the highest marks in both the Abitur and Turkish university examinations. The school has been a pioneer in education for over 130 years and is well known in Türkiye for its achievements. In recognition of its excellence, it has been awarded 'The Seal of Academic Excellence' as a German international school

by the German government. Regarding its notable alumni roster, the school has produced a substantial number of distinguished officials, encompassing three former prime ministers as well as a considerable array of ministers and high-level executives, throughout its historical timeline. Thus, the students in this school are expected to have developed increased self-regulating skills which will help them avoid distractions and addictive behaviors such as NMP and SA. However, depleted self-regulation capacity across the students will increase the likelihood of addictive SMTU and DGB, as well as NMP and SA. Therefore, the sample drawn from this case is critical and expected to explain the phenomena under investigation, namely the mediating role of SMTU and DGB in NMP and SA, which can be attributed to a rich source of data. If the phenomena exist in this school, it exists every secondary school, which will raise extensive public concern and require immediate action by policy makers, school boards, parents and researchers.

Prior to data collection, the participants were presented with an online informed consent that provided details on the research objectives, research team, data collection, data processing, and the measures in place to safeguard participant privacy. Additionally, prior to the commencement of the study, a letter of approval was granted by the Ethics Committee Review Board of the affiliated university. Therefore, the study was conducted in accordance with the guidelines outlined in the Declaration of Helsinki. All participants voluntarily completed the surveys, and no incentives were offered to encourage participation.

3.3. Data collection instruments

The data were collected through (I) Personal Information Form, (II) Smartphone Addiction Scale (SAS-SV) developed by Kwon et al. (2013), and (III) Nomophobia Questionnaire (NMP-Q) developed by Yildirim and Correia (2015).

3.3.1. The personal information form

The form was developed by the researchers. It included open-ended questions to gather some demographics such as age, gender, grade level, and some other questions to assess problematic use of social media tools and digital games played by students. The number of social media tools they use and digital games they play was coded and transferred into continuous variables to serve as multiple mediators in the mediation model.

3.3.2. Smartphone Addiction Scale

The SAS-Short Version is a self-report scale comprising of 10 items rated on a 6-point Likert scale. It was developed by Kwon et al. (2013) and adapted to the Turkish context by Noyan et al. (2015). In the adaptation study, the scale was administered to a group of 367 undergraduate students in Türkiye. Consistent with the original scale, the Turkish version also had 10 items loaded in one factor and weighted in 6-point Likert type items with response options ranging from 1 = "*strongly disagree*" to 6 = "*strongly agree*." The internal consistency coefficient of Cronbach's alpha was 0.87, indicating high reliability, and the test–retest reliability coefficient was estimated as 0.93. In this study, the items of the scale yielded a mean score of 2.69 and standard deviation of 1.02, with a high internal consistency coefficient of 0.86.

3.3.3. Nomophobia questionnaire

The NMP-Q was developed by Yildirim and Correia in 2015. The scale consists of 20 items loaded on four dimensions. Each item is rated using a 7-point Likert scale that ranges from 1 (*strongly disagree*) to 7 (*totally agree*). These ratings are then summed to generate a total score, with higher scores indicating greater severity of NMP. Furthermore, the NMP-Q score can be interpreted in terms of the level of NMP exhibited, with scores ranging from 20 to 140. Specifically, a score of 20 corresponds to an absence of NMP, while scores between 21 and 59 indicate a mild level, scores between 60 and 99 indicate a moderate level, and scores of 100 or greater indicate a severe level of NMP (Yildirim and Correia, 2015). In the present study, the Cronbach's Alpha (α) was estimated for each subscale as such *not being able to communicate* $\alpha = 0.92$, *losing connectedness* $\alpha = 0.85$, *not being able to access information* $\alpha = 0.84$ and *giving up convenience* $\alpha = 0.75$. Cronbach's Alpha (α) coefficient for the scale total is $\alpha = 0.92$, which indicates a high level of psychometric quality. The scale items were summed as $M = 3.24$, SD = 1.18, indicating a mild level NMP.

3.3.4. Social media tools usage

In order to specify the participants' SMTU frequency, the participants were invited to complete an open-ended question to identify their preferences about social media tools. Regarding the social media tools they use, the great majority of the participants ($n = 357$) reported that they use YouTube (83%). In the second place, 324 use WhatsApp (76%), and finally 278 reported that they use Instagram (65%).

3.3.5. Digital gaming behavior

The researchers used an open-ended questionnaire to gather the participants' digital gaming preferences. A significant number of students reported that they play "No games" (27%) at all. Regarding the games they play, 104 reported that they play Minecraft (24%), in the second place, 84 play Counter Strike (20%), and finally 75 reported that they play Among Us (18%).

3.4. Analytical strategy

In the present study, the procedures of parallel multiple mediators model were employed as suggested by Preacher and Hayes (2004). Thus, Hayes PROCESS macro was utilized to compute total, direct, and indirect effects, including both total and specific effects for each mediator, and perform significance tests using BC bootstrap procedures. There is a growing body of research that prefers bootstrap procedures over the Sobel test and other traditional procedures because they do not require the normality assumption of the distribution of the indirect effects, leading to more robust protection against type II error (Teixeira et al., 2010). Therefore, the study presents results for bootstrap tests using a resample procedure of 5,000 bias-corrected bootstrap samples with 95% confidence intervals.

The statistical analysis was carried out using IBM SPSS Statistics (Version 25). Pearson correlation coefficient was estimated to examine the associations among the key variables. A multiple linear regression model was utilized to explore the potential mediating roles of SMTU and DGB in the relationship

between NMP and SA. To investigate the parallel multiple mediating effect, we used Hayes's PROCESS macros version 4.1. A bias-corrected confidence interval (CI) of 95% was calculated based on 5,000 BC bootstrapping samples, and a p value <0.05 was considered statistically significant when the CI did not include zero (MacKinnon et al., 2002).

3.5. Common method bias

To assess whether there exists an inflation or deflation of the true correlation among observable variables, known as common method bias (CMB), in the current study, an exploratory factor analysis (EFA) was conducted following the recommendation of Harman's single factor test (Collier, 2020). The analysis purported a six-factor solution, where all factors had eigenvalues greater than 1, and the first factor explained 15.096% of the total variance. As the percentage of variance explained by the first factor was lower than the critical value of 40% suggested by Podsakoff et al. (2003), it can be concluded that no CMB was observed in the present study.

4. Results

The participants consisted of 427 secondary school students who were receiving online courses during the COVID-19 home confinement. The participants were 128 females (30%) and 299 males (70%). 38 (8.9%) of the participants were 14 years old, 90 (21.1%) were 15 years old, 184 (43.1%) were 16 years old, 67 (15.7%) were 17 years old, 45 (10.5%) were 18 years old and 3 (0.7%) were 19 years old. The average age was 15.93. Regarding the grade levels of the participants, 79 of the participants (18.5%) were in the preparatory class, 173 (40.5%) were at the 9th grade, 99 (23.2%) were at the 10th grade, 58 (13.6%) were at the 11th grade and finally 18 of them (4.2%) were at the 12th grade. The participants reported that 56 (13%) use only 1 social media tool, 100 (23%) use 2, 130 (30%) use 3, 96 (22%) use 4, 38 (9%) use 5 and 12 (3%) use 6 social media tools. The average SMTU was reportedly 2.99. On the other hand, the participants reported that 117 (27%) do not play any digital games. 139 (32%) play at least one game, 80 (19%) two games, 53 (12%) three games, 18 (4%) 4 games, 25 (6%) 5 or more games. The average game play count was reportedly 1.55.

4.1. Preliminary analysis

Prior to investigating the multiple mediator role of SMTU and DGB, the means, standard deviations, Skewness-Kurtosis values, and correlation coefficients for key variables were estimated and presented in Table 1.

Table 1 illustrates that all four correlations were statistically significant. NMP positively correlated with SMTU ($r = 0.216$, $p < 0.01$) and SA ($r = 0.623$, $p < 0.01$). Additionally, SMTU positively correlated with DGB ($r = 0.162$, $p < 0.01$) and SA ($r = 0.222$, $p < 0.01$). However, DGB was not significantly associated with other key variables. The skewness and Kurtosis values were found to be in the range of ±1.5, which ensured the normality assumptions (Tabachnick and Fidell, 2012).

4.2. The parallel multiple mediation analysis

There are two classifications of multiple mediator models. If the mediators are connected in a causal sequence, then it is called as the serial multiple mediator model. Alternatively, they are only associated with each other without causing any causal influence, it is called as the parallel multiple mediator model. Based on this distinction, a parallel multiple mediator model assumes that antecedent variable x impacts subsequent variable y both directly and indirectly through two or more mediators, on the condition that no mediator has a causal effect on any other mediator (Hayes, 2022). Given this, we employed a parallel multiple mediator model in order to test if NMP impacts SA both directly or indirectly through SMTU and DGB. The results were presented in Table 2 and Figure 2. In the multiple mediator analysis, first the significance of the relationship between NMP and SA (c path) was tested [$b = 0.541$, $t = 16.512$, $p < 0.001$ (0.4768 /0.6057)]. Thus, H1 in our study was supported. Then, the mediating role of SMTU and DGB in the relationship between secondary school students' NMP and SA was tested by employing BC bootstrapping with 5,000 samples. As a second step, the relationship between NMP and SMTU (a1 path) was tested. The a1 path was found to be positive and significant [$b = 0.231$, $t = 4.597$, $p < 0.001$ (0.1323 / 0.3298)], supporting the second assumption and H2.1. Third, the relationship between NMP and DGB (a2 path) was tested. The a2 path was found to be negative and not significant [$b = -0.002$, $t = -0.033$, $p = 0.973$ (−0.1237 / 0.1196)], not supporting the third assumption and H2.2. Next, the relationship between SMTU and SA was tested (b1 path), which was found to be positive and significant [$b = 0.070$, $t = 2.199$, $p < 0.05$ (0.0074 / 0.1322)]. This also supported the fourth assumption and H3.1. Later, the relationship between DGB and SA was tested (b2 path), which was found to be positive but not significant [$b = 0.022$, $t = 0.8446$, $p = 0.398$ (−0.0289 / 0.0724)]. This finding did not support the fifth assumption and H3.2. The results also indicated that NMP has a significant indirect effect on the SA through SMTU. Thus, the mediating role of the SMTU was found to be positive and significant, supporting the sixth assumption and H4.1. However, the findings demonstrated that NMP did not have a significant effect on SA through DGB. Thus, the mediating role of DGB was found to be nonsignificant, not supporting the seventh assumption and H4.2. Additionally, the direct effect of NMP on SA (c' path) became weaker but still significant in the presence of the mediator variable SMTU [$b = 0.525$, $t = 15{,}709$, $p < 0.001$ (0.4594 /0.5909)]. This is an indicator of SMTU playing a partial mediating role. As a conclusion, SMTU partially mediated the relationship between NMP and SA. The results of the mediation analysis were introduced in Table 2 and Figure 2.

5. Discussion and conclusion

Adolescents are increasingly affected by the developments in digital technologies, which has become more prominent with the outbreak of the COVID-19 pandemic. The pandemic enforced some infection control measures such as home confinement and lockdowns, leading adolescents to spend more time at home and rely heavily on ICT tools, which caused adverse psychological and behavioral effects (Serra et al., 2021). In particular, online remote teaching practices during the pandemic limited adolescents'

TABLE 1 Means, standard deviations, Skewness-Kurtosis, and correlations between the key variables.

Variables	*N*	*M*	*SD*	Skewness	Kurtosis	1	2	3	4
1. NMP	427	3,24	1,18	0.327	−0.405	1			
2. SMTU	427	2,99	1,26	0.229	−0.489	0.216**	1		
3. DGB	427	1,55	1,51	1,226	1,424	−0.002	0.162**	1	
4. SA	427	2,69	1,02	0.360	−0.528	0.623**	0.222**	0.045	1

*$p<0.05$, **$p<0.01$.
NMP: Nomophobia, SA: Smartphone Addiction, SMTU: Social Media Tools Usage, DGB: Digital Gaming Behavior.

TABLE 2 Summary of mediation analysis.

Hypothesized relationships	Direct effect	Indirect effect	*t*	95% CI		Value of *p*	Conclusion
				LLCI	*ULCI*		
H1: NMP → SA	0.541***		16.512	0.4768	0.6057	0.000	H1 Supported***
H2.1: NMP → SMTU	0.231**		4.597	0.1323	0.3298	0.000	H2.1 Supported***
H2.2: NMP → DGB	−0.002		−0.033	−0.1237	0.1196	0.973	H2.2 Not Supported
H3.1: SMTU → SA	0.070*		2.199	0.0074	0.1322	0.028*	H3.1 Supported*
H3.2: DGB → SA	0.022		0.8446	−0.0289	0.0724	0.398	H3.2 Not Supported
H4: NMP → SA	0.525***		15.709	0.4594	0.5909	0.000	H4.1 Supported *** H4.2 Not Supported
NMP→							
SMTU→		0.0161		0.0023	0.0033		H4.1: Partial Mediation
DGB→		−0.0000		−0.0042	0.0045		H4.2: No Mediation
SA							
Squared multiple correlations (R^2)							
SMTU	0.0469	$F(1, 430) = 21.139, p = 0.000$					
DGB	0.0000	$F(1, 430) = 0.011, p = 0.973$					
SA	0.3970	$F(3, 428) = 93.919, p = 0.000$					

*$p<0.05$, **$p<0.01$, ***$p<0.001$.
NMP: Nomophobia, SA: Smartphone Addiction, SMTU: Social Media Tools Usage, DGB: Digital Gaming Behavior.
Unstandardized coefficients were reported. BC Bootstrap with 5,000 samples and 95% CI.

socialization opportunities, leading to a substantial upsurge in digital gaming behaviors (DGB) and addictive social media tools usage (SMTU) through smartphones. However, excessive use might lead to addictive tendencies including smartphone addiction (SA), and nomophobia (NMP). Although there is an empirical gap since few research studies have focused on the underlying mechanism among these variables, previous research results provided some implications about SMTU and DGB might have a mediating role in this relation. Hence, the present study aimed at exploring the parallel mediating role of secondary school students' SMTU and DGB in the relationship between NMP and SA.

To our knowledge, the present study is the first to explore the relationship between NMP and SA amidst the COVID-19 home confinement and the parallel mediating role of DGB and SMTU in this relation. Our findings revealed that NMP is positive predictor of SA and SMTU. However, no significant associations were found between NMP and DGB. SMTU is positively correlated with SA, and contrary to assumptions, no significant associations were found between DGB and SA. As for the mediating roles, SMTU partially mediates the relation between NMP and SA, however the mediating role of DGB on NMP and SA is not significant. Details about the findings were presented in the following sections.

5.1. NMP is positively associated with SA

The results of the correlational analysis and mediating analysis revealed that NMP was positively associated with SA (H1 supported) ($b=0.541$, $t=16.512$, $p<0.001$ [0.4768 /0.6057]). This finding is concurrent with some previous research findings, indicating that during lockdowns smartphone use and NMP increased dramatically (Serra et al., 2021; Shahzad et al., 2021). Smartphones provide many conveniences to students and teachers in the education process (Almunawar et al., 2015). Despite the conveniences provided by smartphones which are a source of entertainment and spending time apart from educational purposes, heavily reliance on smartphones have increased students' NMP levels and led to an increase in students' SA (Shahzad et al., 2021). This finding was supported by our results. Yet even before the pandemic, one out of every three students has a problem with NMP (Tavolacci et al., 2015). It has been revealed that the COVID-19 pandemic prevents students' social interactions and

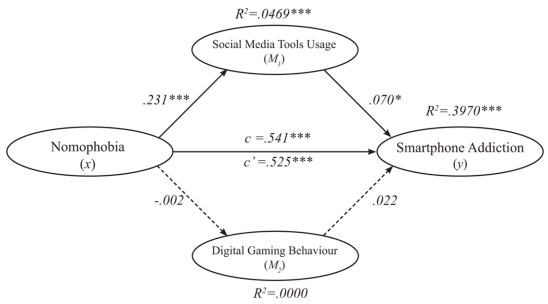

FIGURE 2
Parallel multiple mediator model.

increases SA and SMTU, causing NMP (Pasquale et al., 2021). Our findings also provided some empirical evidence for previous research studies asserting that there is a strong link between NMP and SA (Tavolacci et al., 2015; Anshari et al., 2019; Durak, 2019; Semerci, 2019).

5.2. NMP is positively associated with SMTU

The findings of the present study also indicated that there was a positive significant relationship between NMP and SMTU (H2.1 supported) [$b = 0.231$, $t = 4.597$, $p < 0.001$ (0.1323 / 0.3298)]. This finding mostly overlapped with the previous research in the literature in that adolescents mostly use social media and play digital games through smartphones, which makes them vulnerable to addictive behavior and this might cause NMP amongst them (Yildirim and Correia, 2015) and there is an interaction between NMP and addictive SMTU (Lin et al., 2021). Additionally, previous research highlighted that adolescents perceive social media as safe places to express themselves freely (Shah et al., 2019). However, excessive use of social media can cause negative consequences such as NMP (Bergagna and Tartaglia, 2018; Lin et al., 2021). In a similar vein, excessive social media use increased the risk of social isolation and loneliness in adolescents, thus leading to NMP (Ciacchini et al., 2023). Our results mostly concurred with the previous research findings, which illustrated that there is positive association between NMP and SMTU. Extracted from the results, it is advisable that healthcare providers, educators, parents, and other relevant stakeholders should pay more heed to the issues of NMP and addictive SMTU among adolescents. These issues are of particular concern because they may lead to sleep problems among adolescents, which can have negative impacts on their overall well-being over time (Lin et al., 2021). Therefore, it is important to gain a deeper understanding of nomophobia and social media addiction in order to develop effective interventions to address these issues and promote healthy digital behaviors across secondary school students.

5.3. NMP is not significantly associated with DGB

Contrary to the findings of previous research, the present study did not find a significant relationship between NMP and excessive DGB, which was somewhat surprising (H2.2 not supported). Previous studies have suggested that excessive DGB can lead to psychological problems and increase the risk of NMP. However, the findings of the current study did not provide empirical support for these claims. For instance, Lee (2014) found that adolescents' frequent use of smartphones for social media and gaming makes them susceptible to NMP. In a similar vein, Sandeep (2018) argued that excessive use of digital gaming may lead to NMP. Nonetheless, the present study's results did not overlap with the findings of these studies. On the other hand, the addictive gaming literature has yielded conflicting results. For example, during the COVID-19 pandemic, digital gaming was found to be a helpful tool for managing stress and mitigating the negative effects of public health measures such as lockdowns, quarantines, and social distancing (Balhara et al., 2020). Therefore, it is possible that participants in the current study might have experienced some positive effects of digital gaming during the COVID-19 home confinement and lockdowns. Alternatively, excessive digital gaming might have had a function as a coping mechanism for addressing shortcomings of COVID-19 lockdowns as suggested by previous research (Griffiths and Beranuy, 2009). The issue of online gaming addiction is a real-world problem that needs practical and effective solutions. However, the development of such solutions is hindered by the limited scope of research on the psychological, sociological, and physiological effects of addictive DGB. To address this limitation, there is a need for a more comprehensive and well-established body of literature that can inform education, prevention, intervention, treatment, and legislative policy regarding online gaming addiction (Griffiths, 2009). Therefore, more research is needed to provide educators and other stakeholders with evidence-based policy decisions to make a distinction between excessive and addictive DGB.

5.4. SMTU is positively associated with SA

This study found a significant positive association between SMTU and SA (H3.1 supported) [$b = 0.070$, $t = 2.199$, $p < 0.05$ (0.0074 / 0.1322)]. This finding mostly concurred with the literature. Overuse of the internet, reliance on smartphones, and addictive use of SMTU and digital games are prevalent among adolescents. This situation can make adolescents more vulnerable to SA (Valkenburg and Peter, 2011). Additionally, research illustrates that excessive smartphone use might have negative effects on mental health, cognitive functioning, and sleep quality (Lin et al., 2021). Research also purported that there is a positive correlation between time spent on social media and SA (Marengo et al., 2022). On the other side, previous research argued that SA significantly predicted SMTU (Savcı and Aysan, 2017), which illustrates the complex interplay between SMTU and SA. However, it is well documented in the literature that the most common problems that many adolescents currently experience are SA, and reliance on SMTU and DGB (Yiğit and Günüç, 2020). Our findings are consistent with these previous studies, highlighting the need for in-depth exploration of the complex relationship among these variables. Yet the literature on the impact of social media on adolescents yields conflicting findings, indicating that its effects on psychological outcomes can be both positive and negative (Billieux et al., 2015). This suggests that

young people experience a paradox in relation to social connectedness through online tools. While these tools enable individuals to form and join online groups and communities with greater ease, they can also lead to feelings of alienation and ostracism as documented by a review study (Allen et al., 2014). Thus, the increasing prevalence of SMTU among adolescents necessitates a thorough understanding of its potential positive and negative impacts. Therefore, teachers, parents, and school administrators should take prompt action to address these issues and improve the quality of life and academic performance of adolescents.

5.5. DGB is not significantly associated with SA

The findings, somewhat surprisingly, illustrated that there was not a significant relationship between DGB and SA (H3.2 not supported). Contrary to assumptions and previous research findings, the study disclosed that there was no significant associations between DGB and SA (b2 path) [$b = 0.022$, $t = 0.8446$, $p = 0.398$ (−0.0289 / 0.0724)]. Thus, this finding was not congruent with the literature. Research illustrated that smartphones are regarded as the most important digital gaming and social media tools amongst adolescents (Yildirim and Correia, 2015). Smartphone addiction, digital gaming and social media use are the most common problems amongst adolescents (Yiğit and Günüç, 2020). In this sense, problematic gaming behavior among the adolescents may include the inability to stop playing for an extended period, confusion between the game and reality, neglection of responsibilities due to excessive gaming, and a preference for gaming over other activities (Horzum, 2011), insomnia and poor quality of life (Fazeli et al., 2020). In this context, digital game players are more likely to display behavioral addiction (Grüsser et al., 2007; Griffiths, 2010; Kuss and Griffiths, 2012). Additionally, Savcı and Aysan (2017) argued that digital gaming and SA can anticipate SMTU. Likewise, Liu et al. (2016) found that there was a significant association between smartphone gaming, frequent smartphone use, and SA. Specifically, both the group of individuals who predominantly use their smartphones for gaming and those who use multiple applications on their smartphones for gaming displayed a similar association with SA. Yet these findings were not supported in the present study. However, it is worth noting that the literature on addictive gaming has produced conflicting findings. For instance, recent research has suggested that digital gaming may serve as a helpful tool for managing stress and mitigating the negative effects of COVID-19 (Balhara et al., 2020). In a similar vein, Griffiths and Beranuy (2009) asserted that excessive digital gaming may serve as a coping mechanism for addressing personal shortcomings or difficulties such as a lack of social support, relationship issues, or dissatisfaction with one's appearance. Similar findings were documented in research studies indicating that playing digital games can offer potential benefits, including cognitive, motivational, emotional, and social benefits (Granic et al., 2014), and alleviating feelings of isolation (Carras et al., 2017). In this sense, it is likely that the participants in the present study may have experienced some positive impacts of digital gaming during the COVID-19 home confinement and lockdowns. Furthermore, they may have employed digital gaming as a coping mechanism to mitigate the shortcomings or difficulties of COVID-19 lockdowns. Thus, more research is needed to gain a comprehensive understanding of the complex interplay between digital gaming and smartphone addiction, particularly in the context of the COVID-19 pandemic or future crisis.

5.6. SMTU mediates the relation between NMP and SA

In this study, the mediating role of SMTU in the relation between NMP and SA was confirmed (H4.1 supported). Additionally, the direct effect of NMP on SA (c' path) became weaker in the presence of the mediator variable SMTU ($b = 0.525$, $t = 15{,}709$, $p < 0.001$, [0.4594 /0.5909]). This means adolescents' level of NMP and SA was partially influenced by SMTU. We can conclude from the findings that SMTU is a significant positive predictor of NMP and SA on adolescents. Thus, adolescents who exhibit excessive SMTU are more likely to experience NMP and SA. Given the significant negative effects of NMP and SA on adolescents' well-being, it is notable to pay some heed to SMTU and its potential negative impacts on mental health. Thus, it is crucial to draw attention to the issue of SMTU as a factor that could potentially lead to adverse outcomes for adolescents. The negative effects of addictive SMTU have raised concerns among adolescents and others, including mental distress, depression, sleep disruption, and insomnia (OECD, 2017). In line with this, previous research has documented a range of negative consequences associated with NMP and SA, such as psychological distress, depression, anxiety, sleep disturbances, unhealthy habits, and reduced academic success (Brunborg et al., 2014; Carey et al., 2021), social detachment, anxiousness, worry about contagion, depression and insomnia (Huang and Zhao, 2020; Qiu et al., 2020). These findings underscore the importance of addressing SMTU to mitigate the negative effects of NMP and SA in adolescents. Therefore, school boards and researchers should pay heed to mediating role of SMTU in the development of effective interventions such as cognitive-behavioral therapy, and coping strategies, which will help students develop healthier digital habits and avoid excessive SMTU. These interventions in turn may prevent the negative outcomes associated with NMP and SA across secondary school students. Additionally, school boards and researchers may consider implementing programs aimed at raising awareness about the potential risks of SMTU, leading to exacerbation of NMP and SA.

5.7. DGB does not mediate the relation between NMP and SA

In this study, the mediating role of DGB in the relation between NMP and SA was not confirmed, and NMP was not associated with SA in the presence of DGB as a mediator (H4.2 not supported). Although most of the findings of current study were consistent with existing literature it was surprising to some extent that there was no direct effect of NMP on SA in the presence of DGB. Adolescents level of NMP and SA was not influenced by DGB. This can be an indicator of that adolescents' performing excessive DGB does not lead to NMP and SA. We can conclude from the above findings that DGB is not a significant predictor

of SA in adolescents. This result can be attributable to the special characteristics of the participants because they are the students who got the highest score of 500 and ranked in the 0.01 percentile according to the 2021 Nationwide Central Placement Exam. As they have a high academic orientation and achievement motivation, they can simply self-regulate their own addictive tendencies or employ digital gaming as a coping strategy to mitigate the negative impacts of COVID-19 lockdowns. Therefore, further research is needed to explore the potential mediating role of DGB in the relationship between NMP and SA, especially with diverse sample groups. This would not only help to confirm the current research findings but also provide a better understanding of the conflicting results in the literature regarding the positive or and negative outcomes of DGB. In addition, such studies could help to identify potential intervention strategies for addressing the addictive digital gaming and SA as well as their associated negative impacts on mental health.

As a conclusion, the COVID-19 pandemic and resulting home confinements and lockdowns have led to an increase in excessive technology use among secondary school students. This has raised some concerns regarding NMP, DGB, SMTU, SA, and associated behavioral disorders and technological addiction. The present study documented some empirical evidence indicating the links between NMP and SA, NMP and SMTU, SMTU and SA across secondary school students. Surprisingly, no significant associations were found between NMP and DGB or between DGB and SA. Furthermore, the study proved the partial mediating role of SMTU in the relation between NMP and SA. However, no mediation was found for DGB. The study contributes to a better understanding of the complex interplay among NMP, SA, DGB, and SMTU as well as their prevalence during COVID-19 home confinement. The study provided some implications and recommendations for parents, teachers, schools, and adolescents to address the negative impacts of NMP, SA, DGB, and SMTU.

6. Implications and limitations

The contribution of this research has a bilateral impact on research community both theoretical and practical sides. Regarding theoretical contributions, previous research has focused on the study of the associations between NMP and SA, NMP and DGB, NMP and SMTU and so forth. However, the present study provides some empirical evidence to explain the complex interplay between these variables in addition to highlighting the parallel mediating role of SMTU and DGB in the relation between NMP and SA. More specifically, our results are robust and contribute to a better understanding of underlying complex mechanism in this relation. Regarding practical contributions, it helps public understanding of addictive SMTU, DGB, NMP and SA during the COVID-19 pandemic which have brought about behavioral disorders and technological addiction across secondary school students. More specifically, the implications of our findings are significant for school administrators, teachers, and researchers, as they highlight the need for the development of effective intervention programs and classroom guidance initiatives aimed at assisting students who struggle with NMP and SA. These programs could be devised to address the underlying causes of smartphone addiction and nomophobia, promote healthy digital behaviors, and provide support for affected students. By implementing such programs, school systems and educational institutions can play an active role in promoting the mental health and well-being of their students, while also enhancing academic performance and fostering a positive learning environment.

In addition to its key contributions, the present study provides some practical implications for society, as it sheds light on the psychological and sociological effects of social media and digital gaming on the psychosocial well-being and mental health of adolescents. The study also raises awareness about the growing public concern regarding addictive SMTU. Interestingly, our findings revealed that unlike SMTU, DGB was not significantly associated with NMP and SA. These results provide parsimonious support for previous studies highlighting the potential benefits of digital gaming (Griffiths and Beranuy, 2009; Balhara et al., 2020). By increasing public awareness of these issues, our study may contribute to the development of more effective school guidance and counseling services and interventions aimed at promoting healthy digital behaviors and supporting the mental health and well-being of secondary school students.

Despite its several contributions, a few limitations of the study are inherent and should be acknowledged. First, the sample is restricted to Turkish adolescents studying in one of the most prestigious secondary schools with a highest 0.01 percentile according to the Nationwide Central Placement Exam results. Thus, critical case sampling employed in the present study calls for some caution regarding the generalizability of the results to other populations. Second, the study utilized a cross-sectional design, and relied on self-reported data, which could introduce common method bias (CMB). Therefore, there is a possibility of CMB in this study although we have tested for and no CMB was traced, it is still possible that the relationships between variables may have been over or underestimated. Thus, it was not possible to establish causal relationships between the variables under investigation. These biases are bound to exist and cannot be avoided in survey designs.

Overall, the current research presented valuable empirical support for the previous research studies and contributed a better understanding of the interplay between NMP, SMTU, DGB, and SA. Still, there is a need for more research studies to provide a clearer picture of the phenomena under scrutiny. Therefore, future research may use longitudinal designs to further test the mediation model and reduce the potential for biases. Furthermore, future research should include larger and more diverse samples from various schools and cities and also can employ qualitative or mixed method research design to gain a more comprehensive understanding of the complex interplay among the variables.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Hitit University Non-Interventional Studies Ethical

Board. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The effect of the social support on PTSD and PTG about university student volunteers in the prevention and controlling of coronavirus: with coping style as the intermediary

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To investigate the relationship among post-traumatic stress disorder (PTSD), posttraumatic growth (PTG), social support, and coping style of university student volunteers in the prevention and control of the coronavirus in 2020, a total of 2,990 university student volunteers (students who are enrolled in a university and involved in volunteer activities) from 20 universities in Sichuan Province participated in the prevention and control of the epidemic were investigated when March 20–31, 2020 when the coronavirus first occurred using the post-traumatic stress disorder questionnaire, posttraumatic growth questionnaire, university student social support questionnaire and coping style questionnaire. The results showed that (1) 7.06% of university student volunteers had some degree of PTSD symptoms (the total PCL-C score was 38–49), and 2.88% had obvious PTSD symptoms, (2) PTSD level of university student volunteers was significantly positively correlated with negative coping style, and significantly negatively correlated with social support and positive coping style; on the contrary, the PTG level is significantly positively correlated with social support and positive coping styles, and (3) Positive coping style plays a partial mediating role in the influence of social support on PTG; in the influence of social support on PTSD, the mediating effect of positive or negative coping style was not significant. These results show that in the prevention and control of the coronavirus, the positive coping style and social support of university student volunteers can positively predict the PTG level of them, while the negative coping style can positively predict the severity of their PTSD symptoms. Among them, a positive coping style plays a partial mediating role in the influence of social support on the PTG level.

KEYWORDS

epidemic prevention, university student, volunteers, post-traumatic stress disorder, posttraumatic growth, social support, coping style

1. Introduction

In 2020, the coronavirus disease (COVID-19) pandemic swept the world with high speed, wide range, and multi-channel transmission, which is highly dangerous to people's health and has a ripple effect on all aspects of human life as we know it (Nicola et al., 2020), making it a public health emergency of international concern. The study of "coronavirus" has become a hot

research topic in academia (Chen et al., 2020; Li and Shan, 2020). In response to the epidemic situation, which is long-lasting, widespread and dangerous, our people, under the unified leadership of the Party and the State, concentrated human, material and financial resources to support the serious areas of the epidemic at the first time, and carried out strict preventive and control measures to control the epidemic situation. Among them, many university student volunteers have joined the epidemic prevention and control operation, carrying out vaccination personnel screening, household publicity, temperature measurement at the entrance of public places, "three codes" checking and other work. They played an important role in making up for the lack of rescue force, relieving the government's pressure to fight the epidemic and meeting the needs of the society (Li, 2020). It is inevitable that the university student volunteers who go to the front line of epidemic control will experience more serious trauma exposure. Therefore, we believe that university student volunteers in the outbreak prevention and control have a higher degree of trauma exposure than the general public, and under the premise that trauma exposure is considered a prerequisite or primary factor for the occurrence of PTSD (Dai et al., 2014), we believe that the mental health of university student volunteers in the outbreak prevention and control needs more attention.

PTSD or posttraumatic stress disorder, is a posttraumatic pathological response that manifests as intrusive symptoms, avoidance symptoms, heightened alertness symptoms, negative cognitions, and mood changes (Wang and Jiang, 2002). According to the psychological model of risk (Svenson, 1988), strong physical and psychological reactions such as panic, anxiety, and other adverse psychological reactions may occur when individuals are exposed to more than acceptable levels of risk. In the prevention and control of the COVID-19 pandemic, the volunteer group may witness the painful state of the infected person, constantly worry that they will be infected when they are in close contact with the infected person, and be under the anxiety and fear of the high-risk environment for a long time, which provides multiple risk factors for PTSD generation. In addition, the use of social isolation/lockdown as a strategy to contain the spread of the virus showed more severe trauma and depressive symptoms in students who had previous psychological and psychiatric contact with mental health services. A problematic mindset of "all or nothing" was the strongest predictor of eventual traumatic distress and was primarily associated with psychological distress, anxiety, depression, and post-traumatic symptoms (Giusti et al., 2020). Some studies have pointed out that there are three main characteristics of PTSD in university students: delayed in time, superimposed in events and psychologically curable (Wang and Qiao, 2019). The manifestation of PTSD symptoms in university student volunteers at work may emerge and be superimposed in degree and impactfulness at the tail stage or after the end of prevention and control work. Also based on its psychologically curable nature, the trauma status of university student volunteers needs more attention.

With the development of trauma psychology, PTG, which has received attention in contrast to PTSD, has continued to become a recent research hotspot for researchers. Posttraumatic growth (PTG) refers to the positive changes in psychological aspects experienced by individuals in the process of struggling with negative life events and situations that are traumatic, not caused by the traumatic event itself, but through the individual's struggle with the traumatic event (Tedeschi and Calhoun, 1995). The typical experience of PTG is a greater appreciation for life, a stronger sense of spiritual connection or faith, recognition of new opportunities, acknowledgement of personal power, and/or a stronger sense of connection with others (Dominick, 2022). It has been shown that symptoms of moderate depression are predictive of PTG in a sample of university students and that moderate depressive conditions and associated distress can promote motivation to overcome the psychological consequences of traumatic events (Bianchini et al., 2017). A recent study points to the importance of how university students in the pandemic area cope when faced with problems caused by COVID-19 in themselves or those around them, adjusting their psychological stress response, and gaining experience and growth in the fight against the pandemic. Researchers constructed a mediated regulation model to examine the effects of invasive rumination on university students' creativity during the COVID-19 pandemic, as well as the mediating role of post-traumatic growth and the moderating role of psychological resilience. The results showed that invasive rumination directly influenced creativity and also indirectly influenced creativity through post-traumatic growth. Meanwhile, the correlation between invasive rumination and post-traumatic growth was stronger when the level of psychological resilience was higher (Xu et al., 2022).

So is there some relationship between PTG and PTSD? In this regard, a researcher studied the relationship between PTG and PTSD in elementary school students at 6, 12, and 18 months after the earthquake and found that the relationship differed at different time periods. The two showed a mutually predictive relationship in different directions at different time periods, and contextual changes also affected the relationship. It is also worth noting that this study also explored the relationship between social support and PTSD and PTG, and found that social support was predictive of PTSD and PTG at different time periods (Zhou et al., 2017).

According to the post-traumatic growth model proposed by Tedeschi and Calhoun (1996), social support and coping styles are important factors influencing the development of PTG. In Schaefer and Moos' (1998) crisis-growth model, it is also suggested that a supportive environment not only provides the necessary resources for recovery after trauma but also creates a more reassuring and secure atmosphere. Social support is a key protective factor in the psychological adjustment of individuals to traumatic events (Mitchell et al., 2022). Most psychiatric disorders may arise from the dynamic interaction between neuroscience and social science (Maj, 2014). Therefore, it is important to see the importance of personal and social factors that can positively modulate the response to traumatic events and move a person's psyche in a healthier direction. Good social support has a positive effect on post-traumatic mind changes in terms of improved cognitive understanding. Therefore, social support may be very important to protect a person from mental health problems, especially in a crisis, such as in a prolonged COVID-19 pandemic (Cao et al., 2022).

According to Bandura's (2001) reciprocal determinism, environmental determinism requires the involvement of internal human factors to play a role, so when exploring the influence of external factors, the influence of internal human-related activity factors is equally important. In Tedeschi and Calhoun (1996) posttraumatic growth model, coping is the individual's internal system of coping with the environment. Differences in individual coping styles may be responsible for differences in individual performance. Coping styles as intra-individual factors may constrain the effect of

social support on PTSD and PTG. Related studies have shown that the effect of social support on PTG under group traumatic events such as earthquakes is mediated by intra-individual factors such as self-efficacy and self-esteem (Zhou et al., 2019). It also supports the need to consider intra-individual factors when studying the effects of social support on PTG or PTSD. In a mass traumatic event such as the COVID-19 pandemic, the traumatic event is likely to challenge people's otherwise relatively stable conceptions of self in various ways, and this challenge makes people more likely to feel helpless and powerless, which in turn induces a denial of one's ability or even worth, and leads to a perception of self as incompetent and worthless (Janoff-Bulman, 2010). These perceptions in turn also influence people's behavior in response to traumatic events and ultimately the overall mind–body response (Foa et al., 1999). It is evident that traumatic events challenge people intrinsically through an internal process and that the way in which people cope after being challenged cognitively plays an important role in this internal process. The social conditions in which individuals are placed and the coping styles they use may have different effects on PTSD and PTG. However, it is worth noting that the above model addresses the theoretical significance of each factor on PTG and PTSD, but there is still a lack of empirical research support for the public health emergency context, which provides a possible perspective for this study.

Based on this, this study proposes the following hypothesis: there is a mediating role of coping style in the role of social support on PTSD and PTG.

In conclusion, among the factors influencing PTSD and PTG in previous studies, the social support and coping style in a specific situation become factors influencing the difference between individuals in a specific situation. The crisis situations experienced by university student volunteers in this serious epidemic control operation need more attention and research. Based on this, this study intends to investigate the role of social support on PTSD and PTG, and the role and influence of coping style on social support in the group trauma situation under the epidemic, using university student volunteers who participated in the epidemic prevention and control operation as subjects.

2. Materials and methods

2.1. Participants

In this study, university student volunteers involved in epidemic prevention and control in 20 universities and universities in Sichuan Province were used as the research subjects, and an online survey was conducted from March 20–31, 2020, using the Questionnaire Star program, forwarded to university student volunteers through each university teacher organization. The content included general demographic information, post-traumatic stress disorder status, posttraumatic growth status, coping style and social support and other related information. A total of 3,616 questionnaires were collected, and questionnaires that were completed in too short a time, had too many missing answers, or had the same checkboxes or regularity throughout the questionnaire were excluded. A total of 2,990 valid questionnaires were included in the study, with an effective questionnaire return rate 82.69%; 1,472 were from males and 1,518 were from females; 943 were from science, 1,447 were from arts, and 600 were from engineering; 775 were from freshmen, 684 were from sophomores, 650 were from juniors, 357 were from seniors, and 524 were from postgraduates.

2.2. Instruments

2.2.1. PTSD checklist-civilian version

The PTSD Checklist-Civilian Version (PCL-C) was used. This scale was developed according to the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders of the American Center for Posttraumatic Stress Disorder Research to assess the experience of individuals after experiencing psychological trauma under non-war conditions, and the items measured included three dimensions: avoidance/numbness, hypervigilance, and re-experiencing. There are 17 items in the scale, which can be divided into subjective ratings of the traumatic event, repeated reoccurrence experience, avoidance symptoms, heightened alertness and impaired social functioning, and each item is rated on a scale of 1–5, from no effect to very severe effect, according to the psychological feelings after the traumatic event. The cumulative score of the 17 items is the total PCL-C score, and the higher the score, the more severe the stress disorder condition. If the total score was 17–37, there were no significant PTSD symptoms; if the total score was 38–49, there was some degree of PTSD symptoms; if the total score was 50–85, there were significant PTSD symptoms. The Cronbach's alpha coefficient for the scale in this study was 0.936.

2.2.2. Posttraumatic growth inventory

This study used the Chinese version of the Posttraumatic Growth Inventory (C-PTGI) revised by Geng et al. (2011) to the Posttraumatic Growth Inventory (PTGI) developed by Tedeschi and Calhoun. The scale includes a total of 21 entries in 5 dimensions, namely 7 entries assessing the interpersonal relationship dimension, 5 entries assessing the new possibilities dimension, 4 entries assessing the personal strength dimension, 2 entries assessing the spiritual change dimension, and 3 entries assessing the appreciation of life dimension. The "never" option scored 0 points, the "rarely" option scored 1 point, the "little" option scored 2 points, the "medium" option scored 3 points, the "large" option scored 4 points, and the "maximum" option scored 5 points. "The higher the score, the higher the PTG level. In this study, the Cronbach's alpha coefficient for the scale was 0.944.

2.2.3. Simplified coping style questionnaire

A simplified coping style questionnaire prepared by Yaning Xie was used, and the questionnaire used a total of 20 entries, and the entries were scored on a 4-point scale. The questionnaire was divided into two subscales: positive coping style and negative coping style. The positive coping style subscale consists of questions 1–12, focusing on the characteristics of positive coping style when individuals encounter stress. Specific behaviors such as "Talking to others about inner troubles," "Seeking possible advice from others," "Trying to think and observe the good side of things," etc. The negative coping style subscale consists of 13–20 questions, focusing on the characteristics of individuals' negative coping style when they encounter stress. Specific behaviors such as "avoidance of problems," "meaningless passive waiting," and "habit of relying on others" were identified. In this study, the Cronbach's alpha coefficient for the positive coping subscale was

0.898; the Cronbach's alpha coefficient for the negative coping subscale was 0.798.

2.2.4. Social support scale for university students

The social support scale for university students developed by Yeh and Dai (2008) based on Shuiyuan Xiao's three-factor model of social support was used. The scale consists of 17 entries divided into three dimensions: subjective support, objective support, and support utilization, and each entry is scored using a 5-point scale. This scale has good reliability and validity, with higher scale scores indicating better social support. The Cronbach's alpha coefficient of the scale in this study was 0.957.

2.3. Data analysis

Data processing in this study was performed using SPSS 23.0 with which Process 2.16 program for statistical analysis of data and Bootstrap mediated effects test. First, descriptive statistics of PTSD status of the university volunteers were conducted and ANOVA was performed to study the differences between volunteers with each PTSD level in each dimension. Secondly, the mean and standard deviation of each factor of PTSD, PTG, social support and coping style were described and Pearson correlation analysis was performed. Finally, mediating effects analysis was performed using the Process procedure.

2.4. Common method bias test

Since the instruments used in this study were all self-assessment scales, the data obtained from the measurements may cause covariation, which in turn may lead to systematic errors. Based on this, this study used Harman's one-way test for statistical control of common method bias. It was found that 11 factors were obtained for both rotated and unrotated, and the first factor variances of the results after rotated and unrotated were 22.1% and 13.75%, respectively, which were less than the critical value of 40%. Therefore, we concluded that there was no significant common method bias in this study.

3. Results

3.1. Survey of PTSD symptoms in university student volunteers for epidemic prevention and control

Data analysis showed that among the university student volunteers in epidemic prevention and control, 2,693 (90% of the overall number) had no obvious PTSD symptoms, 211 (7.06% of the overall number) had some degree of PTSD symptoms, and 86 (2.88% of the overall number) had obvious PTSD symptoms. To examine the differences between different groups of PTSD symptoms in other factor dimensions, tests for differences in different factors such as PTG, social support and coping styles were conducted, and the results are shown in Table 1.

As can be seen from Table 1, the differences in positive coping styles and negative coping styles among university volunteers with different PTSD symptoms were significant. Among them, positive coping scores were highest for those without significant PTSD symptoms, and negative coping scores were highest for those with significant PTSD symptoms. In the social support dimension, university student volunteers with different PTSD symptoms had significant differences in the total social support score and each dimension. And in all three dimensions, the highest scores were for those without obvious PTSD symptoms and the lowest scores were for those with obvious PTSD symptoms.

3.2. Correlation analysis of PTSD with PTG, coping style, and social support

Pearson correlation analysis was conducted on PTSD, PTG, positive and negative coping styles, and social support of university students, and the results are shown in Table 2. In this epidemic prevention and control, the PTSD level of university student volunteers showed a significant positive correlation with negative coping styles, and a significant negative correlation with social support and positive coping styles; PTG level showed a significant positive correlation with social support, positive coping styles, and negative coping styles all showed significant positive correlations. Among them, the correlation between PTG and PTSD in this context was significantly negative.

3.3. The mediating role of coping styles between social support and PTG

After normalizing all variables, mediated effects analysis was conducted using the SPSS macro program PROCESS Model 4 under control for grade, gender, and major. A bias-corrected percentile Bootstrap method was used for mediated significance testing, with confidence intervals set at 95%, and 5,000 replicate sampling was performed. The mediating effect of social support on PTSD impact in either positive or negative coping style was not significant (BootLLCI = −0.0051, BootULCI = 0.0165; BootLLCI = −0.0043, BootULCI = 0.0119); the mediating effect of social support on PTG impact in negative coping style was not significant (BootLLCI = −0.003, BootULCI = 0.0083). The mediating effect of social support on positive coping style in the effect of PTG was significant, and the results are shown in Table 3.

As seen in Table 3, positive coping style positively predicted PTG level ($\beta = 1.15$, $p < 0.001$), and social support of university students positively predicted PTG level ($\beta = 0.14$, $p < 0.001$).

The results in Table 4 show that the total effect of social support for university students affecting PTG levels was 0.3631, SE was 0.0250, $p < 0.001$; the direct effect value was 0.1426, SE was 0.0245, $p < 0.001$, the lower limit of BootCI was 0.0944, and the upper limit of BootCI was 0.1907; the indirect effect value was 0.2205, SE was 0.0176, $p < 0.001$, the lower limit of BootCI was 0.1872, and the upper limit of BootCI was 0.2570. The relative effect value of the direct effect was 39.27% and the relative effect value of the indirect effect was 60.73%. Since the lower and upper limits of the BootCI for the indirect effect are greater than 0, it indicates that there is a significant mediating effect of positive coping style in the effect of social support of university students on PTG levels. Since its direct effect is equally

TABLE 1 Means and standard deviations of coping styles, PTG, and social support of university students under different levels of PTSD in university volunteers ($M \pm SD$).

Variables	No significant PTSD symptoms	Have some degree of PTSD symptoms	Significant PTSD symptoms	*F*	*P*
Positive coping	23.03 ± 6.13	21.78 ± 5.47	21.77 ± 6.33	5.60**	0.004
Negative coping	8.18 ± 4.16	10.44 ± 3.96	12.64 ± 5.09	72.77***	0.000
Subjective support	20.78 ± 3.67	18.24 ± 3.81	17.03 ± 4.19	85.04***	0.000
Objective support	26.38 ± 3.87	23.59 ± 4.59	21.03 ± 5.16	118.74***	0.000
Support utilization	24.15 ± 4.87	21.68 ± 4.84	19.94 ± 5.02	53.82***	0.000
Total social support score	71.32 ± 11.25	63.50 ± 12.20	58.01 ± 13.65	98.156***	0.000

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 2 Correlation analysis table of social support, coping style, PTSD, and PTG.

	Variables	$M \pm SD$	1	2	3	4	5
1	Total social support score	70.38 ± 11.76	1				
2	Positive coping style	22.90 ± 6.10	0.376***	1			
3	Negative coping style	8.47 ± 4.28	0.024	0.270***	1		
4	PTG	61.51 ± 16.48	0.257***	0.460***	0.096***	1	
5	PTSD	26.86 ± 8.62	−0.369***	−1.17***	0.261***	−0.050**	1

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

significant, it indicates that the mediating effect is partially mediated. The product of its direct effect value and indirect effect value was greater than 0, indicating the existence of other mediators that positively predicted PTG levels. However, the mediating role of negative coping style was not significant in the effect of social support on PTSD levels.

4. Discussion

In this study, we found that the PTSD detection rate in the outbreak prevention and control was 9.94% in the university student volunteer population, including all participants with PTSD symptoms. This is much lower than the PTSD detection rate (54.6%) among university student volunteers after the Wenchuan earthquake by Lv (2010), which may be related to the traumatic event itself. Most of the panic about the sudden arrival of the COVID-19 pandemic comes from a sense of unfamiliarity and harm, and some studies have shown that people's psychological stress increases significantly in the first few months after the COVID-19 outbreak, but after a few months have passed, levels of anxiety, distress and depression begin to decline (Aknin et al., 2021). With the rapid research and analysis by scientists, the characteristics of the new coronavirus are no longer mysterious, while the clinical efficacy of the developed symptomatic drugs has been highlighted, coupled with the efficient prevention and control of the epidemic by the Party and the government, people's knowledge and confidence in the prevention and control measures of the epidemic are also increasing. Second, although university student volunteers are in the positions most likely to be exposed to the virus, the degree of trauma exposure varies among volunteers, and the degree of trauma exposure in this epidemic prevention and control is different from that of the volunteers in the earthquake zone in Wenchuan. Compared to the more hidden unknown and long lasting trauma exposure in the current epidemic, the more visual and intense stimulation in the earthquake may also have contributed to the high PTSD detection rate among university student volunteers at that time. Although the detection rate of PTSD in the university volunteer population in this epidemic prevention and control is lower than that in other groups of traumatic events, it is noteworthy that there are different degrees of lifetime prevalence of PTSD in different traumatic events (Wang and Jiang, 2002), which poses a great challenge to the mental health of the university volunteer population under the epidemic prevention and control. Currently, two main clinical approaches are used to treat PTSD, namely pharmacotherapy and non-pharmacotherapy. Among them, psychotherapy has a definite effect. Prolonged exposure therapy (PE) and cognitive processing therapy (CPT) are both cognitive-behavioral therapies, and both give full attention to the traumatized population, the former aiming to eliminate the fear by imagining the trauma exposure, and the latter aiming to bring the therapeutic effect into full play by re-establishing the cognitive dysfunction caused by PTSD (Chen et al., 2018). We should pay enough attention to the volunteers involved in the epidemic prevention and control work, and recognize the mental health prevention and control of the volunteer population while controlling the development of the epidemic in a timely manner.

This study also analyzed differences in social support dimensions between university student volunteers with different levels of PTSD symptoms. It was found that there were significant differences in multiple dimensions of social support dimensions, such as subjective support, objective support, and support utilization. The mean scores of the three dimensions showed decreasing results from university volunteers with no PTSD symptoms, to university volunteers with some PTSD symptoms, to university volunteers with significant PTSD symptoms. This study also confirmed the result that social support

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TABLE 3 Test of mediating effect of positive coping style in the effect of social support on PTG.

Regression equation (*N*=2,990)		Fitting index		Coefficient Significance	
Outcome variable	Predictor variable	R^2	*F*	*β*	*t*
Positive coping style		0.15	127.20***		
	Gender			0.53	2.52*
	Major			0.26	1.79
	Grade			0.26	2.62*
	Social support for university students			0.19	21.67***
PTG level		0.22	171.65***		
	Gender			−0.27	−0.50
	Major			0.75	1.99
	Grade			−0.45	−28*
	Positive coping style			1.15	24.36***
	Social support for university students			0.14	5.81***

*$p<0.05$, **$p<0.01$, ***$p<0.001$.

TABLE 4 Indirect versus direct effects of positive coping style in the test of mediating effects in the effect of social support on PTG levels.

	Effect value	Boot standard error	Bootcl lower limit	Bootcl upper limit	Relative effect value (%)
Total effect	0.3631	0.0250	0.3141	0.4121	
Direct effect	0.1426	0.0245	0.0944	0.1907	39.27
Indirect effect	0.2205	0.0176	0.1872	0.2570	60.73

was significantly negatively correlated with PTSD ($r=-0.369$, $p<0.001$). According to Xiao (1994) social support theory, subjective, experiential or emotional support, i.e., university volunteers' more emotional experience and satisfaction of being respected, supported, and understood in the society, affects the production of PTSD. The objective, visible, practical or material direct help that supports university volunteers is itself helping university volunteers to suppress the effects of trauma on the one hand; on the other hand, it also becomes the basis of subjective support. All of the above mentioned subjective and objective supports are related to support utilization. The ability to perceive positive internal experiences, to adopt positive coping styles for oneself, and to use positive coping styles in socially supportive contexts directly affects support utilization. It can be seen that social support utilization is linked to the coping styles of university volunteers.

The present study showed that social support had a significant positive predictive effect on PTG levels, which is consistent with the results of other researchers (An et al., 2018; Zhou et al., 2019). The current study also confirmed the positive predictive effect of two factors, social support and coping style, on the PTG level of college volunteers under epidemic prevention and control in the posttraumatic growth model proposed by Tedeschi and Calhoun (1996). And PTSD in this context showed a negative correlation with PTG, that is, the deeper the university volunteers developed PTSD, the lower their level of post-traumatic growth and the lower their possibility of obtaining healing. Also because, the characteristic that PTSD and PTG can co-exist, it also means that the higher the post-traumatic growth can reduce the PTSD symptoms. According to the two-sided glue model of PTG (Maercker and Zoellner, 2004) PTG includes both positive constructs and self-deception factors. Based on this, university volunteers with different psychological qualities react differently when facing traumatic events. Those volunteers who promptly regurgitated and reconstructed their self-perceptions and self-referred and reassured, although they were in the traumatic environment of the epidemic, their prompt internal reconstruction results suppressed the effect of PTSD triggering factors. The same implies that university student volunteers who fail to respond to the effects of PTSD triggering factors in a timely manner are not only at increased risk of developing PTSD symptoms themselves, but are also less likely to experience regurgitation and reevaluation of their self-perceptions, cueing and reassurance of self, and individuals are more likely to experience intrusive traumatic memories in their cognitive world related to the epidemic prevention and control process (Halligan et al., 2003) and the resulting intrusions make it more difficult for volunteers who are already in a traumatic situation to make positive cognitive evaluations of the traumatic event in a short period of time (Williams and Moulds, 2010; Zhou et al., 2015). Their native power to produce PTG is inhibited.

The present study also confirms the partially mediating role of positive coping style in the effect of social support on PTG. That is, during the effect of social support on PTG levels, part of the role is indirectly realized through other pathways: social support → positive coping style → PTG. Good social support creates a safe and stable atmosphere for university volunteers, which facilitates volunteers to

use more positive coping methods to deal with traumatic events. Positive coping styles such as actively confiding in others and more pro-social behaviors further contributed to the cognitive reconstruction and self-soothing of the volunteers after the traumatic experience, and also further enhanced the support utilization of the university volunteers, enabling them to better accomplish their epidemic prevention and control tasks while maintaining their physical and mental health. However, we also found that although negative coping styles had a significant positive predictive effect on PTG, "avoiding problems," "trying to forget," and "self-deception" increased university volunteers' self-soothing and deception. The volunteers' self-soothing and deception also contributed to PTG to some extent. However, it did not play a mediating role in the path of social support, probably because its lower correlation affected the indirect effect of negative coping styles in the path.

The findings of this study help people ensure healthy lifestyles, promote the well-being of people of all ages, and contribute to the global goals of the 2030 Agenda for Sustainable Development.

5. Limitations and future research

The present study also has some limitations. First, in terms of study design, this study did not test trauma exposure separately, and the level of trauma exposure of different university volunteers was not well controlled. Secondly, the study did not use the latest scale based on DSM-5 to measure PTSD, and the choice of the study instrument should be improved. Again, the data collection in this study was done by a convenience sampling method, and the online survey was distributed to students by teachers in Sichuan universities, which did not achieve a good random sampling. Based on the limitations of the epidemic form in Sichuan and the student structure of universities in Sichuan province, no centralized survey was conducted on the epidemic prevention and control work in high-risk areas of the epidemic, and the representativeness of the subject group needs to be improved. Finally, some university volunteers showed obvious clinical symptoms of PTSD, but this study did not use clinical criteria for further study. Future studies could further consider the relationship with other variables (illness, having a family member/friend who is ill/died, etc.) as well as controls for the length of time volunteers spend volunteering. There were studies using volunteer students and graduates who were experts in the field of civil defense and who had been adequately trained in their professional culture, enabling them to deal flexibly with a variety of emergencies. The results showed that during the COVID-19 pandemic, more than 90% of volunteers demonstrated good mental health and extensive use of functional coping strategies, and less experienced volunteers showed better emotional profiles compared to their colleagues with 10 or more years of experience. In summary, those who work in the volunteer sector will demonstrate a positive, strong sense of helpfulness and an awareness of their group identity, enabling all members to experience a sense of well-being, belonging, solidarity and cohesion (Roncone et al., 2021). In fact, recent studies have also shown that volunteers who served during the COVID-19 pandemic felt "happy" and satisfied despite the initial distressing conditions they experienced. Their ability to experience happiness alongside the inevitable stress helped them to reduce the psychological stress of doing this important but demanding work (Mo et al., 2022).

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

PH and RH contributed to conception and design of the study. LW performed the statistical analysis. RH wrote the first draft of the manuscript. PH and YZ contributed to manuscript revision. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Fostering mask-wearing with virality metrics and social media literacy: evidence from the U.S. and Korea

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Although social media can pose threats to the public health by spreading misinformation and causing confusion, they can also provide wider access to health information and opportunities for health surveillance. The current study investigates the ways in which preventive health behaviors and norms can be promoted on social media by analyzing data from surveys and experiments conducted in the U.S. and South Korea. Survey results suggest that the pathway from social media use for COVID-19 information to mask-wearing behavior through mask-wearing norms emerges only among individuals with strong perceived social media literacy in the U.S. Experimental findings show that wear-a-mask campaign posts on social media foster mask-wearing norms and behavioral intention when they come with large (vs. small) virality metrics (e.g., Likes, shares) in both the U.S. and South Korea. Additionally, American users are more willing to engage with posts that come with supportive (vs. mixed) comments by Liking, sharing and commenting. The results highlight the need to cultivate social media literacy and opportunities for exploiting social media virality metrics for promoting public health norms and behaviors.

KEYWORDS

mask-wearing, social media literacy, virality metrics, opinion climate, perceived norms, social media engagement, public health campaign

1. Introduction

People increasingly use social media for health information (Chou et al., 2021), including COVID-19 news (Mitchell and Liedke, 2021). While social media use for health can be beneficial in terms of increased access to health information and opportunities for health surveillance, it can also pose challenges involving confusion, loss of trust in experts, information overload and misinformation (Moorhead et al., 2013; Huber et al., 2019). The amount of misinformation about COVID-19 was particularly high on social media compared to other digital platforms (e.g., Kouzy et al., 2020). Various content on social media, ranging from original posts and viral hashtags to user comments and endorsements, produces a heterogeneous information environment. Considering that inaccurate health information can be presented on equal footing along with guidance from health authorities on social media, the current study examines whether preventive health behaviors and norms can be fostered on social media through organic interactions emerging between public health posts by institutions such as C.D.C. and user engagement these posts generate. This question is an important one to answer during global health crises such as the COVID-19 pandemic; as efforts to limit the

spread of the coronavirus and protect vulnerable segments largely depend on individuals' willingness to participate in preventive and hospitals health behaviors (e.g., mask-wearing, Lewandowsky and Van Der Linden, 2021), especially in contexts such as public transportation and hospitals. Continued mask wearing, particularly in closed social contexts, continues to be an important recommendation 3 years into the pandemic to protect vulnerable people (World Health Organization, 2022).

To investigate how mask-wearing norms and behaviors operate and can be promoted on social media, the current study analyzes data from surveys (Study 1) and experiments (Study 2) conducted in the U.S. and South Korea. Study 1 establishes a pathway from social media use for COVID-19 information to mask-wearing behavior through mask-wearing norms by drawing from the Theory of Reasoned Action and Planned Behavior (Ajzen, 1991). Importantly, we test whether this pathway is moderated by *perceived social media literacy*, which reflects users' ability to critically evaluate and process misinformation (Borah, 2022; see also Li et al., 2020 for the link between perceived and actual literacy). Next, focusing on the potential of health campaigns on social media involving heightened interactivity (Chou et al., 2013), Study 2 examines if mask-wearing norms and behavioral intention can be fostered upon exposure to wear-a-mask social media posts by health authorities, the Centers for Diseases Control and Prevention (CDC) in the U.S. and the Disease Control and Prevention Agency (DCPA) in Korea. As these institutional posts generate user reactions, the experiments also test if mask-wearing norms and behavioral intention vary by the campaign posts' differing user interaction factors: *virality metrics* (high vs. low engagement in the form of number of Likes, comments and shares) and *opinion climate* (supportive, including only pro-mask sentiments vs. mixed comments, including both pro- and anti-mask sentiments).

Overall, Study 1 establishes a pathway from social media use for COVID-19 information to mask-wearing norms and behavior, which emerges only among people with strong perceived social media literacy (Figure 1) in the U.S. Study 2 reports experimental evidence that wear-a-mask campaign messages on social media strengthen mask-wearing norms and behavioral intentions if they come with large virality metrics. This study seeks to contribute to the prior scholarship in the following ways: First, it clarifies paths through which social media can limit or facilitate health preventive behaviors and normative perceptions. The mechanisms involve perceived social media literacy and messages by health authorities that come with large virality metrics rather than supportive comments. Second, in doing so, this study utilized both survey and experimental methods in an effort to ensure both internal and external validity of the findings. By incorporating how institutional and general user interactions might shape individuals' perceived norms, the experiment provides a more realistic testing of social media effects on public health, Finally, the current study collected data from two different contexts in terms of the pandemic experience and cultures, the U.S. and South Korea (Bromwich, 2020).

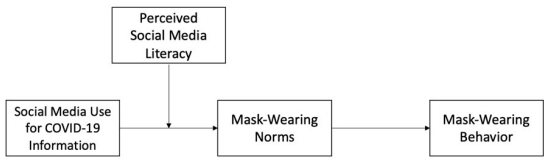

FIGURE 1
Study 1: the theoretical model.

2. Study 1

2.1. Social media use, literacy, and normative perceptions and behavior

There are various considerations on how social media use for COVID-19 news and information can shape normative perceptions and health behaviors. On the one hand, there is a lot of health misinformation on social media both in general and in the context of COVID-19 (Al Khaja et al., 2018; Kouzy et al., 2020) and this misinformation is associated with less frequent health protective behaviors such as vaccination (Pluviano et al., 2017; Romer et al., 2022). In the context of mask wearing, there are mixed results. Misinformation about mask wearing, such as that it actually increases COVID-19 exposure levels, has been widespread especially earlier in the pandemic (Newswise, 2020). Yet, research also showed that social and mobile media use was associated with increased incidences of mask wearing (Liu, 2020). According to Hornik et al. (2021), misinformation about COVID-19 also did not predict mask wearing reduction when specific beliefs about mask wearing were accounted for. This leads us to consider the heterogeneous information environment on social media above and beyond the prevalence of misinformation. Moreover, mask wearing norms could be shaped by not just the amount of reliable vs. misleading information, but a number of other factors on social media such as different actors and user engagement metrics.

Different platforms, nature of content, and sources of information on social media create a heterogenous information environment. On the one hand, platforms differ in the prevalence of pro-mask content. A study of Twitter discourse in the U.S. during the first year of the pandemic found that most discussions were composed of pro-mask tweets, although there were anti-vaccine groups as well (Lang et al., 2021). On the other hand, numerous studies showed the prevalence of anti-mask comments (Keller et al., 2021) and groups on Facebook (Ayers et al., 2021). Aside from the platform differences, the nature of pro- and anti-mask posts on social media differed in a number of ways as well. For example, on Twitter, posts with anti-mask sentiments were found to include more uncivil and toxic language (Pascual-Ferrá et al., 2021). Next, the sources of social media content also complicate the picture: Institutional pages and accounts of health authorities, such as the World Health Organization, CDC and Ministry of Health across nations campaigned for mask wearing for most of the pandemic. Social media companies themselves also tested messages for mask wearing norms; exposure to the campaign messages increased the frequency of self-reported mask wearing (Chen and Sullivan, 2021).

However, norm perceptions could be further shaped by popularity metrics on social media. These would involve both comments and expressions such as Likes and endorsements, which are key actions through which people interact on social media. A study analyzing comments to the CDC posts encouraging mask wearing revealed diverging perceptions; some people resisted these messages and expressed anger in comments, particularly early in the pandemic when there was inconsistent messaging due to limited access to masks

(Batova, 2022). Also, content from individual users and celebrities can be much more mixed, with conservative influencers and celebrities posting against mask wearing and regulations, particularly in more polarized countries like the U.S. For example, pro- and anti- mask hashtags on Twitter polarized the issue along partisan lines especially early in the pandemic (Lang et al., 2021). This makes social media a mixed information environment where both anti- and pro-mask content and opinions were present throughout the pandemic. Accordingly, we ask:

> *RQ1*: What is the relationship between social media use for COVID-19 information and mask-wearing norms?

While we investigate the relationship between social media COVID-19 information exposure and normative perceptions on mask wearing as a research question, we expect to see differences in this relationship based on individuals' levels of social media literacy. In other words, social media use and social media literacy would operate together to form normative perceptions about mask wearing. Literacy, overall, is an important factor in shaping how information is processed. Greater media and news literacy has been associated with more critical and mindful information processing (Tully et al., 2020; Vraga et al., 2021) although it may also be associated with stronger skepticism (Maksl et al., 2015). Individuals with greater news literacy were found to be less reliant on endorsement metrics such as the number of comments and likes when evaluating information; they instead focused on content and titles of news more (Tully, 2021). In the context of identifying fake information, a study examined four types of literacy –media, information, digital, and news literacy, to find that only information literacy had a significant positive association (Jones-Jang et al., 2021). While these studies suggest a somewhat mixed picture, the stronger trend in the results is that overall media literacy is associated with enhanced scrutiny, attentiveness and information processing. Yet, the role of social media literacy, has not been examined to date, particularly in the context of whether it can moderate the association between social media use and mask wearing norms.

In the related context of health literacy, trust in social media content of health professionals such as doctors was an important factor for the adoption of preventative behaviors such as mask wearing (Niu et al., 2021). Recent research shows that individuals are responsive to social endorsements in the form of Likes on Facebook, and perceive posts by health authorities with greater endorsement as more credible (Borah and Xiao, 2018). Individuals who perceive they have stronger social media literacy may be more responsive to these indicators, and hence, they would display a stronger association between their social media use and perceived norms about mask wearing. Thus, while the informational and normative content on social media is heterogeneous, those individuals with greater perceived social media literacy would a) be more critical in processing the diverse information they are exposed to and b) be more responsive to social signals communicated on the platform, such as the popularity and prevalence of mask wearing content by others.

> *H1*: The relationship between social media use for COVID-19 information and mask-wearing norms will be positive for individuals with the highest levels of perceived social media literacy. The relationship will decline in magnitude as perceived social media literacy decreases.

2.2. Normative perceptions and behavior

As a key predictive factor of health behavior according to the Theory of Reasoned Action and Planned Behavior (Ajzen, 1991), perceived norms play a sizable and significant role in health behavior in general, as reviews show (Miller and Prentice, 2016). Surveys showed that social influence increases mask wearing willingness in various countries, including China (Wang et al., 2021) and South Africa (Burger et al., 2022). Numerous experimental interventions aimed to manipulate perceived norms either directly or indirectly in order to boost mask wearing. For example, providing "information about how masks protect others increases the likelihood that someone would wear a mask or encourage others to do so," but these effects are not consistent across countries (Bokemper et al., 2021, p. 1). Also, promotion of altruism was found to increase mask wearing while social shaming did not predict any increase in the U.S. (Bir and Widmar, 2021). Aside from interventions for voluntary behavior change, legislation also helps solidify mask wearing norms. Breaking mask rules in public settings is not only a normative issue but a legal one as well, which can closely shape norms in turn. An analysis of 38 countries found that mask mandates significantly and substantially increased mask wearing during the pandemic (Badillo-Goicoechea et al., 2021). In the U.K., legislation about social distancing during COVID-19 shaped norm perceptions (Galbiati et al., 2021). Given these multiple considerations, we expect that greater perceived norms regarding mask wearing will predict similar behavioral adoption.

> *H2*: Mask-wearing norms will positively predict mask-wearing behavior.

Taking H1 and H2 together, we finally advanced H3 about the moderated mediation relationship (Figure 1). Building on the same logic that individuals with greater social media literacy would be more critical in information processing and responsive to social signals, we expect that social media literacy should also moderate the indirect relationship between social media use and mask wearing behaviors through the mediating role of norms.

> *H3*: The indirect relationship between social media use for COVID-19 information and mask-wearing behavior through mask-wearing norms will be positive for individuals with the highest levels of perceived social media literacy. The relationship will decline in magnitude as perceived social media literacy decreases.

2.3. Materials and methods

2.3.1. Sample

The current study analyzed data from two online national surveys, the first one conducted in the U.S. between June 15 and 30, 2021 ($N = 1{,}194$) and the second one in South Korea between September 3

to 6, 2021 ($N = 550$).[1] Research companies, Dynata and Macromill Embrain, were contracted for data collection through their online panels in the U.S. and South Korea, respectively. To ensure that the samples resembled the American and Korean populations, demographic quotas were applied for age, gender, household income and region. The U.S. sample consisted of 45.4% males, 43.7% females and 0.2% of those who identified as 'other,' with a mean age of 46.8 years. The Korean sample included 49.1% of males and 50.9% of females, with a mean age of 44.7 years. The surveys were conducted in English and Korean, respectively.

2.3.2. Measures

2.3.2.1. Social media use for COVID-19 information

Respondents were asked, "In the past 14 days, on social media, how often they: (a) read or watched content about COVID-19 that people shared, (b) read or watched content about COVID-19 from news sources or public figures that they followed; and (c) read people's personal opinions about COVID-19." Response options ranged from 1 (never) to 6 (every day). An index was created by averaging the three items (U.S.: $M = 2.89$, $SD = 1.68$, $\alpha = 0.93$; Korea: $M = 4.92$, $SD = 0.31$, $\alpha = 0.84$).[2]

2.3.2.2. Perceived social media literacy

Respondents indicated how true the following two statements about their social media use were: "I can easily spot false information on social media" and "I have the necessary skills to check the accuracy of information that I receive on social media" (adapted from Borah, 2022). Response options ranged from 1 (not at all true) to 5 (extremely true). An index was created by averaging the two items (U.S.: $M = 3.41$, $SD = 1.07$, $r = 0.67$; Korea: $M = 2.67$, $SD = 0.89$, $r = 0.69$).

2.3.2.3. Mask-wearing norms

Respondents indicated how much they disagreed or agreed with the following two statements: "Most people important to me wear masks/face coverings" and "Most people important to me would encourage wearing masks/face coverings." Response options ranged from 1 (strongly disagree) to 5 (strongly agree) (U.S.: $M = 3.73$, $SD = 1.16$, $r = 0.79$; Korea: $M = 4.77$, $SD = 0.45$, $r = 0.48$).

2.3.2.4. Mask-wearing behavior

Respondents reported how often they wore a mask or face covering in the past 2 weeks, using a 5-point-scale, ranging from 1 (never) to 5 (always) (U.S.: $M = 3.40$, $SD = 1.42$; Korea: $M = 4.92$, $SD = 0.31$).

2.3.2.5. Control variables

First, demographic variables including sex (male = 0, female/other = 1), age, income and education were controlled for. Additionally, we controlled for three variables that could influence mask-wearing norms and behavior, including political ideology, news media use, and COVID-19-related self-efficacy (Sheeran et al., 2016). *Political ideology* was measured on a 7-point-scale, ranging from 1 (extremely conservative) to 7 (extremely liberal). *News media use* for COVID-19 information was measured by asking respondents in the past 14 days, how often they used the following three sources to get news and information about COVID-19: print newspapers, online news sources and TV news and radio shows on a 6-point-scale (U.S.: $M = 3.37$, $SD = 1.48$; Korea: $M = 4.14$, $SD = 1.02$). *Self-efficacy* of preventing oneself from getting COVID-19 was measured by asking respondents how much they disagreed or agreed with: "I am confident in my COVID-19 preventive behaviors" and "I am confident that I will not be infected with COVID-19" on a 5-point scale (Niu et al., 2021) (U.S.: $M = 3.98$, $SD = 0.73$; Korea: $M = 3.50$, $SD = 0.80$).

2.3.3. Analysis

To test the model (Figure 1), we used the SPSS macro PROCESS model 7 utilizing ordinary least squares regressions (Hayes, 2013).

2.4. Results

2.4.1. The U.S.

Research question 1 investigated the relationship between social media use for COVID-19 information and mask-wearing norms. To test RQ1, mask-wearing norms were regressed on social media use while demographic variables, political ideology, news media use and self-efficacy were controlled for (Table 1, first column). Social media use for COVID-19 information was found to positively predict mask-wearing norms ($b = 0.07$, SE = 0.03, $p < 0.05$). H1 predicted that the relationship between social media use for COVID-19 information and mask-wearing norms would be positive for individuals with the highest levels of perceived social media literacy, and this relationship would decline in magnitude as perceived social media literacy decreased. To test H1, the interaction term between social media use and perceived social media literacy was added to the model (Table 1, second column). The interaction term was positive and significant ($b = 0.05$, SE = 0.02, $p < 0.05$). We probed this relationship using the Johnson-Neyman technique (Hayes, 2013). As shown in Figure 2, the conditional relationship between social media use and mask-wearing norms is positive only among individuals holding perceived social media literacy higher than 3.39. For instance, the relationship among those holding perceived social media literacy of 3.4 was $b = 0.06$ (0.03), 95% CI [0.001, 0.113]. The relationship decreased as individuals held lower perceived social media literacy. This evidence is supportive of H1.

Next, H2 predicted that mask-wearing norms would positively predict mask-wearing behavior, and we found support for H2 ($b = 0.16$, SE = 0.03, $p < 0.01$). Finally, H3 predicted that the indirect relationship between social media use for COVID-19 information and mask-wearing behavior through mask-wearing norms would be positive for individuals with the highest levels of perceived social media literacy, and this relationship would decline in magnitude as perceived social media literacy decreased. Overall, we found support

1 Both surveys were conducted during the COVID third wave when the Delta variant surged. The daily average cases in the U.S. were about 12,000 (0.004% of population); Korea had about 1,400 new cases daily (0.003% of population). The data collection dates and sample sizes differed between the two countries due to logistical issues and funding complications. However, this is not expected to influence results because there were no substantive events in Korea during these 2months. We also replicated the findings using a randomly selected subsample of the American sample to match the Korean sample size (see Footnote 3).

2 Item-by-item *post-hoc* analysis is reported in Section 4.

for H3, the proposed moderated mediation model, as the confidence interval did not cross zero ($b = 0.03$, SE = 0.01, 95% CI [0.004, 0.060]). To probe this relationship, we followed a pick-a-point procedure, setting up the value of the moderator, perceived social media literacy, to one standard deviation below the mean, the mean, and one standard deviation above the mean (Hayes, 2013). The relationship between social media use and mask-wearing behavior through mask-wearing norms was positive and statistically significant for individuals with a high level of perceived social media literacy of 4.48 ($b = 0.07$, SE = 0.02, 95% CI = [0.028, 0.12]) while it was not statistically significant among those with a low or medium level of perceived social media literacy (Table 2).

2.4.2. South Korea

First, regarding RQ1, social media use for COVID-19 information did not appear to positively predict mask-wearing norms ($b = 0.01$, SE = 0.01, $p > 0.05$, Table 3, first column). With regard to H1, the interaction term between social media use and social media information literacy was marginally significant ($b = 0.02$, SE = 0.01, $p < 0.10$, Table 3, second column). However, further analyses using the Johnson-Neyman technique showed there were no transition points within the range of the moderator that were statistically significant (H1 rejected).

Next, we found support for H2 as mask-wearing norms positively predicted mask-wearing behavior ($b = 0.16$, SE = 0.03, $p < 0.01$). Finally,

TABLE 1 Study 1: predicting mask-wearing norms and behavior in the U.S.

	Mask-wearing norms *b* (SE)	Mask-wearing norms *b* (SE)	Mask-wearing behavior *b* (SE)
Constant	1.48 (0.26)**	1.90 (0.31)**	1.07 (0.26)**
Social media news use	0.07 (0.03)*	−0.10 (0.08)	0.12 (0.03)**
Perceived social media literacy	0.04 (0.04)	−0.06 (0.06)	–
SM news use × perceived SM literacy	–	0.05 (0.02)*	–
Mask-wearing norms	–	–	0.68 (0.03)**
Sex	−0.09 (0.07)	−0.09 (0.07)	0.16 (0.08)*
Age	0.00 (0.00)	0.00 (0.00)	−0.01 (0.00)**
Income	−0.01 (0.02)	−0.01 (0.02)	−0.03 (0.02)#
Education	0.06 (0.03)*	0.07 (0.03)**	0.00 (0.03)
Political ideology	0.13 (0.02)**	0.13 (0.02)**	0.02 (0.02)
Self-efficacy	0.10 (0.05)*	0.09 (0.05)#	−0.04 (0.05)
News media use	0.18 (0.03)**	0.18 (0.03)**	0.04 (0.03)
R square	0.19	0.20	0.43
df	962	961	962

**$p < 0.01$, *$p < 0.05$, #$p < 0.10$.

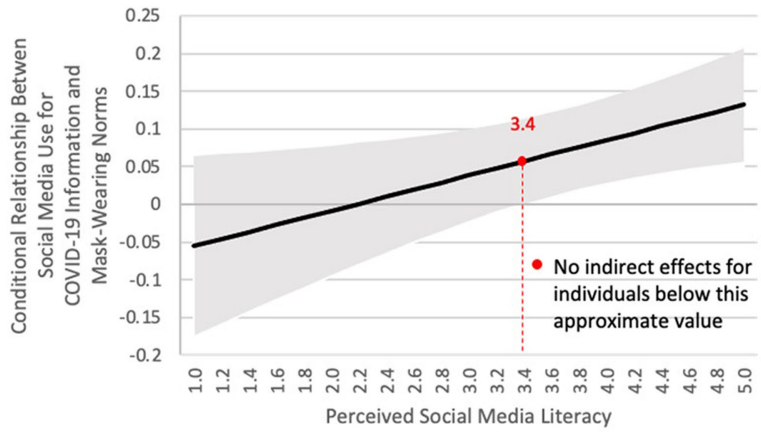

FIGURE 2
Study 1: conditional relationships between social media news use and mask-wearing behavior as a function of perceived social media literacy in the U.S.

we did not find support for H3, the proposed moderated mediation model as the confidence interval crossed zero ($b = 0.004$, SE = 0.003, 95% CI [−0.0004, 0.009]).

3. Study 2

3.1. The influence of virality metrics on social media engagement, normative perceptions, and behavior

Virality metrics work as a key indicator of engagement (Kim, 2018) and message effectiveness (Alhabash et al., 2019) in social media, showing how popular a piece of information is in real-time (Metzger et al., 2010; Calabrese and Zhang, 2019). Theoretically, virality metrics are one type of online social informational cues that signify the number of users' reactions to the information (e.g., the numbers of shares, Likes, and comments, Walther and Jang, 2012). Shares, Likes, and comments each tap into three components of virality (i.e., viral reach, affective evaluation, message deliberation): Shares tap 'viral reach' because users acknowledge the value of a given message by proactively forwarding it to their social networks; Likes involve 'affective evaluation' as users express their positive evaluation of a message, which becomes visible to other users; and comments tap 'message deliberation' because users deliberate on the information from a message in an active and public way (Alhabash and McAlister, 2015). In this study, virality metrics are crucial for demonstrating how users have engaged with the mask-wearing campaign message by health authorities.

Research has shown that virality metrics of a social media post can be a stronger predictor of further engagement than the information quality of the post (Weng et al., 2012). Serving as an endorsement heuristic (Sundar et al., 2009), virality metrics, for example, are found to correlate with higher numbers of sharing on social media (Aswani et al., 2017). Upon receiving a message with large virality metrics, people are inclined to perceive that the message is credible as others endorse and approve it (Metzger et al., 2010). People also tend to agree with the message under the bandwagon effect (Sundar et al., 2009), which may provoke their further engagement with it. Research on political polarization also showed that social endorsements as communicated through virality metrics can shape engagement behaviors including news selection (Messing and Westwood, 2014). Accordingly, we hypothesize that people are more likely to engage with the mask-wearing message with larger virality metrics on social media.

With many others' approval of and support for the message, as signified with the large virality metrics, people may be more easily influenced by the information. This is supported by Lee-Won et al.'s (2017), which found a positive relation between virality metrics and the promotion of health information, specifically the intention to perform cancer screening *via* social media. In the context of alcohol consumption, the intention to consume alcohol was strongly predicted by the intention to engage with a social media message, especially when the message had high virality metrics (Alhabash et al., 2015). Virality metrics can be viewed as persuasive cues that systematically change people's perceptions regarding certain behaviors (Calabrese and Zhang, 2019). This persuasive effect on behavioral intention can be theoretically identified as a normative influence that leads people to conform either consciously or unconsciously (Nolan et al., 2008; Calabrese and Zhang, 2019). While norms largely shape behaviors, injunctive norms, for

TABLE 2 Study 1: conditional indirect relationships between social media news use and mask-wearing behavior through mask-wearing norms at values of perceived social media literacy in the U.S.

Perceived social media literacy	Point estimate	95% C.I.
2.35 (−1SD)	0.01 (0.03)	−0.050 to 0.062
3.42 (Mean)	0.04 (0.02)	−0.002 to 0.082
4.48 (+1SD)	0.07 (0.02)	0.028 to 0.120

TABLE 3 Study 1: predicting mask-wearing norms and behavior in Korea.

	Mask-wearing norms *b* (SE)	Mask-wearing norms *b* (SE)	Mask-wearing behavior *b* (SE)
Constant	4.34 (0.15)**	4.55 (0.19)**	4.05 (0.17)**
Social media news use	0.01 (0.01)	−0.06 (0.04)	0.00 (0.01)
Perceived social media literacy	0.00 (0.02)	−0.07 (0.05)	–
SM news use × perceived SM literacy	–	0.02 (0.01)#	–
Mask-wearing norms	–	–	0.16 (0.03)**
Sex	−0.13 (0.04)**	−0.13 (0.04)**	0.04 (0.03)
Age	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Income	0.03 (0.01)**	0.03 (0.01)**	0.02 (0.01)*
Education	0.02 (0.01)	0.02 (0.01)	−0.01 (0.01)
Political ideology	0.01 (0.02)	0.01 (0.02)	−0.02 (0.01)
Self-efficacy	0.11 (0.02)**	0.11 (0.02)**	0.01 (0.02)
News media use	−0.02 (0.02)	−0.02 (0.02)	0.03 (0.01)#
R square	0.08	0.08	0.09
df	518	517	518

**$p < 0.01$, *$p < 0.05$, #$p < 0.10$.

instance, have been found to increase with virality metrics (Lee-Won et al., 2016), which then leads to a stronger intention to behave in line with the norms. Also, according to the Theory of Reasoned Action and Planned Behavior, subjective norms, the beliefs of whether most people approve the message or not, can predict behavioral intentions through social pressures (Ajzen, 1991). Thus, high virality metrics accompanying the mask-wearing message would imply heightened mask-wearing norms to ultimately encourage mask-wearing behavioral intention.

> *H1*: High engagements, compared to low engagements, promote (a) social media engagement, and (b) mask-wearing norms and (c) behavioral intention.

3.2. The influence of opinion climate on social media engagement, normative perceptions, and behavior

Research has shown that a consensual opinion climate, compared to a mixed one, leads people to perceive a given piece of information more favorably, and further increase people's likelihood of expressing an opinion (Duncan and Coppini, 2019). On the one hand, in a political context, for instance, individuals' views are more quickly crystalized when their views are endorsed by their network; accordingly, they are more likely to express their views (Mutz, 2002). Thus, when participants who (are inclined to) support mask-wearing see comments consistent with their existing or emerging attitude, they may feel confident and show their support through further engagement with the mask-wearing campaign message, for instance, by posting pro-mask comments. On the other hand, according to the corrective action hypothesis, upon sensing that their view is opposed by their network, people may also express their views and participate in an effort to counteract the perceptions that are hostile to their viewpoint (Barnidge and Rojas, 2014). Relatedly, under the backfire effect, people may strengthen their misbeliefs after encountering corrective information although empirical results for this effect are mixed (Haglin, 2017; Nyhan and Reifler, 2019). In the context of the pandemic, presumed influence of social media COVID-19 misinformation on others provoked people's willingness to support corrective actions (Luo and Cheng, 2021). In this study, when participants opposing mask-wearing saw comments supporting mask-wearing campaign messages, which they could perceive as misinformation, they were more likely to express their views with the urge to correct other users through further engagement. In both cases, we hypothesize that comments universally supporting the campaign messages will promote further social media engagement with the message.

Supporting comments can also be a salient endorsement heuristic. The endorsement indicated by supporting comments is a part of an aggregated valence of comments, operationalizing the opinion climate surrounding the message (Shi et al., 2022). It is reported that there is a consistency between the overall valence of opinions expressed in existing comments and people's attitudes to the message (Hsueh et al., 2015; Sung and Lee, 2015). For instance, exposure to an opinion endorsing flu vaccines with favorable comments resulted in positive attitudes toward vaccines; also, a dominant number of supportive comments led to a greater perceived distribution of the supportive opinion (Kim et al., 2020). Furthermore, under the "Bandwagon effect," people make choices based on their perceived consensus of others (Simon, 1954; Bass, 1969). In the social media context, while the perceived consensus can be captured with the dominant opinion climate, the choices people make can involve further engagement and behavioral intention. Alhabash et al. (2015) also found that people's social media engagement is based on favorable evaluations of persuasive messages, and they are closer to the next step to perform offline behavior in line with the messages. Thus, supportive comments on the mask-wearing message may signify a supportive opinion climate to encourage further social media engagement from both sides, and lead people to make choices regarding mask-wearing norms and behavior that are consistent with the message.

> *H2*: Comments supporting the wear-a-mask post, compared to mixed (including both supportive and opposing) comments, promote (a) social media engagement, and (b) mask-wearing norms and (c) behavioral intention.

3.3. Materials and methods

3.3.1. Procedure

Participants in the U.S. ($N = 1{,}194$) and in South Korea ($N = 550$) first read a prompt, "You will be shown a screenshot of a post by the CDC (or the DCPA in Korea) on a social media platform. Please read the post. You will be asked a few questions about it." Then they were presented with one of the four stimuli with a CDC post encouraging mask-wearing,[3] which varied by social media engagement metrics and the opinion climate of comments. Specifically, *social media engagement metrics* were manipulated by randomly assigning participants to two conditions where the provided CDC post showed a *high* (21.3 k reactions, 17.9 k comments, 12.8 k shares) or *low* (213 reactions, 179 comments, 128 shares) number of engagement metrics. The *opinion climate of comments* was manipulated through two conditions where they were exposed to four comments *supportive* of the CDC post (Figure 3) or *mixed* comments (i.e., two supportive and two opposing comments, Figure 4). Finally, respondents answered a series of post-treatment questions and were debriefed at the end.

3.3.2. Measures

3.3.2.1. Mask-wearing norms

Respondents indicated how true the following two statements were: a) Most Americans [Koreans] expect me to wear masks/face coverings and b) Most Americans wear masks/face coverings, on a 5-point scale, ranging from 1 (not at all true) to 5 (extremely true) (U.S.: $M = 3.19$, $SD = 1.12$, $r = 0.76$; Korea: $M = 4.51$, $SD = 0.53$, $r = 0.65$).

3 The CDC post in the stimuli contained the same text from this post by CDC on Facebook about the wear-a-mask campaign (https://www.facebook.com/watch/?v=858138214980932) while in the place of a videoclip, a screenshot of this video by CDC at 0:06 (https://www.facebook.com/watch/?v=255992979505443) was inserted. In all four conditions, the same textual message and image were shown.

FIGURE 3
Experimental stimulus with high engagement and supportive comments. Note. In the place of "Reactions," Facebook's Like, Haha and love reaction emojis (https://about.meta.com/brand/resources/facebookapp/reactions/) were inserted.

FIGURE 4
Experimental stimulus with low engagement and mixed comments. Note. In the place of "Reactions," Facebook's Like, Haha and love reaction emojis (https://about.meta.com/brand/resources/facebookapp/reactions/) were inserted.

3.3.2.2. Mask-wearing behavior

Respondents reported how true the following statement was: I intend to wear masks/face coverings within the next month, on a 5-point scale (U.S.: $M = 3.35$, $SD = 1.51$; Korea: $M = 4.69$, $SD = 0.65$).

3.3.2.3. Social media engagement

Respondents indicated how likely the following three statements were: It is likely that I (a) share; (b) 'Like'; and (c) comment on this post on social media. Response options ranged from 1 (not at all likely) to 5 (extremely likely). An index was created by averaging the three items (U.S.: $M = 2.24$, $SD = 1.44$, $a = 0.96$; Korea: $M = 2.49$, $SD = 1.00$, $a = 0.86$).

3.4. Results

3.4.1. The U.S.

Hypothesis 1 predicted that high engagements, compared to low engagements, promote (a) social media engagement, and (b) mask-wearing norms and (c) behavior. To test hypotheses, three independent samples t-tests were conducted (Table 4). First, *social media engagement* numbers were not different between participants who were presented with a campaign message with high engagement numbers ($M = 2.26$, $SD = 1.44$) and those who were presented with the same message with low engagement numbers ($M = 2.22$, $SD = 1.44$), $t = 0.49$, $p = 0.31$ (H1a rejected). Second, *mask-wearing norms* were higher when participants were presented with a campaign message with high engagement numbers ($M = 3.29$, $SD = 1.10$) than that with low engagement numbers ($M = 3.10$, $SD = 1.14$), $t = 3.04$, $p < 0.01$ (H1b supported). Third, *mask-wearing intention* was higher to a marginal degree when participants were presented with a campaign message with high engagement numbers ($M = 3.41$, $SD = 1.49$) than that with low engagement numbers ($M = 3.29$, $SD = 1.54$), $t = 1.39$, $p < 0.10$. We find marginal support for H1c.

Next, Hypothesis 2 predicted that comments supporting the CDC post, compared to mixed comments, promote a) social media engagement, and b) mask-wearing norms and c) behavior. First, social media engagement numbers were higher when participants were presented with a campaign message with supportive comments ($M = 2.35$, $SD = 1.49$) than that with mixed comments ($M = 2.14$, $SD = 1.38$), $t = 2.45$, $p < 0.01$ (H2a supported). Second, mask-wearing norms were not different between participants who were presented with a campaign message with supportive comments ($M = 3.23$, $SD = 1.15$) and those who were presented with the same message with mixed comments ($M = 3.16$, $SD = 1.10$), $t = 1.05$, $p = 0.15$ (H2b rejected). Third, mask-wearing intention was not different when participants were presented with a campaign message with supportive comments ($M = 3.35$, $SD = 1.51$) than that with mixed comments ($M = 3.34$, $SD = 1.52$), $t = 0.10$, $p = 0.46$ (H2c rejected).

3.4.2. South Korea

Regarding H1, first, social media engagement numbers were not different between participants who were presented with a campaign message with high engagement numbers ($M = 2.48$, $SD = 1.04$) and those who were presented the same message with low engagement numbers ($M = 2.48$, $SD = 1.04$) or that with low engagement numbers ($M = 2.50$, $SD = 0.97$), $t = -0.31$, $p = 0.38$ (Table 5, H1a rejected). Second, mask-wearing norms were higher when participants were presented with a campaign message with high engagement numbers ($M = 4.56$, $SD = 0.54$) than that with low engagement numbers ($M = 4.47$, $SD = 0.51$), $t = 1.86$, $p < 0.05$ (H1b supported). Second, mask-wearing intention was higher when participants were presented with a campaign message with high engagement numbers ($M = 4.74$, $SD = 0.62$) than that with low engagement numbers ($M = 4.64$, $SD = 0.67$), $t = 1.80$, $p < 0.05$ (H1c supported).

Next, with regard to H2, first, social media engagement not different between participants who were presented with a campaign

TABLE 4 Study 2: social media engagement and mask-wearing norms and intention as a function of high vs. low engagement (top) and supportive vs. mixed comments (bottom) in the U.S.

	High engagement		Low engagement			
	M	*SD*	*M*	*SD*	*t*	*p*
Social media engagement	2.26	1.44	2.22	1.44	0.49	0.31
Mask-wearing norms	3.29	1.10	3.10	1.14	3.04	<0.01
Mask-wearing intention	3.41	1.49	3.29	1.54	1.39	<0.10
	Supportive comments		Mixed comments			
	M	*SD*	*M*	*SD*	*t*	*p*
Social media engagement	2.35	1.49	2.14	1.38	2.45	<0.01
Mask-wearing norms	3.23	1.15	3.16	1.10	1.05	0.15
Mask-wearing intention	3.35	1.51	3.34	1.52	0.10	0.46

TABLE 5 Study 2: social media engagement and mask-wearing norms and intention as a function of high vs. low engagement (top) and supportive vs. mixed comments (bottom) in Korea.

	High engagement		Low engagement			
	M	*SD*	*M*	*SD*	*t*	*p*
Social media engagement	2.48	1.04	2.50	0.97	−0.31	0.38
Mask-wearing norms	4.56	0.54	4.47	0.61	1.86	<0.05
Mask-wearing intention	4.74	0.62	4.64	0.67	1.80	<0.05
	Supportive comments		Mixed comments			
	M	*SD*	*M*	*SD*	*t*	*p*
Social media engagement	2.54	1.06	2.44	0.96	1.22	0.11
Mask-wearing norms	4.53	0.53	4.50	0.52	0.82	0.21
Mask-wearing intention	4.66	0.74	4.71	0.55	−1.00	0.16

message with supportive comments (M = 2.54, SD = 1.06) and those who were presented with the same message with mixed comments (M = 2.44, SD = 0.96), t = 1.22, p = 0.11 (H2a rejected). Second, mask-wearing norms were not different between participants who were presented with a campaign message with supportive comments (M = 4.53, SD = 0.53) and those who were presented with the same message with mixed comments when participants were presented with a campaign message with supportive comments (M = 4.53, SD = 0.53) than that with mixed comments (M = 4.50, SD = 0.52), t = 0.82, p = 0.21(H2b rejected). Finally, mask-wearing intention not different participants who were presented with a campaign message with supportive comments (M = 4.66, SD = 0.74) and those who were presented with the same message with mixed comments.

4. Discussion

Social media can be a double-edged sword for public health by making health information accessible to a wider population while also aiding in the spread of incorrect or misleading information or views against crucial public health behaviors (Huber et al., 2019; Kouzy et al., 2020; Chou et al., 2021). During global health crises, such as the COVID-19 pandemic with extreme uncertainty and health risks, it is essential that we have a good theoretical understanding of how preventive health behaviors and norms can be fostered on social media to make the best use. For this, the current study analyzed data from surveys (Study 1) and experiments (Study 2) conducted in two different contexts: the U.S. and South Korea. Study 1 findings suggest a pathway from social media use for COVID-19 information to mask-wearing behavior through mask-wearing norms, consistent with the Theory of Reasoned Action and Planned Behavior (Ajzen, 1991). Importantly, this pathway emerges only among individuals with strong perceived social media literacy in the U.S. Study 2 presents experimental evidence that wear-a-mask campaign posts by health authorities on social media can strengthen mask-wearing norms and behavioral intention when they are accompanied with large virality metrics such as Likes, comments and shares, across the U.S. and Korea. Overall, the results underscore the potential of social media as a space for the nurturing of preventive health behaviors that depend on collective coordination such as masking, through shaping of norms. Study 1 results additionally suggest this is especially true for users who have greater sense of social media literacy.

4.1. Study 1: the roles of perceived norms and social media literacy

Study 1 finds support for the moderated mediation model in which social media use for COVID-19 information can foster mask-wearing norms and behaviors among users with strong perceived social media literacy in the U.S. (Figure 1). Considering that various groups, such as racial minorities, younger people and possibly less educated individuals, tend to engage in more health-related activities

on social media (Chou et al., 2021), this result highlights the potential of social media to be beneficially used for health information and to help with closing the digital divides. However, our findings also note that individuals may not enjoy these benefits if they do not perceive themselves competent in using social media. Indeed, health and COVID-19-related misinformation is rife on social media (Kouzy et al., 2020; Stecula et al., 2020). With false information presented along with correct information on social media feeds, users need to be confident with their literacy skills in order to critically process misinformation and be properly informed (Borah and Xiao, 2018; Vraga et al., 2021).

Indeed, we should recognize that social media content is diverse. Does exposure to all types of COVID-19 content result in the same findings? We were able to conduct further analysis to probe this follow-up question. Our index of social media use for COVID-19 information consisted of three items, two items on content from lay individuals and one item from news sources and public figures. Post-hoc tests revealed that the moderated mediation relationship was held regarding content from lay people ($b = 0.03$, SE = 0.01, 95% CI [0.007, 0.061]), meaning that mask-wearing norms and behaviors were strengthened after consumption of content and opinions from lay people, only among those with strong perceived social media literacy. However, the index of moderated mediation did not reach statistical significance ($b = 0.03$, SE = 0.01, 95% CI [−0.002, 0.053]) regarding content from news sources and public figures although the interaction and mediation ($b = 0.04$, SE = 0.02, 95% CI [0.004, 0.078]) were significant. That is, all users, regardless of their perceived social media literacy, reported heightened mask-wearing norms and behaviors after exposure to COVID-19 content from news sources and public figures. Perhaps social media literacy is especially useful for critical processing of information from lay people, rather than official sources or experts. On the practical front, to benefit all social media users, it would be important to widen the reach of content by health authorities and experts. Aiding people distinguish between content from official sources and lay people is also crucial, as it relates to their social media literacy.

4.2. Study 2: the importance of virality metrics accompanying campaign messages

Social media have the potential to promote health authorities' campaigns because they can provide widened reach with lower costs, tailored messages and heightened interactivity (Chou et al., 2013). Focusing on the interactivity afforded on social media, Study 2 presents experimental evidence that wear-a-mask campaign posts by the CDC can effectively promote mask-wearing norms and behavioral intention with the aid of large virality metrics (e.g., Likes, comments and shares) rather than supportive comments in both countries. This is in line with prior studies viewing virality metrics as an endorsement heuristic; under the bandwagon effect, individuals tend to perceive that a message with large virality metrics is approved by many others, and thus think it is credible and adoptable (Sundar et al., 2009; Borah and Xiao, 2018). A message coming with large virality metrics can be considered credible, often regardless of whether the underlying comments are supportive or mixed (Metzger et al., 2010).

In Study 2, as endorsement heuristics, the large virality metrics accompanying the CDC's posts can signify that many others endorse mask-wearing, thereby strengthening mask-wearing norms, which may then lead to a stronger intention to behave consistent with the norms. Thus, for successful campaigns, health authorities and experts may encourage social media users to actively engage with their messages by sharing, reacting to and commenting on them. While our results show that large virality metrics can foster norms and behaviors in line with the campaign messages among users, social media algorithms will likely further rank these messages higher to reach even more users through positive feedback loops. Although supportive comments, compared to mixed ones, were not found to strengthen mask-wearing norms and behavioral intention, they may facilitate further social media engagement (e.g., Like, share and comment). In a way, supportive comments can effectively help with building larger vitality metrics for successful campaign messages.

On a practical level, these findings highlight the potential value of boosting pro-mask wearing content from official sources in ways that target increased organic engagement from users. At a broader level, it shows the public health value of content regulation in social media that promotes health messages. At the same time, messaging interventions targeting user metrics on social media should be carefully implemented with strong transparency and the coordination of multiple stakeholders, including members of the public, to prevent pitfalls of (or backlash against perceived) social engineering (Freiling et al., 2023).

4.3. Cross-national differences between the U.S. and Korea

The current study examined all the hypotheses and research questions in two very different empirical contexts, the U.S. and South Korea, and investigated how their contextual difference might matter for our empirical results (see Esser, 2014). There are a few reasons why this comparative investigation is important: First, the pandemic severity and management by governments have been different across countries. The U.S. suffered significantly more cases and fatalities during the pandemic, and mask wearing rules in public places have been more contentious with significant variations across different states and localities (Bromwich, 2020). Second, two societies differ in terms of individualistic vs. collectivistic cultures. According to the Culture Compass survey, the U.S. scores much higher than Korea on individualism while Korea scores much higher than the U.S. on long term orientation dimension (Hofstede Insights, 2022). This cultural difference may be an important factor for how group norms and collective action can influence behaviors such as mask wearing in the context of public health management and media use (see Kim and Kwak, 2021).

In Study 1, we found support for the pathway from social media use for COVID-19 information to mask-wearing behavior through norms, which was moderated by perceived social media literacy, only in the U.S.[4]

4 Also, the link between social media for COVID-19 information and mask-wearing norms was positive only in the U.S. The measure of mask-wearing norms is a combination of injunctive and descriptive norms, which tap how

Perhaps this was due to ceiling effects; the mean score of mask-wearing behavior in Korea was 4.69, close to the highest point, 5, while that in the U.S. was 3.35. Also, the standard deviation of mask-wearing norms in Korea was low, 0.53, possibly reflecting Korea's strong collective norms of mask-wearing. This may be due to the two countries' different mask mandates: During the data collection period, in the U.S., fully vaccinated people were no longer required to wear masks under the federal guidance, with varying local guidelines (Netburn, 2021). However, Koreans, even fully vaccinated ones, were required to wear masks indoors as well as outdoors most of the times (DCPA, 2021). Even before the pandemic, the use of masks was considered polite when people were sick in Asia including Korea; Asia also experienced the 2002–3 SARS-1 outbreak which was caused by another coronavirus, and this historical memory may make mask wearing more easily acceptable (Wong, 2020). In Study 2, the results were largely consistent across the two countries, speaking to the applicability of the experimental findings in both societies.[5]

4.4. Limitations and future research directions

Despite its contributions, the current study bears a few limitations. First, Study 1 analyzed cross-sectional survey data, and caution needs to be taken in drawing causal inferences. Although the moderated mediation model was theoretically driven, we tested for the possibility of reverse causality. No support was found for reverse causality,[6] granting more confidence in the results. Relatedly, since Study 1 relied on self-reports, measures such as social media use may not have been the most ideal ones. Also, perceived social media literacy might have been inflated with an overconfidence bias. Future research should measure social media literacy using a variety of questions to explore other dimensions. Still, self-reports effectively captured other main variables including norms.

Next, Study 2 analyzed experimental data, and thus its internal validity is high while its external validity is not. For instance, participants were exposed to screenshots of the health authorities' campaign posts with four comments by strangers, which could feel artificial. This holds true although it was a strategic methodological decision by the authors to combine evidence from surveys and experiments for a more comprehensive understanding of how mask-wearing norms and behaviors can be fostered on social media. Also, the current study investigated mask-wearing as one preventive health behavior, potentially limiting the generalizability of its results.

Finally, future research extending the current study may collect data from more longitudinal surveys along with carefully designed experiments with less artificial settings of social media to more confidently draw causal conclusions. Also, it would be worthwhile to examine a wider variety of preventive health behaviors beyond mask-wearing for generalizability. Lastly, self-reported measures of social media use and literacy can be complemented with social media log data and literacy tests.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The study conducted in the U.S. was determined exempt after a review by the Institutional Review Board of the University of Arizona. The study conducted in Korea was reviewed and approved by the Institutional Review Board of Korea University. The participants provided their written informed consent to participate in this study.

Author contributions

DK, OK, and SK contributed to conception and design of the study, and data analysis. DK and SK collected data, acquired funding, and edited the manuscript. DK wrote the first draft of the manuscript. OK and JZ wrote sections of the manuscript. All authors read and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

socially approved and popular an act is, respectively. Americans who heavily used social media to get information about COVID-19 may have been able to think of mask-wearing instances easily (i.e., availability heuristics, Folkes, 1988) to consider it socially approved and widely performed.

5 There were two minor differences: In the U.S., mask-wearing intention increased with large (vs. small) virality metrics to a marginal degree while in Korea, the difference was statistically significant. In the U.S., social media engagement increased with supportive (vs. mixed) comments while in Korea, the difference was not significant. When we tested the hypotheses in the U.S. using a randomly selected subsample whose size was equivalent to the Korean sample, the results were mostly the same. However, mask-wearing intention no longer increased with large (vs. small) virality metrics (t=0.23 p>0.10) and social media engagement increased with supportive (vs. mixed) comments to a marginal degree (t=1.45, p <0.10).

6 When we test for the alternative moderated mediation model where social media use for COVID-19 information is switched with mask-wearing behavior, and perceived social media literacy moderates the link between mask-wearing norms and social media use, the model is no longer significant in the U.S. (b=0.01, SE=0.01, 95% CI [−0.015, 0.042]).

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After the first lockdown due to the COVID-19 pandemic: Perceptions, experiences, and effects on well-being in Italian people

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Background: Since the COVID-19 pandemic and the subsequent measures of containment, multiple studies have been conducted aimed at assessing the impacts on people's psychophysical well-being; however, few studies have investigated the general population's perceptions, experiences, and effects by adopting a mixed-method approach.

Methods: A total of 855 Italian participants completed an online survey, conducted in the period following the first lockdown in Italy. Psychological well-being, perceived stress and COVID-19-related fears were assessed by standardized questionnaires (*Psychological General Well-Being Index-Short version*, *Perceived Stress Scale 10*, and *Multidimensional Assessment of COVID-19-Related Fears*). The process of sense-making of the experience during the lockdown period was also evaluated by means of an open-ended question.

Results: Participants reported a lower level of general well-being, and a higher level of both perceived stress and COVID-19-related fear during the lockdown period compared to the time of the survey (1 month after the resumption of activities). The thematic analysis of responses to the open-ended question revealed two factors and five clusters, which explain the thematic variance among the narratives: the first factor refers to the type of experience (emotional states and feelings vs. objective descriptions of daily activities), while the second concerns positive or negative connotations of the experiences reported.

Conclusions: This study explored the psychological impact of the first lockdown on people's well-being, and described the process of making sense of the experience during the lockdown 1 month after going back to previous habits. Results highlighted the effectiveness of the mixed-method approach for an in-depth and exhaustive investigation of people's psychological condition during and after the first lockdown.

KEYWORDS

COVID-19 pandemic, psychological effects, Psychological General Well-Being, Perceived Stress, COVID-19-related fear, narratives, mixed-method approach, T-Lab software

Introduction

Italy was the first Western country to face a COVID-19 outbreak, with over 246,000 documented cases and more than 35,000 deaths due to the disease as of July 26, 2020 (Fortunato et al., 2021). Since the first case of COVID-19 in Italy, detected in a town close to Milan on February 20, 2020, the Italian government employed several drastic measures to contain the epidemic within some areas, to prevent a collapse of the healthcare system. However, these proved unable to contain the run of virus, and on 10th March a national quarantine was adopted for the entire Italian population. The first lockdown concluded on 4th May 2020, followed by a second phase (4th May-15th June 2020), characterized by the possibility of visiting close relations and going out for health and work reasons. After 15th June 2020, the third phase was characterized by a partial return to normality, with the possibility of accessing places of entertainment while retaining the obligation to maintain social distances and to wear a mask in enclosed spaces. Since then, several emergency restrictions have been enacted and subsequently eliminated by the Italian authorities. The restrictive measures primarily limited social behaviors: maintaining a social distance of at least one meter; leaving home only if necessary (foods, pharmacy, medical need); and limiting the number of people gathering in public places. Schools were closed and all educational and didactic activities were provided online. Many hospitals restricted ambulatory services and non-emergency admissions. Work habits were also extensively modified: people were only permitted to go to work if it was not possible to carry out the work remotely.

The restrictive measures impacted on all aspects of daily life and the pandemic caused several fears and worries in many people, especially because the new Coronavirus was previously unknown and spread very quickly, claiming hundreds of thousands of victims in a very short time (Lanciano et al., 2020). All these factors contributed to a great distress worldwide (Yu et al., 2020), forcing people to develop new coping strategies to manage daily life, with relevant implications for mental health (Gritti, 2020; Gritti et al., 2020; Li et al., 2020; Mari et al., 2020; Mariani et al., 2020; Yao et al., 2020).

Several studies highlighted a consistent variety of psychopathological manifestations of self-isolation, quarantine, and inactivity (Brooks et al., 2020; D'Ambrosi et al., 2020; Pfefferbaum and North, 2020). Principal outcomes are related to increased levels of stress, anxiety, emotional instability, worry, and depressive symptoms (Winkler et al., 2020), matching the most commonly reported effects in populations that have suffered similar conditions in past adverse events (Ettman et al., 2020). In the Italian scenario, Casagrande et al. (2020) found that the principal predictors of psychological lockdown-related distress were linked to time (long duration of quarantine, boredom), fear of infection (to be infected or infect a close person), agency (frustration), communication (inadequate or ambiguous information), economic (financial loss, impossibility to work), and stigma. Moreover, several surveys were administered to evaluate the level of distress. Mazza et al. (2020) found that gender played a role in the development of anxiety and depression as well as increased levels of stress, while age was a significant factor only for anxiety levels and perceived stress.

During the pandemic, high levels of distress, anxiety, depressive symptoms, negative well-being, decreased quality of sleeping, and decreased vitality and perceived general health are examples of the disturbances experienced due to confinement and uncertainty (Casagrande et al., 2020; Iorio et al., 2020; Moccia et al., 2020; Orgilés et al., 2020; Parrello et al., 2021; Sommantico et al., 2021). Mazza et al. (2020) highlighted that a history of stressful situations and medical problems increased anxiety and depression during national lockdowns. Other authors (Biondi and Iannitelli, 2020; D'Ambrosi et al., 2020; Femia et al., 2020; Boursier et al., 2021) also reported emotional states of anxiety and sadness. This increasing psychological discomfort was evident from the first weeks of the lockdown. To address and prevent it, the Italian National Council of Psychologists encouraged registered specialists to provide online psychological support to the population (Crescenzo et al., 2021a,b; Limone and Toto, 2022).

The COVID-19 pandemic and the subsequent measures of containment have stimulated multiple studies aimed at assessing the impact both on medical staff (Simione and Gnagnarella, 2020; Chirico et al., 2021; Saladino et al., 2022; Tarchi et al., 2022) and on people's psychophysical well-being (Saladino et al., 2020).

During the last couple of years, many studies probed the experience of the first wave of the pandemic through a mixed-method design, collecting both qualitative and quantitative data. Among those studies, those which combined validated questionnaires and open-ended questions or in-depth interviews focused on specific populations, mainly health care workers, nurses and doctors (e.g., Svantesson et al., 2022; Harris et al., 2023; Richards et al., 2023), but also medical students (Rolland, 2022), family caregivers (Leleszi-Tróbert et al., 2022), women with young children (Wandschneider et al., 2022), children with obesity (Welling et al., 2022), supermarket workers (Mayer et al., 2022), and university students (Mourad et al., 2022). To our knowledge, three studies explored the effects of stress during the first wave of the pandemic through a mixed-method design. Two studies focused on the adult population: Bin Helayel et al. (2022) examined stress-related disorders during the quarantine period to underscore the importance of both an early detection of the symptoms and of supporting quarantined individuals. Cipolletta et al. (2022) focused on the episode of the worst experience according to the levels of peritraumatic distress. A third study investigated the impact of the pandemic on youth's daily life according to their levels of post-traumatic growth, their sociodemographic characteristics, and their coping strategies, mainly maintaining social contacts, engaging in leisure activities, and physical exercise (Hébert et al., 2022).

Assuming a different perspective, our research interest was on the impact of the first lockdown on people's well-being, and our study aimed to explore how participants made sense of their experience of the first lockdown 1 month after the resumption of activities (after the third phase). For exploratory and descriptive purposes, we asked people to think back to the period of the first lockdown and to describe how they experienced that period, by means of an open-ended question. In addition, we asked them to rate their state of health and quality of life and sleep during the first lockdown compared to the moment of their participation in the survey. Finally, we measured their state of well-being, perceived stress, and perceived risk of contracting the virus at the time of survey participation through validated questionnaires.

Our research questions concerned:

- **RQ1**: The extent of the psychological impact of the first lockdown, 1 month after going back to one's own previous habits: were participants able to differentiate between the experience of lockdown compared to their actual status as assessed through both self-evaluation (state of health and quality of life and sleep) and validated questionnaires (well-being, perceived stress, and perceived risk of contagion)?

- **RQ2**: The process of sense-making of one's experience during the lockdown: we wanted to assess if participants still felt the fear of the pandemic, the fear of contagion, and the difficulty in resuming activities after the first lockdown or were already able to recall those days through more objective frames. We were also interested in the comparison between the answer to the open-ended question and the results of the questionnaires that measured the level of stress, fear of contagion, and well-being.

Based on the research questions, we hypothesized that participants would report: (1) a more positive self-evaluation of quality of life, sleep, and well-being levels at the time of the survey (1 month after the resumption of activities) compared to the lockdown period; and (2) a worse self-evaluation of perceived stress, perceived risk of contagion, and COVID-19-related fears during the lockdown compared to the time of the survey. We also hypothesized a consistency between the content reported in the open-ended question and the results of the questionnaires measuring stress level, fear of contagion, and well-being.

Materials and methods

Study design and data collection

In this descriptive and explanatory mixed-method study, we collected both quantitative and qualitative data to provide an integrated view of how the COVID-19 pandemic impacted people's psychophysical well-being (McAdams et al., 2001; Anguera et al., 2020; Cipolletta et al., 2022; Mourad et al., 2022). We collected and analyzed self-report validated questionnaires measuring psychological well-being, as well as qualitative data through an open-ended question about the lived experience during the first lockdown period.

A total of 1,325 adults volunteered for the survey and gave their informed consent to data treatment. After eliminating people that answered the first 14 questions only (sociodemographic section), the final sample comprised 855 adults (68.4% females) aged between 18 and 70 years ($M = 40.8$; SD = 13.22). Data were collected using an internet-based self-administered survey delivered in Italian by Survey-Monkey, from the 1st August till the 15th August 2020. The survey was spread via email and social media (LinkedIn, Facebook, and WhatsApp). The online questionnaire required an estimated 15–25 min for the participant to complete it. Participants received information about the aim and procedures of the survey and were asked for informed consent before starting the survey. People over 18 years of age who residing in Italy during the COVID-19 outbreak were eligible to respond to the survey. Participation was completely voluntary, and participants could withdraw from the study at any time.

To assess COVID-19's psychological influence on psychological well-being, we instructed participants to respond to the questionnaire with reference to the COVID-19 epidemic. Data collected when a participant had either taken less than 15 min to complete the test or had not addressed one or more questions were disregarded to ensure the quality of the study.

Measures

Sociodemographic and COVID-19 section

All participants were asked to provide socio-demographic information (e.g., gender, age, level of education, marital status, region of residence, number of children, profession, and changes in work conditions). In addition, they answered some questions regarding their experience during the COVID-19 pandemic in a dedicated section created *ad hoc*. Information was collected about exposure to COVID-19, family members infected by COVID-19, or loss of a family member due to the virus. Participants were asked whether their health condition was aggravated by the virus and about their perceived risk of contracting the virus; they also assessed their perceived quality of life, health status, and sleep quality during the first lockdown and at the time of the survey. Finally, participants described via an open-ended question how their experiences characterized their life during the first lockdown: "*Think back to the lock-down period and tell us about yourself in that period: you can start wherever you want and say whatever you want, you can talk about it or focus on the episode that best represents what you experienced*."

Psychological general well-being index-short version (PGWI-S)

This questionnaire (Grossi et al., 2006) provides a general evaluation of self-perceived psychological health and well-being over the past 4 weeks. It consists of six items that evaluate different aspects of psychological well-being (Anxiety, Vitality, Depressed mood, Self-control, Positive well-being, and Vitality). Each item is rated on a 6-point Likert scale from 0 to 5 (maximum global score = 30). Responses are scored so that higher total PGWB-S scores indicate higher psychological well-being. Cronbach's alpha for the PGWI-S is 0.89.

Perceived stress scale 10 (PSS-10)

This is a 10-item questionnaire that measures the degree of perceived stress over the previous month (Cohen et al., 1983; Fossati, 2010). Participants indicate how often they have felt or thought in a certain way, also including their levels of experienced stress. All the items can be answered on a 5-point Likert scale from 0 (never) to 4 (very often). Higher scores indicate higher stress levels. This is a scale that has reported a good internal and structural consistency. Cronbach's alpha for the PSS is 0.80.

Multidimensional assessment of COVID-19-related fears (MAC-RF)

This questionnaire (Schimmenti et al., 2020) consists of eight items that investigate eight types of COVID-19-related fears: fear of the body, fear for the body, fear of others, fear for others, fear of knowing, fear of not knowing, fear of action, and fear of inaction. The items are grouped into four subscales: fears related to the body, fears related to meaningful relationships, difficulties in cognitive monitoring of concerns, and behavioral difficulties related to fear. Respondents rate all eight items on a 5-point Likert scale ranging from 0 (very unlike me) to 4 (very like me). In literature, authors reported a single-factor structure, satisfactory reliability whereas convergent validity was based on its positive correlation with overall psychopathology. Cronbach's alpha for the MAC-RF is 0.84.

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Data analysis

Descriptive statistics were computed to describe the socio-demographic characteristics of the sample. The Welch *t* test when variances were not homogeneous or the Mann–Whitney test when distributions were not normal were used to assess differences between two groups (e.g., gender), while ANOVA, for correction of non-homogeneous variances, or the Kruskal Wallis test for non-normal distributions were used to assess differences between more than two groups (e.g., education level and civil status). The Wilcoxon rank sum test was used to evaluate changes in quality of life and sleep, health perception, and risk of contracting COVID-19 between the retrospective first lockdown and the survey period (1 month after). Biserial correlations were used to assess changes between main measures and socio-demographic characteristics. Finally, path analysis was used to assess if: (1) psychological well-being was predicted by COVID-19-related fears both directly and through the mediation of perceived stress; and (2) gender moderated the mediation effect, i.e., the effect was stronger for females than males. Data analyses were performed through the software SPSS and JAMOVI (version 2.3.21).

To analyze the answers to the open question in depth and to detect people's experience during the lockdown, a lexicographic analysis was performed with an automatic text analysis tool, the T-LAB software (version T-Lab Plus 2020, Lancia, 2004). The procedure of linguistic and statistical analyses on collected texts consisted of several stages: (1) automatic data processing stage (normalization, vocabulary construction, and corpus segmentation); (2) keywords selection; (3) thematic analysis of elementary contexts; and (4) processing of the results prior to interpretation. Following this process, the results were interpreted by multiple judges (VC, PC, and EC). As for the third phase, the software performed a thematic analysis of the elementary contexts, i.e., a cluster analysis with a bisecting K-Means algorithm, excluding all those elementary contexts that do not present at least two co-occurrences. This procedure constructed a mapping of the corpus contents according to the co-occurrence of the selected keywords and it allowed to organize the text in thematic clusters and analyze recurring words and semantic expressions. That is, clusters were characterized by sets of lexical units that shared the same elementary context units. To choose the number of clusters that were considered for interpretation, reference was made to the number of factors organizing them in space.

Results

Participants' sociodemographic characteristics are reported in Table 1. Most participants (65.3%) lived in the North-Center of Italy and had a high level of education (71.3% having completed a university degree or a post-university degree; 52% having completed high school). Most (73%) were employed (12.5% unemployed or retired and 11.8% students). Among workers (73% of respondents), 27% reported that they never stopped working (even during the lockdown period), 15% went back to work after the first lockdown, and 4.1% did not work or lost their job because of the lockdown.

Most participants (97.9%) declared they were not affected by COVID-19, while 1.5% spent a period at home in quarantine and 0.6% declared they spent a period in the hospital because of COVID-19. Most (75.8%) also declared they did not have a health condition aggravated by COVID-19, while a minority (17.7%) reported that the coronavirus brought them to difficult health

TABLE 1 Socio-demographic characteristics (*N*=855).

	N (%)
Gender	
Male	270 (31.6)
Female	585 (68.4)
Education	
Primary school	3 (0.4)
Secondary school	15 (1.8)
High school	445 (52)
Degree	147 (17.2)
Master's degree/higher	155 (18.1)
PhD	90 (10.5)
Marital status	
Single	336 (39.4)
Married	326 (38.1)
Cohabitant	109 (12.7)
Divorced	71 (8.3)
Widow	13 (1.5)
Region of residence	
Northwest	272 (31.8)
Northeast	115 (13.4)
Center	172 (20.1)
South	169 (19.8)
The Islands	127 (14.9)
Work conditions	
Manager, entrepreneur, freelancer	181 (21.2)
Employee, self-employed	365 (42.7)
Laborer	50 (5.8)
Armed forces	28 (3.3)
Not employed	71 (8.3)
Retired to work	36 (4.2)
Housewife	23 (2.7)
Student	101 (11.8)
About your job (73% of sample)	
I resumed going to work, after having stopped working during the lock down	128 (15)
I went back to work, after having worked in smart-working from home during the lock-down	116 (13.6)
I have never stopped working, even during the lock-down	231 (27)
I am always working in smart working	110 (12.9)
I am not working; I lost my job because of the lock-down	35 (4)
I am not working and was not working even before the lock-down	120 (14)
Other	115 (13.5)

conditions, both physical and psychological. The majority (90.9%) also declared not to have suffered from the loss of relatives and friends because of COVID-19 and 69.1% did not contaminate their family. Finally, almost half the participants (41.3%) declared that COVID-19 caused financial problems for their families.

Daily life, health status, perception of risk, COVID-19-related fears, perceived stress, and psychological well-being

Some participants reported that the COVID-19 pandemic and the first lockdown impacted their daily life habits significantly: 26.9% had no social contact (they could not visit their loved ones such as parents, partners, or friends), 20.3% were not able to go out freely (even for a walk), and 10.6% stayed indoors all the time (see Table 2). Health perception, quality of life, and sleep improved, and the perceived risk of coronavirus infection reduced, from their retrospective assessment of the lockdown period to the survey time (see Table 3).

About COVID-19-related fears, mean and median MAC-RF total scores (21 and 21.5 respectively) resulted to be above the cut-off (20) that, according to Schimmenti et al. (2020), indicates the initial presence of pathological fears in potential need of a clinical consultation. Indeed, most participants (57.9%, $n = 468$) had a score equal to or higher than 20 and 31.1% ($n = 251$) had a score equal or higher than 12, the first threshold indicating the presence of psychological problems in mental, relational, and behavioral functioning. Women showed a significantly but slightly higher median MAC-RF total score than men (Mann–Whitney $U = 57{,}745$, $p < 0.001$, Rank Biserial Correlation = 0,174) and a higher percentage of women than men reported a score equal to or above 20. With respect to education level, participants with a Ph.D./Master/Specialization showed a lower mean score (19.3), and a statistically significant but small difference was found only between them and those with a High School Diploma (21,5). With respect to Civil Status, unmarried participants showed a higher mean score (22.1), and statistically significant differences were found between them and both those cohabiting and those separate/divorced (19.8 and 18.8 respectively).

No statistically significant difference was found in any of the following comparisons: (1) participants who declared to have been infected ($n = 15$) or not ($n = 803$); (2) participants who declared to have loved ones infected ($n = 254$) or not ($n = 554$); and (3) participants who declared to have lost someone due to COVID-19 ($n = 75$) or not ($n = 733$).

Statistically significant and negative correlations were found between the MAC-RF total scores and quality of life, health satisfaction, sleep quality (the higher the values, the lower the score), and risk perception of coronavirus infection (the lower the risk, the lower the score) and the survey period.

With respect to perceived stress, mean and median PSS total scores (19.56 and 20 respectively) indicate moderate stress (Cohen et al., 1983; Lee, 2012). Women showed a significantly but slightly higher median total score than men (Mann–Whitney $U = 58{,}469$, $p < 0.001$, Rank Biserial Correlation = 0.165). Statistically significant and negative

TABLE 2 In which aspect of your life has the Coronavirus had the greatest impact? (multiple choice).

	N	% (of cases)
Social contact: I could not visit my loved ones (parents, partner, friends, etc.).	587	26,90% (69,70)
Being able to go out freely, even for a walk	442	20,30% (52,50)
Environmental insulation (staying indoors all the time)	231	10,60% (27,40)
The ability to engage in recreational activities (cinema, theater, shopping, aperitifs, dinners at restaurants, etc.).	216	9,90% (25,70)
Being able to engage in sports activities	182	8,40% (21,60)
Occupation: having to work/study from home	144	6,60% (17,10)
Employment: I lost my job/my income has decreased	111	5,10% (13,20)
Family management: taking care of the family without external help/services (e.g., managing children or household chores)	96	4,40% (11,40)
Taking care of myself (physical activity, hairdresser, beautician, SPA, massage, etc.)	83	3,80% (9,90)
My health status or that of a family member (I was/They were ill, but I/they have recovered)	49	2,20% (5,80)
Loved ones (I lost someone dear to me to the Coronavirus)	38	1,70% (4,50)
Total	2,179	100%

TABLE 3 Retrospective changes in quality of life and sleep, health perception, and risk of contracting COVID-19 between the first lockdown and 1 month after its conclusion.

Misure	During the first lockdown M (SD)	1 month after the resumption of activities M (SD)	*Z* statistic
Quality of life	3.29 (0.978)	3.78 (0.784)	−13.826***
Health condition	3.56 (1.065)	3.75 (1.004)	−7.261***
Quality of sleep	3.29 (1.065)	3.78 (1.004)	−7.261***
Risk of contracting COVID-19	2.24 (1.393)	2.10 (1.248)	−2.688**

SD: standard deviation.
Wilcoxon rank sum test, non-parametric, (value of p) does not assume normality. Significance values reported as $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

correlations were found with quality of life, health satisfaction, sleep quality (the higher the values, the lower the score), and risk perception of coronavirus infection (the lower the risk, the lower the score).

Psychological well-being (PGWBI-S) mean and median total scores (62.13 and 62.33 respectively) were below the cut-off (70.87) and the differences were statistically significant (one sample $t = -15.854$, df = 809, $p < 0.001$, Cohen's d = 0.557; one sample Wilcoxon $W = 77.169$, $p < 0.001$, Rank Biserial Correlation = 0.53). Women showed a significantly but slightly lower median total score than men (Mann–Whitney $U = 58{,}469$, $p < 0.001$, Rank Biserial Correlation = 0.181). With respect to education level, civil status, and the other factors, no statistically significant difference was found. Statistically significant and positive correlations were found with quality of life, health satisfaction, and sleep quality (the higher the values, the higher the score).

Finally, path analysis showed that the predictive effect of COVID-19-related fears on psychological well-being was both direct and mediated by perceived stress, and that gender moderated the predictive effect of COVID-19-related fears on perceived stress but did not moderate the predictive effect of perceived stress on psychological well-being (see Figure 1).

Lockdown experiences: A qualitative insight

The thematic analysis revealed two main factors (see Figure 2) explaining the thematic variance among the qualitative responses. The first vertical axis explains 30.23% of the lexical variance and relates to

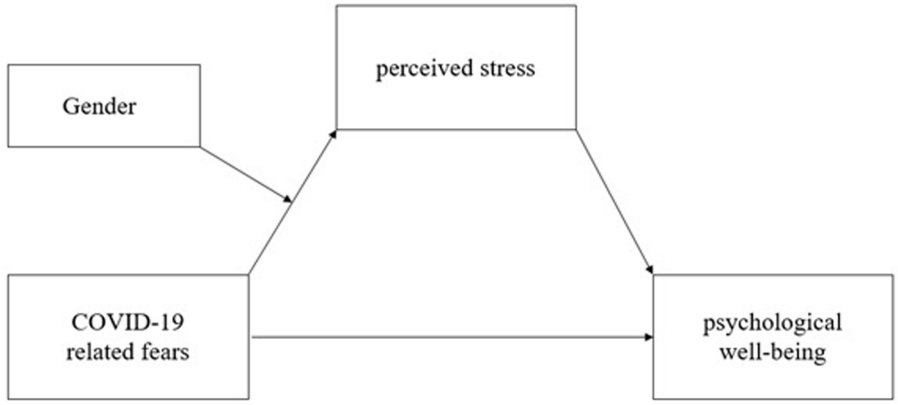

FIGURE 1
The mediation model.

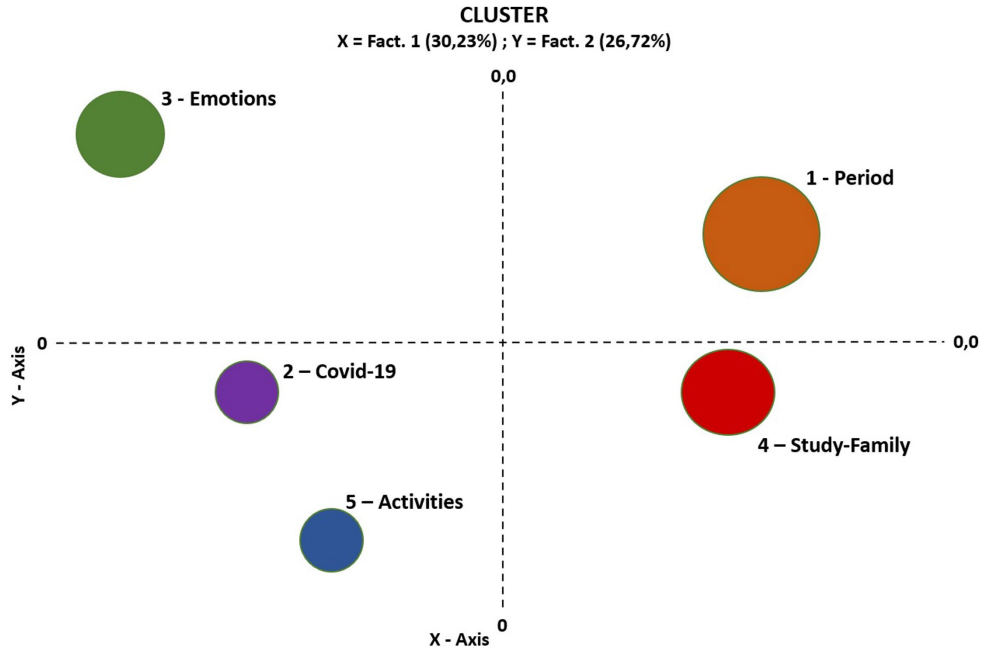

FIGURE 2
Elementary contexts representation.

the type of the experience reported. This first axis contrasts narratives related to emotional states, experiences, feelings (up to the continuum, mainly characterized by terms such as "anxiety," "affection," "thoughts," "nightmare," "fear," and "loneliness") to narratives related to descriptions of activities or everyday life from an objective point of view (down to the continuum, mainly characterized by words such as "working," "smart working," "quitting," "continuing," "from home," "lay-offs," and "exam"). This axis articulates clusters 3 and 1 up to the continuum, and cluster 2, 4, and 5 down to the continuum. The second horizontal axis explains 26.72% of the lexical variance and mainly concerns the positive or negative connotation of the experience analyzed. This axis opposes, at the positive pole, elementary context unit related to a positive experience lived by respondents (i.e., words such as "freedom," "serene," "reflection," "opportunity," and "strong"), and at the negative pole, elementary context unit related to a negative experience lived by respondents (i.e., related words such as "distress," "fear," "sadness," "loneliness," "distance," and "anger"). This axis also opposes clusters 1 and 4 on the right of the continuum, and clusters 3, 2, and 5 on the left of the continuum (Table 4).

Let us now describe each cluster specifically (Table 4). Cluster 1, labeled "period," which explains 27.2% of the thematic variance, classifies 336 elementary contexts (out of the 1,272 classified in the whole corpus). This cluster relates mainly to the qualification of the period either as positive ("*It was fruitful, important*"), or negative (i.e., words such as worry, fragility, stress, withdrawal. For example: "*It has been a beneficial period as I finished my online third year of motor science studies and also preparing my final thesis. This period reunited the family, changed the habits of free time spent playing board games, making special recipes and exercising in the home gym. In summary, it was a period of reflection and hope*"). Cluster 2 labeled "COVID-19," which explains 16.12% of the thematic variance, classifies 197 elementary contexts (out of the 1,272 classified in the whole corpus).

This cluster relates mainly to the impact of COVID-19 on the physical dimension (such as loss of taste and sense of smell), tampons (Covid swabs), daily hospitalization, disease. For example: "*So my husband manages to go out to look after them [children] but I do not, I'm just at home. After a few days when I spray some perfume around the house… I do not smell anything… I do not smell anything… I no longer smell anything… as in a chain everyone follows me, my husband and then Laura… for a good twelve days, no more smells…*" Cluster 3 labeled "Emotions," which explains 19.39% of the thematic variance, classifies 237 elementary contexts (out of the 1,272 classified in the whole corpus). This cluster relates mainly to emotional states related to the lockdown experience. For example: "*A lot of fear at the beginning of having to stay indoors, fear of getting sick but especially of my loved ones getting sick… then a feeling of safety in staying indoors and fear of going out once the lockdown was over.*" Cluster 4 labeled "Study-family," which explains 22.18% of the thematic variance, classifies 271 elementary contexts (out of the 1,272 classified in the whole corpus). This cluster concerns how people tried to reconcile different activities (description of difficulties at school, at university, in the family, etc.). For example: "*I am a working student so after work I spent a lot of time studying and playing with my daughter and family. We dusted off board games and did various activities. I helped my daughter with distance learning.*" Cluster 5 labeled "Activities," which explains 14.81% of the thematic variance, classifies 181 elementary contexts (out of the 1,272 classified in the whole corpus). This cluster mainly relates to work activities (in presence vs. smart working or layoff). For example: "*We asked the company if it was possible to continue with smart working in view of the emergency. The company agreed for the first week but the second I would have to return, but by luck the Prime Minister obliged the companies to work remotely until the situation would return to normal.*"

TABLE 4 Cluster of lockdown experiences.

Cluster	*N*	%	Name
1	336	27.2	Period
2	197	16.12	Covid-19
3	237	19.39	Emotions
4	271	22.18	Study-family
5	181	14.81	Activities

Discussion

Unprecedented situations and fears deeply affected the global population during the first lockdown that was imposed to limit the SARS-COV-2 spread (Yu et al., 2020). The psychological extent of this experience over time was not predictable. Increased levels of stress, anxiety, emotional instability, worry, depressive symptoms, negative well-being, decreased quality of sleeping, decreased vitality and perceived general health, were reported in several studies across countries (*inter alia*, Brooks et al., 2020; Casagrande et al., 2020; D'Ambrosi et al., 2020; Moccia et al., 2020; Orgilés et al., 2020; Winkler et al., 2020; Sommantico et al., 2021). This mixed-method online survey had exploratory purposes and was aimed to detect the psychological impact of the first lockdown on people's well-being, and to understand the process of making sense of the experience during the lockdown, 1 month after going back to previous habits.

Our first research question dealt with the extent of the psychological impact of the first lockdown, 1 month after going back to previous habits (after the third phase). We asked participants to evaluate the experience of lockdown and their actual status and we hypothesized that the participants would report a more positive self-evaluation of quality of life, sleep, and well-being levels at the time of the survey (1 month after the resumption of activities) compared to the lockdown period and a worse self-evaluation of perceived stress, perceived risk of contagion, and COVID-19-related fears during the lockdown compared to the time of the survey.

By the end of the first lockdown respondents began to feel an improvement in perceived quality of life, quality of sleeping, and satisfaction about health. At the moment of the survey, participants acknowledged that their situation was still improving, they appreciated a better quality of life and slept better, they also were more confident in their health and felt more protected from the risk of contagion. Instead, during the lockdown, fear of Covid 19 still reached quite critical and pathological levels; in particular less educated, unmarried, and younger respondents were more impacted. According to Doshi et al. (2021) the higher the education level, the higher the ability to use information on the risk of contracting the infection, and the lower the possibility to develop related fears. The condition of being younger or unmarried may be related to a higher feeling of solitude (Rosenberg et al., 2021; Banerjee and Kohli, 2022). Overall, these data are coherent with the statement given by

participants that social and physical withdrawal were retrospectively the most critical aspects of the first lockdown: fear was felt more strongly by people who lived alone or had fewer strategies, either cultural or personal ones, to deal with it. Fear was also stronger in women: as already known in the literature, women and men reported quite different experiences of the first lockdown, with women generally more psychologically affected by that period (Hossain et al., 2020; Mazza et al., 2020; Winkler et al., 2020; Alsharawy et al., 2021; Doshi et al., 2021; Favieri et al., 2021; Orrù et al., 2021; Quadros et al., 2021; Broche-Pérez et al., 2022a,b).

Following other authors (Alon et al., 2020a,b), we agree that increased levels of anxiety and depression, fear of contagion, and worse quality of sleep may be pooled by cultural factors, mainly the domestic management that involved working mothers in the care of children after the closure of nursery schools and childcare centers. We suggest that fear of contagion may be associated with the forethought of the impact of contagion on the management of domestic issues that would increase the stress due to stressful events (Bitan et al., 2020; Uddin, 2021). The literature shows that women over men tend to prefer jobs with a good work-life balance (Burnett et al., 2010; Mellner et al., 2014; Pace and Sciotto, 2021). As a matter of fact, this aspect might have influenced the stress perception due to working from home and to other work aspects that interfered with home management during the pandemic (İlkkaracan and Memiş, 2021; Lonska et al., 2021). Rossi et al. (2020) pointed out that Italian women who responded to a questionnaire on mental health during the lockdown reported higher levels of adjustment disorders, anxiety, depression, and perceived stress than men. Furthermore, according to Cori et al. (2021), women were more likely to consider the consequences of COVID-19 infection more serious than men, with greater compliance with government-imposed rules to contain the spread of the virus.

The lack of significance between those who had an infected loved one and those who did not, is quite unexpected and it shows that the fear of contracting COVID-19 does not depend on the bond of affection. Moreover, the absence of significant results among people who were infected compared to those who were not can be explained by the inhomogeneity of the two groups (low number of the former compared to the latter). Likewise, the absence of statistical significance among people who have lost a loved one compared to their opposite.

Our second research question was about the process of sense-making of the experience during the lockdown and we hypothesized a consistency between the content reported in the open-ended question and the results of the questionnaires measuring stress level, fear of contagion, and well-being. The content analysis points out two main narratives: the description of emotional states (overall hedonic value of the period), experiences, and feelings opposed to the objective description of daily activities and how they managed to reconcile them (study, family). The second concerns the emotional connotation of the experience through a very rich set of adjectives and expressions from positive to negative ones. Descriptions of changes in daily routines or interpersonal relationships due to the first lockdown already emerged in the narrative research study by Venuleo et al. (2022), however, in our study, participants also provided evaluations of the experience related to this change, which are both negative (fear, loneliness, stress, nightmarish, boring, anger, sadness) and positive (serenity, reflection, freedom, opportunity, strength). During the lockdown, participants in our study recounted feelings of fear related to possible contagion as well as loneliness and sadness at being forced to stay locked in their homes (e.g., Marinaci et al., 2021). At the same time, they tried to reconcile their various activities (work, family) as best as they could, even if there were management difficulties. It was both a period in which they could care for intra-family relations and a period of loneliness and sadness for not being able to visit loved ones, even sick ones. The study by Tomaino et al. (2021) similarly highlighted both the presence of negative emotions and coping modes implemented to deal with lockdown measures. Coherently, authors also noted that the main concerns are related to work aspects and dealing with the separation of one's private and work spheres.

Still, results need to be interpreted in the light of some limitations. The first limitation concerns the convenience sample, which did not allow us to analyze, for example, differences between those who had or had not contracted the virus, or to analyze differences in age or health condition with respect to the lockdown narratives. However, the survey made it possible to collect data from all over Italy and suggested possible territorial differences to be investigated in future studies. Another limitation is the use of self-report measures in the online survey. These measures, especially if administered remotely, may be subject to data collection bias, as they do not ensure consistency of context when compiling the research protocol. As reported in other studies on the COVID-19 pandemic, the adoption of an online survey was the best solution when social distancing measures limited data collection. Finally, although this study is informative regarding how people lived during the first lockdown, inferences drawn from this study through descriptive analyses do not define causal association.

Despite these limitations, from a methodological point of view this study highlights the importance of integrating information from validated quantitative instruments with information gathered in depth by qualitative insight. A mixed-method approach made it possible, on the one hand, to quantitatively understand the impact of COVID-19 on people's daily lives and on their level of well-being, stress, and fear through the use of validated instruments; on the other hand, to collect and understand in depth how participants experienced the period of the first lockdown on each aspect of their lives through the use of a narrative stimulus (e.g., Parola, 2020; Cipolletta et al., 2022).

In conclusion, our study contributes to enriching scientific knowledge regarding the period of the first lockdown in Italy, assessed at approximately 1 month after the third phase.

A month after the first wave of the pandemic, participants in our study were improving their overall sense of wellbeing. The quantitative analyses tell us that they felt better at the time of the survey (in terms of quality of life, health, sleep, fear of contagion) than they did during the lockdown; they also were able to partially return to normalcy, with the possibility of accessing places of entertainment while maintaining social distances and wearing a face mask. People's qualitative narratives of that period denote anxiety, sadness, fear of contagion, but also the discovery of a new daily life as an opportunity to experience relationships and activities in a different way (related to work, school, family, and leisure time management, etc.).

Participants experienced a high level of COVID-19-related fears that affected their personal well-being, mediated, however, by the level of perceived stress. Stress level, as we know, is influenced by difficulties, major events, and changes in adaptive resources daily. Probably, the

unpredictability or uncontrollability of that moment, as well as the fact of being overburdened by everyday life, also influenced the COVID-19-related fears.

The persistence of the fear and the emotional ambivalence in their narratives suggest that psychologists and social professionals should pay particular attention to the sense-making of an unprecedented event such as the COVID-19 pandemic to support a correct reconstruction of experiences as well as of the emotions in the events of that period. Indeed, more vulnerable individuals were more affected by the lockdown: in our study they were less educated, unmarried, and younger adults, while Hébert et al. (2022) pointed out the sufferance of youth gender and sexual minorities. The analysis of the experiences of the first lockdown also allows us to understand what condition people were in when the second wave arrived in the autumn of 2020, resulting in a new lockdown and worsening of the infections. Overall, the results of our study underscore the need for a customized approach in the analysis of the effects and the narratives of the pandemic, in the long term. Given the proportions of the pandemic phenomenon, the experience of the pandemic period has been in flux over the past 3 years. It would therefore be interesting for future studies to understand how after 3 years the pandemic experience has been understood and signified, also because the virus is now close to becoming endemic.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

VC, MC, EC, GM, VM, MP, and DC: conceptualization. VC, GM, PC, and EC: formal analysis. VC, GM, PC, and MC: data curation. VC, MC, PC, GM, AM, and MV: writing–original draft preparation. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Fear of COVID-19 among cancer patients in Henan Province, Central China: causes, results, and coping factors

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Objectives: Cancer patients exhibit fear of COVID-19, which could lead to serious consequences. However, minimal information is available about the effect of the COVID-19 pandemic on the mental health of cancer patients. Therefore, this study aims to examine the fear level of COVID-19 among cancer patients in Henan Province, Central China and to identify its causes, results, and coping factors.

Methods: An online survey was conducted among 1,067 cancer patients. The participants reported their individual fear level of COVID-19, risk of COVID-19 infection, risk of death from COVID-19, COVID-19 vaccination concerns, influence level of COVID-19 pandemic on their disease treatment, loneliness due to COVID-19, economic burden from COVID-19, quality of life, safety behavior, information regarding COVID-19 vaccination, psychological guidance, physical activities, and demographic characteristics. Chi-square and cumulative logistic regression were used to determine the predictors of COVID-19 fear level.

Results: This study indicates that cancer patients report moderate fear level of COVID-19 in Central China (66.9%). The six cause factors (risk of COVID-19 infection, risk of death from COVID-19, COVID-19 vaccination concerns, influence level of COVID-19 pandemic on disease treatment, loneliness due to COVID-19, and economic burden from COVID-19) were positively associated with COVID-19 fear level. Three coping factors (information regarding COVID-19 vaccination, psychological guidance, and physical activities) were negatively associated with COVID-19 fear level. COVID-19 fear level was negatively associated with quality of life and positively associated with safety behavior.

Conclusion: Our results suggest that governments should improve access to personalized vaccine counseling and psychological guidance by undertaking the responsibility of patients' attending physicians and increasing publicity. Physical activities should be included in the treatment program to help cancer patients better recover their physical and mental health.

KEYWORDS

COVID-19 fear level, cancer patients, cause factors, result factors, coping factors, Central China

Introduction

To date, COVID-19 has been spread around the world for 3 years. As a vulnerable group during the COVID-19 epidemic, cancer patients have suffered from a high level of fear associated with COVID-19 (Anuk, 2022). Previous research has shown that more than 90% of cancer patients exhibit moderate or severe fear of COVID-19 (Guven et al., 2020b). Fear of COVID-19 may lead to serious consequences, such as a weakened immune system, treatment compliance disorder, and worsening prognosis, among cancer patients (Erdogan et al., 2022). Therefore, under the realistic background of COVID-19's universalization, we must give attention to public health problems that result from the fear of COVID-19 among cancer patients. Although the number of literature on COVID-19 has increased rapidly, and physical and psychological aspects have been considered, minimal information is available about the effect of the COVID-19 pandemic on the mental health of vulnerable patient groups, such as cancer patients (Musche et al., 2020). What are the causes of their fear? What are the consequences of their state of fear? How should this phenomenon be addressed? Existing research lacks systematic answers to these questions. Accordingly, the current study aims to assess the COVID-19 fear level of Chinese cancer patients and then identify the causes, results, and coping factors of fear of COVID-19.

Causes of fear of COVID-19

At present, scholars have emphasized that an individual's fear of COVID-19 primarily stems from the harm caused by COVID-19 to one's health and the obstacles it poses to socioeconomic development (Mertens et al., 2021). In terms of health factors, cancer patients faced an increased risk of COVID-19 morbidity and mortality compared with the normal population. Previous research has shown that cancer patients with who become infected with COVID-19 have a twofold risk of death (Bernard et al., 2021) and a threefold risk of developing serious complications from COVID-19 compared with those without cancer (Wang et al., 2020). Hence, researchers believe that cancer patients perceive a higher possibility of COVID-19 infection and mortality, increasing their fear level of COVID-19 (Guven et al., 2020b; Yahaghi et al., 2021). Concerns regarding COVID-19 vaccine are also widespread among cancer patients because of the underrepresentation of such patients in the COVID-19 vaccine trial. Moreover, some subgroups of cancer have received different recommendations for vaccination and timing (Fendler et al., 2022; Vanderpool et al., 2022). In Poland, only 40.4% of cancer patients believe that the vaccine is effective for them (Kufel-Grabowska et al., 2021). In the United States, 39% of cancer patients are worried about the vaccine (van der Veldt et al., 2021). Previous research has indicated that concern about the protective effect of the COVID-19 vaccine can increase the fear of COVID-19 among cancer patients (Can and Kurtulus, 2021). In addition to the direct consequences of the pandemic, patients cannot go to hospitals because they worry over becoming infected with COVID-19, along with the prevention and control policies for COVID-19. However, the decline in cancer screening and the cessation of treatment can increase the COVID-19 fear level of cancer patients (Guven et al., 2020b; Anuk, 2022). In terms of socioeconomic factors, cancer patients may suffer from severe loneliness because of the strict social interaction restrictions and isolation policies imposed during the COVID-19 pandemic, which may aggravate the fear of COVID-19 (Humphrey et al., 2022). For cancer patients with economic burden, the decline of income caused by COVID-19 is another reason why they fear COVID-19 (Kirby et al., 2022).

Therefore, we assume that six cause factors are positively associated with COVID-19 fear level, as follows: risk of COVID-19 infection, risk of death from COVID-19, concerns regarding COVID-19 vaccination, influence level of COVID-19 outbreak on disease treatment, loneliness, and economic burden from COVID-19.

Results of fear of COVID-19

For most people, fear of COVID-19 triggers an anxiety response, which is either adaptive (i.e., plays an incentive role in behavior change) or poorly adaptive (i.e., overall quality of life deteriorates) (Korajlija and Jokic-Begic, 2020). Previous research has shown that fear affects the overall quality of life, and this finding has been confirmed in many studies (Naghizadeh and Mirghafourvand, 2021; Demirbas and Kutlu, 2022). In addition to the adverse effects of fear, some studies have indicated that an individual's fear exerts positive effects on safety behavior. Safety behavior, such as handwashing and physical distancing, is adherent and actively prescribed by government authorities during the COVID-19 pandemic to curtail infection rates. However, such behavior requires individuals to incur an immediate cost for the sake of society (Weismuller et al., 2021). Emotion–motivation models predict that negative emotions will lead to avoidance behavior, i.e., safety behavior during the COVID-19 pandemic (Hein et al., 2022). Therefore, numerous studies have demonstrated that safety behavior is associated with fear (Parlapani et al., 2020; Fink et al., 2021). Some scholars have even proposed that fear is one of the most powerful factors that affects safety behavior (Demirtas-Madran, 2021). Negative effects related to COVID-19, such as fear, have been predicted to prompt people to avoid potential sources of infection, improving compliance with safety behavior related to COVID-19.

Therefore, the current study assumes that fear of COVID-19 will lead to two results: quality of life deterioration and adoption of safety behavior. COVID-19 fear level is negatively associated with quality of life and positively associated with safety behavior.

Coping with fear of COVID-19

Previous studies have indicated that coping methods for COVID-19 includes those at the individual and social levels. Firstly, the contribution of the health system to reducing the fear level of COVID-19 is the most important. Vaccination is recognized worldwide as the most important protective measure for reducing the infection and mortality rates of COVID-19. Previous studies have shown that vaccination and vaccine cognition can be associated with an individual's fear level of COVID-19 (Can and Kurtulus, 2021; Gao et al., 2022). Given the different recommendations on vaccination and timing for some subgroups of cancer, cancer patients are more cautious about COVID-19 vaccination and tend to seek professional advice than the general population. Therefore, we believe that professional

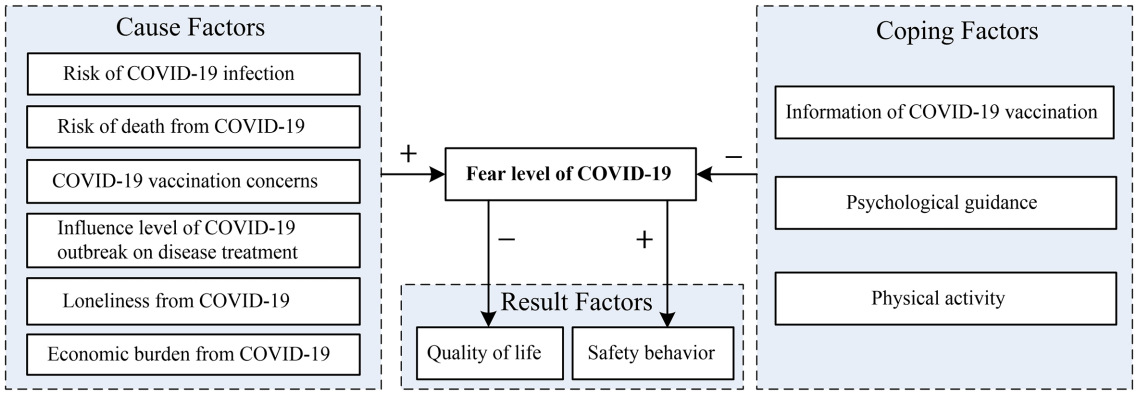

FIGURE 1
Theoretical model for predicting fear level of COVID-19.

vaccination advice can help cancer patients improve their confidence in the effectivity of the COVID-19 vaccine, reducing their COVID-19 fear level. Meanwhile, many studies have proposed that psychological guidance should be strengthened to reduce an individual's fear of COVID-19 (Guo et al., 2022); however, only a few studies have confirmed the value of psychological counseling. Second, in terms of individual-level coping measures, a previous research examined associations between physical activities and mental health during the COVID-19 lockdown in the United Kingdom (Wright et al., 2021) and Arab countries (Alsalhe et al., 2020). The results found that physical activities during the COVID-19 pandemic can counteract the negative effects of fear on mental health. This study suggested that physical activities may play a positive role in reducing the fear of COVID-19.

Therefore, we assume that the coping factors for fear of COVID-19 include the following: information about COVID-19 vaccination, psychological guidance, and physical activities. These factors are negatively associated with COVID-19 fear level.

Characteristics of fear of COVID-19

In addition to causes, results and coping factors of fear level of COVID-19, previous studies have shown that some characteristics factors were associated with COVID-19 fear level. For example, individual with female (Broche-Perez et al., 2020), young (Levy and Cohen-Louck, 2021), unemployed (Levy and Cohen-Louck, 2021), low income (Argabright et al., 2022), low educational status (Cerda and Garcia, 2021), bad health condition (Erdogan et al., 2022) could have high level of fear of COVID-19.

Therefore, we assume that the characteristics factors for fear of COVID-19 include the following: gender, age, education status, job conditions, disease status and so on. These factors will serve as control factors that might affect the dependent variables in this research.

Objective and hypotheses of current research

The current research aims to identify the causes, results, and coping factors that predict an individual's fear level of COVID-19 during the pandemic-related lockdown. This study focuses on a model (Figure 1) that investigates the relationship between cause factors (risk of COVID-19 infection, risk of death from COVID-19, COVID-19 vaccination concerns, influence level of COVID-19 outbreak on disease treatment, loneliness due to COVID-19, and economic burden from COVID-19), results factors (quality of life and safety behavior), coping factors (information regarding COVID-19 vaccination, psychological guidance, and physical activities), and COVID-19 fear level. The literature review indicates that the fear level can affect the quality of life and safe behavior of individuals, while the other factors affect fear level. Therefore, on the basis of the literature, the hypotheses are as follows.

> *H1*: Risk of COVID-19 infection, risk of death from COVID-19, COVID-19 vaccination concerns, influence level of COVID-19 outbreak on disease treatment, loneliness due to COVID-19, and economic burden from COVID-19 are positively associated with COVID-19 fear level.
>
> *H2*: Information regarding COVID-19 vaccination, psychological guidance, and physical activities are negatively associated with COVID-19 fear level.
>
> *H3*: COVID-19 fear level is negatively associated with quality of life.
>
> *H4*: COVID-19 fear level is positively associated with safety behavior.

Methods

Sample population

This cross-sectional study was conducted from December 2021 to March 2022 through the Wen Juan Xing platform, a famous online survey platform in China. A web-based survey was created for cancer inpatients in Henan Province, which has a higher prevalence of cancer in China. The participants received the questionnaire via WeChat (a Chinese social media and messaging application), and they responded using the "Quick Response code" on their mobile phones.

We used the following Cochrane formula to determine the minimum sample size for this study:

$$N = \frac{Z^2 pq}{d^2}$$

where N is the sample size; p is the incidence of cancer among the population in Henan Province (data from the Henan cancer registration annual report in 2021); q is $1 - p$; Z is the standard normal deviation that is typically set at 1.96, corresponding to the 95% confidence interval (*CI*); and d is the degree of desired accuracy, which is set at 0.03 in this study. Therefore, the computed minimum sample size was 846. However, assuming that 10% of the questionnaire responses would be incomplete, the minimum sample size was set at 930 participants.

In this survey, our target population was recruited from two provincial hospitals because of the large number of cross-regional patients, such as city, county, township, or village. Patients with cancer were recruited through the chief nurse of each inpatient area in the sample hospitals. The inclusion criteria were as follows: age ≥ 18 years and living in Henan Province. All cancer patients admitted to the hospitals who met the inclusion criteria and agreed to participate in the survey were included. Patients who could not answer questions because of their mental state or presented severe clinical symptoms were excluded. A total of 1,067 cancer patients completed the survey (meeting the minimum sample requirements). The protocol for the current study was approved by the Life Science Ethics Review Committee of the Zhengzhou University (Approval number: 2021-01-12-05).

Data measures

COVID-19 fear level

COVID-19 fear level was measured using the Fear of COVID-19 Scale (FCV-19S) (Heyne et al., 2022). FCV-19S achieved good internal consistency in this study (Cronbach's $\alpha = 0.85$). FCV-19S include seven items, such as "You are very afraid of COVID-19" and "The thought of COVID-19 makes you feel uncomfortable." The participants indicated their level of agreement on a five-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). The total score was calculated by adding the score of each item. The average scores were then divided into the high, moderate, and low groups.

Causal factors

The causal factors included the following: (1) risk of COVID-19 infection, (2) risk of death from COVID-19, (3) COVID-19 vaccination concerns, (4) influence level of COVID-19 outbreak on disease treatment, (5) loneliness due to COVID-19, and (6) economic burden from COVID-19. The participants indicated their perception level from "high," "medium" and "low."

Coping factors

The coping factors included the following: (1) information regarding COVID-19 vaccination, (2) psychological guidance, and (3) physical activities. Among them, COVID-19 vaccination concerns were assessed using four items, and this variable exhibited good internal consistency in the current study (Cronbach's $\alpha = 0.70$).

Result factors

The result factors of fear of COVID-19 among cancer patients, the dependent variables were quality of life and safety behavior. The degree of quality of life among cancer patients was measured using EQ-5D, which included five items. This variable presented good internal consistency in this study (Cronbach's $\alpha = 0.85$). The degree of safety behavior was measured using five items in accordance with COVID-19 prevention and control measures issued by the National Health Commission in China. It also showed good internal consistency in this study (Cronbach's $\alpha = 0.75$). The participants indicated their level of agreement on a five-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). The total score was calculated by adding the score of each item. The average scores were divided into the high, moderate, and low groups.

Control variables

The control variables included those that might affect the dependent variables on the basis of previous research, namely, individual characteristics (i.e., gender, age, education, and residential area) and disease status (i.e., type of cancer and status of cancer metastasis).

Statistical analysis

All statistical analyses were performed using SPSS 26.0. All variables were presented as frequency distribution and percentage. The chi-square test was employed to investigate the corresponding associations of COVID-19 fear level, degree of quality of life, and safety behavior with the independent and control variables. Only variables with statistically significant differences were included in the cumulative logistic regression model. Variables with $p < 0.05$ (two-tailed) were considered statistically significant.

1. Results

1.1. Sample characteristics

The characteristics of the study population are provided in Table 1. The proportion of males (52.1%) was higher than that of females (47.9%). The majority of the participants were older than 50 years (64.5%) and had an education status above junior high school level (76.0%). The proportion of participants who came from rural areas was higher (64.0%) than that from urban areas (36.0%). The majority of the participants were married (90.8%). Nearly half of participants had jobs (47.2%). In this survey, nearly half (48.0%) of the inpatients were diagnosed with cancer within 1 year. The major cancer types were digestive system cancer (42.5%), followed by respiratory system cancer (15.9%) and mammary gland system cancer (11.7%). The

TABLE 1 Distribution of Individual characteristics, causal factors, result factors, coping factors and COVID-19 fear level in this study's sample (*N*=1,067).

Variables	All participants (%)	Fear level of COVID-19			χ^2	*p*-Value
		High (%)	Middle (%)	Low (%)		
Total participants	*n*=1,067 (100)	*n*=207 (19.4)	*n*=714 (66.9)	*n*=146 (13.7)		
Demographic characteristics						
Gender					7.147	0.028
Male	556 (52.1)	117 (21.0)	352 (63.3)	87 (15.6)		
Female	511 (47.9)	90 (17.6)	362 (70.8)	59 (11.5)		
Age					5.654	0.686
18–29	55 (5.2)	12 (21.8)	22 (60.0)	10 (18.2)		
30–39	130 (12.2)	25 (19.2)	93 (71.5)	12 (9.2)		
40–49	194 (18.2)	36 (18.6)	128 (66.0)	30 (15.5)		
50–59	342 (32.1)	65 (19.0)	235 (68.7)	42 (12.3)		
≥60	346 (32.4)	69 (20.0)	224 (64.9)	52 (15.1)		
Education status					15.827	0.015
Primary school and below	257 (24.1)	40 (15.6)	177 (68.9)	40 (15.6)		
Junior high school	371 (34.8)	63 (17.0)	248 (66.8)	60 (16.2)		
Senior high school	272 (25.5)	58 (21.3)	183 (67.3)	31 (11.4)		
College school and above	167 (15.7)	46 (27.5)	106 (63.5)	15 (9.0)		
Residential area					0.223	0.895
City	384 (36.0)	75 (19.5)	259 (67.4)	50 (13.0)		
Rural	683 (64.0)	132 (19.3)	455 (66.6)	96 (14.1)		
Marital status					1.962	0.375
Married	969 (90.8)	193 (19.9)	643 (66.4)	133 (13.7)		
Others	98 (9.2)	14 (14.3)	71 (72.4)	13 (13.3)		
Job conditions					8.341	0.015
Job	504 (47.2)	115 (22.8)	329 (65.3)	60 (11.9)		
Jobless	563 (52.8)	92 (16.3)	385 (68.4)	86 (15.3)		
Disease status						
Duration of cancer diagnosis					7.796	0.253
Less than one year	512 (48.0)	85 (16.6)	355 (69.3)	72 (14.1)		
One year	303 (28.4)	69 (22.8)	196 (64.7)	38 (12.5)		
Two years	91 (8.5)	18 (19.8)	56 (61.5)	17 (18.7)		
Three years and above	161 (15.1)	35 (21.7)	107 (66.5)	19 (11.8)		
Types of cancer					13.025	0.525
Digestive system	453 (42.5)	98 (21.6)	296 (65.3)	59 (13.0)		
Respiratory system	170 (15.9)	26 (15.3)	114 (67.1)	30 (17.6)		
Mammary gland system	125 (11.7)	18 (14.4)	93 (74.4)	14 (11.2)		
Genitourinary system	39 (3.7)	9 (23.1)	24 (61.5)	6 (15.4)		
Endocrine system	60 (5.6)	11 (18.3)	40 (66.7)	9 (15.0)		
Nervous system	102 (9.6)	23 (22.5)	68 (66.7)	11 (10.8)		
Circulatory system	97 (9.1)	16 (16.5)	65 (67.0)	16 (16.5)		
Other	21 (2.0)	6 (28.6)	14 (66.7)	1 (4.8)		
Status of cancer metastasis					2.413	0.299
No	938 (87.9)	181 (19.3)	634 (67.6)	123 (13.1)		
Yes	129 (12.1)	26 (20.2)	80 (62.0)	23 (17.8)		
Days of hospitalization					10.416	0.034
″3 days	166 (15.6)	31 (18.7)	117 (70.5)	18 (10.8)		
4–6 days	244 (22.9)	39 (16.0)	180 (73.8)	25 (10.2)		
≥ 7 days	657 (61.6)	137 (20.9)	417 (63.5)	103 (15.7)		

(Continued)

TABLE 1 (Continued)

Variables	All participants (%)	Fear level of COVID-19				
		High (%)	Middle (%)	Low (%)	χ^2	*p*-Value
Total participants	*n*=1,067 (100)	*n*=207 (19.4)	*n*=714 (66.9)	*n*=146 (13.7)		
Causal factors of fear of COVID-19						
Risk of COVID-19 infection					41.382	<0.001
High risk	135 (12.7)	45 (33.3)	80 (59.3)	10 (7.4)		
Medium risk	149 (14.0)	20 (13.4)	107 (71.8)	22 (14.8)		
Low risk	543 (50.9)	116 (21.4)	362 (66.7)	65 (12.0)		
Do not know	240 (22.5)	26 (10.8)	165 (68.8)	49 (20.4)		
Risk of death from COVID-19					51.474	<0.001
High risk	551 (51.6)	145 (26.3)	346 (62.8)	60 (10.9)		
Medium risk	203 (19.0)	31 (15.3)	146 (71.9)	26 (12.8)		
Low risk	91 (8.5)	18 (19.8)	59 (64.8)	14 (15.4)		
Do not know	222 (20.8)	13 (5.9)	163 (73.4)	46 (20.7)		
Worry level of COVID-19 vaccination					38.751	<0.001
High	215 (20.1)	61 (28.4)	132 (61.4)	22 (10.2)		
Medium	684 (64.1)	121 (17.7)	483 (70.6)	80 (11.7)		
Low	168 (15.7)	25 (14.9)	99 (58.9)	44 (26.2)		
Influence level of COVID-19 outbreak on disease treatment					35.232	<0.001
High	692 (64.9)	161 (23.3)	459 (66.3)	72 (10.4)		
Medium	254 (23.8)	37 (14.6)	172 (67.7)	45 (17.7)		
Low	121 (11.3)	9 (7.4)	83 (68.6)	29 (24.0)		
Loneliness from COVID-19					29.306	<0.001
Serious	83 (7.8)	33 (39.8)	40 (48.2)	10 (12.0)		
General	384 (36.0)	64 (16.7)	255 (66.4)	65 (16.9)		
Not serious	600 (56.2)	110 (18.3)	419 (69.8)	71 (11.8)		
Economic burden from COVID-19					25.959	<0.001
Serious	506 (47.4)	120 (23.7)	321 (63.4)	65 (12.8)		
General	346 (32.4)	55 (15.9)	256 (74.0)	35 (10.1)		
Not serious	215 (20.1)	32 (14.9)	137 (63.7)	46 (21.4)		
Result factors of fear of COVID-19						
Quality of life					13.362	0.010
Better	309 (29.0)	42 (13.6)	222 (71.8)	45 (14.6)		
General	588 (55.1)	119 (20.2)	390 (66.3)	79 (13.4)		
Worse	170 (15.9)	46 (27.1)	102 (60.0)	22 (12.9)		
Safety behavior					64.029	<0.001
Better	216 (20.2)	75 (34.7)	120 (55.6)	21 (9.7)		
General	714 (66.9)	123 (17.2)	502 (70.3)	89 (12.5)		
Worse	137 (12.8)	9 (6.6)	92 (67.2)	36 (26.3)		
Coping factors of fear of COVID-19						
Information of COVID-19 vaccination					291.618	<0.001
Unobtainable	585 (54.8)	187 (32.0)	342 (58.6)	55 (9.4)		
Not sure	331 (31.0)	12 (3.6)	299 (90.3)	20 (6.0)		
Obtainable	151 (14.2)	8 (5.3)	72 (47.7)	71 (47.0)		
Psychological guidance					49.223	<0.001
Unobtainable	842 (78.9)	189 (22.4)	544 (64.6)	109 (12.9)		
Not sure	112 (10.5)	1 (0.9)	102 (91.1)	9 (8.0)		
Obtainable	113 (10.6)	17 (15.0)	68 (60.2)	28 (24.8)		
Physical Activity					11.375	0.023
Less or never	421 (39.5)	94 (22.3)	286 (67.9)	41 (9.7)		
General	331 (31.0)	60 (18.1)	219 (66.2)	52 (15.7)		
Always	315 (29.5)	53 (16.8)	209 (66.3)	53 (16.8)		

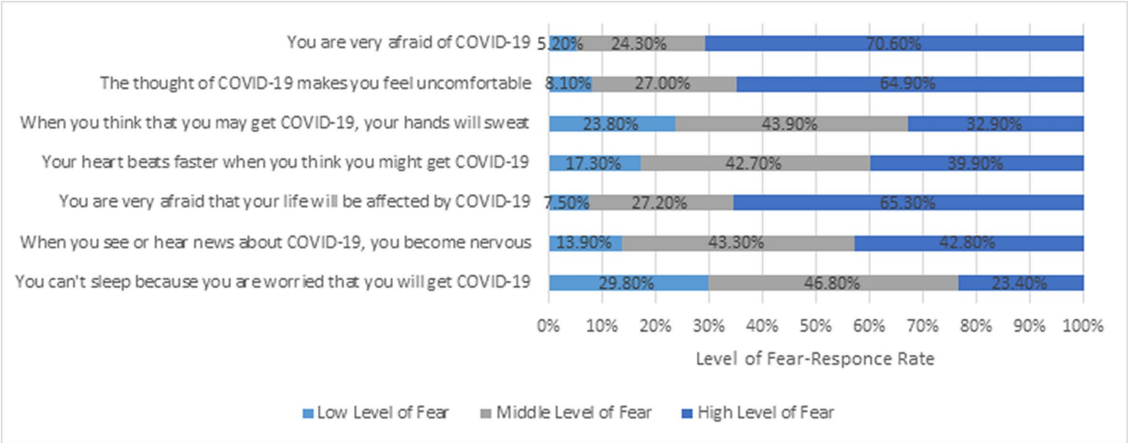

FIGURE 2
Distribution of responses on fear of COVID-19 items (N=1,067).

majority of the participants did not experience cancer metastases (87.9%), and 61.7% were hospitalized for more than 7 days.

Prevalence of COVID-19 fear level

Among the 1,067 cancer patients, 207 expressed a high level of COVID-19 fear (19.4%), while 714 (66.9%) and 146 (13.7%) expressed moderate and low levels of COVID-19 fear, respectively. In terms of specific items (Figure 2), the fear of COVID-19 of cancer patients was mostly manifested through psychological reactions, such as feeling uncomfortable (64.9%), and less through physiological reactions caused by fear, such as sweating hands (32.9%), faster heartbeat (39.9%), or difficulty sleeping (23.4%).

A significant difference was found in COVID-19 fear level in relation to various control variables. A higher fear level of COVID-19 was observed among participants who were female ($\chi^2=7.147$, $p=0.028$), had a high level of education ($\chi^2=15.827$, $p=0.015$), had a job ($\chi^2=8.341$, $p=0.015$), and had a long period of hospitalization ($\chi^2=10.416$, $p=0.034$). Meanwhile, the research showed that causal, result, and coping factors were associated with COVID-19 fear level. A higher fear level of COVID-19 was observed among participants who had higher risk of COVID-19 infection ($\chi^2=41.382$, $p<0.001$), higher risk of death due to COVID-19 ($\chi^2=51.474$, $p<0.001$), more concerns regarding COVID-19 vaccination ($\chi^2=38.751$, $p<0.001$), higher influence on their disease treatment ($\chi^2=35.232$, $p<0.001$), severe loneliness due to COVID-19 ($\chi^2=29.306$, $p<0.001$), serious economic burden from COVID-19 ($\chi^2=25.959$, $p<0.001$), worse quality of life ($\chi^2=13.362$, $p=0.010$), better safety behavior ($\chi^2=64.029$, $p<0.001$), could not obtain information regarding COVID-19 vaccination ($\chi^2=291.618$, $p<0.001$), no psychological guidance ($\chi^2=49.223$, $p<0.001$), and less or no daily physical activities ($\chi^2=11.375$, $p=0.023$). The detailed results are provided in Table 1.

Causes of fear of COVID-19

In this study, half of the participants believed that they had a low risk of COVID-19 infection (50.9%). However, more than half of the cancer patients believed that they had a high risk of dying once they got infected with COVID-19 (51.6%). The majority of the patients had moderate (64.1%) or high (20.1%) level of fear toward COVID-19 vaccination. The majority of the cancer patients believed that the COVID-19 pandemic exerted a high level of influence on their disease treatment (64.9%). Simultaneously, half of the cancer patients expressed a low level of loneliness (56.2%), but nearly half of the participants experienced serious economic burden because of the COVID-19 pandemic (47.4%).

After discovering that gender, education status, job conditions, and days of hospitalization were significantly associated with COVID-19 fear level, these factors were controlled using cumulative logistic regression analysis to examine the causal factors of COVID-19 fear level. The participants who believed that they had a high risk of COVID-19 infection had a higher fear level than patients who unclearly expressed their risk of COVID-19 infection ($\beta=-0.551$, 95% $CI=-1.065$ to -0.038, $p=0.035$). Compared with those who did not know their risk of death due to COVID-19, respondents who had a high ($\beta=-0.927$, 95% $CI=-1.348$ to -0.507, $p<0.001$), moderate ($\beta=-0.643$, 95% $CI=-1.125$ to -0.161, $p=0.009$), and low ($\beta=-0.711$, 95% $CI=-1.302$ to -0.120, $p=0.018$) risk of death when infected with COVID-19 had a higher level of fear of COVID-19. Respondents with high ($\beta=-1.260$, 95% $CI=-1.709$ to -0.810, $p<0.001$) and moderate ($\beta=-0.791$, 95% $CI=-1.164$ to -0.418, $p<0.001$) levels of concern toward COVID-19 vaccination had a higher fear level of COVID-19 than those with a low level of concern. During the COVID-19 pandemic, patients had high ($\beta=-0.941$, 95% $CI=-1.371$ to -0.511, $p<0.001$) and moderate ($\beta=-0.540$, 95% $CI=-1.013$ to -0.068, $p=0.025$) levels of disturbance of their disease treatment apparently had a higher level of COVID-19 fear than those with a low level of disturbance of their disease treatment. Patients who experienced serious loneliness because of COVID-19 had a higher fear level of COVID-19 than those who experienced a low level of loneliness ($\beta=-0.816$, 95% $CI=-1.311$ to -0.321, $p=0.001$). Compared with the respondents whose economic status was less affected by COVID-19, participants who had serious ($\beta=-1.094$, 95% $CI=-1.467$ to -0.722, $P<0.001$) and general ($\beta=-0.693$, 95% $CI=-1.069$ to -0.317, $p<0.001$) economic burden from COVID-19 were more afraid of the COVID-19 pandemic. The detailed results are provided in Table 2.

TABLE 2 Outcome of a cumulative logistic regression model examining causal factors of COVID-19 fear level.

Variables	*B*	*p*-Value	*OR*	95%CI	
				Lower	Upper
Control variables					
Gender					
Male	0.085	0.526	1.088	−0.177	0.347
Female	Ref.				
Education status					
Primary school and below	0.791	0.001	2.206	0.338	1.244
Junior high school	0.649	0.003	1.914	0.227	1.072
Senior high school	0.272	0.206	1.313	−0.150	0.694
College school and above	Ref.				
Job conditions					
Job	−0.388	0.004	0.678	−0.653	−0.123
Jobless	Ref.				
Days of hospitalization					
≤3 days	−0.069	0.713	0.933	−0.435	0.297
4–6 days	−0.018	0.909	0.982	−0.335	0.299
≥7 days	Ref.				
Independent variables					
Risk of COVID-19 infection					
High risk	−0.551	0.035	0.576	−1.065	−0.038
Medium risk	0.208	0.430	1.231	−0.309	0.724
Low risk	−0.287	0.154	0.751	−0.683	0.108
Do not know	Ref.				
Risk of death from COVID-19					
High risk	−0.927	<0.001	0.396	−1.348	−0.507
Medium risk	−0.643	0.009	0.526	−1.125	−0.161
Low risk	−0.711	0.018	0.491	−1.302	−0.120
Do not know	Ref.				
Worry level of COVID-19 vaccination					
High	−1.260	<0.001	0.284	−1.709	−0.810
Medium	−0.791	<0.001	0.453	−1.164	−0.418
Low	Ref.				
Influence level of COVID-19 outbreak on disease treatment					
High	−0.941	<0.001	0.390	−1.371	−0.511
Medium	−0.540	0.025	0.583	−1.013	−0.068
Low	Ref.				
Loneliness from COVID-19					
Serious	−0.816	0.001	0.442	−1.311	−0.321
General	0.029	0.845	1.029	−0.258	0.315
Not serious	Ref.				
Economic burden from COVID-19					
Serious	−1.094	<0.001	0.335	−1.467	−0.722
General	−0.693	<0.001	0.500	−1.069	−0.317
Not serious	Ref.				

Results of fear of COVID-19

Among the 1,067 cancer patients, half of the participants had general (50.9%) or better (14.0%) quality of life, while 15.9% respondents had poor quality of life. During the COVID-19 pandemic, the majority of the participants tended to practice safety behavior (87.1%), while 12.8% of the patients had negative protective behavior. A significant difference was found between quality of life and safety behavior on various control variables. Better quality of life was observed among participants who had a shorter length of cancer diagnosis ($\chi^2 = 15.735$, $p = 0.015$) and shorter days of hospitalization ($\chi^2 = 17.594$, $p = 0.001$). Better safety behavior was observed among

TABLE 3 Distribution of Individual characteristics, disease status and coping factors of COVID-19 fear level in this study's sample (*N*=1,067).

Variables	Quality of life			χ^2 (*p*-Value)	Safety behavior			χ^2 (*p*-Value)
	Better (%)	General (%)	Worse (%)		Better (%)	General (%)	Worse (%)	
Demographic characteristics								
Gender								
Male	167 (30.0)	306 (55.0)	83 (14.9)	1.201 (0.549)	102 (18.3)	371 (66.7)	83 (14.9)	6.016 (0.049)
Female	142 (27.8)	282 (55.2)	87 (17.0)		114 (22.3)	343 (67.1)	54 (10.6)	
Age								
18–29	19 (34.5)	28 (50.9)	8 (14.5)	14.872 (0.062)	13 (23.6)	35 (63.6)	7 (12.7)	3.357 (0.910)
30–39	49 (37.7)	69 (53.1)	12 (9.2)		32 (24.6)	84 (64.6)	14 (10.8)	
40–49	57 (29.4)	112 (57.7)	25 (12.9)		34 (17.5)	134 (69.1)	26 (13.4)	
50–59	99 (28.9)	186 (54.4)	57 (16.7)		70 (20.5)	226 (66.1)	46 (13.5)	
≥60	85 (24.6)	192 (55.7)	68 (19.7)		67 (19.4)	234 (67.8)	44 (12.8)	
Education status								
Primary school and below	73 (28.4)	134 (52.1)	50 (19.5)	7.309 (0.293)	44 (17.1)	164 (63.8)	49 (19.1)	13.624 (0.034)
Junior high school	102 (27.5)	209 (56.3)	60 (16.2)		82 (22.1)	246 (66.3)	43 (11.6)	
Senior high school	79 (29.0)	150 (55.1)	43 (15.8)		54 (19.9)	188 (69.1)	30 (11.0)	
College school and above	55 (32.9)	95 (56.9)	17 (10.2)		36 (21.6)	116 (69.5)	15 (9.0)	
Residential area								
City	114 (29.7)	217 (56.5)	53 (13.8)	2.033 (0.362)	83 (21.6)	249 (64.8)	52 (13.5)	1.172 (0.556)
Rural	195 (28.6)	371 (54.3)	117 (17.1)		133 (19.5)	465 (68.1)	85 (12.4)	
Marital status								
Married	282 (29.1)	531 (54.8)	156 (16.1)	0.440 (0.802)	198 (20.4)	645 (66.6)	126 (13.0)	0.604 (0.740)
Others	27 (27.6)	57 (58.2)	14 (14.3)		18 (18.4)	69 (70.4)	11 (11.2)	
Job conditions								
Job	145 (28.8)	280 (55.6)	79 (15.7)	0.087 (0.958)	95 (18.8)	339 (67.3)	70 (13.9)	1.753 (0.416)
Jobless	164 (29.1)	308 (54.7)	91 (16.2)		121 (21.5)	375 (66.6)	67 (11.9)	
Disease status								
Duration of cancer diagnosis								
Less than one year	161 (31.4)	285 (55.7)	66 (12.9)	15.735 (0.015)	102 (19.9)	343 (67.0)	67 (13.1)	1.190 (0.977)
One year	93 (30.7)	162 (53.5)	48 (15.8)		63 (20.8)	198 (65.3)	42 (13.9)	
Two years	20 (22.0)	49 (53.8)	22 (24.2)		19 (20.9)	62 (68.1)	10 (11.0)	
Three years and above	35 (21.7)	92 (57.1)	34 (21.1)		32 (19.9)	111 (68.9)	18 (11.2)	
Types of cancer								
Digestive system	111 (24.5)	261 (57.6)	81 (17.9)	38.036 (0.001)	99 (21.9)	310 (68.4)	44 (9.7)	26.693 (0.021)
Respiratory system	51 (30.0)	94 (55.3)	25 (14.7)		24 (14.1)	119 (70.0)	27 (15.9)	
Mammary gland system	33 (26.4)	76 (60.8)	16 (12.8)		23 (18.4)	84 (67.2)	18 (14.4)	
Genitourinary system	7 (17.9)	27 (69.2)	5 (12.8)		9 (23.1)	20 (51.3)	10 (25.6)	
Endocrine system	19 (31.7)	35 (58.3)	6 (10.0)		15 (25.0)	33 (55.0)	12 (20.0)	
Nervous system	50 (31.7)	40 (39.2)	12 (11.8)		27 (26.5)	62 (60.8)	13 (12.7)	
Circulatory system	33 (34.0)	42 (43.3)	22 (22.7)		18 (18.6)	69 (71.1)	10 (10.3)	
Other	5 (23.8)	13 (61.9)	3 (14.3)		1 (4.8)	17 (81.0)	3 (14.3)	
Status of cancer metastasis								
No	280 (29.9)	509 (54.3)	149 (15.9)	3.140 (0.208)	183 (19.5)	635 (67.7)	120 (12.8)	2.785 (0.248)
Yes	29 (22.5)	79 (61.2)	21 (16.3)		33 (25.6)	79 (61.2)	17 (13.2)	
Days of hospitalization								
″3 days	58 (34.9)	91 (54.8)	17 (10.2)	17.594 (0.001)	27 (16.3)	121 (72.9)	18 (10.8)	3.350 (0.501)
4–6 days	67 (27.5)	151 (61.9)	26 (10.7)		50 (20.5)	163 (66.8)	31 (12.7)	
≥ 7 days	184 (28.0)	346 (52.7)	127 (19.3)		139 (21.2)	430 (65.4)	88 (13.4)	

participants who were female ($\chi^2 = 6.016$, $p = 0.049$) and had higher educational background ($\chi^2 = 13.624$, $p = 0.034$). The detailed results are presented in Table 3.

After discovering that the duration of cancer diagnosis, types of cancer, and days of hospitalization were significantly associated with quality of life, while gender, education status, and types of cancer were significantly associated with safety behavior, these factors were controlled using cumulative logistic regression analysis to examine the result factors on COVID-19 fear level. The results revealed that compared with patients with low fear level of COVID-19, respondents

TABLE 4 Outcome of a cumulative logistic regression model examining COVID-19 fear level of quality of life.

Variables	*B*	*p*-Value	*OR*	95%CI	
				Lower	Upper
Control variables					
Duration of cancer diagnosis					
Less than one year	−0.484	0.007	0.616	−0.839	−0.130
One year	−0.399	0.038	0.671	−0.776	−0.022
Two years	0.077	0.763	1.080	−0.425	−0.580
Three years and above	Ref.				
Types of cancer					
Digestive system	0.031	0.944	1.031	−0.823	0.885
Respiratory system	−0.182	0.688	0.834	−1.068	0.704
Mammary gland system	−0.038	0.933	0.963	−0.940	0.863
Genitourinary system	−0.004	0.994	0.996	−1.041	1.034
Endocrine system	−0.386	0.436	0.680	−1.356	0.585
Nervous system	−0.845	0.071	0.430	−1.762	0.072
Circulatory system	−0.164	0.727	0.849	−1.087	0.759
Other	Ref.				
Days of hospitalization					
″3 days	−0.444	0.010	0.641	−0.781	−0.108
4–6 days	−0.241	0.104	0.786	−0.532	0.050
≥ 7 days	Ref.				
Independent variables					
Fear level of COVID-19					
High	0.548	0.010	1.730	0.132	0.965
Medium	0.022	0.902	1.022	−0.327	0.370
Low	Ref.				

with a high level of COVID-19 fear apparently had worse quality of life ($\beta = 0.548$, 95% $CI = 0.132$ to 0.965, $p = 0.010$). Participants with high ($\beta = -1.560$, 95% $CI = -2.020$ to -1.100, $P < 0.001$) or moderate ($\beta = -0.514$, 95% $CI = -0.897$ to -0.131, $p = 0.009$) COVID-19 fear level could demonstrate better safety behavior than those with low fear level. The detailed results are provided in Tables 4, 5.

Coping with fear of COVID-19

In terms of coping measures, approximately half (54.8%) of the participants expressed that personalized information regarding COVID-19 vaccine and psychological guidance (78.9%) could not be obtained. Only 29.5% of the participants had physical activities.

After discovering that gender, education status, job conditions, and days of hospitalization were significantly associated with COVID-19 fear level, these factors were controlled for using cumulative logistic regression analysis to examine the causal factors on COVID-19 fear level.

Cancer patients who could not obtain personalized information regarding COVID-19 vaccination ($\beta = -2.983$, 95% $CI = -3.424$ to -2.542, $p < 0.001$) and psychological guidance ($\beta = -1.461$, 95% $CI = -1.931$ to -0.991, $p < 0.001$) had a higher level of fear than the respondents who could obtain them. Compared with participants who had better physical activities, the respondents who exercised less or never exercised had a high level of COVID-19 fear ($\beta = -0.431$, 95% $CI = -0.753$ to -0.109, $p = 0.009$). The detailed results are provided in Table 6.

Discussion

This study indicates that cancer patients reported a moderate level of fear of COVID-19 in Central China. During the lockdown, the majority of cancer patients were psychologically afraid and had no corresponding physiological reaction. However, about 30% of the respondents had already presented physiological responses, such as sweaty hands, fast heartbeat, and difficulty sleeping, because of fear of COVID-19 infection. This phenomenon is threatening the disease rehabilitation of cancer patients. Furthermore, females experienced higher levels of fear of COVID-19 than males. This finding is parallel to a meta-analysis of gender and fear of COVID-19 (Metin et al., 2022). Cancer patients with a high level of education tend to have higher fear level of COVID-19 than others. This result is contrary to those of previous studies on the general population (Cerda and Garcia, 2021). Similarly, the result showed that employed cancer patients had

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TABLE 5 Outcome of a cumulative logistic regression model examining COVID-19 fear level of safety behavior.

Variables	*B*	*p*-Value	*OR*	95%CI	
				Lower	Upper
Control variables					
Gender					
Male	0.488	0.001	1.629	0.210	0.766
Female	Ref.				
Education status					
Primary school and below	0.427	0.047	1.533	0.005	0.849
Junior high school	−0.078	0.695	0.924	−0.468	0.312
Senior high school	0.029	0.890	1.029	−0.379	0.437
College school and above	Ref.				
Types of cancer					
Digestive system	−1.025	0.030	0.359	−1.950	−0.100
Respiratory system	−0.584	0.232	0.558	−1.542	0.374
Mammary gland system	−0.506	0.313	0.603	−1.490	0.478
Genitourinary system	−0.301	0.598	0.740	−1.421	0.819
Endocrine system	−0.782	0.144	0.457	−1.833	0.268
Nervous system	−0.963	0.057	0.382	−1.955	0.028
Circulatory system	−0.856	0.093	0.425	−1.853	0.141
Other	Ref.				
Independent variables					
Fear level of COVID-19					
High	−1.560	<0.001	0.210	−2.020	−1.100
Medium	−0.514	0.009	0.598	−0.897	−0.131
Low	Ref.				

higher COVID-19 fear level than those who were unemployed; the difference is from Inna Levy and Keren Cohen-Louck (Levy and Cohen-Louck, 2021). This result could be attributed to employed patients being more afraid of unemployment caused by COVID-19. Meanwhile, this study revealed that cancer patients with a long period of hospitalization had a high level of COVID-19 fear. This finding suggests that the attending physician should pay attention to the mental health of such patients in addition to disease treatment.

This study constructed a model that included six cause factors, two result factors, three coping factors, and fear level of COVID-19. The data supported our hypotheses. This study's major findings indicate that six cause factors (risk of COVID-19 infection, risk of death from COVID-19, COVID-19 vaccination concerns, influence level of COVID-19 outbreak on disease treatment, loneliness due to COVID-19, and economic burden from COVID-19) are positively associated with COVID-19 fear level. Meanwhile, three coping factors (information regarding COVID-19 vaccination, psychological guidance, and physical activities) are negatively associated with COVID-19 fear level. In terms of result factors, COVID-19 fear level is negatively associated with quality of life and positively associated with safety behavior.

Our findings indicated that individuals had a high fear level of COVID-19 when they thought they had a high risk of COVID-19 infection, high risk of death from COVID-19, high concern level toward COVID-19 vaccination, and high influence level of COVID-19 outbreak on disease treatment. These factors are primarily related to the health status of the participants. For cancer patients, the COVID-19 pandemic exacerbates their concerns about their own health problems, particularly when the effectiveness of COVID-19 vaccination may be insufficient or have COVID-19 vaccination contraindications. In addition, 64.9% of cancer patients experienced a high level of treatment delays due to COVID-19 in the present research. A series of effort had been exerted to stop the spread of COVID-19 worldwide, although these policies could disturb normal medical behavior. Hence, this finding is in line with a survey in the Netherlands whereby chemotherapy, immunotherapy, or radiotherapy for many cancer patients was postponed or cancelled (Guven et al., 2020a; van der Veldt et al., 2021; Barik et al., 2022). However, patients' fear of COVID-19 grew as a result of the delay in treatment. Providing normal health care services during the COVID-19 pandemic is a practical problem that must be solved urgently. Furthermore, cancer patients who suffer from severe loneliness and economic burden from COVID-19 had a high level of fear of COVID-19. This result is consistent with a previous survey of the general population (Nurnberger et al., 2022). In China, most hospitals require that inpatients not be allowed to visit during the COVID-19 pandemic, increasing the loneliness of cancer patients. This result further support the previous content that cancer patients with a long period of hospitalization had a high level of COVID-19

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TABLE 6 Outcome of a cumulative logistic regression model examining coping factors of COVID-19 fear level.

Variables	*B*	*p*-Value	*OR*	95%CI	
				Lower	Upper
Control variables					
Gender					
Male	−0.006	0.966	0.994	−0.269	0.257
Female	Ref.				
Education status					
Primary school and below	0.353	0.105	1.423	−0.074	0.779
Junior high school	0.447	0.028	1.564	0.049	0.884
Senior high school	0.206	0.328	1.229	−0.207	0.619
College school and above	Ref.				
Job conditions					
Job	−0.287	0.034	0.751	−0.552	−0.021
Jobless	Ref.				
Days of hospitalization					
≤3 days	0.024	0.897	1.024	−0.342	0.391
4–6 days	−0.013	0.938	0.987	−0.330	0.305
≥7 days	Ref.				
Independent variables					
Information of COVID-19 vaccination					
Unobtainable	−2.983	<0.001	0.051	−3.424	−2.542
Not sure	−1.711	<0.001	0.181	−2.137	−1.286
Obtainable	Ref.				
Psychological guidance					
Unobtainable	−1.461	<0.001	0.232	−1.931	−0.991
Not sure	−0.869	0.004	0.419	−1.468	−0.270
Obtainable	Ref.				
Physical Activity					
Less or never	−0.431	0.009	0.650	−0.753	−0.109
General	−0.137	0.427	0.872	−0.475	0.201
Always	Ref.				

fear, which could be associated with being lonely. Meanwhile, the increasing economic burden caused by COVID-19 seems to have become a concern of people worldwide (Argabright et al., 2022). This issue could be more serious for cancer patients because they need to expend on disease treatment.

Our findings indicated that individuals with a high fear level of COVID-19 could have a worse quality of life and adopt active safety behavior. As defined by the World Health Organization, quality of life is based on people's understanding of different aspects of their life. It is related to the value system of the country where they are living and their goals, expectations, standards, and priorities. During the COVID-19 pandemic, individuals of mental quality of life is directly affected by fear of COVID-19 that develop negative emotions and psychological problems. Then, other aspects could be affected, such as physical pain or decreased immunity. Hence previous research has the same results as the current study (Naghizadeh and Mirghafourvand, 2021; Demirbas and Kutlu, 2022). The decline in quality of life is one of the most serious consequences of the COVID-19 pandemic in addition to health status. Although fear of COVID-19 has exerts a considerable side effect on individuals, it still has some positive effects. This study demonstrated that fear COVID-19 will help individuals actively improve their health awareness and practice more effective safety behavior. This result is consistent with many theories, such as emotion–motivation model (Hein et al., 2022) or protection–motivation model (Bhati et al., 2021). For cancer patients, active safety behavior is an effective approach to protecting themselves from COVID-19 infection, particularly those with diseases that require delayed vaccination as per protocol. However, we must give attention to the non-recommended safety behavior due to excessive fear of COVID-19 (Kohler et al., 2021), such as excessive hoarding of food, which requires the joint effort of the whole society.

Furthermore, our research demonstrated the effectiveness of three mainstream coping measures in dealing with fear of COVID-19. First, providing professional COVID-19 vaccination

advice to cancer patients is an effective way to reduce their fear. Although a large number of scientists worldwide believe that the safety of COVID-19 vaccines can be guaranteed (Gundavda and Gundavda, 2021), some cancer patients remain skeptical about the safety and effectiveness of COVID-19 vaccination, because the existing vaccination recommendations for cancer patients are an extension of the findings of the clinical trials based on the general population. Concurrently, COVID-19 vaccination suggestions vary for cancer patients with different types, which may lead to confusion among patients. As mentioned earlier, worry and confusion about COVID-19 vaccination will increase cancer patients' fear level of COVID-19. Therefore, providing professional COVID-19 vaccination advice to cancer patients is a necessary measure for improving vaccination rate and reducing fear level of COVID-19. However, our research showed that only 14.2% of cancer patients have received professional advice on COVID-19 vaccination. Second, psychological counseling is also an internationally recognized effective measure to help individual reduce their fear level of COVID-19 (Loscalzo, 2022). Our research also proves this result. However, very few people receive psychological counseling at present. This research showed that 86.3% of respondents have medium and high levels of COVID-19 fear, while only 10.6% patients have used psychological guidance. Previous studies have also shown that cancer patients do not need psychological counseling, although they suffer from depression and anxiety (Mo et al., 2022). These results indicate that cancer patients do not recognize the importance of psychological counseling. Therefore, the health system should focus on how to improve the rate of providing personalized vaccine counseling and psychological guidance during the COVID-19 pandemic, such as undertaking this responsibility by their attending physicians. Finally, our finding indicated that physical activities also play a positive role on reducing the fear level of COVID-19. Previous studies have suggested that physical exercise as therapy can counteract or at least mitigate the mental and physical consequences of COVID-19-induced restrictive measures (Jimenez-Pavon et al., 2020). Therefore, some scholars have proposed that physical activities should be incorporated as part of cognitive behavior therapy during the COVID-19 pandemic (Ho et al., 2020).

Limitations

This study has several shortcomings. First, the study only included participants who were under cancer treatment during the execution of the study. Meanwhile, data were collected via online questionnaires by utilizing the convenience sampling approach instead of probability sampling, limiting the representativeness of the whole population with cancer. Second, our research focused on analyzing six cause factors, two result factors, and three coping factors of COVID-19 fear level based on previous research and reality. However, factors related to the fear level of COVID-19 are complex and require further research in the future. Third, this study is based on self-reports; therefore, the results represent participant's subjective assessment of some variables, such as influence level of COVID-19 outbreak on disease treatment. Therefore, future studies should consider examining our model by using objective data.

Conclusion

The contributions of this study are theoretical and practical. It contributes to the body of literature by presenting a model for predicting the causes, results, and coping factors of COVID-19 fear level. In accordance with our model, individuals with a high risk of COVID-19 infection, high risk of death from COVID-19, high level of concern toward COVID-19 vaccination, high influence level of COVID-19 pandemic on disease treatment, severe loneliness, and economic burden from COVID-19 can lead to a high level of fear of COVID-19. Cancer patients with a high level of COVID-19 fear will have worse quality of life and active safety behavior. Furthermore, cancer patients with fear of COVID-19 can be reduced by obtaining information about COVID-19 vaccination, psychological guidance, and physical activities. Therefore, the authors suggest that governments should improve access to personalized vaccine counseling and psychological guidance during the COVID-19 pandemic by undertaking the responsibility of patients' attending physicians and increasing publicity. Moreover, physical activities should be part of the treatment program to help cancer patients better recover their physical and mental health.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the Life Science Ethics Review Committee of the Zhengzhou University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

YMA, YMI, JW, and JZ: conceptualization. YMA, WM, DK, HF, and BZ: data curation. YMA, HF, and BZ: formal analysis. YMA and JW: funding acquisition. YMA, WM, DK, HF, and BZ: investigation. YMA and YMI: methodology. JW, and JZ: project administration. YMA and JW: writing and review editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1122894/full#supplementary-material

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From economic difficulties to psychological maladjustment in Italian women during the Covid-19 pandemic: does marital dissatisfaction moderate or mediate this association?

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Introduction: The empirical study about the negative impact of economic difficulties due to Covid- 19 on the psychological well-being of Italian women by considering perceived stress and marital satisfaction is an area worthy of investigation. The study explored these variables by hypothesizing that marital satisfaction (DAS) could moderate or mediate the links between economic difficulties, perceived stress (PSS), and psychological maladjustment (PGWBI).

Methods: A total of 320 Italian women completed an online survey about the study's variables during the lockdown period. Women's perceptions of economic difficulties due to COVID- 19 restrictions were detected through an ad-hoc specific question. Perceived stress, marital satisfaction and psychological maladjustment were assessed by standardized questionnaires (Perceived Stress Scale 10, Dyadic Satisfaction Scale and Psychological General Well-being Inventory).

Results: 39.7% of women who answered the online survey said that the Covid-19 significantly impacted their family income. Results indicated that marital satisfaction did not moderate the associations investigated. Conversely, data showed how economic difficulties (X) predicted lower psychological maladjustment through the mediation of perceived Stress (M1), which, in turn, was associated with higher levels of marital dissatisfaction (M2).

Conclusion: The results of the present study confirm the significant role of marital dissatisfaction in explaining the indirect effects of economic difficulties on psychological maladjustment in women. In particular, they indicated a significant spillover effect which transmitted strains experienced in one domain (economic difficulties) to another (the dissatisfaction of the couple), which in turn affected the psychological maladjustment.

KEYWORDS

COVID-19, economic difficulties, perceived stress, marital satisfaction, psychological maladjustment, women

Introduction

The lockdowns imposed because of the COVID-19 pandemic in European Countries and overseas impacted people at different levels, with consequences on the psychological well-being of the people involved as well as implications for their income (Brooks et al., 2020; International Labour Organization, 2020). Confining lockdown measures, including self-isolation, and the suspension of superfluous activities, led to a consequent reduction in work hours, income loss, and job loss for many workers (Crayne, 2020; Hensher, 2020; Matthews et al., 2021; McDowell et al., 2021). The economic difficulties and the worries and uncertainty of the future led to a condition of financial strain - the subjective stress about financial concerns – which impacted many individuals and families (Friedline et al., 2021; Hertz-Palmor et al., 2021). Several surveys undertaken during the COVID-19 pandemic showed that unemployment, economic difficulties, and financial strain predicted higher levels of psychological distress and mental health disorders (Achdut and Refaeli, 2020; Kelley et al., 2020; Armour et al., 2021). More specifically, both loss of job/income (objective financial hardship) and perceptions of financial strain (the subjective feeling of economic well-being) were related to psychological maladjustment in terms of anxiety and depressive symptoms (Hertz-Palmor et al., 2021). Some authors (Ruengorn et al., 2021; Trógolo et al., 2022) suggested that the subjective perceptions of financial strain had more damaging effects on mental health (particularly on anxiety, depression, and perceived stress) than objective economic indicators (i.e., income or job loss). Conversely, other scholars suggested that objective financial hardship, such as job loss, unemployment, and lower income or loss of income, during the pandemic led to more psychological distress and depressive symptoms (Crayne, 2020; Pierce et al., 2020; van der Velden et al., 2020). Specifically, some European studies (Pierce et al., 2020; van der Velden et al., 2020) showed that, during the pandemic, people who lost their job, were unemployed, or had no income were more distressed than individuals who were employed or already unemployed before COVID-19. Similarly, other studies from the U.S. demonstrated that low income, lack of savings, and unemployment were risk factors for depression during the COVID-19 pandemic compared with pre-pandemic (Ettman et al., 2020; Fitzpatrick et al., 2020; Twenge and Joiner, 2020).

These findings outlined the associations between the COVID-19 related decrease in financial security and the deterioration in mental health. Indeed, individuals with higher economic difficulties and financial strain could perceive more psychological distress, which in turn promoted the onset of anxiety, depression, and a series of other mental health problems (Wilson et al., 2020; Witteveen and Velthorst, 2020; Hertz-Palmor et al., 2021). Specifically, some studies demonstrated that psychological distress due to financial strain led to the onset of anxious and depressive feelings or the exacerbation of depression (Wilson et al., 2020; Witteveen and Velthorst, 2020; Hertz-Palmor et al., 2021).

During the pandemic, economic difficulties and financial strain also harmed couple relationships by promoting greater dissatisfaction with marriage and lower relationship commitment, resulting in more frequent conflicts (see Epifani et al., 2021 for a review). For example, Balzarini et al. (2020) showed how economic difficulties, perceived stress, and confining lockdown measures were negatively associated with the couple's relationship quality. In a recent meta-analysis, Falconier and Jackson (2020) indicated how economic strain impacted the quality of the couple's relationship functioning, independently from sociodemographic factors, study design, or sample type.

The impact of financial stress on the quality of the couple's relationships and psychological well-being has already been pointed out in the past literature (Kelley et al., 2022). Several studies showed how objective financial stressors, such as unstable income and perceived financial stress, predicted lower levels of marital satisfaction (Gudmunson et al., 2007; Archuleta et al., 2011; Stewart et al., 2017) and an increase in marital conflicts and marital dissolution (Dew et al., 2012). To explain the association between external stress (such as economic difficulties) and marital satisfaction, literature introduced the notion of "spillover effect." The spillover effect refers to a situation when stress felt in one domain (e.g., work or couple) is transmitted to another domain (e.g., family/parenting behaviors) and negatively impacts the well-being of individuals in their other roles (Kouros et al., 2014). Many studies (e.g., Frone, 2003; Ilies et al., 2007; Kouros et al., 2014) have found that job stressors can spill over to the family domain and increase partner distress and marital dissatisfaction. More specifically, according to Pietromonaco and Overall (2020), unemployment, economic strain, and work difficulties could spill over and negatively impact the quality of the couples' relationship by creating a context in which partners are distracted, fatigued, or overwhelmed. As a result, the partners could become conflictual and critical, give less support, and become less happy with their romantic relationship.

Moreover, literature indicated how deteriorated marital relationships could be a link between economic difficulties and psychological maladjustment. For example, Romeo et al. (2022) suggested that people who indicated a negative impact of COVID-19 on their family income reported a deteriorated couple relationships and higher levels of internalizing symptoms and post-traumatic symptoms.

During the Covid-19 pandemic, the study of Pieh et al. (2020, 2021) showed how the couple's relationship quality was related to mental health and well-being. They found that good relationship quality predicted higher levels of psychological well-being and mental health.

The protective role of a good marital relationship on mental health was also outlined in several previous studies (Horwitz et al., 1996; Simon, 2002; Williams, 2003; Thoits, 2011) that showed how, according to the stress-buffering model (Cohen and Wills, 1985), significant others may buffer the harmful effects of stressful events on mental health through providing emotional support and active coping assistance. Indeed, if individuals receive emotional support from their significant others, in case of external stressors, they will be more effective in mobilizing their resources and become less prone to suffer from psychological maladjustment (Jesus et al., 2016; Viseu et al., 2018).

With specific reference to the negative impact of economic difficulties on mental health, some researchers (Conger et al., 1999; Lincoln and Chae, 2010) indicated that a good marital relationship might protect against economic hardship and reduce some negative affect that frequently accompanies economic pressure. More specifically, Lincoln and Chae (2010) investigated whether marital satisfaction moderates the influence of economic difficulties on psychological distress among African Americans. Results showed how marital satisfaction had a protective role in moderating the negative effects of financial difficulties on psychological distress. Moreover, Viseu et al. (2018) assessed the association between economic difficulties and the symptoms of stress, anxiety, and depression by

testing the moderating effect of informational, practical, and emotional support from significant others on these associations. Results showed the moderating effects of support from significant others regarding the association between economic stress and mental health. Similarly, another recent study (Chai, 2023) investigated the association between economic difficulties and psychological distress by exploring how this link could be mediated by sleep problems and moderated by marital status (a moderated mediation model). Results showed that economic problems predicted psychological distress through the partial mediation of sleep problems. Moreover, marital status moderated the associations between economic problems and psychological distress and between sleep difficulties and psychological distress.

Considering the above-cited literature, we were interested in exploring a line of research that is almost blank and rife with potential for exploration. Specifically, we decided to investigate the predictive role of economic difficulties on psychological maladjustment in Italian women by focusing on marital satisfaction as both a potential protective factor (moderator) or explicative mechanism of this association (mediator).

The present study had two aims. The first one is to explore the role of marital satisfaction in moderating the indirect effects of economic difficulties on women's psychological maladjustment through the mediation of perceived stress. According to the literature (Lincoln and Chae, 2010; Chai, 2023), we supposed that marital satisfaction could exert a protective role by reducing the negative impact of economic difficulties and perceived stress on women's psychological adjustment.

The second aim is to explore the potential spillover effect from economic difficulties to women's psychological maladjustment by considering the serial mediation of perceived stress and marital dissatisfaction. In other words, based on the literature (Epifani et al., 2021; Friedline et al., 2021; Hertz-Palmor et al., 2021), we hypothesized that economic difficulties during the Covid-19 outbreak could predict the onset of higher levels of perceived stress which, in turn, negatively affects the couple's relationship with consequences for psychological adjustment.

The focus is on women because research (Reizer et al., 2020) has shown that they were more prone than men to stress and psychological adjustment problems during the COVID-19 period. Specifically, women reported higher levels of internalizing symptoms, depression, anxiety, and stress during the COVID-19 pandemic in China (Wang et al., 2020) and in 25 European countries (Gamonal-Limcaoco et al., 2020).

Methods

Procedure

A web-based survey was created on the Qualtrics Platform and spread through different social media sites (the survey link was posted on Facebook, LinkedIn, and Instagram, with a snowball sampling via WhatsApp) from April 2020 to July 2020. The survey was directed to married or cohabiting women, who were asked to answer some questions about sociodemographic characteristics and to fill out some questionnaires about the study's variables during the lockdown period.

Participation in the survey was voluntary, and women had to give their informed consent to participate as well as to data treatment before starting to answer the questions. The survey took approximately 20 min to be completed. In the treatment of the participants, we have followed APA guidelines and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

TABLE 1 Demographic characteristics of the study sample (*N* =320).

		N	*Percentage*
Education	High School Degree or Less	166	52.0%
	More than High Scool Degree	154	48.0%
Profession pre Covid-19	Simple professions/ Housewife/Unemployed/	30	9.4%
	Skilled Workers	33	10.3%
	Service and sales occupations	*131*	40.9%
	Professionals in scientific, tecnical and human fields	*32*	10%
	Lagislators, Mangers and Executives	*94*	29.4%
Professional Condition in the Lockdown Period	Housewife/Unemployed	30	9.4%
	Face to Face Working	50	15.6%
	Smart Working	148	46.3%
	Job Interruption	88	27.5%
	Job Loss	8	2.5%
Relational Status	Married	243	75.9%
	Cohabitants	77	24.1%
Family Income	17.000 Euro or less	147	45.9%
	From 17.000 to 35.000 Euro	156	48.8%
	More than 35.000 Euro	17	5.3%

Participants

For the survey (which addressed married or cohabitant women with children), 320 Italian women aged between 30 and 58 years old ($M = 42.48$; $DS = 6.0$) agreed to participate and provided data. A summary of the participant's demographic characteristics is displayed in Table 1. In short, a significant number of women were married (76%; duration of marriage or cohabitation: $M = 13.0$; $DS = 7.8$), well educated (48% with more than a high school degree), and with a total family income ranging from 17.000 to 35.000 euro (49%).

Measures

Economic difficulties

Women's perceptions of Economic Difficulties due to COVID-19 restrictions were detected through an *ad-hoc* specific question: "*Did the restrictive measures due to the Covid-19 emergency negatively impact your family income, with a consequent condition of concern, tension, and stress?*." The answers were dichotomously coded as "Yes" =1; or "Not" = 0. We used a dichotomous response as we are primarily interested in detecting the appraisal of the presence/absence of a negative economic impact of Covid-19. 39.7% of the sample indicated that the restrictive measures negatively impacted their family income.

Perceived stress

The women's perceived stress was assessed with the Perceived Stress Scale (PSS-10). The PSS-10 (Cohen et al., 1983; 1988; Italian version Fossati, 2010) is a self-report measure consisting of 10 items aimed to measure self-reported stress in terms of "H*ow unpredictable, uncontrollable, and over-loaded respondents find their lives*." Participants are asked to answer each question on a Likert scale ranging from 0 (never) to 4 (very often). The PSS-10 total score ranges from 0 to 40, with higher scores indicating higher levels of perceived stress. In this study, the value of the internal consistency of the measure was found to be high for the *Perceived Stress Scale* ($\alpha = 0.84$).

Marital satisfaction

The women's marital satisfaction was measured with the Dyadic Adjustment Scale (DAS; Spanier, 1976); Italian validation by Gentili et al. (2002). The DAS is a measure that assesses the quality of marital adjustment, and it has four subscales: (1) *Dyadic Consensus* (13 items), (2) *Dyadic Satisfaction* (10 items), (3) *Affective Expression* (4 items), and (4) *Dyadic Cohesion* (5 items). In the present study, due to the survey length, we administered only the *Dyadic Satisfaction* items to gain information about the level of women's *marital satisfaction* (in terms of positive interactions or conflicts and thoughts of separation/divorce). In the study of the Italian validation of the DAS (Gentili et al., 2002), the internal consistency value for Marital *Satisfaction* was: $\alpha = 0.87$, in this sample, the internal consistency of this Scale was also high ($\alpha = 0.81$).

Psychological maladjustment

The participant's psychological maladjustment was assessed using the Psychological General Well-being Inventory (PGWB; Dupuy, 1984). We used the Italian Short Version of the measure (Grossi et al., 2006), which is composed of six items that refer to these sub-scales: positive well-being, self-control, general health, vitality, anxiety, and depression. Higher scores show better psychological adjustment. In our sample, the internal consistency of the Total Score was high: $\alpha = 0.86$.

Data analysis

Point-serial correlations were used to investigate the associations between the variables.

Measures of central tendency (mean or median and absolute and relative frequencies) and dispersion (standard or interquartile deviation) were first computed to describe the sample. Descriptive statistics such as Skewness, Kurtosis, and boxplot were also used to inspect data distributions and to find outliers.

A Point-biserial correlation matrix was computed to investigate the associations between the predictor economic difficulties (a categorical variable) and the other variables of the study. Path analyses were performed to test the hypothesized relationships within a moderated mediation model and a serial mediation model. We used the Process Macro for SPSS (Hayes and Preacher, 2013) with Model 59 for the moderated mediation model and with Model 6 for the serial mediation model, which was estimated with a bias-corrected bootstrap sampling method (5,000 samples) because it is particularly suitable for small samples (Hayes, 2012). "A value of p of 0.05 was set as the critical level for statistical significance (for the analysis of indirect effects, if the 95% confidence interval includes 0, then the indirect effect is not significant at the 0.05 level, while if the interval does not include 0, is not in the interval then the indirect effect is statistically significant at the 0.05 level" (Hayes, 2013, p. 633).

The first model allowed exploring whether marital satisfaction (W) moderated the indirect effects of economic difficulties (X) on psychological maladjustment(Y) through perceived Stress (M).

The serial mediation model allowed for exploring the indirect effects of economic difficulties (X) on psychological maladjustment (Y) through perceived stress (M1) and marital satisfaction (M2) as serial mediators.

Results

Descriptive and correlational analyses

Descriptive statistics, point-biserial, and Pearson correlations are reported in Table 2. Means and standard deviations of scores in all scales were similar to those found in other Italian and international studies with normative samples (Grossi et al., 2006; Camisasca et al., 2016, 2019; Grabowski et al., 2021). Economic difficulties were significantly associated with perceived stress, marital satisfaction, and psychological maladjustment (r from −0.13 to 0.17), and perceived stress was correlated with both marital dissatisfaction ($r = 0.27$) and psychological maladjustment ($r = -0.69$).

The moderated mediation model

This model (see Figure 1) allowed exploring whether marital satisfaction (W) moderated the indirect effects of economic difficulties (X) on psychological maladjustment (Y) through perceived stress (M).

TABLE 2 Descriptive, point-biserial, and Pearson correlational results.

	M	*SD*	*Percentage*	1	2	3	4
1. Economic difficulties (Specific question)	–	–	39.7%	–			
2. Perceived stress (PSS-10)	18.21	7.0	–	0.178**	–		
3. Marital satisfaction (DAS)	39.77	5.9	–	−0.131*	0.270**	–	
4. Psychological maladjustment (PGWBI-S)	17.50	5.1	–	−0.138*	−0.699**	0.276**	-

$N = 320$; M, means; SD, standard deviation; $^{**}p < 0.01$; $^{*}p < 0.05$.

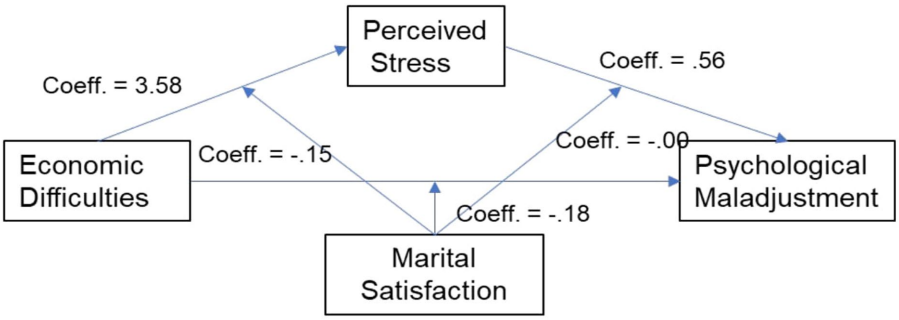

FIGURE 1
The moderated mediation model.

In the analyses, we also considered the effect of family income as a possible covariate.

Results showed that economic difficulties resulted in predicting the perceived stress (Coeff. = 3.58; $p < 0.01$; LLCI-ULCI: 0.58;6.59), while marital satisfaction did not moderate this association (Coeff. = −0.15; p 0.16; LLCI-ULCI: −0.36;0.06). Marital satisfaction did not even moderate the effect of economic difficulties on the psychological maladjustment (Coeff. = 0.18; p 0.08; LLCI-ULCI: −0.40;0.02) nor the effects of perceived stress on psychological maladjustment (Coeff. =0.003; p 0.06; LLCI-ULCI: −0.001;0.01). Finally, the indirect effect of economic difficulties on women's psychological maladjustment through the mediation of perceived stress ($R^2 = 0.50$; $F = 53.03$; $p < 0.01$; Eff. =0.37; LLCI-ULCI: −1.29; −2.04), was not moderated by marital satisfaction (*Index of Moderated mediation;* −0.08; LLCI-ULCI: −0.20;0.09). The covariate family income did not exert a predictive role on both perceived stress (Coeff. = 0.67; $p = 0.06$; LLCI-ULCI: −0.04;1,40) and psychological maladjustment (Coeff. = −0.16; $p > 0.05$; LLCI-ULCI: −0.53;0.20).

The serial mediation model

This model (see Figure 2) allowed for exploring the indirect effects of economic difficulties (X) on psychological maladjustment (Y) through perceived stress (M1) and marital satisfaction (M2) as serial mediators. In the analyses, we also considered the effects of family income as a possible covariate.

The total effect of economic difficulties on psychological maladjustment was statistically significant (Coeff. =0.93, $p < 0.05$; *c path*), while the direct effect was not found to be significant (Coeff. = 0.10 $p = 0.81$; *c path*). Additionally, significant indirect effects were found ($R^2 = 0.49$; $F = 104.25$; $p < 0.001$). In particular, the first indirect pathway passed from X (economic difficulties) to Y (psychological maladjustment) through M1 (perceived Stress: Coeff. = 0.91; LLCI-ULCI: −1.98−0.09). The second indirect pathway passed from X (economic difficulties) to Y (psychological maladjustment) through M1 (perceived stress) negatively affecting M2, marital satisfaction (Coeff. = −0.04; LLCI-ULCI: −0.10;.−0.00).

The covariate family income did not exert a predictive role on either perceived stress (Coeff. = 0.66; $p = 0.06$; LLCI-ULCI: −0.02;1.34) or psychological maladjustment (Coeff. = −0.18; $p > 0.05$; LLCI-ULCI: −0.54;0.18).

Discussion

The Covid-19 pandemic involved an increase in economic difficulties with a consequent perceived psychological stress and a worsening of both mental health (Codagnone et al., 2020) and quality of family relationships (Pietromonaco and Overall, 2022). Thus, during the Covid-19 pandemic, some studies explored the predictive role of economic difficulties on both mental health and couple relationships (Balzarini et al., 2020; Falconier and Jackson, 2020). However, no study focused on marital satisfaction as a potential moderator or mediator of the effects of these associations. For this reason, we conducted a study in order to: (1) investigate the role of marital satisfaction in moderating the indirect effects of economic difficulties on psychological maladjustment through the mediation of perceived stress and (2) explore the potential spillover effect from economic difficulties to psychological maladjustment through the serial mediation of perceived stress and marital dissatisfaction.

Regarding the first aim, path analyses indicated that marital satisfaction did not moderate the indirect effects of economic difficulties on psychological maladjustment. In other words, we did not detect a protective role of marital satisfaction in decreasing the predictive impact of economic difficulties on psychological maladjustment. Results showed that economic difficulties predicted perceived stress which, in turn, predicted psychological maladjustment. However, these associations were not moderated by marital satisfaction.

The negative impact of economic difficulties on psychological maladjustment is consistent with the results of other contemporary studies, which showed that, aside from the utilitarian aspect of compensation, individuals derive significant meaning and value from their work (Crayne, 2020; Matthews et al., 2021; McDowell et al., 2021). As Crayne (2020, p. 180) suggested, "Work is a source of motivation and expression of personal beliefs that people hold as inextricable from their self-concept. Moreover, workplaces are a primary source of high-quality interpersonal interaction and relationship-building for many adults. Therefore, given the considerable proportion of adult life generally spent at work, it is reasonable that economic difficulties and work restrictions during the Covid-19 pandemic could have negatively contributed to psychological maladjustment." However, in contrast with the buffering hypothesis (Cohen and Wills, 1985), which states that some factors, such as marital satisfaction (Rosand et al., 2011, 2012), may protect against

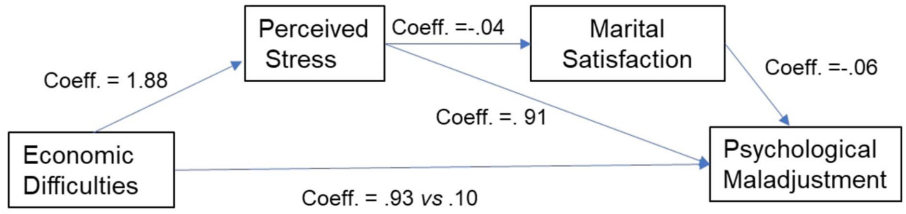

FIGURE 2
The serial mediation model.

severe effects of certain strains, this study's results did not confirm the protective role of marital satisfaction. This finding aligns with the one reported by Balzarini et al. (2022, p. 24), who stated that "partner responsiveness is less effective in alleviating the strain from financial stress and financial concerns may be less mitigable through a partner's support". That is, when a partner feels lonely or stressed, a responsive partner could provide support through either spending time with his/her partner (to relieve loneliness) or being supportive of the stress. However, a partner's support may not help relieve the financial strain because economic stressors may persist despite a partner's responsiveness (e.g., if an individual loses a job, a partner's support and responsiveness might not be useful to mitigate financial concerns and economic difficulties). In line with our results, Shi and Whisman (2023) in a recent longitudinal study showed that marital satisfaction did not moderate the association between acute stressful life events and depressive symptoms.

Concerning the second aim, results showed a significant *spillover effect* from economic difficulties to psychological maladjustment. The spillover effect was detected through higher levels of perceived stress and marital dissatisfaction. Our results about the predictive effect of economic difficulties on perceived stress are consistent with those of the literature (Harvey and Bray, 1991; Achdut and Refaeli, 2020; Friedline et al., 2021; Hertz-Palmor et al., 2021), which showed that unemployment and economic difficulties had high psychological costs, including the potential loss of meaning in life, impairment of personal identity, and the reduction of self-esteem that an individual typically draws from his/her job. Therefore, economic difficulties and strain promoted higher worry, tension, unhappiness, pessimism, and perceived stress.

Our data also indicated that the adverse emotional climate due to perceived stress spilled over to the couple's relationship by increasing marital dissatisfaction and unhappiness. This result is also consistent with the literature (Pietromonaco and Overall, 2020; Işık and Kaya, 2022), which showed that increased levels of perceived stress led to decreased spousal support and marital satisfaction during the Covid-19 pandemic. Specifically, Pietromonaco and Overall (2020, p. 4) argued that "external stress made it difficult for partners to be responsive to each other because they were distracted, fatigued, or overwhelmed. As a result of this emotional climate, partners can become overly critical or argumentative, blame their partner, provide poorer support, and, over time, become less satisfied with their partner and relationship." Again, Turliuc and Candel (2021) indicated that higher levels of external stress were associated with subsequent lower marital satisfaction during the Covid-19 pandemic, particularly for women.

Another significant result of our study is that the quality of the couple's relationship, denoted by unhappiness and dissatisfaction, was directly associated with psychological maladjustment in women. This result is in line with previous studies (see Falconier et al., 2015), which showed that extra-dyadic stress is directly and indirectly related to lower psychological well-being through increased intra-dyadic stress from relationship problems. In particular, the female extra-dyadic and intra-dyadic stress negatively affected relationship satisfaction and posed more risks for marital quality.

In sum, the results of the present study confirm the significant role of marital dissatisfaction in explaining the indirect effects of economic difficulties on psychological maladjustment in women. In particular, they indicated a significant spillover effect which transmitted strains experienced in one domain (economic difficulties) to another (the dissatisfaction of the couple), which in turn affected the psychological maladjustment.

Limitations and future directions of research

A series of limitations affect the findings of this study. The first one is that only one individual in the couple (a woman) was involved, preventing the analyses of the interplay between the couple's members. Examining both partners and using dyadic data would have improved the knowledge of the associations of the considered variables. Second, the cross-section design of the study cannot demonstrate any causal effect. Results should thus be interpreted cautiously, and bi-directional effects could be considered. For example, we could also explore how economic difficulties affect psychological maladjustment, which in turn could be associated with marital dissatisfaction. Third, the sociodemographic homogeneity of participants and the small sample size limit the generalizability of results, even though the bootstrapping method could partly overcome this limitation. Another limitation is due to the single-item question used to assess the economic difficulties. We used a single-item query with a dichotomic answer to detect the presence/absence of economic difficulties (due to the pandemic). The use of an interval-level scale could have allowed a better and more detailed understanding of the degree of Covid-19 economic impact. Moreover, although we considered the family income as a covariate in the mediational analyses, the exploration, in further research, of other variables (the sample's professional condition before and during the Covid pandemic) could be useful to better understand the associations investigated.

Moreover, another limitation consisted in administering only the items of the subscale dyadic satisfaction of the Dyadic Adjustment Scale (DAS). Indeed, exploring the other dimensions of this scale could allow an in-depth understanding of the role of the quality of the

couple's relationship in the associations investigated. A last limitation is related to the self-reported data because it is well known that self-report measures assessing sensitive information can be affected by social desirability, which could have inflated some associations.

Despite these limitations, the results of the present study can contribute to the advancement of knowledge about the effect that economic difficulties during the Covid-19 pandemic had on women's psychological well-being through the mediation of both perceived stress and marital dissatisfaction. Longer-term studies could indicate whether these changes in relationship satisfaction remain a temporary phenomenon or will continue after the Covid-19 pandemic and, eventually, substantiate increased risks of partnership dissolution. Moreover, our results substantiate the importance of better understanding the associations between economic difficulties, marital satisfaction, and psychological maladjustment by assuming the interdependence between husband and wife. Therefore, future studies could consider the crucial aspects of interpersonal interaction in intimate relationships using an analysis method focused on the internal correlation of couple data. In this perspective, the actor–partner interdependence model (APIM, Kenny and Cook, 1999) can be used to investigate dyadic paired data, which can be examined directly at the dyadic level, as well as roles and partnerships.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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An investigation into teachers' occupational well-being and education leadership during the COVID-19 pandemic

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Introduction: The COVID-19 pandemic has necessitated rapid adjustments by teachers to ensure effective education. This shift in circumstances has created a more challenging working environment for teachers, leading to growing concerns about their occupational well-being both nationally and globally. While adapting to change and sustaining professional well-being are crucial for teachers, it is equally important to address their well-being during the pandemic. This study aims to contribute to the existing literature by employing questionnaires and semi-structured interviews to explore the occupational well-being of in-service teachers in Hanoi, Vietnam. Additionally, it seeks to examine their perceptions of school leaders' efforts to enhance teachers' well-being during the COVID-19 pandemic.

Methods: Convenience sampling was utilized to collect questionnaire data from 103 in-service teachers and lecturers in Hanoi, Vietnam, between 2021 and 2022. Moreover, a purposive sampling approach was employed to select eight participants for semi-structured interviews. The questionnaires and interviews formed the primary methods of data collection for this study.

Results: The findings of this study indicate that, overall, the participants exhibited a moderate level of occupational well-being. It was also observed that the participants received support from school leaders in terms of professional development, flexibility, and well-being activities during the COVID-19 pandemic. These results provide valuable insights for teachers to understand their personal occupational well-being and contribute to institutional awareness.

Discussion: The outcomes of this study have significant implications for teachers and principals. They shed light on the promotion of teachers' occupational well-being during this critical period. Furthermore, the study illustrates how education stakeholders can play a role in enhancing teachers' well-being. The discussion delves into the importance of personal occupational well-being and institutional awareness, emphasizing the need for collaboration among various stakeholders to create a conducive environment for teachers.

KEYWORDS

teachers' well-being, education leadership, education policy, COVID-19, professional development

Introduction

The global Coronravirus disease 2019 (COVID-19) outbreak has profoundly influenced individuals' mental health and well-being (Holmes et al., 2020). Since March 2020, teachers have been confronted with increasing standards and fewer resources, so they are not immune to these effects (Kim and Asbury, 2020). Due to the current health crisis, schools, universities, institutes, and colleges around the globe have been forced to implement emergency remote teaching, which refers to a temporary adjustment in instructional delivery as a replacement for face-to-face schooling (Daniel, 2020; Fuchs, 2022). In an effort to prevent the development of COVID-19 in Vietnam, the Ministry of Education and Training (MOET) issued a directive for schools to use remote learning via television or the Internet to ensure the continuation of students' education (Nguyen, 2020). Previously predicated on traditional face-to-face education, the unanticipated restructuring of the school system resulted in significant shifts in learning and teaching practices (Trung et al., 2020). In the midst of the COVID-19 pandemic, instructors must adjust fast to continue and assure the quality of education delivery, and their work environment appears to be increasingly demanding. Understanding the occupational well-being of teachers is crucial, given that insufficient well-being might have severe consequences for the profession. It can, for instance, result in educators leaving the profession (Kim and Asbury, 2020), increase the financial load on the educational system (Carver-Thomas and Darling-Hammond, 2017), and have uncertain effects on the learning outcomes of children (Zhou and Yao, 2020). Developing conditions for recognizing and promoting teacher well-being, especially occupational well-being during the pandemic, should therefore be a major priority.

While research on mental health and well-being during the COVID-19 pandemic has largely focused on students, there has been a lack of recognition and acknowledgment of teachers' well-being, experiences, and needs in relation to their work (Lee, 2020). Although there have been studies on teacher, few have specifically examined teachers' mental health and welfare during unprecedented events like the COVID-19 pandemic. Ideally, supporting teacher well-being would involve ensuring adequate salaries and benefits, manageable workloads, professional development opportunities, and support from employers and the government (Wu and Lu, 2022). However, the current situation in Vietnam falls short of this ideal, with many teachers facing challenges such as low salaries, heavy workloads, and limited support, leading to high-stress levels and burnout (Hoang et al., 2020). These challenges have been exacerbated by the COVID-19 pandemic.

Given the need for further research on teachers' occupational well-being during the COVID-19 pandemic, this study aims to investigate the levels of occupational well-being among in-service teachers in Hanoi. Understanding these perspectives can provide valuable insights for school leaders and policymakers seeking to improve teachers' well-being.

In this sense, this paper aims to answer two specific research questions:

- What are the occupational well-being levels of Hanoi's in-service teachers during the COVID-19 pandemic?
- What do teachers in Hanoi believe school administrators could do to improve teachers' occupational satisfaction?

By examining these questions, this study aims to contribute to the existing literature by providing insights into the unique experiences of teachers during the COVID-19 pandemic and identifying strategies that can support their well-being.

Literature review

Teachers' occupational well-being during the COVID-19

Occupational well-being refers to the meaning and satisfaction that individuals obtain from their jobs (Doble and Santha, 2008). Similarly, Collie and collaborators defined job-related well-being as "individuals' positive evaluations and healthy functioning in the workplace" (Collie et al., 2015). The theoretical and practical significance of teachers' occupational well-being cannot be overstated. It is related to teacher burnout, psychological health, physical fitness, and student motivation and achievement (Bauer et al., 2006; Shen et al., 2015; Klusmann et al., 2016). Diener et al. (1999) identify the presence of positive aspects, such as job satisfaction and work passion, and the absence of negative experiences, such as stress and emotional distress, as indicators of teachers' occupational well-being, which refers to their optimal psychological performance and experience at work (Ryan and Deci, 2000). This study utilizes the definition of teachers' occupational well-being as "teachers' responses to the cognitive, emotional, health, and social situations associated with their work and profession" (Viac and Fraser, 2020). This adoption is based on the fact that Viac and Fraser (2020) take into account the established major components of teachers' occupational well-being. In particular, their emphasis on the occupational aspect of teacher well-being shows the relationships between teacher well-being, teachers' practice, and the impact on the education system and students.

COVID-19, a coronavirus, was officially declared a pandemic by the World Health Organization on March 12, 2020. The global pandemic of COVID-19 and the consequent societal limitations enforced by governments around the world have had extensive social and psychological repercussions (Passos et al., 2020). The COVID-19 pandemic has wreaked havoc on school systems worldwide and numerous schools in Vietnam are transitioning from conventional face-to-face teaching to distance education (MOET, 2020; Trinh, 2021).

The quick shift to remote teaching during the COVID-19 outbreak may have altered the demands instructors faced at work (Pöysä et al., 2021). This is important to note from the perspective of teachers' occupational well-being. Several studies on the well-being of teachers during the COVID-19 pandemic revealed a variety of stressors and work-related requirements during school closures. UNESCO, for instance, asserts that uncertainty and stress are among the harmful effects of school closures on teachers (UNESCO, 2021). This position is supported by MacIntyre et al. (2020) conclusion that teachers reported high-stress levels during school closures. According to Li et al. (2020), the incidence of anxiety among instructors during the COVID-19 pandemic is nearly three times greater than previously observed. In addition, Collie (2021) indicated that during school closures, autonomy-restrictive leadership is associated with increased emotional exhaustion in teachers, whereas autonomy-supportive leadership increases workplace buoyancy, thereby reducing teachers' somatic burden,

stress, and emotional exhaustion. In addition, social isolation and a lack of frequent social support may have negatively affected teachers' mental health and well-being. According to Dabrowski (2020), the sudden absence of interaction generated by COVID-19 substantially affects teachers' emotions. When teachers cannot meet their students in person, they may experience a sense of loss, culminating in grief in teachers who were underappreciated or unsupported. Teachers who work from home have extra responsibilities and must balance work and family life. The fact that teachers are "on-call" 24 h a day, 7 days a week, has a negative effect on their well-being (Dabrowski et al., 2020).

Teachers' occupational well-being framework

Several research papers propose analytical frameworks for evaluating the well-being of teachers. Van Horn et al. (2004) established five analytical aspects of the occupational happiness of teachers: (1) emotional well-being; (2) social well-being; (3) professional well-being; (4) cognitive well-being; and (5) psychosomatic well-being. Collie et al. (2015) suggested examining teachers' work-related well-being across three dimensions: "(1) workload well-being, (2) organizational well-being, and (3) student interaction well-being." In this approach, workload well-being refers to problems associated with workload and concomitant stress. Organizational well-being is correlated with teachers' impressions of the school as an organization, including judgments of school leadership and the culture toward teachers and teaching. Student interaction wellbeing is correlated with teachers' interactions with students (Collie et al., 2015). Despite the fact that both the Collie et al. (2015); Van Horn et al. (2004) 'models highlight multiple dimensions, it is essential to remember that they are interdependent (Viac and Fraser, 2020).

A recent Organization for Economic Cooperation and Development (OECD)'s working paper examined the research on teacher well-being, proposed a conceptual framework, and suggested instruments to be included in the Programme for International Student Assessment (PISA, 2021) teacher questionnaire to assess teachers' occupational well-being (Viac and Fraser, 2020). During the COVID-19 pandemic, this study uses and modifies the original and holistic framework to measure the occupational well-being of in-service teachers in Hanoi. Viac and Fraser (2020)'s framework focuses specifically on the topic of this study, which is teachers' occupational well-being, as opposed to investigating teachers' well-being in general.

According to Viac and Fraser (2020)'s approach, teachers' occupational well-being is defined by four primary dimensions: cognitive, subjective, physical and mental, and social. Each of these dimensions has several indicators that facilitate their measurement. Self-efficacy (from cognitive well-being), work satisfaction (from subjective well-being), psychosomatic symptoms (from physical and mental well-being), and social relationships (from social well-being) were each represented by a single indicator in this study (from social well-being). Consequently, this framework allows us to address the research questions: "What are the occupational well-being levels of Hanoi's in-service teachers during the COVID-19 pandemic?" and "What do teachers in Hanoi believe school administrators could do to improve teachers' occupational satisfaction?" This comprehensive approach provides a robust foundation for examining teacher well-being and identifying strategies that school administrators can employ to enhance job satisfaction among teachers in the current challenging circumstances. Specifically, this research was a case study done to investigate teachers' professional well-being amid periods of upheaval and disruption brought on by the COVID-19 pandemic, despite time and space constraints. Given this, reducing the original, expansive framework is appropriate by assessing the most relevant and noticeable indication for each component of teachers' occupational wellbeing.

Interest in teacher well-being is neither novel nor unexpected; it has been investigated across all educational age groups and is pursued globally. Cook et al. (2017) recognized an abundance of data indicating that teaching is a challenging profession and that teacher stress and burnout can hinder teacher effectiveness in the United States. They concluded that participants in the ACHIEVER Resilience Curriculum for boosting teacher well-being had superior outcomes, such as increased teaching effectiveness and decreased job-related stress and anxiety. Their findings suggest that interference in teacher preparation and continuous professional development should focus on teacher well-being. Moreover, Bricheno et al. (2009) conducted a literature analysis on intervention methods for teachers' well-being in the United Kingdom, focusing primarily on mental health and stress. Zhu et al. (2011) investigated school cultural characteristics, teacher institutional dedication, and well-being as outcomes of school culture in China, whereas Yin et al. (2016) examined the emotional nature of teachers' professions and the extent to which it is detrimental to teachers' well-being. Mattern and Bauer (2014) discovered that the cognitive self-regulation of secondary mathematics teachers improved their occupational well-being or level of emotional exhaustion and job satisfaction, which directly impacted the quality of their work, job satisfaction, and overall well-being.

Since the COVID-19 began, educators have faced a variety of challenges, but their professional well-being has not gotten much consideration (Chan et al., 2021). In a report, school leaders from 17 school districts in California expressed grave concerns regarding teacher mental health and workload, as well as a growing teacher shortage in the COVID-19 context (Carver-Thomas et al., 2021). Similarly, research from other nations demonstrated that teachers' mental health declined during the outbreak (Ali and Razali, 2019; Allen et al., 2020). In the United Kingdom, for instance, longitudinal research revealed an increase in teachers' anxiety after school closures (Allen et al., 2020). Another study, including 1,633 Spanish teachers, found that almost one-fourth of respondents had "severe" to "extremely severe" stress and anxiety (Ozamiz-Etxebarria et al., 2021). According to information received from Zhou and Yao (2020), 9.1% of teachers in China had stress symptoms in March 2020. In Vietnam, Nguyen and Le (2021) investigated the effects of COVID-19 on the psychological well-being of Vietnamese adults in their study. Research on the effects of COVID-19 on the education sector is beginning to emerge. For instance, Vu and Bosmans (2021) demonstrated that COVID-19 anxiety is highly and specifically associated with learning-related cynicism but not learning fatigue, indicating that the pandemic affects Vietnamese students' capacity to develop via education.

Similarly, Kim et al. (2022) found that teachers' mental health and well-being declined throughout the COVID-19 by applying the Viac and Fraser (2020) model. In the literature, however, extensive data on teacher occupational well-being in the context of COVID-19 are mostly ignored. It means that considerable efforts to investigate the occupational health of Vietnamese educators during this vital and difficult period of health issues need to be implemented. This study aims to fill this gap in the literature by identifying the occupational well-being levels of Vietnamese teachers and what school leaders may do to assist them survive in the digital age pedagogy due to the COVID-19 pandemic.

Methodology

This study employed a mixed-method design in order to achieve an objective and comprehensive perspective. The combination of quantitative and qualitative approaches is critical because it answers this study's research questions. In particular, this study followed the explanatory sequential design (Creswell and Clark, 2017), starting with quantitative data collection and analysis and following up with the qualitative data, leading to interpretation.

Participants

Among 170 surveys distributed, 142 surveys were collected (83.5% response rate). After eliminating the incomplete surveys, the final number of included surveys was 103.

There are 103 final participants involved in the survey part, and 8 were chosen for further interviews. All the participants are Vietnamese and currently living and working in Hanoi, Vietnam. The demographic information of the participants is shown in Table 1.

Eight teachers (3 lower secondary school teachers, 3 upper secondary school teachers, and 2 university lecturers) who had previously completed the questionnaire voluntarily agreed to participate in the interview (more information about the interviewee is provided in Table 2).

TABLE 1 Participants' demographic information.

Characteristics		*N*	%	*M*
Gender	Female	89	86.4%	/
	Male	14	13.6%	
Age	22 to 25	17	16.5%	35.34
	26 to 30	17	16.5%	
	31 to 40	36	34.9%	
	More than 40	33	32.1%	
Experience (years)	1 to 3	25	24.3%	12.14
	4 to 8	17	16.5%	
	9 to 18	32	31.1%	
	More than 18	29	28.1%	
Teaching grade level	Lower secondary	32	31.1%	/
	Upper secondary	23	22.3%	
	Tertiary	48	46.6%	
Teaching qualification	Bachelor	54	52.4%	/
	Master	31	30.1%	
	Ph.D	18	17.5%	

Measures

Participants were requested to complete an online survey after consent to the research objective and data confidentiality procedure with three critical categories of questions: (1) individual demographics questions, including gender, age, number of years teaching, highest teaching qualification, and grade level; (2) twenty questions on a 5-point Likert scale about the state of occupational well-being during the COVID-19 pandemic; and (3) ten open-ended questions about the factors affecting the level of occupational well-being and the teachers' opinions on the measures taken by school leaders to enhance the well-being. Twenty questions on a 5-point Likert scale were divided into four sections (see Appendix 1 in Supplementary material). In the first half, five questions assessed various aspects of teachers' self-efficacy; in the second section, five questions assessed teachers' job satisfaction. The third segment contained five questions regarding teachers' psychosomatic symptoms, while the fourth section contained five questions regarding teachers' social relationships.

After the closed-ended questions, five open-ended questions were posed to the teachers (see Appendix 1 in Supplementary material). The purpose of the first six qualitative questions was to acquire a more profound knowledge of the factors influencing teachers' occupational well-being. These elements include burdens and empowering experiences considered beneficial or detrimental to their professional well-being (Viac and Fraser, 2020). The remaining four questions were designed to answer study question 2, which examines the steps done by school leaders that teachers subjectively perceived as beneficial to their occupational well-being during the COVID-19 outbreak.

The second research question (i.e., what do teachers believe their school leaders could do to improve teachers' occupational well-being?) requires qualitative data because occupational well-being is such a complex and individual topic. After the survey, further interviews were conducted. In this study, individuals were selected through the use of convenience sampling during survey collecting. Convenience sampling is a type of non-probability or non-random sampling in which members of the target population meet specific practical requirements, such as easy accessibility, geographical proximity, availability at a specific time, or willingness to participate in the research (Dörnyei, 2007). The participants who finished the survey and were willing to participate in the study, and were easily accessible, were chosen for the further semi–structured interview. In addition, due to the spread of the COVID-19 pandemic, there are specific time and communication constraints during the study process; thus, convenience sampling proved to be the most suitable method for collecting sufficient data in this study.

Through open questions in the semi-structured interview session, richer data will be gathered, as this interview instrument is ideally suited for exploring participants' thoughts and opinions on complex and frequently sensitive matters, as well as examining additional information and clarifying questionnaire responses (Louise Barriball and While, 1994). The semi-structured interview questions were

TABLE 2 Interview participants' demographic information.

No	Pseudonym	Gender	Age	Experience (Years)	Grade level	Teaching qualification
1	Khanh Linh	Female	26	3	Lower secondary school	Bachelor
2	Van Nam	Male	36	10	University lecturers	PhD
3	Hiep Nguyen	Male	45	18	Upper secondary school	Master
4	Tue Chi	Female	40	15	University lecturers	PhD
5	Van Anh	Female	27	4	Lower secondary school	Bachelor
6	Van Nhan	Male	30	5	Upper secondary school	Master
7	Huyen My	Female	22	1	Upper secondary school	Bachelor
8	Minh Hang	Female	32	8	Lower secondary school	Bachelor

included in the interview protocol (see Appendix 2 in Supplementary material).

Procedures

In this study, the researchers focused on the participants who are currently working as teachers in some high schools and universities in the Hanoi area. The authors began the data collection by distributing an online survey to high school teachers in Hanoi, Vietnam, from December 2021 to March 2022. Participants currently working as teachers in some Hanoi high schools and universities and who are willing to participate in this study are chosen. Participants who did not consent to the study were skipped.

The study was approved and followed the rules and requirements of the ethics board of the University of Language and International Studies, Vietnam National University. The participants accepted to participate by signing the consent form after the researcher introduced the study and confirmed the participants' anonymity and confidentiality. Participants were introduced to data protection and confidentiality again before the interview. Some were conducted face-to-face at the participants' chosen places, and others were conducted online as they lived far from the researcher's location. All interviews were conducted in Vietnamese so participants could freely express their thoughts and experiences.

Data analysis

Regarding the survey, the data were acquired using a modified OECD-developed quantitative questionnaire (Viac and Fraser, 2020) and analyzed by SPSS 26 software (see Appendix 1 in Supplementary material). For the interview, the data were transcribed and analyzed by using the NVivo software. The thematic analysis was applied in this paper when we analyzed the transcript, looked for patterns in the meaning of the data, and put the data in suitable themes.

Results

Levels of teacher's occupational well being

This section begins with a discussion of teachers' cognitive health as reflected by their teaching self-efficacy. Table 3 displays the proportion of in-service teachers who responded to questions on their self-efficacy with varying degrees of agreement and disagreement. As seen in the table, the majority of participants expressed confidence in their teaching abilities in the online environment. Among the required items, item SE2 received the highest proportion of "agree" and "strongly agree" responses, with 89.5% of instructors agreeing or strongly agreeing with the statement. In both SE1 and SE3 items, 82.5% of respondents selected "agree" or "strongly agree" as their response. The percentage of "agree" and "strongly agree" responses for item SE5 was 69.9%, which was 5.9% lower than for item SE4 and the lowest of the 5 items. Regarding disagreements, it appears that just a tiny percentage of respondents disagreed with the mentioned statements. Particularly, 8.7% of teachers disagreed with the statement that they can encourage pupils to participate in online learning. The percentages of instructors who disapproved of items SE4 and SE5 were 7.8 and 5.8 percent, respectively. On question SE1, 9.7% of participants selected "disagree" and "strongly disagree," while 2.9% of teachers selected "disagree" and "strongly disagree" for item SE2. In addition, 21.4% of teachers were unsure of their capacity to motivate pupils to participate in online learning.

According to the aforementioned statistics, teachers demonstrated their proficiency in online classroom management by successfully enforcing classroom regulations. A moderate proportion of participants, however, lacked confidence in their ability to engage students in online learning, which may have been considerably impacted by the quality of the technical infrastructure throughout the COVID-19 pandemic. In addition, teachers' responses indicate a high level of readiness, preparedness, and efficacy for technology-based pedagogy in remote learning; however, there are still barriers to incorporating digital materials and technological tools into classroom practices, which requires substantial effort from teachers and support from school leaders.

According to Table 4, the self-efficacy of in-service instructors during the COVID-19 pandemic is quite high ($M = 3.83$; SD = 0.47). Teachers' self-efficacy did not differ significantly among groups. However, teachers with 1 to 3 years had significantly lower self-efficacy (mean = 3.67, SD = 0.54) than teachers with 4 to 8 years of teaching experience (mean = 3.94, SD = 0.36), 9 to 18 years of teaching experience (mean = 3.80, SD = 0.50), and more than 18 years of teaching experience (mean = 3.94, SD = 0.40). The self-efficacy of instructors with a Bachelor's degree (mean = 3.79, SD = 0.5) was not similar to that of teachers with a Master's degree (mean = 3.87, SD = 0.48) and a Ph.D. (mean = 3.89, SD = 0.35) in terms of teaching qualification.

TABLE 3 In-service teachers' self-efficacy in percentage.

Items	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
I can get students to follow the online classroom rules. (SE1)	1.9%	7.8%	7.8%	72.8%	9.7%
I can use technology tools well in testing and evaluating students. (SE2)	1%	1.9%	7.8%	72.8%	16.5%
I can use technology tools well in my online lessons. (SE3)	0%	5.8%	11.7%	69.9%	12.6%
I can solve technical problems when using technology in the online classroom. (SE4)	0%	7.8%	16.5%	68%	7.8%
I can encourage students to engage in online learning. (SE5)	0%	8.7%	21.4%	63.1%	6.8%

TABLE 4 In-service teachers' self-efficacy in descriptive statistics.

		Teachers' self-efficacy					
		Count	Mean	Standard deviation	Minimum	Maximum	Mode
TOTAL		103	3.83	0.47	2.00	5.00	4.00
Gender	Female	89	3.83	0.49	2.00	5.00	4.00
	Male	14	3.81	0.32	3.40	4.40	4.00
Age (years old)	22 to 25	17	3.76	0.38	3.00	4.40	3.80
	26 to 30	17	3.71	0.60	2.00	4.60	4.00
	31 to 40	36	3.87	0.50	2.60	4.80	4.00
	More than 40	33	3.89	0.40	3.20	5.00	4.00
Experience (years)	1 to 3	25	3.67	0.54	2.00	4.60	3.80
	4 to 8	17	3.94	0.36	3.20	4.60	4.00
	9 to 18	32	3.80	0.50	2.60	4.80	4.00
	More than 18	29	3.94	0.40	3.20	5.00	4.00
Grade level	Lower secondary	32	3.81	0.53	2.00	4.80	4.00
	Upper secondary	23	3.85	0.55	2.80	5.00	3.80
	Tertiary	48	3.84	0.39	2.60	4.60	4.00
Teaching qualification	Bachelor	54	3.79	0.50	2.00	5.00	4.00
	Master	31	3.87	0.48	2.60	4.60	4.00
	Ph.D	18	3.89	0.35	3.20	4.60	4.00

Teachers' job satisfaction

Table 5 displays a variety of teachers' perspectives on their job satisfaction. Overall, teachers reported high levels of job satisfaction, with 74.8% agreeing or strongly agreeing that online education had not diminished their interest in their work. In addition, 64.1% of participants said they were supplied with more resources to promote their professional development during the COVID-19 pandemic than prior to its occurrence. The percentages of teachers who agreed with JS2 and JS3 items were 58.2 and 56.6%, respectively. In contrast, 33% of instructors disagreed with the statement, "Amid COVID-19, I do not believe that the quality of my teaching job is lower than it was before COVID-19." This indicates a significant lack of work satisfaction among teachers. Moreover, during the COVID-19 pandemic, the rates of teachers' uncertainty and uncertainty regarding their autonomy and job satisfaction were relatively high, at 30.1 and 34%, respectively.

The change from face-to-face teaching to distant learning may have altered the working habits of instructors, hence influencing their opinions of their job satisfaction. Moreover, it is claimed that the challenges of increased workload and the need to grasp technology solutions for online education reduce instructors' job happiness. On the other side, teachers' prospects for autonomy and career advancement may enhance their job satisfaction.

The mean value of teachers' job satisfaction was 3.52, indicating a high job satisfaction level among in-service teachers in Hanoi during the pandemic. There was no notorious difference in teachers' job satisfaction depending on their age; however, female teachers were more satisfied with their job ($M = 3.53$, SD = 0.52) than male teachers (M = 3.44, SD = 0.80). As shown in Table 6, teachers having 4 to 8 years of teaching experience had a lower level of job satisfaction (mean = 3.39, SD = 0.54) than the other teachers. In addition, a considerable difference can be witnessed between the grade level of teachers. Teachers working at lower secondary schools had a much lower job satisfaction (mean = 3.43, SD = 0.56) than teachers working at teachers working at upper secondary schools (mean = 3.53, SD = 0.51) and those working at universities (mean = 3.57, SD = 0.59). Regarding teachers' teaching qualifications, the average job satisfaction level of teachers holding

TABLE 5 In-service teachers' job satisfaction in percentage.

Items	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
During the COVID-19 period, I do not lose interest in my job. (JS1)	1%	8.7%	15.5%	64.1%	10.7%
During COVID-19, I think that the quality of my teaching job is not lower than it was before COVID-19. (JS2)	0%	33%	8.7%	45.6%	12.6%
During COVID-19, I have more decisions on the content, format, and methods of teaching than I did before COVID-19. (JS3)	1%	12.6%	30.1%	49.5%	6.8%
During COVID-19, I am provided with more resources that can boost my professional growth more than before COVID-19 happened (training sessions, seminars, online conferences). (JS4)	0%	12.6%	23.3%	56.3%	7.8%
During COVID-19, I think the teaching profession is more appreciated than it was before COVID-19 happened. (JS5)	0%	19.4%	34%	35%	11.7%

TABLE 6 In-service teachers' job satisfaction in descriptive statistics.

		Teachers' job satisfaction					
		Count	Mean	Standard deviation	Minimum	Maximum	Mode
TOTAL		103	3.52	0.57	1.80	4.60	3.60
Gender	Female	89	3.53	0.52	2.20	4.60	3.60
	Male	14	3.44	0.80	1.80	4.60	2.80[a]
Age (years old)	22 to 25	17	3.48	0.60	2.20	4.40	3.60
	26 to 30	17	3.46	0.56	2.60	4.60	2.80
	31 to 40	36	3.52	0.58	1.80	4.60	3.40[a]
	More than 40	33	3.56	0.56	2.60	4.60	3.60
Experience (years)	1 to 3	25	3.50	0.60	2.20	4.60	3.20[a]
	4 to 8	17	3.39	0.54	2.40	4.40	2.80[a]
	9 to 18	32	3.59	0.56	1.80	4.60	3.40
	More than 18	29	3.52	0.57	2.60	4.60	3.60
Grade level	Lower secondary	32	3.43	0.57	2.40	4.60	3.60
	Upper secondary	23	3.53	0.51	2.40	4.40	4.00
	Tertiary	48	3.57	0.59	1.80	4.60	3.60
Education	Bachelor	54	3.43	0.58	2.20	4.60	3.60
	Master	31	3.70	0.43	2.60	4.60	3.40[a]
	Ph.D	18	3.49	0.69	1.80	4.60	3.60

[a]Multiple modes exist. The smallest value is shown.

a Master's degree was 3.70, SD = 0.43, which was much higher than that of teachers with a Bachelor's degree (mean = 3.43, SD = 0.58) and a Ph.D. (mean = 3.49, SD = 0.69).

Teachers' perceptions of what school leaders could do to improve teachers' well-being

The qualitative data from the interview transcriptions and the open-ended questions in the questionnaire helped answer research question 2: "What do in-service teachers in Hanoi believe school leaders could do to improve their occupational well-being?." The qualitative findings are summarized in Table 7. Through thematic analysis, three broad themes were detected: (1) teachers' professional development in distance learning, (2) flexibility, and (3) well-being initiatives. The three themes are presented and discussed in further depth in the subsections below. Transcripted and anonymized excerpts from the data are presented where appropriate to highlight major themes.

Theme 1: teachers' professional development in distance learning

It is critical to offer teachers educational opportunities to enhance their credentials in their teaching profession since earlier studies

TABLE 7 School strategies to support teachers' occupational well-being during the COVID-19 pandemic reported by teachers.

Themes	Subthemes	Example quotes	Percentage (%)
a. Teachers' professional development in distance learning	Instructional training in distance learning	"Actively organize seminars and workshops on online teaching methodology for teachers" (Participant 77, interview 5, 2022)	61%
	Technical training and resources provision	"Introduce and instruct how to use some applications and platforms for online teaching" (Participant 29, survey 29, 2022)	38%
	Quality workload	"Reduce the administrative tasks" (Participant 78, survey 78, 2022)	9%
b. Flexibility	Time autonomy	"Working time should be more flexible" (Participant 80, interview 8, 2022)	21%
	Teaching flexibility	"School leaders allow teachers to be autonomous in their teaching work" (Participant 28, survey 28, 2022)	17%
c. Well-being initiatives	Financial support	"Increase salary, give extra allowance" (Participant 66, survey 66, 2022)	47%
	Relaxation aids	"Organize workshops on mindfulness" (participant 16, survey 16, 2022)	42%
	Communication and interaction	"Discussions about difficulties when teaching online" (Participant 78, interview 1, 2022)	26%
	Appreciation and motivation	"The school leaders often empathize and encourage teachers regularly and timely" (Participant 69, interview 7, 2022)	14%
	Physical health support	"Teachers should be given general health check-ups" (Participant 54, survey 54, 2022)	5%

indicated that meaningful professional development is related to teacher morale and job satisfaction. It follows that when school leaders enable professional development that satisfies teachers' needs for occupational progress, their occupational well-being improves. In this study, growth and the opportunities to thrive in the teaching profession encompassing instructional training in distance learning, technical training, and resource provision, and quality workload were frequently mentioned by the teachers as something leaders could positively influence teachers' occupational well-being during the COVID-19 pandemic.

The most frequently reported measure to support teachers' occupational well-being was instructional training in distance learning. Findings from the open-ended questions in the survey indicate that 61% of the in-service teachers in Hanoi highlighted instructional training in distance learning as a necessary measure by school leaders. For example, Participant 43 mentioned in the survey that she believed her school should "organize a series of professional training sessions on online teaching methods to improve teachers' competence and skills." Due to the COVID-19 pandemic, teachers were obliged to implement new pedagogical approaches and practices to support students' distance learning. Therefore, they were in great need of training opportunities to enhance their pedagogical knowledge and teaching skills in the online teaching environment. In addition, there was a need to diversify how the instructional training was delivered as Hiep Nguyen put it "School leaders should build a reference framework for online teaching competencies for teachers to refer to and provide more resources of online teaching skills that teachers can self-study because sometimes the presenters in the seminars or workshops on online teaching methods delivered the content quite quickly or teachers are too busy to participate." This excerpt not only suggests the pitfalls of organizing seminars or workshops on online teaching methods but also underscores the importance of varying the possible kinds of school leaders' support regarding instructional training in distance learning amidst the pandemic. This inevitably entails school leaders' concerted efforts to sensibly cater to teachers' conceivable needs.

The provision of technical training and resources provided by 38% of the participants was another subtheme under the teachers' professional development in distance learning. This highlights the significance of teachers' digital competences and the training provision to aid teachers in developing their technological knowledge and technology-assisted teaching practices in the online teaching environment during the COVID-19 pandemic. For instance, Huyen My expressed in the survey that her school needed to "organize training sessions on the use of information technology in teaching, testing, and assessment." In the interview, Van Nam exemplified the specific kind of information technology provision that school leaders could offer: "online training on survey and assessment tools such as Cognito forms and Microsoft forms." As can be inferred from these narratives, teachers are concerned about how to incorporate digital technologies effectively into their teaching and teaching-related workload. This is directly related to their aspirations for the establishment of professional learning to enhance their digital literacy and competence, which play a pivotal role in fostering their professional development during digital education.

Moreover, participants also emphasized the digital and technology-related resources that could facilitate their teaching work by mentioning that school leaders should make resource provisions for teachers. For example, in the survey, Participant 51 recommended that leaders should "equip teachers with free and unlimited Zoom accounts," while Participant 41 stressed that her well-being would be enhanced if her school could "provide teachers with accessible digital learning platforms and resources in which teachers could further collaborate on to ease their workload." The teachers' responses regarding resources provision were comprehensible since, during remote learning, teachers needed to make use of digital teaching materials, video-conferencing platforms such as Zoom, and some forms of learning management systems such as Microsoft Teams to engage students in online lessons. Besides, collaborative working in the digital environment could be seen as an advantageous job resource with which school leaders could accommodate teachers. Thanks to this kind of job resource support, teachers could collectively flourish in their work and sustain coordinated performance among teachers themselves, which could possibly alleviate the stress caused by additional workload due to the shift to remote learning.

A quality workload subtheme manifested itself from the mention of 9% of the participants, underscoring the necessity to streamline teachers' workload during the COVID-19 pandemic. Tue Chi indicated that her well-being would be improved when her school tried to "lessen administrative tasks," which was further elaborated on by Van Nhan, who emphasized that:

"Administrative formalities still need to be streamlined continuously. If everyday teachers receive dozens of repetitive emails, messages, and notifications via multiple groups in Zalo, it clearly denotes ineffective administrative tasks because I think that effective work means with fewer texts and announcements, the work is still operating well."

As can be inferred from the excerpts above, revised administrative procedures can aid in keeping teachers' workload manageable, and then teachers could focus more on improving and ensuring their quality teaching, which in turn positively contributes to their occupational well-being. The excerpts also indicate that the heavy workload, especially the administrative tasks during the COVID-19 pandemic, is an impediment to improving teachers' occupational well-being.

Theme 2: flexibility

A number of teachers in this study reported that the flexible working environment that promotes time autonomy and teaching flexibility was a component that elevates their occupational well-being. Firstly, 21% of the participants were concerned about school leaders' support for time autonomy in distance learning. Participant 37 expressed in the survey that "the school administrators were a bit rigid in applying the same time frame of face-to-face learning to the online one. They could possibly let teachers adjust or rearrange the teaching schedule if the interruption to distance education arose by external factors due to the COVID-19 pandemic." Additionally, Khanh Linh mentioned that "as a lot of workloads arose during remote learning, the school meeting schedule mostly took place in the evening, encroaching on teachers' personal rest time. So cutting down on the meeting schedules that were out of office hours would significantly do teachers a favor." Participant 21 further shed light on this matter by explaining in the interview:

"If teachers lack personal time to rest, to calm down (due to school work), the work is ineffective. If teachers want to have the initiative to change teaching methods and write research papers, they must have time to calm down and be mindful. If teachers are not of sound mind, their bodies will be weak, and everything will not be okay (that is not counting the unnamed things teachers have to deal with at home when their children study online at home). In organizing activities outside office hours, school leaders should not only create the maximum conditions for teachers to determine whether to participate or not but also consider minimizing the required activities that may cause teachers' psychological inhibition."

Some insightful implications arise from these above teachers' narratives. Firstly, the teachers' working conditions during the pandemic should be modified in terms of the teaching timetable. The teaching schedule in a face-to-face classroom environment might not be perfectly applied to the distance learning environment, which could be affected by a variety of contextual factors such as the technology tools and infrastructure of students and teachers or the unanticipated situations when teachers are infected with COVID-19. These influential factors may cause changes to teachers' teaching schedules, prompting them to take some control in flexibly customizing their teaching timeline to ensure teaching continuity. Secondly, school leaders should attend to teachers' autonomy during their outside office hours as it appears to be of significant importance to teachers' occupational well-being. Working from home has increased duties for teachers, who must manage their work and personal life in a balanced manner.

In addition, teaching flexibility was mentioned by 17% of the participants as another sub-theme that could positively influence teachers' occupational well-being. Specifically, Minh Hang reported in the survey that she was satisfied when her school provided teachers with "more flexibility in the methods of teaching." In the narrative of Tue Chi, she also shared positive feelings about the teaching autonomy she received in her school, which "there was not much close inspection in my school, which makes me feel more comfortable and autonomous in my teaching." The above school leaders' support reported by the participants, namely a higher degree of teaching methods flexibility and less strict supervision, indicate school leaders' trust in teachers' teaching capability and empathy for teachers in times of crisis since they had to deal with new challenges and unanticipated changes in their work during the COVID-19 pandemic.

The above extracts show that during the COVID-19 pandemic, time restraints, out-of-hours work, and heavy workload may deprive teachers of adequate time to relax and to look after their well-being, causing anxiety, burnout, and occupational stress, which consequently deteriorate teachers' occupational well-being. Conversely, it was found that having choices or control over work arrangements, work patterns, and working time and getting opportunities to exercise autonomy positively strengthen teachers' occupational well-being. Apparently, due to the COVID-19 pandemic, teachers indicated that they had to deal with inconvenient changes in their work, and they wanted different autonomy and flexibility over different aspects of their role. Thus, it is recommended that school leaders should get to know and understand teachers' difficulties and needs and determine the specific kinds of autonomy support (i.e., time autonomy and/ or teaching autonomy) that would be most beneficial to teachers' occupational well-being.

Theme 3: well-being initiatives

Teachers also stated some well-being initiatives that could boost their occupational well-being. Under the theme of well-being initiatives, there were six sub-themes, including financial support, relaxation aids, communication and interaction, appreciation and motivation, and physical health support.

A commonly voiced opinion among teachers was school leaders' financial support. According to the participants' responses, 47% of the teachers stressed the need to be given financial support when teaching during the COVID-19 pandemic. Khanh Linh, for example, stated in the survey that "there should be extra financial support for teachers if working overtime, provide salary increase and financial aids for research projects to increase teachers' motivation." Participant 47 also said that "the guarantee of monthly salary and additional income for teachers is a great practice that helps teachers feel secure in their work." This reveals that many teachers were discontented with their salaries and welfare benefits. Guaranteeing teachers' job quality,

passion, and motivation will be difficult if the school leaders do not make efforts to improve teachers' salaries radically. As a result, pay is a problem that demands immediate school leaders' attention if teachers' occupational well-being is to be enhanced.

The second sub-theme that emerged was the provision of relaxation aids, which was mentioned by 42% of the participants. Particularly, Participant 13 emphasized that school leaders can "organize many seminars and workshops on improving the mental health of teachers" while "mindfulness or meditation classes" and "online music concerts" were mentioned in an interview with Participant 80, who explained that these relaxation aids could help teachers feel less tense and increase their connectedness with their colleagues and school leaders. From teachers' responses, it is quite apparent that the activities that promote teachers' positive emotions and state of mind are of vital importance to teachers. This is further reinforced when taking into account the notion that school practices to support teachers' mental health, such as mindfulness-based interventions, could do wonders for teachers' wellbeing, performance, and resilience.

Enhanced communication and interaction was another suggestion that 26% of the teachers reported. Working from home during the COVID-19 pandemic, teachers in this study disclosed that it was critical to strengthen social ties and maintain regular communication and interaction with their school leaders, colleagues, and students. Particularly teachers wanted their difficulties, challenges, and opinions to be heard. For example, Tue Chi shared in the interview that the leaders of her faculty did not consult much with the teachers before making a decision: "they inform us instead of consulting us, I feel that those decisions are sometimes not very practical, reasonable, and effective because the leaders of my Faculty do not teach much, they do not understand many difficulties of the teachers who actually teach." She then emphasized the necessity of communication and connection between teachers and school leaders when she highlighted "it is more effective if the school leaders have more discussions with teachers to listen to opinions from many angles instead of making decisions on their own." Participant 54 also agreed on this when stating "there should be a monthly or quarterly survey about teachers' mental health status and their teaching conditions in order to listen to their needs and difficulties and provide timely support." These extracts suggest that some participants in this study experienced insufficient communication and a lack of understanding from school leaders, and quality communication with school leaders could be advantageous to teachers' well-being. Specifically, from the teachers' perspective, in order to foster teachers' occupational well-being, school administrators should understand the necessity of providing teachers with constant communication, a proactive investigation into challenges facing teachers, and timely measures to satisfy their needs during the pandemic. The interaction among teachers and between teachers and students seems to be another critical factor that can positively impact teachers' occupational well-being since teachers cannot interact with their students in person during remote learning. Participant 8 expressed that "school leaders should develop interactive activities among teachers and between teachers and students; organize sharing sessions to create opportunities for students to express their feelings as well as show respect and gratitude to teachers."

Appreciation and motivation were the fourth school leaders' measure reported by 14% of the respondents, indicating teachers' longing for their efforts to be recognized and stimulated. Van Anh, for example, emphasized the importance of receiving good comments and recognition. She listed that school leaders should "give teachers encouragement and credits for their endeavor to complete their work. The acclamation and motivation of school leaders are critical to teachers' working spirit." Teachers' negative affections caused by a lack of appreciation or comprehension of the job done by teachers would probably promote their dissatisfaction and thus negatively affect their occupational well-being.

The last subtheme under the well-being initiatives theme was physical health support, which 5% of the participants mentioned. Teachers named several physical activities that school leaders could do to foster teachers' occupational well-being, such as "give eye and back pain examination" and "give a general health check," and "provide health-promoting exercise videos." The current pandemic scenario is characterized by challenges that affect teachers physically and emotionally, which in turn may worsen teachers' state of being well in the profession. Because of these new health conditions, school leaders ought to carry out occupational health schemes of health protection by alleviating occupational illnesses or ensuring teachers' good health conditions.

Discussion and conclusion

The levels of teachers' occupational well-being

Overall, in-service teachers in Hanoi had a moderate level of occupational well-being, which could be drawn from the findings of each component constituting teachers' overall occupational well-being. Specifically, the mean values of teachers' self-efficacy, job satisfaction, and social relations indicate that these three constructs contribute positively to teachers' occupational well-being. These findings align with the existing literature, which emphasizes the importance of self-efficacy beliefs, job satisfaction, and positive social relationships in promoting teachers' well-being (Mattern and Bauer, 2014; McCallum et al., 2017; Zhou and Yao, 2020). However, the psychosomatic symptoms dimension significantly hindered teachers' state of being well while working during the COVID-19 pandemic.

Moreover, teachers' gender is not a factor affecting their level of occupational well-being, which was also found with previous literature (Shen et al., 2015). There are minor differences in teachers' levels of occupational well-being in terms of their age. Teachers having 1 to 3 years of experience and those teaching for 4 to 8 years had slightly lower occupational well-being than the average. The opposite is true for teachers with 9 to 18 years of experience and teachers working in their job for more than 18 years.

Furthermore, the occupational well-being of lower secondary school teachers was pretty lower than that of upper secondary school teachers and university lecturers. Regarding teachers' teaching qualifications, teachers holding a Ph.D. had a similar level of occupational well-being to the average, while teachers with a Master's degree had a higher level of occupational well-being, and the teachers with a Bachelor's degree showed a slightly lower level of occupational well-being.

By reinforcing previous research findings, this study further contributes to the growing body of literature on teachers' occupational

well-being during challenging times, such as the COVID-19 pandemic. Identifying the specific dimensions contributing to or hindering teachers' well-being provides valuable insights for policymakers, school administrators, and other stakeholders seeking to support and enhance teachers' occupational satisfaction and overall well-being in similar contexts.

Teachers' perceptions of what school leaders could do to improve teachers' occupational well-being

According to teachers' perceptions, school leaders' support in three key areas—teachers' professional development in distance learning, flexibility, and well-being initiatives—played a crucial role in improving teachers' occupational well-being during the COVID-19 pandemic. In the same vein with Day and Qing (2009) and Carver-Thomas et al. (2021), teachers frequently highlighted the significance of professional growth and development opportunities in enhancing their well-being. These opportunities included instructional training in distance learning, technical training, provision of resources, and ensuring a manageable workload, all identified as factors that positively influenced teachers' occupational well-being during the pandemic.

Furthermore, we found a new finding that teachers emphasized the importance of a flexible working environment that promotes time autonomy and teaching flexibility. The ability to adapt their teaching methods and schedules to meet the demands of remote instruction was seen as a significant component that elevated teachers' occupational well-being.

In terms of school leaders' well-being initiatives, six specific measures were identified by teachers. These measures included financial support, relaxation aids, effective communication and interaction, appreciation and motivation, and support for physical health. These findings are consistent with prior research emphasizing supportive measures' role in promoting teachers' well-being during challenging times. Financial support, resources for relaxation, opportunities for communication and interaction, recognition of teachers' efforts, and support for physical health were all highlighted as important factors in improving teachers' occupational well-being during the COVID-19 pandemic.

Implications

This research's findings have theoretical and practical implications that can inform policy and practice to support teachers' occupational well-being during the COVID-19 pandemic.

From a theoretical standpoint, this study contributes to the existing literature on teachers' occupational well-being by examining the specific context of Hanoi during the pandemic. Replicating and reaffirming previous findings reinforce the theoretical foundation of understanding teachers' well-being. Moreover, the adoption of Viac and Fraser's (2020) multidimensional framework underscores the complex nature of teachers' occupational well-being, encompassing cognitive, subjective, physical and mental, and social dimensions. This theoretical understanding highlights the need for comprehensive support strategies that address the diverse factors influencing teachers' well-being.

Practically, the findings carry important implications for policymakers and practitioners in the education sector. Policymakers play a crucial role in recognizing and prioritizing teachers' occupational well-being during the pandemic. They must allocate appropriate resources to support teachers and their well-being needs. Financial support, resource provision, and policies that promote flexibility and autonomy in decision-making are essential measures that policymakers should consider. Additionally, school leaders are responsible for creating supportive environments that enhance teachers' well-being. Prioritizing teachers' professional development in distance learning, providing technical training and necessary resources, and fostering a flexible working environment are critical actions that school leaders can undertake. Well-being initiatives, such as financial support, relaxation aids, effective communication, appreciation, and support for physical health, should also be integrated into school practices.

Furthermore, drawing lessons from the United States context, collaboration and trust between teachers and policymakers emerge as key elements. Establishing policies that foster teacher autonomy and decision-making based on mutual trust while considering variations in working conditions can positively impact teachers' well-being. Encouraging open communication channels and involving teachers in decision-making are practical steps toward creating a supportive and empowering work environment.

Limitations and suggestions for further studies

Like any research endeavor, this study is not without its limitations. Firstly, the research instruments employed in this study were specifically designed for use among teachers, which may present challenges in generalizing the findings to other occupational groups. Secondly, based on the OECD framework proposed by Viac and Fraser (2020), the framework utilized to investigate teachers' occupational well-being is comprehensive and intricate. This framework encompasses four key elements: cognitive well-being, subjective well-being, physical and mental well-being, and social well-being, each consisting of multiple indicators. Due to practical considerations in terms of time and scope, this study focused on a single key indicator for each dimension, thereby warranting further exploration with a more extensive investigation involving additional indicators to capture the full range of teachers' professional well-being constructs.

Another constraint pertains to the sample size of the quantitative data. In this research, 103 in-service teachers from various schools and universities in Hanoi, Vietnam, participated in the survey. However, it is worth noting that a larger sample size would be necessary to obtain nationally representative levels of teachers' occupational well-being. Moreover, given the limited number of male teachers in the sample, it may not be ideal to conduct a robust assessment of teachers' occupational well-being by gender. Thus, it is recommended that future studies aim for a larger sample size with gender parity to ensure more comprehensive and representative insights into teachers' occupational well-being.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2023.1112577/full#supplementary-material

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Hope, optimism, and pessimism as predictors of positive and negative psychological changes related to the COVID-19 pandemic in Slovak adults

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Background and objectives: Positive and negative changes in outlook represent psychological changes that are the results of the cognitive processing of stressful and traumatic events by an individual. The objectives of the study were (1) to determine the level of occurrence and types of positive and negative changes in connection with the COVID-19 pandemic among adults in Slovakia and (2) to study the role of personality factors such as hope (dispositional and perceived) and life orientation (optimism and pessimism) in the prediction of positive and negative changes in adults during the fourth pandemic wave.

Methods: A Short Form of the Changes in Outlook Questionnaire (CiOQ-S), the Dispositional Hope Scale (DHS), the Perceived Hope Scale (PHS), and the Life Orientation Test (LOT-R) were administered. The research sample consisted of 102 participants, whose ages ranged from 20 to 65 years ($M_{age} = 38.90$, $SD = 14.28$). The research design was quantitative, exploratory, and confirmatory.

Results: In total, 95% of participants reported positive changes related to COVID-19. Concurrently, up to 70% of these participants also reported negative changes from the impact of the pandemic. Only 25% of participants reported positive changes without noticing any negative perception of the consequences of the pandemic. Overall, 68% of participants reported negative changes related to COVID-19. Only 29% of participants reported negative changes without noticing any positive perception of the consequences of the pandemic. In total, up to 86% of participants agreed with experienced psychological changes (positive or negative) as a result of the COVID-19 pandemic. The high prevalence of positive changes along with the relatively high prevalence of negative changes related to the COVID-19 pandemic outline the question of whether reported positive changes represent real or illusory growth. Optimism and pessimism were found to be significant independent predictors of positive changes related to the COVID-19 pandemic. Hope was identified as a significant independent predictor of negative changes related to the COVID-19 pandemic.

KEYWORDS

hope, optimism, pessimism, positive and negative psychological changes in outlook, COVID-19

Introduction

The novel coronavirus (COVID-19) emerged in Wuhan province in China in December 2019. In the period of the following few months, the virus spread around the world and caused a worldwide pandemic. By 31 December 2020, there were more than 82 million confirmed cases worldwide, with more than 1.8 million deaths (World Health Organization, 2021). The first confirmed case in Slovakia was detected on 6 March 2020 (Ministry of Health of the Slovak Republic, 2020). At the time of research data collection in February and March 2022, the global COVID-19 pandemic recorded 441,045,255 cases of infection and 6,013,580 deaths since its outbreak. In Slovakia, during this period, 1,458,129 cases of infection among the ∼5,428,792 inhabitants and 18,530 deaths were recorded (source https://www.worldometers.info/coronavirus).

Acute and chronic negative psychological, mental, and emotional consequences of the COVID-19 pandemic have been documented in many studies worldwide [e.g., higher levels of stress, anxiety, depression, frustration, post-traumatic symptoms, insomnia, higher level of fear of infection, and loneliness (Arora and Grey, 2020; Cénat et al., 2020; Mazza et al., 2020; Rajkumar, 2020; Xiong et al., 2020; Zhou et al., 2020 and others)]. Currently, there is an increasing number of studies that focus on describing and providing deeper understanding of positive psychological changes (e.g., in the context of post-traumatic growth) as a possible consequence of people's experience with the COVID-19 pandemic (Britton et al., 2019; Tamiolaki and Kalaitzaki, 2020; Asmundson et al., 2021; Lau et al., 2021; Park and Im, 2021; Gökalp et al., 2022). Systematic reviews (e.g., Manchia et al., 2022) summarizing the impact of the COVID-19 pandemic on stress resilience and mental health have found that the effects of the pandemic, whether related to COVID-19 itself or related measures, are surprisingly heterogeneous across populations. *Therefore, the first aim of this study was to determine the level of occurrence and types of positive and negative psychological changes in connection with the COVID-19 pandemic among adults in Slovakia.*

Another significant finding from the study conducted by Manchia et al. (2022) was that the effects of stress and resilience capacity rely on various (neuro)biological, psychological, and environmental factors. Furthermore, these effects are highly influenced by an individual's unique circumstances. Stueck (2021) presented a comprehensive theory, known as the Pandemic Management Theory (PMT), to explain the psychological mechanisms underlying coping with and processing a pandemic. The PMT is based on a biocentric health management approach. According to the PMT, being healthy during a pandemic entails maintaining a congruent connection between the biological and psychological levels and preserving the fundamental mechanisms of autoregulation and autopoiesis in the biocentric core (Stueck, 2021). One of the theses of the PMT states that people's identity is threatened by more fears than just the fear of death alone. These types of fear include the fear of contracting and falling ill and the fear of losing autonomy. These fears can impact self-esteem, cultural values, physical experience, and ultimately affect hormonal and central nervous processes, as well as the stability of the immune system in the biocentric core (Goldenberg et al., 2000). Stueck (2021) defined six phases of coping with the burden of the lockdown and the further load process of the COVID-19 pandemic. The first phase involves interpreting the pandemic situation with its load. This phase includes two evaluative processes: situation and reaction-oriented evaluation and the assessment of coping resources. The assessment processes are influenced by situational and habitual factors, such as personality aspects (internal–external orientation, anxiety and cognitive styles, risk attitude, and overall personality) and behavior. Positive experiences in managing and interpreting the burden (e.g., viewing challenges, having faith in one's coping resources, and self-belief) during the pandemic can lead to positive changes in later phases. *Therefore, the second aim of the research was to study the role of personality factors such as hope (dispositional and perceived) and life orientation (optimism and pessimism) in the prediction of positive and negative changes in adults during the COVID-19 pandemic.* We perceive the identification of specific personality factors causing different resistance and vulnerability to the pandemic as important information for defining effective therapeutic strategies and developing an effective approach to public health.

Positive and negative psychological changes as a response to stressful events

Joseph et al. (2005) assume that negative and positive psychological changes occur when people are confronted with stressful/traumatic events (directly or indirectly) which challenge their assumptions about themselves and the world. The organismic valuing theory of growth through adversity by Joseph and Linley (2005, p. 1) *"posits an intrinsic motivation toward growth, showing how this leads to the states of intrusion and avoidance that are characteristic of cognitive-emotional processing after trauma"*. The theory posits three possible outcomes of this cognitive-emotional processing: assimilation, negative accommodation (negative personality changes, depression, and learned helplessness), and positive accommodation (positive changes and personality growth). The positive changes following adversity can be manifested in three basic areas: perception of self, philosophy of life, and relationships. The theory describes personal changes as gaining wisdom, acquiring inner strength, or a greater ability to sympathize with others. The theory also understands a change in life philosophy as a change in life values. A change in relationships is characterized by the fact that people adopt new attitudes toward their closest ones. Due to the trauma people have experienced, they value their family and friends more (Joseph, 2017).

Researchers have used various alternative terms to denote positive changes that appear as a result of the struggle with adversity and lead the individual to achieve a higher level of functioning than before the event. One of the most elaborated concepts is *"post-traumatic growth"* (PTG). Tedeschi and Calhoun defined PTG as the phenomenon of *"positive psychological change experienced as a result of the struggle with highly challenging life circumstances"* (Tedeschi and Calhoun, 2004, p. 1). In the functional-descriptive model, PTG is defined as a significant positive change in the

individual's cognitive and emotional life, which can have its external manifestations in behavior (Tedeschi and Calhoun, 2004).

The pandemic has incurred significant psychological stress among those affected (Song, 2020). Nevertheless, recently, an increasing number of studies have reported high percentages of positive changes and psychological growth related to the COVID-19 pandemic. For example, Asmundson et al. (2021) conducted an analysis of studies monitoring the prevalence of PTG due to the pandemic and found that 39–89% of participants reported PTG. They also found that ∼77% of participants reported growth, the most common being developing a greater appreciation for healthcare workers, for the value of one's own life, for friends and family, for each day, and changing priorities about what is important in life and greater feelings of self-reliance. In addition, later published studies, e.g., Xie and Kim (2022), claim that more than half of the participants (60.8%) reported PTG during the pandemic. To clarify the prevalence of growth related to the COVID-19 pandemic, a partial objective was added to the first one, and we decided to determine the level of occurrence of positive and negative changes in connection to the COVID-19 pandemic among adults in Slovakia. Recent evidence indicates that it is important to distinguish between real and illusory PTG. New findings suggest that some self-reported PTG may reflect dysfunctional coping strategies for stressful events, but people may report experiencing PTG as part of a self-deceptive strategy. By implementing this strategy, people try to persuade themselves that they cope with the situation better than they do (Asmundson et al., 2021). In alignment with the above-mentioned, the Short Form of Changes in Outlook (CiOQ-S) developed by Joseph et al. (1993) was administered to the participants. The advantage of this tool is that it measures positive and negative reactions to stressful and traumatic events, thus offering a more comprehensive picture of ongoing changes (Joseph et al., 2005). The CiOQ-S is designed to gauge the outcomes of cognitive processing of traumatic events as demonstrated by subjectively observed psychological changes (Ba, 2007). Joseph et al. (2006) in their validation studies found positive correlations between negative psychological changes and symptoms of post-traumatic stress disorder; on the contrary, positive psychological changes were significantly related to post-traumatic growth.

Hope, optimism, and pessimism

Snyder (2002) conceptualized hope as a trait-like cognitive construct encompassing affirmative positive beliefs about one's ability to accomplish personal goals. Dispositional hope has been conceptualized as consisting of two constructs: pathways and agency. The pathways component reflects an individual's perceived means or routes available to achieve goals. The agency is described as the belief in one's ability to succeed in using pathways to achieve desired aims and is characterized by determination, motivation, and energy directed toward meeting one's goals (Creamer et al., 2019). Thus, Snyder's Hope Theory also includes goals (Snyder, 2002) as mental targets that anchor agency and pathways. People with high hope have more resources to overcome their difficulties, have the ability to generate possible means, identify multiple viable routes of attaining desired goals, find alternative routes when their initial strategies fail, and have greater confidence in applying these coping strategies (Creamer et al., 2019).

Apart from the concept of dispositional hope, there is also a new, independent concept of perceived hope that was postulated by Krafft et al. (2017), and that differs from Snyder's dispositional hope. Perceived hope is understood as a deep trust in the positive development of the event, especially in difficult life situations beyond our control. Krafft et al. (2017) tried to fill in the missing dimensions in Snyder's theory of hope (spiritual and relational level) and added aspects of human destiny that a person cannot influence. Perceived hope may flow from self-transcendent sources and is strongly associated with needs such as experiencing the meaning of life, helping others, developing close and intimate relationships, and spiritual and religious experiences (Krafft and Walker, 2018; Slezáčková et al., 2020).

There is a growing body of evidence supporting the notion that hope functions to drive adaptive behavior (Folkman, 2013). Fredrickson (2001) states that hope has the potential to influence people to adjust their relationship with negative thoughts and emotions by focusing on positivity and that improves their ability to cope with stressful life events. Several studies from the pandemic period point to findings that hope had a direct effect on the improvement of psychological health and wellbeing during the early stage of the COVID-19 pandemic and that adults with high hope are more likely to be capable of bouncing back from stressful situations and have greater subjective wellbeing and better psychological health (Yildirim and Arslan, 2020). Hope was found to be associated with reduced pandemic stress and increased wellbeing by serving as an adaptive mechanism for recovering from stress (Gallagher et al., 2021).

In addition to hope, we also decided to explore life orientation (optimism and pessimism) as a personality factor that might potentially predict positive and negative psychological changes related to the COVID-19 pandemic. Emerging empirical evidence suggests that disposition hope (Snyder, 2002) and disposition optimism (Scheier and Carver, 1985) represent conceptually related yet still distinct constructs. According to Laranjeira and Querido (2022), both concepts share several common elements: personality traits, cognitive constructs, reference to general expectancies, relation to significant personal goals, future orientation [expecting good or positive things and a better future (Bailis and Chipperfield, 2012)], and acting as determinants of behavior (Krafft et al., 2021). According to Bruininks and Malle (2005), perceived hope and optimism are two different constructs. The authors suggest that the effect of optimism is context-independent. Dispositional hope manifests itself mainly in situations that are more personally relevant and are associated with specific goals. The perspective of hope and optimism are two different constructs presented in several other studies (Yang et al., 2014; Rand, 2018; Wider et al., 2022). The results of these studies suggest that hope and optimism can predict various mental health-related consequences.

Dispositional optimism and pessimism are described as a generalized tendency to expect favorable experiences about future events (Scheier and Carver, 1985). Optimism and pessimism are conceptualized as important constructs in coping with uncontrollable life events (Nes, 2016). Seligman (1991) has applied optimism and pessimism to the ways in which people explain

events in their lives. Optimism and pessimism are stable personality characteristics that have important implications for regulating one's behavior (Arslan et al., 2021). The issue of whether optimism and pessimism are two ends of independent continuums or represent two opposite ends of the same continuum has not been resolved yet. We are inclined to believe that these two constructs represent two unipolar dimensions, that is, the opposite of optimism is the lack of optimism, which is distinguishable from the presence of pessimism (Marshall et al., 1992).

Optimism increases people's motivation to pursue goal-oriented behavior (Scheier and Carver, 1985). Optimistic individuals use more problem-focused strategies (adaptive coping strategies) that contribute to better adaptation and proactive functioning when facing negative life events compared with those who are pessimistic (Nes and Segerstrom, 2006; Nes, 2016). Recent studies revealed that optimism helped to protect mental health, lessen psychological distress, and lower anxiety and depression (Carver and Scheier, 2014; Kwok and Gu, 2017; Fischer et al., 2018). A meta-analytic review by Bostock et al. (2009) demonstrates that the relationships between PTG, optimism, and pessimism are ambiguous. At the same time, little is known about the role of pessimism in relation to post-traumatic changes, whereas optimism was more frequently studied in relation to PTG. Recent studies (Laslo-Roth et al., 2020; Koliouli and Canellopoulos, 2021; Di Corrado et al., 2022) confirmed that a prominent level of hope and optimism during the pandemic period could be a significant factor in attaining goals. Moreover, hope and optimism can help people reframe a traumatic event in a positive perspective that highlights opportunities for personal growth. The cited studies did not examine pessimism in relation to PTG. A study conducted by Britton et al. (2019) examined both factors (optimism and pessimism) and found that optimism was a predictor of PTG, and pessimism did not appear to influence PTG. Arslan et al. (2021) found that higher optimism and lower pessimism can reduce the negative impact of psychological inflexibility on the experience of psychological problems, and optimism partially mediated the relationship between coping flexibility and both psychological problems and wellbeing during the COVID-19 pandemic.

Based on the above review, the second aim of our study was to determine the role of hope and life orientation in predicting positive and negative psychological changes related to COVID-19 in adults using regression models. In the first model for positive changes, we assumed that hope (dispositional and perceived) and optimism will increase the frequency of positive psychological changes related to the COVID-19 pandemic, and conversely, pessimism will decrease the frequency of positive changes. In the second model for negative psychological changes, we assumed that hope (dispositional and perceived) and optimism will decrease the frequency of negative reactions, and conversely, pessimism will increase the frequency of negative changes.

Method

Sample and procedure

The research sample consisted of 102 participants aged between 20 and 65 years (43 men and 59 women, M_{age} = 38.90, SD = 14.28). Data were collected from February 2022 to March 2022 using the snowball sampling technique, and we used pen-and-paper and online methods for data collection. This approach to data collection was chosen due to restrictions resulting from public health measures during the COVID-19 pandemic. It took ∼20 min to complete the questionnaires.

Materials

The Dispositional Hope Scale (DHS; Snyder et al., 1991) is a 12-item self-report scale that assesses the sense of hope. Four items measure the agency factor, e.g., *"I energetically pursue my goals."*, and four items measure the pathway factor, e.g., *"I can think of many ways to get the things in life that are important to me."* Four items are used as distractors, e.g., *"I feel tired most of the time."* The items are scored on a 4-point scale ranging from *"absolutely false"* to *"absolutely true."* The score range is 4–16 on each scale and 8–32 on the total scale.

The Perceived Hope Scale (PHS; Krafft et al., 2017) is a unidimensional scale that includes six items, such as *"Hope outweighs anxiety in my life"*. The questions are rated on a 6-point Likert scale from 0 *"strongly disagree"* to 5 *"strongly agree"*. The total score range is 6–30.

The Revised Life Orientation Test (LOT-R; Scheier et al., 1994) is used to measure the level of dispositional optimism as predisposition expectations of positive outcomes. It is composed of 10 items, in which subjects indicate the degree of agreement or disagreement with statements such as *"Overall, I expect more good things to happen to me than bad."*. It uses a scale of 5 points, where 0 corresponds to *"strongly disagree"* and 4 corresponds to *"strongly agree"*. Three items are positively formulated (optimistic), three are negatively formulated (pessimistic), and four items are used for control. The score range is 3–15 on each scale. With regard to the interpretation of the test, there are two options (Ferrando et al., 2002): on the one hand, each factor can be measured separately, the option we adopted; on the other hand, total optimism can be measured by reversing the scores of the items drafted with a negative direction.

The Short Form of Changes in Outlook (CiOQ-S; Joseph et al., 2006) is a self-report instrument designed to measure positive and negative psychological changes following the experience of stressful events. The CiOQ-S is a 10-item instrument consisting of five items measuring positive changes (CiOP-S: e.g., *"I value my relationships much more now."*) and 5 items measuring negative changes (CiON-S: e.g., *"My life has no meaning anymore."*). In line with the purpose of the research, the participants were asked to answer all questions related to positive and negative changes, specifically in association with the pandemic, and to focus on those changes that they could identify in their lives. Each item is rated on a 6-point scale from strongly disagree (1) to strongly agree (6) so that there is a potential range of scores of 5–30 for both CiOP-S and CiON-S. Higher scores indicate greater positive and negative psychological changes.

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Data analysis

Statistical analyses were performed using IBM SPSS Statistics 24.0. Descriptive statistics (mean, SD) were used to describe the basic features of the dataset. Skewness and kurtosis of all variables were examined with all values in the range from −1.04 to 1.21. When transformed to *z*-scores (Field, 2009), values in absolute value were not >1.96. Therefore, parametric tests (paired Student's *t*-test, and the Pearson product-moment correlation coefficient) were used. To assess the strength of the relationship and the effect size, Cohen's *d* was used with the following interpretation: the results of interval 0.1–0.3 indicate a small relationship/difference; 0.3–0.5 indicate a medium relationship/difference; and 0.5 and above indicate a large relationship/difference. Multiple linear regression analysis (Enter method) was used for the analysis of models for predicting the positive and negative changes. We tested data for linear regression assumptions, especially multicollinearity and independence of residuals. Analysis of collinearity statistics shows that this assumption has been met, as Variance Inflation Factor (VIF) scores were below 10 and tolerance scores above 0.2 [$VIF_{(max)} = 2.67$ and $Tolerance_{(min)} = 0.37$, respectively]. The Durbin–Watson statistic (independence of residuals) showed that this assumption had been met for both DVs, as the obtained value was close to 2 (Durbin–Watson = 1.90, resp. 2.06).

Results

Prevalence of positive and negative psychological changes related to the COVID-19 pandemic

Perceived positive changes in all participants reached a minimum value of 8 and a maximum value of 30, with an average value of 21.57. Negative changes ranged from 5 to 30 points, with an average value of 12.85, which indicates a higher rate of positively perceived changes in the Slovak research sample. The difference is large and statistically significant [$M_{\_CiOP-S} = 21.57$; SD = 4.96 vs. $M_{\_CiON-S} = 12.85$; $SD = 5.32$; $t_{(101)} = 13.049$; $p = 0.000$].

Up to 95% of participants in the CiOP-S subscale reported moderate-to-strong COVID-related growth, specifically in respect to at least one positive change. Additionally, up to 70% of participants in our research group expressed moderate-to-strong agreement with statements that highlighted experiencing negative changes associated with the COVID-19 pandemic, also in at least one aspect. Based on this significant finding, we can conclude that only 25% of participants reported moderate-to-strong COVID-related growth, at least in one aspect of a positive change, without concurrent mild to strong agreement with statements focused on experiencing negative changes in connection with the COVID-19 pandemic. In total, 68% of participants indicated moderate-to-strong agreement with statements focused on experiencing negative changes in connection with the COVID-19 pandemic in at least one aspect, in the CiON-S subscale. Only 29% of participants reported moderate-to-strong COVID-related negative changes, at least in one aspect, without concurrent agreement (mild to strong) with statements focused on experiencing positive changes in connection with the COVID-19 pandemic. In total, up to 86% of participants agreed with experiencing psychological changes (positive or negative) as a result of the COVID-19 pandemic, in respect to at least one change. Only 16% of participants non-reported moderate-to-strong COVID-related positive and negative changes.

TABLE 1 Item scores on the CiOQ-S and percentage of respondents reporting moderate-to-high COVID-19 pandemic-related positive and negative psychological changes.

Subscale	Item	*M (SD)*	% reporting moderate-to-high changes in outlook
Negative changes (CiOQ-S: CiON-S)	1. I don't look forward to the future anymore.	2.02 (1.23)	24.4
Negative changes (CiOQ-S: CiON-S)	2. My life has no meaning anymore.	1.61 (1.17)	12.7
Positive changes (CiOQ-S: CiOP-S)	3. I don't take life for granted anymore.	3.65 (1.63)	72.5
Positive changes (CiOQ-S: CiOP-S)	4. I value my relationships much more now.	4.62 (1.26)	91.3
Positive changes (CiOQ-S: CiOP-S)	5. I am a more tolerant and understanding person now.	4.37 (1.34)	86.3
Positive changes (CiOQ-S: CiOP-S)	6. I no longer take things or people for granted.	4.67 (1.25)	91.2
Negative changes (CiOQ-S: CiON-S)	7. I Have very little trust in other people now.	3.71 (1.54)	90.5
Negative changes (CiOQ-S: CiON-S)	8. I feel very much as if I am in limbo.	2.82 (1.03)	56.8
Negative changes (CiOQ-S: CiON-S)	9. I have very little trust in myself now.	2.70 (1.48)	46.1
Positive changes (CiOQ-S: CiOP-S)	10. I value other people more now.	4.27 (1.23)	89.3

CiOQ-S: CiOP-S, The Short Form of Changes in Outlook: Positive changes; CiOQ-S: CiON-S, The Short Form of Changes in Outlook: Negative changes; *M*, mean; *SD*, standard deviation.

When performing the CiOQ-S item analysis, we were inspired by the analysis carried out by Asmundson et al. (2021). Item scores on the CiOQ-S along with the percentage of participants reporting moderate-to-high COVID-related positive and negative psychological changes on each item (scoring ≥ 4 on each item) are presented in Table 1. Up to 91% of participants reported a change in social relationships in connection with the COVID-19 pandemic (Item 4 *"I value my relationships much more now."*). Similarly, 91% of participants reported a personal change associated with gaining wisdom (Item 6: "*I no longer take things or people for granted.*"). The least common type of growth was related to Item 3: *"I don't take life*

for granted anymore." The results for negative changes related to COVID-19 show that up to 90% of participants reported a loss of trust in people (Item 7). The least common type of negative change was a loss of meaning in life (12% of participants) (Item 2).

Correlation analysis

A correlational matrix in Table 2 points to the relationships between personal variables such as hope (dispositional and perceived), optimism, pessimism, and positive and negative changes in the participants during the COVID-19 pandemic. Positive changes were positively related to perceived hope and optimism, and the strength of the relationships varied from small to moderately strong (according to Cohen's *d*). We did not find statistically significant relationships between positive changes, pessimism, and dispositional hope. On the contrary, in the case of negative changes, we found statistically significant negative relationships with all variables, such as dispositional hope (agency and pathways), perceived hope, and optimism. The values of the correlation coefficient varied from medium to large. Negative changes were positively and moderately correlated with pessimism.

Correlations between optimism and hope (dispositional—agency, pathways, and perceived) were positive. The value of the correlation coefficient varied from medium to large. Similarly, pessimism correlated negatively with hope variables. The values of the correlation coefficient varied from medium to large.

Linear regression analysis

The second aim of our study was to determine the role of hope (dispositional: 1. agency, 2. pathways, and 3. perceived) and life orientation (4. optimism and 5. pessimism) in predicting positive and negative changes related to COVID-19 in adults using regression models.

Positive changes were significantly explained by two out of five independent predictors ($F = 4.71$, $p = 0.001$; the overall proportion of explained variance was 19.7%). Both optimism and pessimism predicted positive changes in outlook (optimism: $\beta = 0.448$, pessimism: $\beta = 0.312$).

Negative changes were statistically significantly explained by two independent predictors out of five ($F = 17.18$, $p < 0.000$; the overall proportion of explained variance was 47.2%). Dispositional hope$_{\text{Pathways}}$ and perceived hope predicted negative changes in outlook (dispositional hope$_{\text{Pathways}}$: $\beta = -0.278$, perceived hope: $\beta = -0.420$) (Table 3).

Discussion

The first aim of this study was to determine the level of occurrence and types of positive and negative psychological changes in connection with the COVID-19 pandemic among adults in Slovakia. Data were collected from February 2022 to March 2022. During this period, the fourth pandemic wave with the dominance of the Omicron variant was on the rise. Linley and Joseph (2004) claim that growth should be evaluated as the process can take months or even years after the negative event. The way of thinking changes little by little and shifts from negative to positive thinking (Hallam and Morris, 2014). We assumed that it would be possible to monitor the development of potential positive psychological changes in individuals after 2 years of the pandemic outbreak.

Up to 95% of our participants reported moderate-to-high COVID-19-related positive psychological changes in at least one aspect. Only 25% of participants reported growth without concurrent mild to strong agreement with statements focused on experiencing negative changes in connection with the COVID-19 pandemic. Our data on the prevalence of COVID-19-related growth are lower compared to the results of foreign studies in this area, where the prevalence of PTG ranged from 39 to 89% (Asmundson et al., 2021). These differences can be explained by a different methodology for evaluating the occurrence of growth. In our study, from the participants who reported the occurrence of positive changes, we filtered out those who concurrently reported the occurrence of negative changes caused by the COVID-19 pandemic. Using this procedure, we identified the number of participants who reported growth. In studies presenting a higher prevalence of growth (Asmundson et al., 2021), data on the occurrence of PTG were reported directly, based on the participants' statements, without the specific correction that we implemented in our study.

As it was mentioned before when conducting a more detailed analysis, we found that 95% of participants reported growth related to COVID-19, and concurrently, up to 70% of them also reported negative changes. This result supports the existence of two types of growth: real and illusory, introduced by Zoellner and Maercker (2006) in the theory of the two-component model of PTG. In this model, one aspect of growth is real, functional, constructive, and self-transcending. The second component is a distorting and self-deceiving illusion. According to Taylor and Brown (1988), people who demonstrate distorting and self-deceiving illusions are typically those who experienced unrealistic optimism and a sense of control to cope with the trauma.

Similarly, Asmundson et al. (2021) identified two clusters of COVID-19-related growth in their study: real and illusory. These two clusters, as the authors' state, did not differ significantly in terms of socially desirable reaction tendencies, and the authors hypothesize that *"people with delusional growth are unlikely to be deliberately deceptive or engage in some kind of impression management"*. Our result on experiencing growth and, at the same time, experiencing negative psychological changes in connection with the COVID-19 pandemic might seem paradoxical, but it offers another direction of interpretation. In line with second-wave positive psychology, particularly with the approach taken by Wong et al. (2021), it is possible to think about our result in terms of the coexistence of positive and negative emotions and experiences. Wong et al. (2021) in the self-transcendence approach to global wellbeing states that *"every positive or negative emotion contains a seed of its opposite and therefore, it is difficult, if not impossible, to achieve flourishing without going through the gates of overcoming adversity"*. Based on this theory, we can assume that *"a mind that is big enough to hold two opposing ideas"* can help people experience PTG.

TABLE 2 Correlation matrix (*r*) with Pearson's correlation coefficients and 95% confidence intervals, reliability.

	1. DHS (pathways)	2. DHS (agency)	3. PHS (perceived hope)	4. LOT-R (optimism)	5. LOT-R (pessimism)	6. CiOQ-S (positive changes)	M ± SD (95% CI of mean)	Reliability—Cronbach's α/McDonald's ω (number of items)
Dispositional hope_ Pathways (DHS)	–	–	–	–	–	–	12.294 ± 2.159 (11.869, 12.718)	0.741/0.752 (4)
Dispositional hope_Agency (DHS)	0.663** (0.537, 0.759)	–					11.735 ± 1.964 (11.349, 12.121)	0.602/629 (4)
Perceived hope (PHS)	0.578*** (0.432, 0.694)	0.511*** (0.352, 0.642)					21.117 ± 5.972 (19.944, 22.290)	0.911/0.914 (6)
Optimism (LOT-R)	0.419*** (0.244, 0.567)	0.388*** (0.209, 0.541)	0.679*** (0.559, 0.772)	–			10.058 ± 2.957 (9.477, 10.639)	0.786/0.789 (3)
Pessimism (LOT-R)	−0.354*** (−0.513, −0.171)	−0.456*** (−0.598, −0.287)	−0.623*** (−0.729, −0.488)	−0.564*** (−0.684, −0.415)	–		8.676 ± 2.670 (8.151, 9.201)	0.730/0.745 (3)
Positive changes (CiOQ-S: CiOP-S)	0.041 (−0.155, 0.234)	0.041 (−0.155, 0.234)	0.237* (0.045, 0.412)	0.354*** (0.171, 0.513)	−0.022 (−0.216, 0.173)	–	21.528 ± 4.968 (20.602, 22.554)	0.786/0.851 (5)
Negative changes (CiOQ-S: CiON-S)	−0.544*** (−0.668, −0.391)	−0.445*** (−0.588, −0.274)	−0.631*** (−0.735, −0.498)	−0.405*** (−0.556, −0.228)	0.501*** (0.340, 0.634)	0.14(−0.056, 0.326)	12.852 ± 5.323 (11.807, 13.898)	0.843/0.817 (5)

M, mean; SD, standard deviation; *r*, Pearson's product-moment correlation coefficient; DHS, The Dispositional Hope Scale; PHS, Perceived Hope Scale; LOT-R, The Revised Life Orientation Test; CiOQ-S, The Short Form of Changes in Outlook.
$p < 0.05^{*}$, $p < 0.01^{**}$, $p < 0.001^{***}$.

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TABLE 3 Regression models for prediction of positive and negative psychological changes related to the COVID-19 pandemic (CiOQ-S).

	R^2	F	B	SE (B)	B	t
Positive changes (CiOQ-S)	0.197	4.71**				
Dispositional hope$_{_Pathways}$ (DHS)			−0.389	0.306	−0.169	−1.27
Dispositional hope$_{_Agency}$ (DHS)			0.024	0.326	0.009	0.07
Perceived hope (PHS)			0.183	0.124	0.220	1.47
Optimism (LOT-R)			0.752	0.216	0.448	3.47**
Pessimism (LOT-R)			0.580	0.231	0.312	2.50*
Negative changes (CiOQ-S)	0.427	17.188***				
Dispositional hope$_{_Pathways}$ (DHS)			−0.686	0.266	−0.278	−2.58**
Dispositional hope$_{_Agency}$ (DHS)			0.014	0.283	0.005	0.051
Perceived hope (PHS)			−0.374	0.108	−0.420	−3.46**
Optimism (LOT-R)			0.200	0.188	0.111	1.06
Pessimism (LOT-R)			0.412	0.201	0.206	2.04

R^2, coefficient of determination; F, Fisher's F-test; B, unstandardized regression coefficient; $SE(B)$, standard error of unstandardized regression coefficient; β, standardized regression coefficient; t, t-statistic.
$p < 0.05^*$, $p < 0.01^{**}$, $p < 0.001^{***}$.

More research is needed to determine how the reported growth (whether real or illusory) in a certain phase of the COVID-19 pandemic affects the trajectory of further adaptation to its development. We are inclined to agree that illusory growth does not have to be perceived negatively; this aspect of growth can eliminate the negative effects of a traumatic event, and thus temporarily fulfill the role of another positive adaptive strategy (Mareš, 2012).

In addition to monitoring the level of occurrence of positive and negative psychological changes in connection with the COVID-19 pandemic, we also explored the areas mostly affected by these changes. Up to 91% of participants reported changes in social relationships, including higher awareness of the value of social relationships. Similarly, 91% of participants reported personal changes, specifically gaining wisdom and realizing the importance of genuine relationships. A small number of participants reported growth in terms of different perceptions of life. PTG was originally used to describe major changes in beliefs, attitudes, or ways of relating to the world, such as finding greater meaning or purpose in life, and later expanded its definition to include smaller but potentially important changes, such as an appreciation for the little things in life (Asmundson et al., 2021). Our participants, in the actual phase of the pandemic, reported COVID-19-related growth mainly in minor changes (primarily in the area of social relations), and minor changes were identified in areas of deeper, existential issues related to the meaning of life. These results seem to be obvious since PTG is a process that develops over time (Linley and Joseph, 2004). However, we are aware that such a fundamental change is very individual and complex. As for experiencing negative changes, we found that 68% of participants indicated moderate-to-strong agreement with statements focused on experiencing negative changes in connection with the COVID-19 pandemic in at least one aspect. Only 29% of participants reported negative changes without noticing any positive perception of the consequences of the pandemic. The most common negative change related to COVID-19 was a loss of trust in people, which was reported by 90% of participants. Only 12% of participants reported a loss of meaning in life related to COVID-19. No notable inclinations toward alterations in the perception of life's purpose were observed in the realm of personal development and negative transformations, even 2 years after the pandemic began. At the end of the discussion regarding the prevalence of the consequences of the COVID-19 pandemic, it is necessary to underscore that the pandemic has affected many people. This is also supported by our result that up to 86% of participants reported experiencing psychological changes (positive or negative) as a result of the COVID-19 pandemic.

The second aim of our study was to determine the role of hope and life orientation in predicting positive and negative psychological changes related to COVID-19 in adults. Life orientation (optimism and pessimism) was found to be a significant positive predictor of positive consequences of the COVID-19 pandemic. We found a positive connection between optimism and positive psychological changes which has also been confirmed by other authors (Taku and Cann, 2014; Britton et al., 2019). The result is also consistent with the idea by Britton et al. (2019) that people who report more positive emotions and personality traits show higher ego-resilience (Fredrickson and Joiner, 2002), which enables people to adapt to their environment (Klohnen, 1996) and thrive after trauma (Fredrickson et al., 2003). The effect of optimism is context-independent (Bruininks and Malle, 2005), and optimistic people have a positive outlook, believe good things will happen

in the future, and are motivated to show effort even in the face of difficulties (Scheier and Carver, 1985). The abovementioned characteristics of optimism can account for people's ability to experience positive changes during the COVID-19 pandemic; therefore, despite the waves and development of the pandemic, optimistic people were able to resist and see the opportunity for growth. Genc and Arslan (2021) state that optimism provides an adaptive way to cope with stressful life events during the pandemic, which they explain by *"the adaptive role of optimism, which can be considered as a fundamental component of the ability to cope with stress experiences because it involves a positive outlook on life and that motivates individuals to undertake actions even in difficulties, and subsequently, optimism evokes favorable feelings and positivity about the future, and that may lessen the negative effects of coronavirus stress on subjective well-being"*.

However, at the same time, our findings indicated that not only the presence of optimism but also pessimism can contribute to positive psychological changes. Taku and Cann (2014) and Britton et al. (2019) did not find an effect of pessimism on PTG. Similarly, Arslan et al. (2021) found that higher optimism and lower pessimism can reduce the negative impact of psychological inflexibility on the experience of psychological problems during the COVID-19 pandemic. Our result regarding the relationship between pessimism and positive psychological changes as a response to stressful events requires further investigation. Joseph et al. (2005) state that also those factors, which are primarily perceived as *"negative"* (e.g., ruminative forms of intrusive thinking), can predict subsequent adjustment and growth. Ruminative forms of intrusive thinking support the cognitive-emotional processing of a traumatic event. This behavior is probably related to greater suffering but may be useful for the adaptation and growth of an individual in the future. Our findings highlight the importance of exploring not only positive but also negative aspects of psychological factors related to growth, which could lead to a better understanding of its development.

The importance of hope in the prediction of positive consequences of the COVID-19 pandemic was not significant. However, hope, in two factors (dispositional hope in the path component and perceived hope), was identified as a significant predictor of negative changes related to the COVID-19 pandemic. Our results indicate that when a person who has a goal and a plan to achieve it faces some obstacles (Path component) and at the same time believes that the current situation and difficulties can be controlled and overcome (perceived hope), positive beliefs can reduce negative psychological changes (such as the worsening of social relationships, loss of self-confidence, and lacking the meaning of life) during the pandemic. The importance of dispositional hope in the Agency component in the prediction of negative changes was not significant. Agency represents a significant component of dispositional hope, and it includes self-confidence in achieving defined goals. In our research, the concept of perceived hope appears to be a more significant component of self-confidence in achieving goals during the pandemic period. Perceived hope is understood as a deep trust for a positive outcome, especially in difficult life situations that are beyond our direct control and in deeper resources for coping built not only on trust in one's own strength but also on faith in something or someone beyond us (Krafft and Walker, 2018). Due to the COVID-19 pandemic, people were exposed to various unpredictable stressful life events for a long time, quite often without being able to control them. We assume that in such situations, people relied not only on their own strengths but also on self-transcendent sources in the process of achieving goals. Evidence that hope had a direct impact on improved mental health during the COVID-19 pandemic has been supported by several studies (Yildirim and Arslan, 2020, 2022; Gallagher et al., 2021; Genc and Arslan, 2021; Wider et al., 2022). Hopeful people are more creative and remain resolute in pursuit of their goals, which can lead to reduced levels of mental health disorders such as anxiety and depression (Arnau et al., 2007), practice more adaptive coping strategies in managing adverse life circumstances (Folkman, 2013), are better able to respond difficult situations, are more likely to be capable of bouncing back from a stressful situation and motivated toward goals, and create pathways for attaining a desired goal (Yildirim and Arslan, 2022). Other studies from the pandemic period found that hopelessness and desperation have been associated with negative outcomes, including suicidal ideation (Thakur and Jain, 2020).

The importance of life orientation (optimism and pessimism) in the prediction of negative changes was not significant. This finding can be explained by the different theoretical backgrounds of the hope and optimism concepts. Wider et al. (2022) state that optimists may believe that things will turn out the way they want to but may not possess the pathways to pursue goals related to what they hope to achieve, whereas hope focuses directly on the personal attainment of pursued goals and one's beliefs in their capability to achieve those goals. As we have already mentioned, dispositional hope manifests itself mainly in situations that are more personally relevant and are associated with specific goals. During the COVID-19 pandemic, many people experienced feelings of fear or being under threat. These situations required faith in their own abilities to find effective ways to achieve goals, thus decreasing the risk of negative psychological changes.

Last but not least, the different roles of dispositional hope and optimism with an impact on various life changes supports the perspective (Yang et al., 2014; Rand, 2018) that hope and optimism are similar but basically different constructs because they can predict various mental health-related consequences. Rand (2018) explains this perspective through the role of different coping strategies as mediating factors. Optimism should be negatively related to dysfunctional coping, while hope should be associated more with coping strategies related to the achievement of goals, such as active problem-focused coping.

Limitations

This study has several limitations. First, the research sample size and the predominantly online data collection limited the desired representativeness of the research file and the possibility to formulate general conclusions. We are fully aware that through online surveys, only a selected group could have access to the study, possibly depending on their educational level or economic status. This approach was chosen due to the public measures related to the pandemic situation at the time of data collection. Regarding

the sample size, multiple linear regression analysis (Enter method) was used for the analysis of models to predict the positive and negative changes. Power analysis was conducted using G*Power version 3.1.9.4 (Faul et al., 2007). The results for multiple linear regression with six predictors indicated the required sample size to achieve 80% power for detecting a medium effect, at a significance criterion of $\alpha = 0.05$, $n = 98$. The obtained sample size of $n = 102$ is, from this aspect, sufficient for testing the hypotheses of the study.

Second, data on the occurrence of positive and negative changes in connection with the pandemic were collected during the fourth wave of the COVID-19 pandemic, 2 years after its outbreak. It is questionable whether the changes reported by the participants in the CiOQ-S questionnaire during the measurement period resulted from the current pandemic situation, whether their ability to evaluate was weakened, or the reported changes were the result of other situations. Despite these considerations, we assume that the pandemic, even in this period, had the potential to evoke changes in individuals' views of their lives. The course of the pandemic turned out to be a dynamic process. Similarly, at the time of data collection, when the onset of the fourth wave of the pandemic was reported and the omicron variant became the dominant circulating variant, people in Slovakia were exposed to diverse information, according to which, e.g., *"this is a less severe variant than delta variant, but on the other hand, extremely high numbers of infected people are expected"*. We assume that the aforementioned types of publicized information had the potential to trigger another wave of stress in people, the *"coronavirus fear"*, and to intensify uncertainty and anxiety.

Third, the approach used in this study does not clarify whether the obtained results support growth as a real, transformative phenomenon, or only as a product of a positive illusion. For this purpose, we propose to supplement the measurement of the presence of personal growth by, for example, the administration of a behavioral checklist with the inclusion of negative changes in the level of mental health, on a personal, emotional, and social level, and in activities of daily life. At the same time, we also see an opportunity for longitudinal research that would monitor the stability of personal growth.

Fourth, in the submitted research, one of our goals was to monitor the coincidence of the occurrence of positive and negative psychological changes in adults during the fourth wave of the COVID-19 pandemic, but we did not explicitly investigate how our participants experienced the pandemic due to their level of stress (in several studies, the inclusion of this variable has been shown to be beneficial for a deeper understanding of the psychological mechanisms associated with personality growth, e.g., Hu et al., 2021, Asmundson et al., 2021, and others).

Conclusion

Despite the aforementioned limitations, we have assessed the submitted study from two main perspectives. First, we conducted parallel monitoring to track both positive and negative changes associated with the COVID-19 pandemic. This approach allowed us to gain a more comprehensive understanding of the potential shifts in participants' experiences related to the pandemic. Additionally, it prompted us to question whether these changes were genuine or merely perceived. Second, we incorporated two different orientations (optimism and pessimism) and two types of hope (dispositional and perceived) in regression models. These variables were utilized to predict the occurrence of positive and negative changes in relation to the COVID-19 pandemic. Our results indicated that life orientation and hope should be perceived as important resources to adapt to adverse life events during the COVID-19 pandemic, mainly in terms of supporting positive development and reducing the occurrence of developing negative psychological life changes.

Hope and optimism are promising targets for interventions to foster resilience during the COVID-19 pandemic, considering their potential link with positive expectations and adaptive responses. We recommend incorporating hope interventions into mental health support to enable individuals to develop the capacity to set and achieve personal goals and effectively utilize hope during times of stress or when facing life satisfaction challenges. Such interventions can be integrated into various forms of psychotherapy. To ensure the effectiveness of hope-based interventions, it is essential to validate them through randomized control trials (RCTs), comparing them with established gold-standard treatments and assessing optimism interventions. Several interventions focusing on fostering positive expectations, including hope (Cheavens and Guter, 2018) and optimism (Malouff and Schutte, 2017), have already been developed. Additionally, interventions targeting the most vulnerable individuals during the COVID-19 pandemic have been implemented, such as an RCT study of an internet-based positive psychology intervention for healthcare students in Tunisia, which resulted in increased levels of hope and optimism (Krifa et al., 2022). To determine the real effectiveness of optimism and hope in the process of coping with adverse life events, more evidence and studies are needed, focusing on better insight into the mechanism between positive psychological states and life changes in times of crisis. As we have already mentioned, the process of growth takes more time, the shift from negative to positive thinking occurs gradually, and both hope and optimism require some time to affect personal growth.

It has been demonstrated that integrating a comprehensive biocentric and psychological approach to disaster management, such as Body–Mind Interventions, Biodanza, and Ethical ecological strategies, could enhance people's preparedness and ability to cope with a pandemic, post-pandemic period, or crisis. Pandemics tend to disrupt connections and cause dissociations across various levels, including the immune system, hormonal system, central nervous system, instincts and behavior, motor activity and sympathetic arousal, desire for connection and physical separation, and lack of contact and physicality, as well as the mind–body connection and the interplay between feeling, thinking, and acting. Based on biocentrically oriented studies by Parker et al. (2020) and Stueck (2021), we consider that working with the body through practices such as practicing meditation and autogenic training plays a crucial role in stress regulation, reducing the secretion of stress hormones such as adrenocorticotropic hormone (ACTH), cortisol, and catecholamines. Moreover, these practices have a positive impact on various aspects of mental health by fostering positive expectations, hope, and optimism, which can contribute to positive psychological changes related to the pandemic.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

EJ and LP conducted the literature review and the analysis, wrote the first draft of the manuscript, conceptualized the study design, and conducted the study. MR, LR, and TS assisted with the analysis and commented on drafts. MR and LP conducted the literature review. LP collected the data. All authors have reviewed and approved the final manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Psychometric properties of a new instrument for the measurement of the perceived quality of distance learning during the coronavirus disease 2019 (COVID-19) pandemic

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Introduction: The lockdown restrictions due to the COVID-19 pandemic forced many students to use distance learning. Few studies have examined the psychological effects of distance learning during the pandemic on university or on non-university students using a specific psychometric tool. The principal aim of this study was the construction and validation of a new psychometric tool, the Perceived Quality of Distance Learning (PQDL), to measure students' appreciation and reaction to distance learning. The connection between anxiety, depression, perceived self-efficacy, and students' perception of distance learning was analyzed to assess the nomological validity of the new scale.

Method: The sample consists of 429 students who attended university or training courses. The factor structure of the new instrument was analyzed through Exploratory and Confirmatory Factor Analyses and its nomological validity was analyzed through regression analysis.

Conclusion: The results showed that PQDL consists of two subscales: Distance Learning Organization and Cognitive-Emotive Reaction to Distance Learning. Higher student's ability to organize and plan distance learning and higher student's positive cognitive-emotive reaction to distance learning, higher student's perceived quality of distance learning. Anxiety and depression scores were negatively correlated with students' perceived quality of distance learning. Furthermore, students' perceived emotional self-efficacy of negative emotions and perceived scholastic self-efficacy were positively correlated with students' perceived quality of distance learning. These data indicate that PQDL is a reliable questionnaire to assess student's perceived quality of distance learning.

KEYWORDS

COVID-19, anxiety, depression, perceived self efficacy, distance learning

Introduction

Recent data showed that the Coronavirus disease 2019 (COVID-19) pandemic had a negative impact on the psychological well-being of different population samples due to restrictive measures (Gismero-González et al., 2020; Khoshaim et al., 2020; Paolini et al., 2020; Macdonald and Hülür, 2021; Partouche-Sebban et al., 2021). These included the halting of social and working activities, the reduction of social interactions, and a reduction in economic resources. These factors were associated with behavioral changes, such as insomnia or sleep disorders, concentration and attention difficulties, and low appetite (Bao et al., 2020; Holmes et al., 2020; Tommasi et al., 2020). In particular, the pandemic reduced people's confidence in their ability to deal with everyday problems, as people's level of uncertainty (Taylor, 2019), anxiety, and fear about the future increased in reaction to lockdown restrictions imposed by governments (Rubin and Wessely, 2020). During the lockdown period, one of the most important restrictions was distance learning (DL), which forced people to attend classes only on online education and learning platforms. DL compelled a vast number of individuals to adopt information and communication technologies, leading to a significant surge in their development and usage during the lockdown period. DL was instrumental in meeting the dual objective of providing education while ensuring health safety by maintaining physical distancing ("*environmental health*") (Akuratiya and Meddage, 2020; Toquero, 2020). Most universities and educational institutions worldwide were unprepared for dealing with the transition from face-to-face to distance learning (Crawford et al., 2020). Distance learning was characterized by three dimensions: *social presence*, *social interaction*, and *satisfaction*.

The expression *social presence* refers to the degree of realness assigned to the other in communication (e.g., Short et al., 1976; Kreijns et al., 2014, 2022). *Social presence* includes three groups of characteristics: lesson organization and structure and the methodology or technique used for teaching (e.g., cooperative learning and peer education); clear instructions to help the online students understand the lesson topic; the possibility of using teaching tools and devices for online students (e.g., videos).

Social interaction refers to the different forms of communication adopted by users (i.e., students and teachers) when interacting with each other, as well as any other forms of engagement that enable social connections and collaboration in the online learning environment. The quality of social interaction is related to critical thinking and flexibility in the organization of teaching.

Satisfaction includes the assessment of individual learning, social presence, and social interaction. All these dimensions enable students' engagement (Fortune et al., 2011; Gray and DiLoreto, 2016; Bali and Liu, 2018).

Dhawan (2020) identified several strengths and weaknesses associated with DL. The advantages included the ability to offer temporal and spatial flexibility, a vast array of courses and content, and prompt feedback. However, DL also had some drawbacks, such as technical difficulties, challenges in time management, potential distractions, frustrations, anxiety and confusion, and a lack of attentiveness.

Although numerous studies have been conducted on the psychological impact of the COVID-19 pandemic on university students, only a small number of them have specifically investigated the psychological effects resulting from the mandatory use of DL during the COVID-19 lockdown (Cao et al., 2020; Irawan et al., 2020; Russell et al., 2023).

Regarding the relationship between DL and psychological outcomes and characteristics, in the literature, it was evidenced that there is an association between DL and depressive symptoms (Elmer and Stadtfeld, 2020), an increment in stress and a decrease in attention during the online lessons (Quintiliani et al., 2021), an increment of worries about the availability and difficulty in using online platforms (Moawad, 2020) and a larger problem for students in DL to interact with teachers or to find technical support (Attri, 2012; Dodo et al., 2013; Musingafi et al., 2015).

Lastly, cross-sectional and quantitative studies in particular have consistently demonstrated that the COVID-19 pandemic, and the resulting sudden shift to DL, had detrimental impacts on the motivation and mental health of university students. Nicholson et al. (2023) employed a mixed methods design to examine the experiences of students in an Australian University both at the outset of the pandemic in 2020 and again, in a second step at the conclusion of their academic year, 6 months later. Results showed that despite quantitative findings suggesting poorer attitudes toward learning during the pandemic, qualitatively students perceived both positives and negatives towards studying online.

Instruments to measure students' perception of face-to-face learning environment

Regards the assessment of students' perception of face-to-face learning, Mather and Sarkans (2018) used qualitative methodology to collect descriptive data. The instrument assessed learner preference, interactivity, workload, performance, challenges, and preference for future learning. Öhman et al. (2016) developed an instrument to measure Swedish nursing students' perception of their learning environment. The authors studied the construct validity and reliability of the instrument, which had four factors: supervisor relationship, pedagogical atmosphere, leadership style, and patients' premises.

Most of the studies in the literature assessed *blended learning*, which is the hybrid learning method that combines face-to-face and online teaching methods (Garrison and Kanuka, 2004; Usta and Özdemir, 2007; Glogowska et al., 2011). Several studies developed instruments to measure students' perceptions of *blended learning*. Extavour and Allison (2018) administered an online survey at the end of a pharmacy course. The survey was a 5-point Likert-like scale from 1 (Not useful) to 5 (Very useful). Adas and Shmais (2011) developed a 41-item questionnaire to measure students' perception of *blended learning* in a sample of Palestinian university students. The instrument was a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree) and the self-report assessed three domains: students' attitudes towards the *blended learning* process; students' attitudes towards blended learning content; students' attitudes towards the ease of use of computers. Owston et al. (2013) developed a self-report instrument composed of 31 items, 25 of which were on a 5-point Likert-style scale from 1 (Strongly Disagree) to 5 (Strongly Agree) and six were multiple choice questions in a sample from York University. The instrument was adapted by Bidder et al. (2016) in a sample of Malaysian university students. Ginns and Ellis (2007) developed a self-report instrument to measure students' perception

of *blended learning* in a sample of Australian Veterinary Science students. The instrument was composed of 18 items on a 3-point Likert-style scale (Disagree, Neutral, Agree). The authors studied the factor structure and the reliability of the instrument. Berga et al. (2021) adapted the Web-based Learning Environment Instrument (WBLEI; Chang and Fisher, 2001) to measure nursing students' perception of online learning environments. The instrument was composed of 37 items on a 5-point Likert-style scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The WBLEI assessed four factors: Interaction, Access, Response, and Results for Maths and Science education students. Studies have analyzed the construct validity, descriptive statistics, and reliability of the instrument (Chang and Fisher, 2001; Berga et al., 2021). These findings had poor generalizability to a greater number of participants, due to administration through the convenience sampling method; only two studies (Ginns and Ellis, 2007; Berga et al., 2021) examined the factor structure of the instruments. Other researchers studied the reliability, frequencies, and descriptive statistics of instruments. Furthermore, instruments we are not suitable for the pandemic context. Finally, studies analyzed perceptions of the difference between face-to-face and distance education or *blended learning* and face-to-face environments (Smith, 2013; Platt et al., 2014; Tichavsky et al., 2015; Wright, 2017; Yilmaz, 2019; Gherheş et al., 2021; Mali and Lim, 2021; Johnson King et al., 2022). These studies were not specifically on measuring students' perception of face-to-face learning environments.

Association between self-efficacy, anxiety, and depression in the online and face-to-face learning environments

Few studies have analyzed the association between perceived emotive self-efficacy and clinical variables (e.g., anxiety and depression) in university students (Morales-Rodríguez and Pérez-Mármol, 2019).

Self-efficacy refers to an individual's belief in his or her capacity to exert control over one's own motivation, behavior, and social environment and to execute behaviors required to produce specific performance attainments (Bandura and Adams, 1977, Bandura 1986, 1997).

More recently, the concept of self-efficacy has evolved into regulatory, emotional self-efficacy, a process of modulating cognition, emotions, and behavior to achieve goals in life (Caprara et al., 2008). Regulatory, emotional self-efficacy includes two dimensions: self-efficacy in managing negative emotions and self-efficacy in expressing positive emotions (Caprara et al., 2010, 2013). The first dimension allows the modulating of negative emotions (e.g., anger and fear) to control impulsive behaviors; the second dimension allows the expression of positive emotions. Regulatory, emotional self-efficacy enables the promotion of positive emotions (e.g., serenity and happiness), prosocial behavior (e.g., helping and sharing), and academic achievements (Caprara et al., 2011). Positive emotions, academic achievements, and prosocial behaviors increase psychological well-being and decrease depression and anxiety (Mesurado et al., 2018; Picconi et al., 2019). Some studies investigated the association between anxiety, depression, and self-efficacy. Poor self-efficacy generates high levels of worry and rumination which are symptoms of anxiety and depression disorders, respectively (Liu et al., 2019; Zhou and Yu, 2021). It has been noted that challenges in comprehending the significance of emotions can result in individuals amplifying the adverse facets of social scenarios and evading situations that may trigger emotional responses. Difficulties in understanding the role of emotions have been identified, which can lead people to exaggerate negative aspects of social situations and avoid situations that can activate emotional states. In the scholastic context, students with higher scholastic self-efficacy believe that they can achieve their academic goals and, therefore, have higher motivation to study (Zimmerman and Bandura, 1994; Yokoyama, 2019). The beginning of a person's university career marks the transition from childhood to adulthood and the acquisition of new social roles. These changes can also create higher levels of stress, academic difficulties, and lower levels of well-being. Therefore, it is important to study the role of individual self-efficacy in coping with stressful events (Onyeizugbo, 2011; Arnett et al., 2014; Gutierrez and Park, 2015; Aimé et al., 2017; Faramarzi and Khafri, 2017; Mirzaei-Alavijeh et al., 2017; Grøtan et al., 2019; Morales-Rodríguez and Pérez-Mármol, 2019; Gutiérrez García and Landeros Velázquez, 2020). In particular, some authors found that higher levels of anxiety and depression were associated with poor perceived self-efficacy (Bandura, 1993; Chou, 2018; Zheng et al., 2020). These findings were not confirmed by Faramarzi and Khafri (2017), who did not find any correlations between academic self-efficacy, anxiety, and depression. Their study showed that only alexithymia was negatively correlated with self-efficacy.

Self-efficacy in a DL context is called online learning self-efficacy (OLSE) and is focused on the technological factor of self-efficacy (e.g., internet self-efficacy, learning management self-efficacy, and computer self-efficacy) (Alqurashi, 2019; Aldhahi et al., 2022). OLSE consists of three dimensions: learning-related self-efficacy, technology-related self-efficacy, and time management-related self-efficacy. To the best of our knowledge, only one study has analyzed the association between self-efficacy, anxiety, and depression in the context of DL (Zhou and Yu, 2021). The researchers found a significant, negative association between online learning self-efficacy and anxiety in a sample of Chinese undergraduate students. Furthermore, they found that anxiety mediated the positive association between online self-efficacy and well-being, thus reducing self-efficacy.

Students' perception of online learning during the COVID-19 pandemic

Several studies examined students' perceptions of online learning during the COVID-19 pandemic. In particular, some authors (Almusharraf and Khahro, 2020; Mukhtar et al., 2020; Bączek et al., 2021) found a high level of satisfaction regarding DL in a sample of post-secondary and university students. Data showed that digital support (e.g., slides, audio, and video), teaching modes (e.g., group or individual discussions), the possibility of studying according to own personal pace, and the possibility of staying at home made lessons more accessible and understandable. Furthermore, the majority of the students worked towards their academic goals. A study on a sample of dental and medical students in Pakistan showed the positive aspects of DL: free access to online materials and a greater sharing of videos

made by teachers with laboratory and clinical expertise (Mukhtar et al., 2020).

Several studies (Agung et al., 2020; Bahasoan et al., 2020; Hamid et al., 2020; Mukhtar et al., 2020; Nambiar, 2020; Lemay et al., 2021) explored the unfavorable facets of DL, encompassing social and psychological issues as well as technological obstacles. With regard to social and psychological difficulties, the majority of students complained of social isolation, an increase in stress and anxiety, difficulty in understanding learning content, difficulty in maintaining high concentration levels during lessons, a decrease in motivation, and poor perceived emotional and scholastic self-efficacy. Mukhtar et al. (2020) reported that dental and medical students expressed concerns regarding the absence of opportunities to interact with patients.

Nicholson et al.'s (2023) qualitative results further highlighted that the DL experience is not the same for everyone and suggests the need to reconsider the standard approaches to providing support to students. In each case, students reported poor mental health and low levels of commitment and motivation, also expressing their need for contact with peers.

Evidence suggests that students' achievement emotions are important contributors to their learning and success online. It is, therefore, essential to understand and support students' emotional experiences in order to enhance online education, especially in the COVID-19 context. However, to date, very few studies (Shao et al., 2023) have investigated how students' achievement emotions may be affected by teaching and learning factors in online learning environments.

Technical problems (e.g., outages of internet connection) involved the difficulty of getting an internet connection in their homes and the scarce availability of digital support (e.g., CDs, pen drives, and memory cards), the inefficacy of online courses due to high costs, the higher difficulty in completing course work and signal instability during online lessons. These studies did not examine the nomological network between students' perception of online learning, anxiety, depression, and perceived emotional and scholastic self-efficacy during the COVID-19 pandemic. Furthermore, these studies examined students' perceptions of online learning during the COVID-19 pandemic without psychometric tests.

Aims of the study

The principal aim of this study was the creation and validation of a new questionnaire to measure students' perceived quality of DL and an analysis of the nomological structure of individual socio-demographic characteristics, anxiety, depression, and emotional and scholastic perceived self-efficacy relating to DL.

In relation to the nomological structure, we developed the following hypotheses:

1. H1: negative variations of behavior and life habits are significantly and negatively correlated with students' perceived quality of DL;
2. H2: anxiety has a negative connection with students' perceived quality of DL;
3. H3: depression has a negative connection with students' perceived quality of DL;
4. H4: perceived emotional self-efficacy has a positive connection with students' perceived quality of DL;
5. H5: perceived scholastic self-efficacy has a positive connection with students' perceived quality of DL.

Materials and methods

Data collection and procedures

A total of 429 participants responded when contacted. Regarding the bias of response in the Perceived Quality of Distance Learning questionnaire, women tended to choose higher response categories (from partially agree to strongly agree) for items 1 ("I can easily access the internet"), 3 ("I own computer devices to attend classes"), 6 ("I think distance learning offers better study organization for working students"), and 10 ("I can record lessons"), and lower response categories (from strongly disagree to partially disagree) for items 2 ("I feel detached from physical and group relationships"), 8 ("I feel fatigue, have eyestrain, and headaches"), and 19 ("I feel nostalgic recalling pre-COVID-19 events of physical and social interaction"). Men tended to choose higher response categories for items 1 ("I can easily access the internet"), 3 ("I own computer devices to attend classes"), 17 ("I feel embarrassed during written exams"), and 20 ("I cry more easily when I think about friends I have not seen in a long time due to pandemic restrictions").

There were no refusals regarding the completion of the questionnaire. In fact, all students gave their consent to respond to all items.

The snowball sampling method was used, i.e., the authors asked their students to distribute the link among their friends. The sample was obtained through quota sampling, as individuals were selected from pre-established groups (university courses and training programs with a requirement of having attended online classes). Therefore, the representativeness of the sample cannot be guaranteed. The study herein was conducted according to the principles of the Helsinki Declaration[1] (Accessed on 22 August 2021), APA Ethics Code, and European and Italian Privacy Law (i.e., EU Reg. 679/2016, GDPR and Legislative Decree no. 196/2003, namely the Personal Data Protection Code). It was approved by the Psychology, Communication, and Social Sciences PhD curriculum meeting, (University of Macerata. Prot. no. 0041598 of 31/03/2021 - UOR: SI000018 - Classif. VI/6).

The test battery was administered online and was created using Google Forms. The link to the survey was distributed via WhatsApp and the platforms used during DL (e.g., Microsoft Teams, Google Meet, and Zoom).

The instrument can be requested from Dr. Maria Rita Sergi (mariaritasergi@libero.it).

Participants

In total, 429 (74.8% female) participants were contacted for the collection of data. The mean age was 23.20 years (SD = 5.91).

1 https://www.wma.net/what-we-do/medical-ethics/declaration-of-helsinki/

Participants were students of different categories: 219 (51.0%) were university students attending lessons in the humanities faculty, 158 (36.8%) were university students attending lessons in scientific faculties, 16 (3.7%) were university students attending linguistic faculties, 15 (3.5%) were students attending non-university training courses, 7 (1.6%) were students attending economic faculties, 6 (1.4%) were students attending law faculties; 4 (0.9%) were students attending PhD and masters courses, and 4 (0.9%) were students who did not indicate their faculties. Furthermore, 203 participants (47.3%) lived in Central Italy, 194 lived in Southern Italy (45.2%), 28 (6.5%) lived in Northern Italy, and 4 (0.9%) lived on the Italian islands (i.e., Sicily and Sardinia).

Measures

Socio-demographic characteristics

Socio-demographic characteristics were age, educational level, and behavioral changes as a result of the COVID-19 pandemic.

Anxiety

The state of anxiety was measured with the State–Trait Anxiety Inventory, X1 form (STAI-X1; Spielberg et al., 1970). STAI-X1 is a 20-item self-report inventory and responses to each item are given using a 4-point scale ranging from 1 ("none") to 4 ("very much") and was presented at the beginning of the survey ($\alpha = 0.95$). A reduced form of STAI-X1 (STAI-X1/R) with 10 items, was presented at the end of the survey ($\alpha = 0.94$). The comparison between the STAI-X1 and the STAI-X1/R score was used to evaluate whether the level of anxiety decreased or increased while completing the survey. Trait anxiety was assessed with the State–Trait Anxiety Inventory, X2 form (STAI-X2; Spielberg et al., 1970) which consists of 20 items. Responses in each item were given using a 4-point scale ranging from 1 ("hardly ever") to 4 ("almost always") ($\alpha = 0.92$).

Depression

The cognitive and somatic factors of depression (e.g., psychomotor slowdown and sadness) were measured with the Depression Questionnaire (QD; Bertolotti et al., 1997), comprising 24 items. Each item had a dichotomic scale (yes vs. no) (KR20 = 0.865).

Perceived self-efficacy

Perceived Emotive Self-Efficacy (PESE; Caprara, 2001) is a scale for assessing the ability to express positive emotions (seven items) ($\alpha = 0.90$) and to manage negative emotions (eight items) ($\alpha = 0.875$) on a 5-point Likert scale. The higher the score, the higher the ability to express positive emotions or manage negative emotions. Scholastic Perceived Self-Efficacy (SPSE; Pastorelli and Picconi, 2001) is a one-dimensional scale consisting of nine items, on a 5-point Likert scale. This scale assessed students' beliefs in achieving scholastic objectives ($\alpha = 0.90$).

Perceived quality of distance learning questionnaire

Perceived quality of distance learning (PQDL) is a questionnaire for assessing students' perception of DL quality. PQDL consists of 32 items that assessed students' perceived quality of DL. Items were determined through interviews. In particular, the questionnaire assesses students' ability to use online platforms and applications, organize their online lessons, cope with technical difficulties, attention and concentration during online lessons, and their cognitive and emotional reactions to DL (worries and irrational thoughts about the pandemic). Participants responded using a 5-point Likert scale ranging from 1 ("I strongly disagree") to 5 ("I strongly agree"). The higher the score, the higher the perceived quality of DL. Examples of items were: "*I have the possibility to record lessons*," "*Despite restrictions, I still have hope for the future*," "*I face exam sessions with more motivation*." The instrument was developed on the basis of previous literature (Wagner, 1994; Huang, 2002; Wang et al., 2014; Martin and Rimm-Kaufman, 2015) and experiences of research in direct contact with students. Previous literature analyzed connectivism as a new learning theory based on the digital age (Siemens, 2004; Goldie, 2016). In particular, connectivism is defined as *actionable knowledge*, in which new connections, deriving from various information sources (such as computers network and the Web), are established and integrated in users' minds. This process leads one to critically evaluate situations and contexts and increases critical thinking skills (Duke et al., 2013). According to this point of view, connectivism can be considered a new theory of mind, because actionable knowledge builds new neural connections (Goldie, 2016). In addition, connectivism is evaluated in distance learning, which is characterized as collaborative learning. It is defined by an open, extended interaction, in which "connections are extended from individuals to groups, from small groups to massive possibilities" (Wang et al., 2014, p. 125).

Statistical analyses

Descriptive statistics

Descriptive statistics for the collected data were means, standard deviations, skewness, and kurtosis. Skewness and kurtosis values between-2 and 2 indicate a normal distribution of the data (Gravetter and Wallnau, 2014).

Exploratory factor analysis

To assess the factor structure of the PQDL questionnaire on students' perception of DL, the sample was randomly divided into two subsamples (Bollen, 1986). The factorial structure of the instrument in the first subsample was analyzed with an Exploratory Factor Analysis (EFA), while the data from the second subsample were analyzed with a Confirmatory Factor Analysis (CFA). Regarding the EFA, the principal axis factoring method of extraction was used. The number of latent factors was chosen on the basis of a scree plot (Cattell, 1966) and eigenvalues >1 (Kaiser, 1974). The promax rotation was used for oblique factor rotation. In addition, all items with factor loadings < |.30| or with loadings > |.30| in two or more factors were deleted.

The multidimensional scaling plot was used to visualize the matrix of distance among variables, using the PROXSCAL algorithm (Busing et al., 1997).

Confirmatory factor analysis

All CFAs were performed using the "Maximum Likelihood" estimation method (Muthen and Kaplan, 1985). Goodness-of-fit indices were the χ^2, the root mean square error of approximation

(RMSEA) and the corresponding confidence interval (90% RMSEA), the Comparative Fit Index (CFI), the Tucker-Lewis fit Index (TLI), and Akaike's information criterion (AIC). Models with an acceptable fit should have an RMSEA <0.08, and CFI and TLI >0.90 (Hu and Bentler, 1999; Schermelleh-Engel et al., 2003). AIC allows the comparison of two or more factorial models. The best model must have smaller AIC values (Hu and Bentler, 1999). Mardia's normality test is used to assess the normality of data distribution. A low Mardia's value indicates the normality of data distribution (Mardia's normalized estimate = 0.534; Mardia, 1974). To reduce factorial structure complexity, the items of the scale were grouped into parcels. This technique is based on the grouping of many variables into fewer groups or levels (parcels) that have greater reliability in relation to single items (Bandalos, 2002; Nasser-Abu Alhija and Wisenbaker, 2006; Saggino et al., 2015).

Reliability

The reliability of the PQDL questionnaire was calculated with Cronbach's Alpha (Cronbach, 1960) and McDonald's Omega (Zinbarg et al., 2005; Dunn et al., 2014). Values >0.90 indicate excellent reliability, values between 0.80 and 0.90 indicate good reliability, values between 0.70 and 0.80 indicate discrete reliability, values between 0.60 and 0.70 indicate sufficient reliability, and values <0.60 indicate inadequate reliability (Balsamo, 2017).

Nomological analysis

The convergent validity of the PQDL questionnaire on students' perception was assessed with bivariate correlations between the PQDL scores and scores of self-efficacy. Divergent validity was assessed with bivariate correlations between the PQDL scores and scores of anxiety and depression. In addition, bivariate correlations between the PQDL scores and socio-demographic characteristics were calculated. Educational level was transformed into dummy variables with values "0″ (students attending non-university training courses) and "1″ (university students). Also, behavioral changes (sleep problems, change in life habits, eating disorders, reduction of appetite, and sedentary life) due to pandemic restrictions were transformed into variables with dummy coding values "0″ (no or negligible change) and "1″ (moderate or strong change).

Predictive validity

Multiple regressions were performed to analyze the predictive validity of socio-demographic and psychological factors on PQDL questionnaire scores.

All statistical analyses were made using SPSS 25.0 (IBM Corp., 2017) for Windows. McDonald's Omegas were estimated using JASP Version 0.11.1.0 (JASP Team, 2019). EFA and CFA were carried out using Mplus 7.0 (Muthén and Muthén, 1998–2012).

Results

The majority of participants were university students and most of the sample suffered from sleep problems and changes in life habits due to the pandemic (Table 1).

Table 2 shows the descriptive statistics of all items of the PQDL questionnaire on students' perceived quality of DL. The skewness and kurtosis values are all between −2 and 2.

TABLE 1 Characteristics of participants (N = 429).

Educational level	Frequency (f)	Percentage (%)
University students	406	94.5
Students attending non-university training courses	15	3.5%
PhD/Master	4	0.9%
Missing	4	0.9%
Behavioral changes	**Frequency (f)**	**Percentage (%)**
Sleep problem	236	55.05%
Change of life habits	95	22.1%
Eating disorders	67	15.65%
Reduction of appetite	27	6.3%
Sedentary life	4	0.9%

Exploratory factor analysis and reliability

EFA was performed on a sample of 214 participants. Bartlett's Test of Sphericity [χ^2 (df = 496) = 2940.499; $p < 0.001$] and Kaiser–Meyer–Olkin (KMO = 0.849) confirmed sample adequacy for factor analysis. Initial eigenvalues were: 7.695; 2.522; 1.882 and 1.348. Figure 1 shows the scree plot. By combining the scree plot and eigenvalues, the two-factor solution seemed the most probable structure of the scale.

Items 1-3-2-5-11-16-24-26-27 were removed for having loadings < |.30| or double-factor loadings. The first factor accounts for 30.20% of the total variance and the second factor for 8.84% of the total variance. The 2-factor solution explained 39.04% of the variance (Table 3). Based on the content items, Factor 1 was named Distance Learning Organization (DLO) and Factor 2 was named Cognitive-Emotive Reaction to DL (CER-DL). Both DLO and CER-DL had a good level of reliability ($\alpha = 0.86$ and $\alpha = 0.865$, respectively, and $\omega = 0.87$ and $\omega = 0.87$, respectively). Figure 2 shows the matrix of distance among variables as items are distributed between two dimensions.

Confirmatory factor analysis

CFA was performed on 215 participants. Partly considering the results obtained with EFA and partly on the basis of a theoretical approach, we hypothesized four-factor structures for the PQDL scale: a model with only one first-order latent variable (M1), a model with two correlated first-order latent variables (M2), a model with two uncorrelated first-order latent variables (M3), and a hierarchical model with first-and secondary-order latent variables (M4). The PQDL items were grouped into six parcels (f1p1, f1p2, f1p3, f2p2, f2p1, f2p3). Parceling reduces the magnitude of specific variances that lead to correlated residuals and dual-factor loadings in a given model (Little et al., 2013). In the M1 model, all parcels loaded on the single first-order factor; in M2, f1p1, f1p2, and f1p3, which grouped the items of the DLO subscale, loaded on one first-order factor and f2p2, f2p1, and f2p3, which grouped the items of the CER-DL subscale, loaded on the other first-order factor. In M2, both factors were uncorrelated. M3 had the same structure as M2, with the only exception that both factors were correlated. M4 had the same structure as M2, with the exception that both first-order factors loaded on a single second-order general factor. Table 4 shows that M2 is the model with the best fitting. DLO and CER-DL were correlated.

TABLE 2 Mean, standard deviation and normality indices of items of the perceived quality of distance learning questionnaire (*N* = 429).

PQDL items	Mean	SD	Skewness	Kurtosis
(1) I can easily access the internet.	4.16	1.033	−1.200	0.765
(2) I feel detached from physical and group relationships.	2.16	1.181	0.876	−0.104
(3) I own computer devices (e.g., tablet, PC, etc.) to attend classes.	4.67	0.628	−1.709	1.608
(4) I perceive greater communicative contact between teachers and students.	2.61	1.188	0.181	−0.901
(5) There is a reduction in expenses for commuter and/or off-site students.	3.64	1.371	−0.660	−0.770
(6) I think distance learning offers better study organization for working students.	3.90	1.206	−0.946	−0.019
(7) During my classes, I can stay focused for several hours.	2.42	1.265	0.387	−1.072
(8) I feel fatigue, have eyestrain, and headaches.	2.18	1.231	0.891	−0.175
(9) I feel more engaged with the educational topics proposed in class.	2.83	1.167	−0.011	−0.847
(10) I can record lessons.	3.85	1.213	−0.854	−0.231
(11) I share lecture topics with other students.	3.38	1.220	−0.365	−0.807
(12) I perceive a better quality in my learning.	2.78	1.222	0.158	−0.817
(13) I can better organize my study material.	3.29	1.260	−0.208	−0.960
(14) During class hours, it is easier for me to divert my attention from my current worries.	4.16	1.033	−0.037	−0.957
(15) I perceive greater difficulty in taking oral exams, due to the difficulty of physical contact between teachers and students.	3.22	1.380	−0.184	−1.164
(16) Despite the restrictions, I am hopeful about the future.	3.60	1.183	−0.521	−0.633
(17) I feel embarrassed during written exams.	3.97	1.234	−0.974	−0.153
(18) I am concerned about my academic commitments, as they may change due to new government restrictions.	2.94	1.354	0.156	−1.130
(19) I feel nostalgic recalling pre-COVID-19 events of physical and social interaction.	2.07	1.316	0.986	−0.293
(20) I cry more easily when I think about friends I have not seen in a long time due to pandemic restrictions.	3.25	1.480	−0.213	−1.361
(21) I feel that I study with "greater effort."	2.69	1.401	0.308	−1.160
(22) I procrastinate the start of my daily study sessions, due to negative thoughts about the consequences of the pandemic.	3.45	1.403	−0.427	−1.122
(23) I think of the moment of social and economic uncertainty with pessimism.	2.84	1.263	0.275	−0.913
(24) Being informed about the health and social situation is not an obstacle in pursuing my established educational objectives.	3.41	1.209	−0.395	−0.709
(25) I feel 'lost' in this pandemic moment and this makes concentration on studying difficult.	2.99	1.428	0.074	−1.326
(26) Despite the precariousness caused by the pandemic, I have faith in the economic, social, and job recovery.	3.14	1.157	−0.107	−0.828
(27) Thinking about the moment when I will be able to attend classes in person makes studying easier for me.	3.31	1.192	−0.129	−0.862
(28) I feel uneasy dealing with distance learning.	3.67	1.258	−0.469	−0.953
(29) I have the tenacity to stick to the syllabus and educational programs, despite the restrictions imposed by the government.	3.31	1.192	−0.206	−0.857
(30) I face exam sessions with more motivation.	2.58	1.208	0.386	−0.687
(31) I perceive greater difficulty in taking written exams, due to the difficulty of physical contact between teachers and students.	3.68	1.333	−0.682	−0.717
(32) I feel ashamed during oral exams.	3.02	1.445	0.042	−1.326

Reverse items: 8, 15, 17, 18, 19, 29, 21, 22, 23, 25, 27, 28, 31, 32.

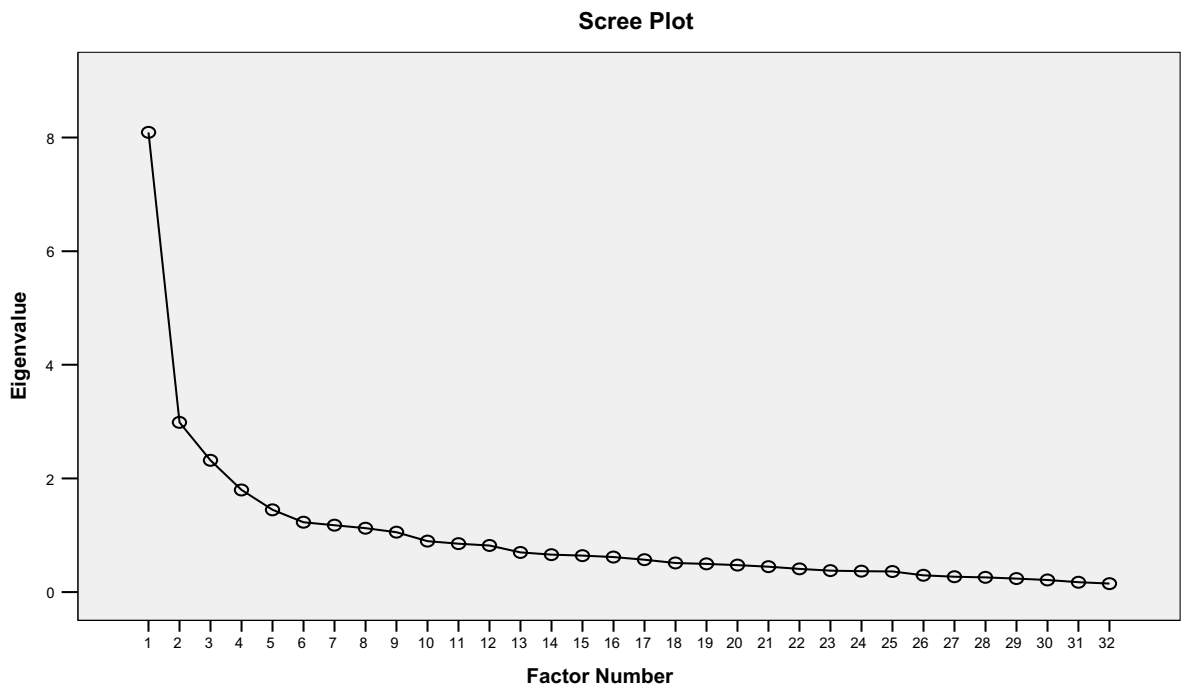

FIGURE 1
Scree plot of EFA ($N = 214$).

Association between distance learning, socio-demographic variables anxiety, depression, and perceived self-efficacy

Table 5 shows significant correlations between DLO, CER-DL, emotional management of scholastic achievements, and the socio-demographic variables anxiety, depression, and perceived self-efficacy. Correlations ranged from $r = -0.160$; $p < 0.01$ between DLO and Behavioural changes to $r = -0.435$; $p < 0.01$ between CER-DL and STAI-X1.

Questionnaire predictors on perceived quality of distance learning questionnaire score

Predictive validity

Regression analyses were used to assess the predictive validity of age, behavioral changes, state of anxiety at the beginning of the survey and at the end of the survey, trait anxiety, depression, Perceived Self-Efficacy of negative emotions, and Perceived School Self-Efficacy on the DLO and CER-DL. Results showed that age ($t = 4.394$), depression ($t = -3.008$), and Perceived School Self-Efficacy ($t = 6.842$) were significant predictors of DLO. Age ($t = 4.505$), behavioral changes ($t = -2.451$), and depression ($t = -2.845$) were significant predictors of CER-DL (Table 6).

Discussions

The principal aim of this study was the creation and validation of a new questionnaire to measure students' perceived quality of DL in a sample of Italian university students and Italian students attending non-university training courses. To date, no specific psychometric tools have been available to assess students' reactions to online lessons during the COVID-19 pandemic.

Furthermore, the literature has not studied the nomological network between students' perception of online learning, anxiety, depression, and perceived emotional and scholastic self-efficacy during the pandemic.

The construction of a new instrument to assess the perceived quality of distance learning

The new instrument for measuring students' perception of online lessons, the Perceived Quality of Distance Learning (PQDL), has shown good psychometric reliability. The PQDL consists of two subscales: the Distance Learning Organization (DLO) subscale and the Cognitive-Emotive Reaction to Distance Learning (CER-DL). The first subscale measures the perceived organization of DL. In particular, DLO assessed the quality of the online interaction between students and teachers, the possibility of recording lessons, the perception of DL quality, the organization of online lessons, and the control of sustained attention during lessons. The second subscale assessed the cognitive and emotive reactions to DL. In particular, the CER-DL subscales assessed the sensation of embarrassment during online examinations, individual engagement in DL, emotional instability, the tendency to procrastinate with online lessons, irrational thoughts regarding the pandemic, and individual pessimism. Procrastination allows a person to avoid or postpone difficult and frustrating situations.

TABLE 3 Item loadings and communalities (h^2) of the perceived quality of distance learning questionnaire (N = 214).

PQDL items	Factor 1	Factor 2	h^2
(1) I can easily access the internet.	0.287	0.040	0.097
(2) I feel detached from physical and group relationships.	0.082	0.283	0.113
(3) I own computer devices (e.g., tablet, PC, etc.) to attend classes.	0.299	−0.054	−0.159
(4) I perceive greater communicative contact between teachers and students.	**0.626**	−0.092	0.336
(5) There is a reduction in expenses for commuter and/or off-site students.	0.262	−0.046	−0.139
(6) I think distance learning offers better study organization for working students.	**0.675**	−0.071	0.407
(7) During my classes, I can stay focused for several hours.	**0.604**	0.095	0.438
(8) I feel fatigue, have eyestrain, and headaches.	−0.195	**0.494**	0.175
(9) I feel more engaged with the educational topics proposed in class.	**0.896**	−0.163	0.667
(10) I can record lessons.	**0.343**	−0.057	0.099
(11) I share lecture topics with other students.	0.629	−0.365	−0.457
(12) I perceive a better quality in my learning.	**0.848**	0.049	0.768
(13) I can better organize my study material.	**0.847**	−0.033	0.688
(14) During class hours, it is easier for me to divert my attention from my current worries.	**0.504**	−0.120	0.201
(15) I perceive greater difficulty in taking oral exams, due to the difficulty of physical contact between teachers and students.	0.039	**0.394**	0.173
(16) Despite the restrictions, I am hopeful about the future.	0.255	0.093	−0.061
(17) I feel embarrassed during written exams.	0.070	**0.361**	0.163
(18) I am concerned about my academic commitments, as they may change due to new government restrictions.	−0.114	**0.522**	0.219
(19) I feel nostalgic recalling pre-COVID-19 events of physical and social interaction.	−0.007	**0.363**	0.129
(20) I cry more easily when I think about friends I have not seen in a long time due to pandemic restrictions.	−0.022	**0.616**	0.365
(21) I feel that I study with "greater effort."	0.157	**0.691**	0.622
(22) I procrastinate the start of my daily study sessions, due to negative thoughts about the consequences of the pandemic.	0.131	**0.698**	0.606
(23) I think of the moment of social and economic uncertainty with pessimism.	−0.270	**0.737**	0.394
(24) Being informed about the health and social situation is not an obstacle in pursuing my established educational objectives.	0.290	−0.112	0.059
(25) I feel 'lost' in this pandemic moment and this makes concentration on studying difficult.	0.012	**0.807**	0.662
(26) Despite the precariousness caused by the pandemic, I have faith in the economic, social, and job recovery.	0.275	0.064	−0.091
(27) Thinking about the moment when I will be able to attend classes in person makes studying easier for me.	0.034	0.273	0.086
(28) I feel uneasy dealing with distance learning.	0.205	**0.541**	0.459
(29) I have the tenacity to stick to the syllabus and educational programs, despite the restrictions imposed by the government.	**0.464**	0.204	0.363
(30) I face exam sessions with more motivation.	**0.662**	0.108	0.530
(31) I perceive greater difficulty in taking written exams, due to the difficulty of physical contact between teachers and students.	0.121	**0.457**	0.285
(32) I feel ashamed during oral exams.	−0.043	**0.502**	0.230
% of variance	30.204	8.841	
Cumulative %	30.204	39.045	

Significant factor loadings (> |0.30|) are in bold types. Reverse items: 8, 15, 17, 18, 19, 29, 21, 22, 23, 25, 27, 28, 31, 32.

Furthermore, procrastination is linked with cognitive processes of worry and rumination (Constantin et al., 2018; Gautam et al., 2019; Mohammadi Bytamar et al., 2020). Worry involves thinking about potential future threats or negative events that may happen. Rumination, on the other hand, involves a persistent focus on past events or mistakes, often accompanied by feelings of guilt or regret (Ellis et al., 2010). Our instrument lies within the growing field of research that explores online learning, showing two principal dimensions: the use of digital skills and cognitive schemas related to the pandemic. Indeed, online learning might help to improve digital skills, such as writing emails or using touch screens (Jackman et al., 2021). Cognitive schemas are a representation of events, that become dysfunctional when thinking errors occur (*beliefs*). Beliefs are reflected in words (such as *must* or *it's terrible*) connected to the consequences of the pandemic (Beck and Haigh, 2014).

Although there are many studies about individual reactions to DL in the literature (Agung et al., 2020; Almusharraf and Khahro, 2020; Bahasoan et al., 2020; Hamid et al., 2020; Mukhtar et al., 2020; Nambiar, 2020; Bączek et al., 2021; Lemay et al., 2021), our study is the

first that attempts to assess this reaction using a questionnaire completely dedicated to perceived quality of DL during the pandemic.

Hypothesis testing

In relation to our principal hypotheses, hypothesis H1 was confirmed: the changes in behavior habits and styles due to the lockdown (sleep problems, changes in life habits, eating disorders, reduction of appetite, and sedentary life) predicted low score levels in CER-DL.

Hypotheses H2 and H3 were verified: lower levels of anxiety and depression were correlated with students' better perceived quality of DL. In addition, lower levels of depression predicted higher scores of DLO and CER-DL.

Hypothesis H4 was partially verified. Only the perceived emotional self-efficacy of negative emotions showed a positive correlation with students' perceived quality of DL. Finally, hypothesis H5 was verified. High Perceived School Self-Efficacy predicted high DLO scores.

Our study confirmed the presence of significant correlations between anxiety, depression, and perceived self-efficacy (Aimé et al., 2017; Mirzaei-Alavijeh et al., 2017; Chou, 2018; Alqurashi, 2019; Grøtan et al., 2019; Morales-Rodríguez and Pérez-Mármol, 2019; Gutiérrez García and Landeros Velázquez, 2020; Zheng et al., 2020; Zhou and Yu, 2021; Aldhahi et al., 2022). Our data showed that a high score in DLO and CER-LS, in other words, a high individual ability in organizing DL and a positive reaction to online lessons, respectively, were significantly related to low levels of depression and high levels of perceived scholastic self-efficacy.

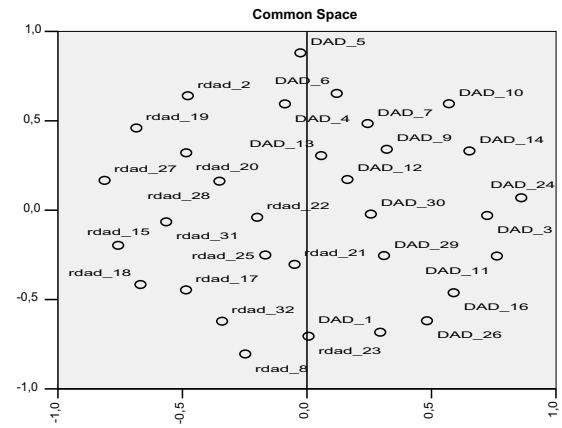

FIGURE 2
Multidimensional scaling plot (N = 214).

Limitations

The principal limitations of our study were that participants were not subjects with severe mental illness and that the sample was mainly composed of university students. In the future, we hope to replicate the study with a sample extracted from the clinical population (people with severe anxiety and depression problems) and with a sample of non-university students (for example primary and secondary school students).

Conclusion

The aim of our study was the construction and development of a new psychometric tool to assess students' reactions to DL. The new instrument, the Perceived Quality of Distance Learning, consists of two subscales: Distance Learning Organization and Cognitive-Emotive Reaction to Distance Learning. The dimensions assessed by these subscales were both predicted by depression, while the Perceived School Self-Efficacy only predicted DLO scores and behavioral changes only predicted CER-DL scores.

Practical implications

Shared activities to reduce social isolation and improve the planning of DL could reduce depression and increase perceived self-efficacy. In particular, future educational programs should consider the social impact of DL. Good planning of distance learning helps students and teachers to organize online lessons and courses (the educational methodology or technique used, e.g., cooperative learning or peer education) with less emotional impact. Finally, better communication strategies between students and teachers in online lessons would improve the quality of DL. All these interventions could reduce the level of depression and increase the level of perceived self-efficacy in students using DL.

Theoretical implications

According to Learning Theories for Online Education, Learning Experience is characterized by three components: Social presence,

TABLE 4 Goodness-of fit indexes of the perceived quality of distance learning questionnaire (N = 215).

Model	χ^2	df	RMSEA	CFI	TLI	SRMR	Interval RMSEA	AIC
M1	238.603	9	0.344	0.576	0.293	0.177	0.307 0.383	3148.017
M2	19.605	8	0.082	0.979	0.960	0.040	0.036 0.129	2931.020
M3	32.374	9	0.110	0.957	0.928	0.113	0.071 0.152	2941.789
M4	19.624	7	0.092	0.977	0.950	0.041	0.045 0.141	2933.039

One factor model (M1), two correlated first-order factors model (M2), two independent factors model (M3), hierarchical model (M4). df, degrees of freedom; RMSEA, root-mean-square error of approximation; CFI, comparative fit index; TLI, Tucker–Lewis fit index; SRMRS, standardized root-mean square residual; AIC, Akaike information criterion.

TABLE 5 Zero-order correlation analysis among factors of the perceived quality of distance learning questionnaire, socio-demographic variables, state anxiety and trait anxiety, depression, and perceived self-efficacy ($N = 429$).

Factors of the questionnaire on students' perception of online classes	Age	Educational level	Behavioral changes	STAI-X1	STAI-X2	STAI-X1/R	DQ	Perceived self-efficacy of negative emotions	Perceived self-efficacy of positive emotions	Scholastic perceived self-efficacy
Distance learning organization	0.198**	−0.038	−0.160**	−0.277**	−0.279**	−0.258**	−0.335**	0.232**	0.043	0.384**
Cognitive-emotive reaction	0.222**	−0.058	−0.325**	−0.435**	−0.429**	−0.411**	−0.468**	0.242**	−0.045	0.163**

p, significance; $^{**}p < 0.01$. State Anxiety Inventory (STAI-X1) at the beginning of the survey; State–Trait Anxiety Inventory Reduced Form (STAI-X1/R) at the end of the survey; Trait Anxiety Inventory (STAI-X2); Depression Questionnaire (DQ).

TABLE 6 Regression analysis for assessing predictive validity of age, behavioral changes, state anxiety at the beginning of the survey and at the end of the survey; trait anxiety, depression, perceived self-efficacy of negative emotions and perceived school self-efficacy on DLO and CER-DL.

Distance learning organization										
Predictors	β	β^*	t	$p(t)$	VIF	$p(\eta^2)$	R^2	F(df1,df2)	p(F)	f^2
Age	0.026	0.192	4.394	**0.000**	1.046	0.035	0.055	16.205 (8,420)	<0.001	0.05
Behavioral changes	0.018	0.010	0.196	0.845	1.301	0.000				
STAI-X1	−0.007	−0.109	−1.345	0.179	3.590	0.003				
STAI-X2	0.008	0.124	1.498	0.135	3.761	0.004				
STAI-X1/R	−0.001	−0.011	−0.151	0.880	3.089	0.000				
DQ	−0.037	−0.233	−3.008	**0.003**	3.286	0.016				
Perceived self-efficacy of negative emotions	−0.002	−0.015	−0.267	0.790	1.748	0.000				
Scholastic perceived self-efficacy	0.038	0.330	6.842	**0.000**	1.275	0.085				
Cognitive-emotive reaction to distance learning										
Predictors	β	β^*	t	p(t)	VIF	$p(\eta^2)$	R^2	F(df1,df2)	p(F)	f^2
Age	0.027	0.189	4.505	**0.000**	1.046	0.034	0.084	21.563 (8,420)	<0.001	0.08
Behavioral changes	−230	−0.115	−2.451	**0.015**	1.301	0.010				
STAI-X1	−0.009	−0.137	−1.762	0.079	3.590	0.005				
STAI-X2	−0.007	−0.100	−1.259	0.209	3.761	0.002				
STAI-X1/R	−0.007	−0.062	−0.855	0.393	3.089	0.001				
DQ	−0.034	−0.212	−2.845	**0.005**	3.286	0.013				
Perceived self-efficacy of negative emotions	−0.010	−0.073	−1.340	0.181	1.748	0.003				
Scholastic perceived self-efficacy	0.002	0.014	0.297	0.766	1.275	0.000				

Significative values are in bold types State Anxiety Inventory (STAI-X1) at the beginning of the survey; State–Trait Anxiety Inventory Reduced Form (STAI-X1/R) at the end of the survey; Trait Anxiety Inventory (STAI-X2); Depression Questionnaire (QD). β, raw beta coefficients; β*, standardized beta coefficients; VIF, variance inflation factor; $p(\eta^2)$, partial eta squared. R^2, multiple correlation coefficient. df1 and df2, degrees of freedom for numerator and denominator, respectively. f^2, effect size for multiple regression.

Teaching Presence, and Cognitive Presence (Picciano, 2021). These components are integrated into interactions between students and teachers (Anderson, 2001). According to Connectivism (Siemens, 2004), learning is transformed from an individual perspective to the shared exchange of information within a group through communication networks (Siemens, 2004). Online Collaborative Learning (Harasim, 2012) emphasizes the significance of interaction between students and teachers, who act as facilitators of knowledge building.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by University of Macerata, Italy. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MS assisted with the design of the study, assisted with the data analyses, recruited the sample, wrote the manuscript, and collaborated in editing the final manuscript. LP designed the study, collaborated in recruiting the sample, collaborated in writing the manuscript, and collaborated in editing the final manuscript. AS assisted with the design of the study, collaborated in the data analyses, and collaborated in writing the manuscript. AF designed the study, collaborated in recruiting the sample, and collaborated in editing the final manuscript. RB collaborated in recruiting the sample and collaborated in editing the final manuscript. MT assisted with the design of the study, collaborated in writing the manuscript, and collaborated in editing the final manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Factors associated with changes in psychological resilience of older adults with mild cognitive impairment during the COVID-19 pandemic

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Introduction: Psychological resilience is an indicator of mental health, but there has been no research to date on changes in psychological resilience among older adults with mild cognitive impairment (MCI) during the stress of the coronavirus disease 2019 (COVID-19) pandemic including factors related to those changes. To fill the gap, this study examined the factors and the changes in psychological resilience of older adults with MCI during the COVID-19 pandemic.

Methods: One hundred thirty participants completed the 10-item version of the Connor-Davidson Resilience Scale (CD-RISC-10) between December 2020 and June 2021 as a baseline assessment and between December 2021 and February 2022 as a follow-up. Participants also answered questions on sleep quality, depression symptoms, activities in daily living (ADL), instrumental ADL and social participation to explore factors associated with changes.

Results: In this cohort, the mean CD-RISC-10 scores were significantly higher than the baseline at follow-up ($p < 0.05$), indicating the improvement of psychological resilience. In multiple regression analyses, sleep quality was significantly correlated with change in CD-RISC-10 score (coefficient = 3.94, 95% confidence interval = 1.11 to 6.78).

Discussion: Psychological resilience could improve even during the stress of the COVID-19 pandemic in older adults with MCI who were at risk of developing dementia. The factor associated with improved psychological resilience was good sleep quality.

KEYWORDS

older adults, mild cognitive impairment, psychological resilience, CD-RISC-10, COVID-19, sleep quality

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic began spreading in Japan in March 2020, and the Japanese government declared a state of emergency in April 2020 to mitigate the infection spread. People were strongly recommended to stay at home and were restricted from using facilities where people gather; public life faced social restrictions to enforce infection control measures. Research on mental health among older adults with mild cognitive impairment (MCI) during the COVID-19 pandemic is important because a large number of older adults with MCI or at risk of dementia developed increased anxiety and depression during the lockdown (Barguilla et al., 2020) and faced severe adversity. Taking preventive measures against mental health problems among older adults with MCI in the future is thus important.

Psychological resilience is the ability to recover one's mental health following adversity or stressful experiences (Levasseur et al., 2017). This acts as a protective factor preventing the worsening of depressive symptoms (Chang et al., 2023a). Some studies have reported that several brain regions are involved in psychological resilience, including the medial prefrontal cortex (mPFC), which functions as a mechanism for psychological resilience (Bremner, 2007; Menon and Uddin, 2010; Hsieh et al., 2021; Chang et al., 2023b). However, the state of psychological resilience in older adults with MCI has not been described; understanding this state can help develop supportive mental health measures. Therefore, we previously examined the psychological resilience of older adults with MCI during the COVID-19 pandemic in a cross-sectional study using the Japanese version 10-item version of the Connor-Davidson Resilience Scale (CD-RISC-10), which has confirmed reliability and validity (Campbell-Sills and Stein, 2007; Ito et al., 2009). In our previous study, it was reported that the psychological resilience of the participants was observed to be low (Matsumoto et al., 2022). However, other studies have found that psychological resilience increases with exercise and treatment (Pakalniskiene et al., 2016; Eyre et al., 2017). In other words, psychological resilience may be a dynamic factor. In addition, psychological resilience improves with time more than depression and anxiety indicators (Okuyama et al., 2018). Thus, our hypothesis was that psychological resilience can improve in older adults with MCI. Therefore, we investigated changes in the psychological resilience of older adults with MCI during the COVID-19 pandemic. Further, we explored factors associated with the change in psychological resilience. Investigating changes in psychological resilience in older adults with MCI and the factors associated with such changes can be expected to contribute to the development of more specific supportive interventions to help prevent mental health deterioration in the face of natural disasters or the spread of new infectious diseases.

2. Methods

2.1. Study design

We conducted a longitudinal study during the COVID-19 pandemic as a substudy of the Japan-Multimodal Intervention Trial for Prevention of Dementia (J-MINT) (Sugimoto et al., 2021). We conducted the CD-RISC-10 as a baseline from December 2020 to June 2021 with a follow-up from December 2021 to February 2022. We conducted assessments other than CD-RISC-10 between February 2020 and March 2021.

2.2. Participants

The target participants were 150 older adults with MCI aged 65–85 years in the control group of J-MINT, where we considered a diagnosis of MCI if they fulfilled the following criteria: (1) having a cognitive decline in the National Center for Geriatrics and Gerontology (NCGG) Functional Assessment Tool (Makizako et al., 2013; Shimada et al., 2017), (2) Mini-Mental State Examination (MMSE) (Folstein et al., 1975) score of 24 or more at baseline, and (3) not diagnosed with dementia. A cognitive decline in NCGG-FAT is age- and education-adjusted cognitive decline with a standard deviation (SD) of $\geq$1.0 from the reference threshold on at least one of the four cognitive domains of memory, attention, executive function, and processing speed as measured by the NCGG-FAT. Participants with self-reported depression or missing data on the CD-RISC-10 were excluded. We conducted the study with the approval of the NCGG Ethics Committee (No. 1468).

2.3. Measurements

We administered a questionnaire to the participants that collected information on sociodemographic characteristics (age, sex, marital status, education, and household income) as well as the Barthel Index (Mahoney and Barthel, 1965), Lawton Index (Lawton and Brody, 1969), CD-RISC-10, 15-item Geriatric Depression Scale (GDS) (Sugishita et al., 2017), Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989), and social participation scores (Kanamori et al., 2014). A Barthel Index score of 100 indicates complete independence. Perfect scores of Lawton Index are 5 for men and 8 for women, it was treated as a binary value with a perfect score and no perfect score. A CD-RISC-10 score ranges is from 0 to 40, and higher CD-RISC-10 scores reflect greater psychological resilience. The reliability of the CD-RISC-10 was moderate among the older adults, with a mean score of MMSE 27.2 (Tourunen et al., 2021). A GDS score ranges is from 0 to 15, and the score of 7 or more indicates depressive symptoms and was treated as a binary value. A PSQI score ranges is from 0 to 21, and the score of 5 or less indicates good sleep quality and was treated as a binary value. We measured social participation by asking participants if they belonged to any of eight types of organizations listed, with each organization type scored as 1 point.

2.4. Statistical analysis

We calculated means, standard deviations, medians, interquartile ranges, frequencies, and percentages to describe

the demographic data in the participants as appropriate. We then used a paired-sample *t*-test to compare the baseline and follow-up CD-RISC-10 scores. We further used single and multivariate analyses to evaluate the relationships between changes in the CD-RISC-10 score (CD-RISC-10 values at follow-up minus values at baseline) and explanatory variables. To develop a multivariate model, we included as moderator variables sociodemographic characteristics, which have been associated with psychological resilience in previous studies (Campbell-Sills et al., 2009; Matsumoto et al., 2022). Then, we performed multiple regression analysis with the change in the CD-RISC-10 score as the objective variable and assessments other than CD-RISC-10, MMSE, and baseline CD-RISC-10 score as explanatory variables, thereby obtaining regression coefficients and 95% confidence intervals. We performed all analyses using Stata 16.1 (Stata Corp, College Station, TX, USA), considering $p < 0.05$ statistically significant.

3. Results

We received 136 responses from the 150 participants who received our questionnaire (90.7%). We excluded 6 participants who met the exclusion criteria, resulting in 130 participants. The mean age of the study participants was 73.1 ± 4.5 years; 42.3% were female; 80.0% were married; the mean number of years of education was 12.5 ± 2.3 (**Table 1**). The mean CD-RISC-10 scores were 24.1 ± 6.3 and 26.6 ± 7.8 points at the baseline and the follow-up, respectively ($p = 0.0001$), for a median change of 3 points. In the single regression analysis, the only factor that was significantly associated with the change in the CD-RISC-10 score was the baseline CD-RISC-10 score (coefficient = −0.35, 95% CI = −0.54 to −0.17); the PSQI tended to be associated, but not statistically significant (coefficient = 2.86, 95% CI = −0.01 to 5.73) (**Table 2**). In contrast, in multivariate models with all explanatory variables entered simultaneously, both the PSQI score and the baseline CD-RISC-10 score were significantly associated with changes in the CD-RISC-10 score (coefficient = 3.94, 95% CI = 1.11 to 6.78 and coefficient = −0.37, 95% CI = −0.56 to −0.18, respectively).

TABLE 1 Demographic characteristics of participants (*n* = 130).

Attribute information	All participants
Age, mean ± SD	73.1 ± 4.5
Female, *n* (%)	55 (42.3)
Marital status: married, *n* (%)	104 (80.0)
Education years, mean ± SD	12.5 ± 2.3
Household income, *n* (%)	
<JPY 2,000,000	16 (12.3)
JPY 2,000,000–3,990,000	65 (50.0)
JPY 4,000,000–5,990,000	25 (19.2)
JPY 6,000,000–7,990,000	13 (10.0)
JPY 8,000,000–9,990,000	9 (6.9)
JPY 10,000,000 and above	2 (1.5)
NCGG-FAT: cognitive decline, *n* (%)	
Memory	55 (42.3)
Attention	52 (40.0)
Executive function	41 (31.5)
Processing speed	4 (3.1)
Barthel Index, median (IQR)	100 (100, 100)
Lawton Index: expect a perfect score, *n* (%)	7 (5.4)
MMSE, median (IQR)	28 (26, 29)
Social participation, mean ± SD	1.2 ± 0.9
PSQI: good sleep quality, *n* (%)	100 (76.9)
GDS: depressive symptoms, *n* (%)	12 (9.2)
CD-RISC-10: baseline, median (IQR)	24 (20, 27)
CD-RISC-10: follow-up, median (IQR)	26 (21, 33)

CD-RISC-10, 10-item Connor–Davidson Resilience Scale; GDS, 15-item Geriatric Depression Scale; IQR, interquartile range; JPY, Japanese Yen; MMSE, Mini-Mental State Examination; NCGG-FAT, National Center for Geriatrics and Gerontology Functional Assessment Tool; PSQI, Pittsburgh Sleep Quality Index.

4. Discussion

We investigated changes in psychological resilience in older adults with MCI during the COVID-19 restrictions; interestingly, the results showed a trend toward increased psychological resilience. In addition, we investigated the associations between changes in CD-RISC-10 score and factors that have been related to psychological resilience (Aburn et al., 2016; Clement-Carbonell et al., 2019; Bazzani et al., 2021). Among the associated factors, the PSQI score was positively associated with changes in the CD-RISC-10 score; good sleep quality was a factor that may be associated with an increase in psychological resilience.

It is necessary to understand the state of psychological resilience in this vulnerable population so that intervention measures are already in place in the event of future disasters or other emergencies. The results of our investigations could help in developing preventive measures against mental health deterioration in this population.

In a previous examination of the psychological resilience of adolescents affected by a natural disaster, the young people's median CD-RISC-10 score increased from 20 to 23 in 1 year (Okuyama et al., 2018), similar to the change in the CD-RISC-10 score observed in this study, although we cannot directly compare the change in CD-RISC-10 score from the present study with the change from the previous study. Our findings indicated that older adults with MCI can improve their psychological resilience after some time even if they also have a risk of developing dementia. In addition, this study was conducted during the COVID-19 pandemic, and the results indicate that psychological resilience improves even in the presence of stress due to, for instance, social contact restrictions. However, the social restrictions differed at baseline and follow-up, and stress was not constant: a state of emergency was announced at baseline, and semi-emergency

TABLE 2 Simple and multiple regression analysis results for changes in psychological resilience.

	Simple regression analysis		Multiple regression analysis	
	Coefficient	95% CI	Coefficient	95% CI
Age	−0.26	−0.53 to 0.01	−0.22	−0.48 to 0.05
Sex: female	−1.28	−3.76 to 1.19	−0.82	−3.29 to 1.64
Marital status: married	1.31	−1.75 to 4.37	−0.21	−3.32 to 2.91
Education	−0.23	−0.77 to 0.31	−0.49	−1.01 to 0.04
Household income	−0.87	−1.94 to 0.19	−1.07	−2.12 to −0.01
Barthel Index	1.25	−0.00 to 2.51	1.03	−0.19 to 2.25
Lawton Index: no perfect score	0.15	−5.29 to 5.59	0.27	−4.90 to 5.43
MMSE	0.53	−0.17 to 1.23	0.28	−0.44 to 0.99
Social participation	0.16	−0.75 to 1.08	0.50	−0.36 to 1.36
PSQI: good sleep quality	2.86	−0.01 to 5.73	3.94	1.11 to 6.78*
GDS: no depressive symptoms	0.38	−3.86 to 4.62	1.35	−2.82 to 5.51
CD-RISC-10	−0.35	−0.54 to −0.17*	−0.37	−0.56 to −0.18*

*$p < 0.05$.
CD-RISC-10, 10-item Connor–Davidson Resilience Scale; CI, confidence interval; GDS-15, 15-item Geriatric Depression Scale; MMSE, Mini-Mental State Examination; PSQI, Pittsburgh Sleep Quality Index.

coronavirus measures were applied in follow-up. This stress reduction may be associated with increased psychological resilience.

Good sleep quality was a factor associated with changes in psychological resilience. Psychological resilience entails high control of one's emotions under stress (Bazzani et al., 2021), and poor sleep quality can impair this emotional functioning (Walker, 2009). In other words, psychological resilience might have improved in the present study because respondents who experienced good sleep quality were able to maintain high functioning in their emotion control spheres. In neuroimaging, psychological resilience is related to the frontal-associated regions, including the mPFC, amygdala, and anterior cingulate cortex (Hsieh et al., 2021). Among these frontal-associated regions, the functional connectivity between the mPFC and the amygdala is involved in sleep and emotion. The mPFC modulates the amygdala, which processes emotions (Walker, 2009). In previous research, sleep-deprived people have exhibited significant amygdala activation in response to negative stimuli, as well as a significant loss of functional connectivity in contrast with a control group (Walker, 2009). Sleep deprivation may impair the functional connectivity of the mPFC and amygdala, reducing the psychological resilience involving these regions. However, this apparent connection between psychological resilience and sleep quality remains speculative.

This present study has some limitations. First, Aichi and Gifu prefectures, where the study participants live, were placed under a state of emergency from mid-January to February 2021 (during the baseline), and participants responded to the questionnaires in different infection statuses, but we did not include these differences in our analyses. Second, our findings have limited generalizability to broader populations, because this is a substudy of the J-MINT and we did not perform random sampling. Third, the COVID-19 pandemic has been ongoing in Japan since March 2020, and people have faced social restrictions for a long time. Due to long-term social restrictions, people may have adjusted to restricted lifestyles, increasing their psychological resilience. Our analyses did not reflect this factor. Fourth, it was not possible to determine whether changes in psychological resilience differed by type of cognitive impairment, as the present study did not distinguish participants by type. Fifth, this study was unable to determine why resilience improved because sleep quality and depressive symptoms were not assessed with the follow-up in this study.

This study showed that psychological resilience improved after some time even during the stress of the COVID-19 pandemic in a population of older adults with MCI who were at risk of declining mental health. For instance, good sleep quality was related to improvements in psychological resilience, which maintains mental health. However, further research may be needed to determine whether factors related to changes in psychological resilience contribute to the maintenance of mental health in older adults with MCI.

Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the National Center for Geriatrics and Gerontology

Ethics Committee (No. 1468). The patients/participants provided their written informed consent to participate in this study.

Author contributions

NM designed the study, performed the statistical analyses, and wrote the first draft. All authors contributed to the interpretation and discussion of the results and reviewed the manuscript and contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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When work bothers your mind: a diary study on the relationship of German teachers' work-related rumination with fatigue

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This study investigated the association of school attendance restrictions in the early stages of the coronavirus disease pandemic with teacher-specific workload, and work-related rumination of teachers in Germany. Deduced from the effort-recovery model, that assumes that work might lead to strain reactions, making recovery necessary to avoid long-term health impairments, fatigue and positive as well as negative contents of work-related rumination in nonwork time were investigated in a five-day diary study with three measurement points per day. A total of 1,697 daily measures of 174 teachers were gathered over three consecutive workdays and the weekend. Only those days were included in which the teachers worked. Multilevel structural equation modeling revealed that teachers during school restrictions showed lower teacher-specific workload, which was associated with lower levels of affective rumination and problem-solving pondering. The effect on fatigue was mediated only by affective rumination such that a higher affective rumination was related to a higher fatigue level on the between and within-level. There was a significant three-path mediation from group belongingness over teacher-specific workload to affective rumination and fatigue. Problem-solving pondering did not affect fatigue level. The present study provides evidence of the association of COVID-19 restrictions with teacher-specific workload and the importance of differentiating the facets of work-related rumination.

KEYWORDS

teachers, work-related rumination, fatigue, diary study, COVID-19

1. Introduction

Many occupational groups were affected by work-related restrictions due to the COVID-19 pandemic, not being able to work at their usual workplace and working time. One of them are teachers, as they continued distance teaching despite the schools were closed (Mahmood et al., 2021; Pöysä et al., 2021). Studies show that the pandemic and accompanying political orders were related to and impact emotional reactions, stress, negative affect, and life satisfaction (Zacher and Rudolph, 2020; Bellingtier et al., 2021; Kumar et al., 2021). However, the examination of the effects of changed work situations in times of social distancing on recovery and work-related stress above for example boundary management styles (Allen et al., 2021) still needs to be established (Rudolph et al., 2021). As shown in meta-analysis, recovery experiences are essential for well-being and stress experience (Headrick et al., 2019; Steed et al., 2021). In recent times, differences in occupations in recovery experiences (Headrick et al., 2019) and in

the context of COVID-19 have been stressed upon (Rudolph et al., 2021).

To focus research on teachers' health, psychological well-being, and recovery is necessary for several reasons. Teachers are central protagonist in every educational system and their performance is crucial to the health and achievement of students (Viac and Fraser, 2020). Impaired psychological health of teachers is shown to be related to lower well-being and achievement of students, lower perceived performance of teachers and higher rates of turnover intentions of teachers (Madigan and Kim, 2021a,b; Klusmann et al., 2022; Maricuţoiu et al., 2023). As the COVID-19 related school restrictions might have influenced teachers' psychological well-being and health, it becomes apparent to focus on that influence in detail. School restrictions and the necessity to work at home could have increased the difficulties of managing the work and nonwork boundaries for recovery, which is considered a challenge for teachers anyway (Türktorun et al., 2020). Conversely, it can be argued that school restrictions and the changed teaching conditions are associated with lower strain due to teacher-specific job demands. This is because the amount of daily hassles such as the direct confrontation with students' misbehaviour or parents' expectations (Montgomery and Rupp, 2005; Beltman et al., 2011) might be reduced.

The present diary study was conducted in the earliest stages of the pandemic outbreak in Germany in the year 2020. It contributes to the literature in three ways: first, the study examines short-term associations of a changed work condition because of COVID-19 related school restrictions with work-related stress and recovery experience of teachers (*cf.* Rudolph et al., 2021). The following study, focuses on the experience of teacher-specific job demands as stressful, which can be summarized as workload (*cf.* van Dick and Wagner, 2001), and its relationship to school restrictions in the first weeks of the lockdown. In doing so, the study follows the call to extend research above the health care sector and account for differences between occupations in times of COVID-19 (Rudolph et al., 2021). Even though the pandemic outbreak affected the data collection, the study was originally planned to investigate the effect of daily teacher-specific workload on work-related rumination and well-being. Therefore, second, the study contributes to recovery research, as originally planned. It focuses on work-related ruminative thoughts of teachers in nonwork time, which is a crucial component in recovery research and is associated with differential effects on individual well-being considering different content and valence of the work-related ruminative thoughts (Headrick et al., 2019; Jimenez et al., 2021; Wendsche et al., 2021; Weigelt et al., 2023). Especially in teachers difficulties in mentally distancing from work and negative connoted work-related thoughts has been shown to be related to well-being impairments (Varol et al., 2021; Weiher et al., 2022). The effect of daily work-related rumination in leisure time on fatigue in the next morning as an indicator of (un-) successful recovery and individual well-being (Meijman and Mulder, 1998; Sonnentag, 2018) is investigated. Work-related thoughts in nonwork time are shown to be a mediator between job demands and stress experience (Sonnentag and Fritz, 2015). The abrupt restrictions provided the opportunity to investigate the association between changed work situation and teacher-specific workload in the first weeks of the lockdown. The study, therefore, considers different work situations and its further effects on recovery experience. This is significant, since occupation-specific demands have rarely been taken into account when studying work-related thoughts in nonwork time, especially in the teaching profession (Türktorun et al., 2020). Furthermore, the study follows the call (*cf.* Headrick et al., 2019) to not only consider the negative (e.g., affective rumination), but also more neutral connoted forms of work-related thoughts in nonwork time in taking problem-solving pondering into consideration (Querstret and Cropley, 2012) that might also have beneficial effects on well-being. Third, the present diary study contributes to the literature by integrating a daily perspective on fatigue level. This elaborates on occupational health research in times of pandemics, which is mostly cross-sectional in nature (Rudolph et al., 2021) and add to the few daily diary studies, which has been conducted during the pandemic (Chong et al., 2020). In separating between- from within-person effects, the present study examines the effect of school restrictions and accompanying workload differences on average fatigue in the morning. Furthermore, daily fatigue level with respect to daily workload and work-related rumination is examined. The results should facilitate practical implications such as the development of interventions aimed to foster well-being in teachers above the time of the COVID-19 pandemic.

1.1. The work situation of German teachers in times of COVID-19

From March, 16, 2020 school attendance were restricted nationwide for primary and secondary schools (Steinmetz et al., 2020). Besides final examinations of secondary schools, compulsory school attendance for students was suspended and promotion to the next class was guaranteed. Work for teachers remained compulsory. They ensured children care from system-relevant occupation employees (e.g., health care). Teachers were not under any financial risk and did not have to fear heightened job insecurity. There is some evidence about the teachers' work in this early time in Germany (Huber and Helm, 2020). Typical work requirements, such as the preparation of teaching materials, correction of examinations or student contact, only occurred to a limited extent for distance teaching, as the overall concept for the provision and assessment of learning opportunities still had to be worked out at many schools (Eickelmann and Drossel, 2020). During the first few weeks of the restrictions, lower levels of direct interaction (e.g., video-based teaching) took place (Huber and Helm, 2020). Additionally, the risk and fear of being exposed to the virus has to be considered as well (*cf.* Chen et al., 2022), since it might have led to the perception of elevated levels of threats to ones' own health while working in class (*cf.* Sinclair et al., 2021). Teachers in class can be classified as the group with medium risk exposure level as defined by the World Health Organization (2020), because social distancing in work situation (while teaching) was not always possible (*cf.* Sinclair et al., 2021). Hence, school restrictions and thus, no or reduced attendance in class might imply less risk exposure due to teachers' job demands (e.g., students in class) for teachers during compared to teachers before school restrictions. Overall, it is feasible to suggest that lower teacher-specific workload was experienced during the first weeks of the school restrictions (vs. months *cf.* Pöysä et al., 2021). That said, we are aware of differential picture of demands and strain level of teachers during the time of COVID-19. For example Klusmann et al. (2023) reported cross-sectional data from October 2020 in which 56.4% of the teachers reported an increase in emotional exhaustion during COVID-19 and

43.3% no change. Bleck and Lipowsky (2022) could not report an association between the COVID-19 pandemic and exhaustion when asking German teachers in summer 2020. As the political orders and demands concerning the work of teachers changed frequently during the time, it is, therefore, necessary to examine the exact time of the studies being conducted. There are three studies to our knowledge that focused on teachers' well-being roughly in that time the present study was conducted. Huber and Helm (2020) surveyed a representative sample of German, Austrian, and Swiss school staff members (86% teachers) at the end of March to beginning of April 2020. They found that 39% agreed or partly agreed, 23% (partly) disagreed and 39% were undecided to the sentence that they would be highly burdened of the situation. Eickelmann and Drossel (2020) found in a representative sample of German teachers in April 2020 that 33.9% of the teachers experienced higher burden due to the new situation. However, 28.1% did not see any difference and 36.2% of the teachers experienced less burden. The cross-sectional nature of the two studies makes it difficult to draw conclusions to the daily experience and the comparison between the time before and during the COVID-19 situation. However, Hilger et al. (2021) conducted a longitudinal study with teachers with one measurement point in January/February 2020 and the second in May 2020. They found a decrease in resources but also a decrease of demands and fatigue level during this time. Hence, following our aforementioned argumentation and other data from more well educated samples, showing good well-being during the first weeks of the lockdown (Schad and Rabovsky, 2022), it is feasible to postulate the following hypotheses when conducting a diary study:

> *Hypothesis 1*: Compared to the teachers before school restrictions, the teachers during school restrictions experienced lower amount of teacher-specific workload in the first weeks of the lockdown.

1.2. Work, recovery, and fatigue in times of COVID-19

According to the effort-recovery model (E-RM; Meijman and Mulder, 1998), one of the core theories in recovery research (Headrick et al., 2019; Steed et al., 2021), work is stressful and demands individuals' cognitive, emotional, and physical resources (Meijman and Mulder, 1998). Work may trigger strain reactions leading to higher physiological or negative activation (Steed et al., 2021) and resource mobilization. As soon as the individual is no longer exposed to job demands, the activation level will adjust to the baseline level. However, when individuals are unable to recover because of higher job demands, such as higher workload, or insufficient time for recovery, the baseline level is not reached (Meijman and Mulder, 1998; Steed et al., 2021), and higher fatigue in the morning is likely (*cf.* Headrick et al., 2019). Fatigue is a crucial factor in occupational health and recovery research and is related to psychological, physical and job impairments (Headrick et al., 2019; Steed et al., 2021). Supporting the suggestions of the E-RM, Bennett et al. (2018) showed in a meta-analysis that higher job demands were related to a higher level of fatigue, mediated by recovery experiences.

As suggested above, job demands of teachers could have been experienced as less stressful during the first weeks of the school restrictions, enabling better preconditions for recovery. As proposed by the E-RM, this could lead to better recovery outcome (Meijman and Mulder, 1998). Following the E-RM it is further assumed that higher daily workload is associated with higher fatigue level the next morning within the teachers.

> *Hypothesis 2*: Compared to the teachers before school restrictions, the teachers during school restrictions have lower average levels of fatigue in the morning (a). This relationship is mediated (b) by teacher-specific workload such that higher stress experience due to job demands are associated with higher levels of fatigue the next morning (between-level). (c) Higher daily teacher-specific workload is associated with higher daily fatigue level the next morning (within-level).

1.3. Work-related rumination: relationship with stressors and fatigue

Meta-analytic evidence supports that the effect of job demands on health-related outcomes such as fatigue is mediated by psychological detachment (Bennett et al., 2018), which is confirmed by recent diary study in the teacher sample (Aulén et al., 2022). Psychological detachment is defined as the absence of work-related thoughts in nonwork time (Sonnentag and Fritz, 2015). Teachers have been shown to be especially vulnerable for difficulties in detaching psychologically from work, which is related to higher psychosomatic complaints and higher risk of sickness absence (Varol et al., 2021). In recent times considering the content of work-related rumination in nonwork time has been recommended (Cropley and Zijlstra, 2011; Wendsche and Lohmann-Haislah, 2017; Headrick et al., 2019; Jimenez et al., 2021). Rumination is defined as conscious and recurrent thoughts revolving around a topic in the absence of immediate demands that would require those thoughts (Martin and Tesser, 1996). It is a state that fluctuates within a person; however, it also differs between persons, as there appears to be a trait-like tendency to engage in rumination (Watkins and Nolen-Hoeksema, 2014). Cropley and Zijlstra (2011) introduced the construct "work-related rumination" that refers to rumination on work-related content. Psychological detachment and work-related rumination overlap theoretically. However, research shows that both are distinct factors and that it is important to distinguish the content of work-related thinking (Weigelt et al., 2019, 2023). Cropley and Zijlstra (2011) differentiated two content facets. Affective rumination (AR) is defined as a cognitive state involving the presence of work-related thoughts, which are negative in affective terms, and are likely to be accompanied by negative emotional reactions (Cropley and Zijlstra, 2011). Contrariwise, problem-solving pondering (PSP) is defined as the prolonged thinking about evaluation of previous work to improve it or a particular problem to solve it (Cropley and Zijlstra, 2011). It does not include negative emotional processes and might be joyful or interesting (Cropley and Zijlstra, 2011; Syrek et al., 2017).

In line with the E-RM, job demands can lead to a negative affective response during work (Meijman and Mulder, 1998; Ganster and Rosen, 2013). Sonnentag and Fritz (2015) suggest that higher negative affect might be prolonged in nonwork time and stimulate negative ruminative thoughts about the past work day (Sonnentag and Fritz, 2015; Sonnentag, 2018). This might occur

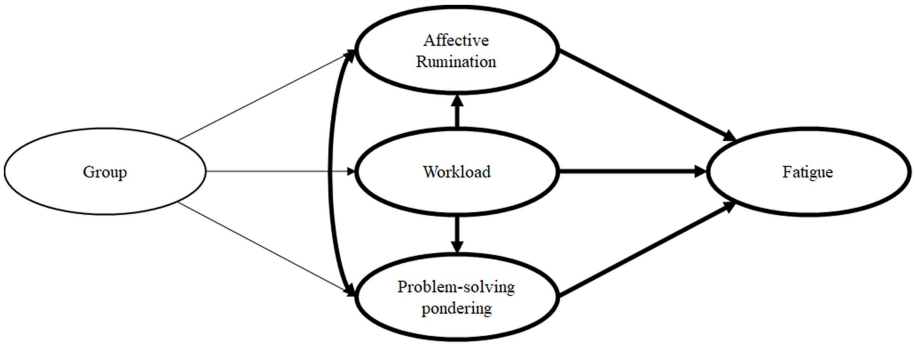

FIGURE 1
Path model including study variables. Bold paths contain study variables on the between and within level.

especially as higher job demands heighten the probability of more unfinished goals that trigger rumination to cognitively converge with goal attainment (Martin and Tesser, 1996; Syrek et al., 2017). Thus, higher AR is expected when a higher amount of job demands or workload are given. Within the E-RM, AR appears to keep the impact of negative activation constant (Cropley and Zijlstra, 2011; Syrek et al., 2017), hindering recovery and leading to higher level of fatigue the next morning (see also Brosschot et al., 2005). Previous evidence supports that AR is related to higher stable stress experience and sleep impairments (Querstret and Cropley, 2012; Hamesch et al., 2014; Syrek et al., 2017; Jimenez et al., 2021). Although PSP might also be triggered by work stress (Hamesch et al., 2014) and unfinished tasks (Syrek et al., 2017), the expected outcome is less clear and meta-analytic evidence only provided small average effect sizes (Jimenez et al., 2021). It might lead to a prolonged exposure to job demands in nonwork time and therefore to negative activation and negative health outcomes (*cf.* Hamesch et al., 2014). However, if problem solution become reachable, negative affect and activation, which hinder recovery, could be reduced (*cf.* Martin and Tesser, 1996). Thus, PSP would be expected to lead to lower levels of fatigue the next morning. There is evidence that shows that PSP is related to lower fatigue or less sleep impairments and more engagement, but also non-significant findings or positive correlations with health complaints were reported (Querstret and Cropley, 2012; Syrek et al., 2017; Vahle-Hinz et al., 2017; Jimenez et al., 2021). Thus, findings on the impact of PSP on health variables are still mixed.

The present study aims to clarify the effect of school restrictions on fatigue due to work-related rumination. As proposed earlier, teachers during the school restrictions should experience lower level of workload. Thus, it is expected that lower work-related rumination is present. As rumination is seen as a state and a trait-like tendency (Watkins and Nolen-Hoeksema, 2014), it is proposed that the effect can be found on the between- and within-level.

> *Hypothesis 3*: Compared to the teachers before, the teachers during school restrictions have lower average levels of (a) PSP and (b) AR. This relationship is mediated by teacher-specific workload such that higher teacher-specific workload is associated with higher AR (c) and PSP (d) on the between-level. Higher teacher-specific workload is associated with higher AR (e) and PSP (f) on the within-level.

Following meta-analytic findings a lack of psychological detachment is found to mediate the effect between job demands and negative health outcomes (Bennett et al., 2018). Less is known about differential effects of different content of work-related rumination especially in the teaching context (Türktorun et al., 2020). As different study designs were used in the differentiation between the work-related rumination facets, such as cross-sectional studies or weekend studies, the present study aims to clarify the effect of both facets in a daily diary study. PSP is examined exploratory. Overall study assumptions can be seen in Figure 1.

> *Hypothesis 4*: AR is related to higher levels of fatigue on the (a) between- and (b) within-level. PSP is related to fatigue on the (c) between- and (d) within-level. AR mediate the effect of teacher-specific workload on fatigue on the (e) between- and (f) within-level. PSP mediate the effect of teacher-specific workload on fatigue on the between- (g) and within-level (h).

2. Methods

2.1. Procedure and sample

The reported data were part of a research project on teachers' reflection on work. In the following sections, we only report data, which were necessary for this study and for the hypotheses (e.g., teacher-specific workload; work-related rumination; fatigue and demographic as well as school-specific variables). Data, which was not part of the hypotheses and research questions, are not reported (e.g., daily sleep quality, vitality, other psychological energy indicators, trait measures of recovery experiences and work-related rumination). The data collection took place from February to March 2020 (4 weeks before and 2 weeks during the restrictions starting with the 16th of March). Teachers from different schools within the same federate state (and therefore with the same restriction level, Steinmetz et al., 2020) in Germany (Hesse) were invited to participate in the study using the official email distribution list of partner schools of a university in Hesse and by the snowballing technique. The teachers were informed via e-mail about the procedure. Confidential data handling was guaranteed. The project, the present study was part of, was permitted by the Hesse Ministry

of Education and Cultural Affairs and the study adhered to ethical guidelines. As incentives, all participants received vouchers for an online warehouse and a feedback on their personal work strain patterns. The study was conducted using an online survey software allowing participation through various digital devices. The participants filled out an online questionnaire, which was mandatory for participating in the diary part of the study, and comprised for example demographic variables and general information about their work conditions (e.g., average working hours). A week later, the teachers received e-mail invitations and short message service (SMS) within standardized time frames to participate 5 days in the daily questionnaires from Wednesday to Monday morning. In the morning before starting work (05:00–08:30 a.m.), they rated their fatigue level. In the afternoon after school (03:00-06:15 p.m.) the teachers reported their teacher-specific workload. In the late evening (08:30–11:30 p.m.) they reported their work-related rumination. A total of 186 teachers registered for the study at different time points during February and March 2020 and therefore received the online questionnaire and the daily online diaries accordingly. Six teachers did not finish the general questionnaire or did not participate in the diary part of the study. Six teachers did not work or only worked once in the time frame of the study or stemmed from a different federal state and thus, were excluded. The final sample comprised 174 teachers (female = 80.5%; male = 19.5%; $M = 40.29$ years old, $SD = 9.45$). The amount of female teachers is typical for Hesse in which over 71% of the teachers in for example primary and secondary schools are female (*cf.* Hessisches Statistisches Landesamt, 2020). The teachers were from different school types (e.g., primary and secondary), taught a variety of school subjects and their teaching experience was between 1 and 37 years ($M = 13.05$, $SD = 8.38$). The participants were divided into two groups according to the date the school attendance was restricted. Group 0 ($n = 138$) comprised teachers who participated in the weekly assessment before restriction of school attendance (4 weeks in total); group 1 ($n = 36$) comprised teachers who participated in the weekly assessment during restriction of school attendance (2 weeks in total starting with the 16th of March 2020).

For the purposes of analysis, only those days (defined as data points with afternoon, evening and next morning measures) were included, in which the teachers specified that they had worked. Either the report on work activity was indicated by at least one specification on the workload questionnaire in the afternoon (see below) or – in the case a teacher missed the afternoon questionnaire – by affirming in the evening that they had worked on that day. In total, 1,697 daily measures were collected: 565 in the afternoon (6.77% missing data) and 552 in the late evening (8.91% missing data) and 580 in the morning (4.29% missing data). All the data points, even the ones with missing data, were included (*cf.* Hox, 2010). The average cluster size was 3.48.

2.2. Measures

Descriptive statistics, reliabilities, and (intraclass-) correlations (ICC) of the primary study variables are shown in Table 1. McDonald's omega was used as a reliability estimate. All responses to the items were rated on a 5-point Likert scale, except for the items of the teacher-specific workload, which were rated on a 6-point Likert scale. Unless otherwise specified, mean scores were computed.

Teacher-specific workload was assessed by eleven items of the German teacher-specific workload scale by van Dick and Wagner (2001). The scale included eleven stressors, describing problems in the school context (e.g., too many students in class, student misbehaviour, problems with foreign students, difficulties with administration, problems with parents of the students). The items were slightly adapted so that they applied to the daily context. Teachers were asked to indicate how stressful they experienced each stressor on that given day from 0 (*not at all stressful*) to 5 (*very stressful*). As not all stressors might have been present on 1 day, the participants could indicate "not applicable." The sum score of the teacher-specific workload per day was computed for all items on which the teacher rated the stress level.

Work-related rumination. The German version (*cf.* Hamesch et al., 2014) of the Work-Related Rumination Questionnaire (Cropley et al., 2012) was used to assess AR and PSP with five items each (*cf.* Weigelt et al., 2019). The items were slightly adapted to the workday evening: "This evening I became tense when I thought about work-related issues during my free time" (AR), and "This evening I found myself reevaluating something I have done at work in my free time" (PSP).

TABLE 1 Descriptive statistics, reliabilities and correlations of variables.

Variables	M_b	SD_b	ω	ICC	1	2	3	4
1 Affective rumination	2.25	0.711–0.721 ($M = 0.716$)	0.886–0.899 ($M = 0.894$)	0.537				
2 Problem solving pondering	2.39	0.541–0.55 ($M = 0.544$)	0.759–0.859 ($M = 0.813$)	0.412	0.548** (0.439**)[a]			
3 Fatigue	2.26	0.654–0.657 ($M = 0.656$)	0.898–0.906 ($M = 0.902$)	0.479	0.585** (0.199**)[b]	0.332** (0.120**)[b]		
4 Teacher-specific Workload	16.5	7.01–7.06 ($M = 7.03$)	0.825–0.973 (M = 0.884)	0.366	0.510** (0.124*)[b]	0.394**(0.237**)[b]	0.439** (0.073)[b]	
5 Group					−0.433*[a]	−0.322†[a]	−0.303†[a]	−0.911**[b]

Standardized coefficients are presented for correlations. Coefficients are based on random intercept models with within-level correlations shown in parenthesis (n_{level2} = [a]173–[b]174; n_{level1} = 552–606). 1–4 was regressed on group as a predictor; age was included as a covariate. Group: 0 = teachers before school restrictions, 1 = teachers during school restrictions. ω = McDonalds' Omega ($n_{afternoon}$ = 64–159; $n_{evening}$ = 62–150; $n_{next\_morning}$ = 66–158). ω of WL: Because of non-identification of the model, 4 days are reported (fixing one item-factor loading to 1 led to a ω = 0.922 in the excluded day). M_b/SD_b = estimated between-level mean and standard deviation based on random intercept models with FIML. ICC, intraclass correlation; †$p < 0.10$, one-tailed; *$p < 0.05$, one-tailed; **$p < 0.01$, one-tailed.

Fatigue in the morning. Fatigue was measured by four items of the German Profile of Mood States (Albani et al., 2005). The participants rated adjectives (e.g., "exhausted") according to their fatigue level from 1 (not at all) to 5 (extremely) in that moment.

2.3. Analyses

To analyse the composition of the two groups in demographic variables, all available data was used, and *t*-test and Chi-squared (χ^2) tests were conducted using IBM SPSS Statistics (Version 27). Moreover, the data had a hierarchical data structure since daily reports were nested within persons. The amount of variance in study variables lying between- and within-persons was inspected by the ICC. To consider the associations of restrictions of school attendance and potential mediating effects, multilevel structural equation modeling (MSEM) was used (*cf.* Preacher et al., 2010). All predictor variables (except group belongingness) were grand-mean centred. A stepwise approach was conducted. First, fatigue was regressed on group belongingness (model 1). Second, teacher specific-workload was included as a predictor of fatigue on the within- and between level (model 2). Third, work-related rumination facets were included as predictors of fatigue on the within- and between level. Both facets were regressed on group-belongingness and teacher-specific workload (model 3) Full information maximum likelihood estimation with a robust estimator in Mplus6 (Muthén and Muthén, 1998-2010) was used to deal with the missing data. Only saturated models were tested.

3. Results

3.1. Group composition in demographic and work-related variables

As shown in Table 2, there were no significant differences between the groups in most of the demographic and work-related variables as assessed with the general questionnaire. There were also no significant differences in group compositions such as school type, $\chi^2(6) = 2.40$, $p = 0.879$, working part- or full-time, $\chi^2(3) = 1.86$, $p = 0.601$, gender distribution, $\chi^2(1) = 2.05$, $p = 0.152$, and relationship status, $\chi^2(2) = 0.25$, $p = 0.882$. A significant difference was observed only in age, which was considered as a covariate in the models. There were no differences between the groups regarding the days the teachers participated and worked, $\chi^2(4) = 1.79$, $p = 0.774$ and no difference between the distribution in workday (0) versus weekend (1), $\chi^2(1) = 1.55$, $p = 0.213$. The inclusion of "workday versus weekend" on the within level (model 2 and 3) did not change the results decisively. Therefore, the more parsimonious models were reported.

3.2. Preliminary analysis

The ICC of the level 1 variables (Table 1) indicated that it is appropriate and necessary to implement multilevel modelling as 36.6 - 53.7% of the variance of the level 1 variables was between-person variation (*cf.* Preacher et al., 2010). Correlations (Table 1) showed that higher PSP was related to higher fatigue on the between- and within-level. The within-level relationship between teacher-specific workload and fatigue in the morning was not significant. However, experiencing higher teacher-specific workload on average was related to higher average fatigue in the morning over the course of the working days. All other relationships were significant and in the expected direction.

TABLE 2 Group comparison in level 2 variables.

Variable	Group	M	SD	*t*-value (*df*)	95% CI
Age	0	39.35	9.17	−2.61* (172)	[−7.98, −1.11]
	1	43.89	9.76		
Amount of students in school	0	558.32	378.55	−0.56 (172)	[−144, 136.03]
	1	562.31	380.93		
Average amount of students in class	0	21.77	5.05	0.14 (172)	[−1.7, 1.96]
	1	21.64	4.57		
Average working hours per day	0	7.56	1.97	−0.001 (168)	[−0.72, 0.72]
	1	7.56	1.86		
Average working hours in school per week	0	28.08	13.66	0.66 (172)	[−3.42, 6.86]
	1	26.36	14.84		
Average working hours at home per week	0	11.36	16.6	0.84 (172)	[−3.24, 8.08]
	1	8.94	8.77		
Average working hours per weekend	0	5.09	4.76	0.51 (172)	[−0.88, 1.72]
	1	4.67	3.08		
Amount of children	0	1.10	1.08	−1.44 (172)	[−0.68, 0.11]
	1	1.39	0.99		

Group: 0 = teachers before school restrictions, 1 = teachers during school restrictions. CI = Confidence interval of difference. $N = 170–174$. For average working hours per day, four teachers were excluded because of unrealistic data (e.g., 24 h). *$p < 0.05$, two-tailed.

3.3. Test of hypotheses

There was (*cf.* Table 1) a significant negative relationship between AR (*Hypothesis* 3b) and teacher-specific workload (*Hypothesis 1*) with group belongingness in the expected directions. There was also the tendency that PSP was related to group belongingness, even though the effect was not significant, $\beta = -0.322$, $SE = 0.207$, $p = 0.06$ (*Hypothesis* 3a). In the first step (model 1), average fatigue in the morning was regressed on group belongingness. A significant effect was observed, indicating that teachers during the restrictions had on average significantly lower level of fatigue in the morning as compared

to teachers before the restrictions, β = −0.413, SE = 0.212, $p = 0.026$. However, when age was included as a covariate, the effect failed to reach significance, β = −0.303, SE = 0.217, $p = 0.081$. *Hypothesis 2*a was not fully supported. Older teachers experienced lower average level of fatigue in the morning, β = −0.241, SE = 0.083, $p = 0.004$. In the second step (model 2), teacher-specific workload was included. There was no effect on the within-level (*Hypothesis 2*c), β = 0.078, SE = 0.061, $p = 0.103$. However, the indirect effect of teacher-specific workload on the between-level was significant, β = −0.361, SE = 0.145, $p = 0.007$. Teachers during the restrictions experienced lower levels of teacher-specific workload on average compared to teachers before the restrictions, β = −0.895, SE = 0.251, $p < 0.001$. Lower levels of levels of teacher-specific workload was related to lower levels of fatigue in the morning, β = 0.403, SE = 0.102, $p < 0.001$. These results supported *Hypotheses 1* and *2*b. In the third step (model 3), the facets of work-related rumination were included into the model (Table 3).

Between-level: When including work-related rumination, the paths of group belongingness on AR and PSP were fully mediated by teacher-specific workload. Teachers during restrictions experienced on average lower levels of teacher-specific workload, which was associated with lower levels of AR, β = −0.451, SE = 0.167, $p = 0.004$, and PSP, β = −0.333, SE = 0.14, $p = 0.017$. These findings supported *Hypotheses 3*c and *3*d. There was no significant relationship between PSP and fatigue; PSP did not mediate the relationship between workload, β = −0.022, SE = 0.045, $p = 0.618$, or group-belongingness, β = −0.001, SE = 0.013, $p = 0.967$, and fatigue in the morning. *Hypotheses 4*c and *4*g were not supported. However, AR mediated the effect between teacher–specific workload, β =0.273, SE = 0.082, $p < 0.001$, but not group belongingness, β =0.011, SE = 0.112, $p = 0.461$, and fatigue. The direct path of teacher-specific workload on fatigue was no longer significant. Those teachers who on average experienced higher levels of teacher-specific workload reported higher levels of AR after work in the evening. Higher levels of AR were related to higher average levels of fatigue in the morning. *Hypotheses 4*a and *4*e were therefore supported. Exploratory, a three-path mediation from group belongingness over teacher-specific-workload and AR to fatigue in the morning was tested. The effect reached significance, β = −0.239, SE = 0.103, $p = 0.011$.

Within-level: Higher teacher-specific workload was associated with higher AR and PSP on the within-level. *Hypotheses 3*e and *3*f were supported. PSP was not related to fatigue in the morning and there was no mediating effect of PSP in the relationship between teacher-specific workload and fatigue, β = 0.009, SE = 0.014, $p = 0.536$. *Hypotheses 4*d and *4*h were not supported. In support of *Hypothesis 4*f, there was a significant indirect effect of AR: Higher levels of teacher-specific workload were related to higher levels of AR on the within-level, which was related to higher levels of fatigue, β = 0.022, SE = 0.012, $p = 0.04$.

4. Discussion

The present study investigated the associations of restrictions of school attendance with recovery and stress experience of teachers. Following the E-RM (Meijman and Mulder, 1998) and especially the aspect of negative affect and negative activation (Sonnentag, 2018), it was hypothesized that teachers during restrictions would experience on average lower levels of teacher-specific workload, being associated directly to the level of fatigue in the morning and indirectly through work-related rumination. In implementing a diary study design and multilevel modelling, different aspects of the association and influence of school restrictions and differences in teacher-specific workload were emphasized. Considering age as a covariate, model 1 showed the tendency ($p = 0.08$) that during restrictions teachers had lower average fatigue levels over the working days. In line with the E-RM (Meijman and Mulder, 1998) and deducible suggestions concerning negative (affective) activation (Sonnentag and Fritz, 2015; Sonnentag, 2018), model 2 showed that teachers during the first 2 weeks of the school restrictions experienced lower levels of teacher-specific workload on work days compared to the teachers 4 weeks before the school restrictions. Teacher-specific workload

TABLE 3 Multilevel structural equation model to test hypothesis (third model).

	Fatigue	Affective rumination	Problem-solving pondering	Teacher-specific workload
Parameter	Estimate (SE)	Estimate (SE)	Estimate (SE)	Estimate (SE)
Between-person level				
Group	0.051 (0.213)	0.021 (0.211)	0.009 (0.227)	−0.876 (0.253)**
Affective rumination	0.531 (0.118)**			
Problem-solving pondering	−0.059 (0.116)			
Teacher-specific workload	0.171 (0.140)	0.515 (0.099)**	0.380 (0.115)**	
Age	−0.240 (0.079)**	0.047 (0.081)	−0.040 (0.087)	−0.082 (0.094)
Intercept	3.45 (0.26)**	−0.01 (0.09)	−0.02 (0.1)	0.23 (0.1)
Within-person level				
Affective rumination	0.177 (0.059)**			
Problem-solving pondering	0.036 (0.058)			
Teacher-specific workload	0.037 (0.065)	0.123 (0.053)**	0.238 (0.053)**	

Standardized predictor coefficients are presented. There was a significant correlation between the work-related rumination facets on the between- ($r = 0.449$**) and within-level ($r = 0.424$**). $n_{level2} = 174$; $n_{level1} = 606$. *$p < 0.05$, one-tailed; **$p < 0.01$, one-tailed.

was a significant mediator in the previous mentioned relationship between group belongingness and average level of fatigue. It is important to note that teacher-related demographic variables did not differ between the groups in the general questionnaire and could be ruled out as an explanation for differences between the groups in teacher-specific workload. It is also crucial to state that there was no difference concerning the distribution of working days and the weekend over the five-day span of the study. Therefore, it is not possible to conclude from the present study that teachers during the school restrictions worked on less days (average cluster size: Group 0 = 3.43; group 1 = 3.69). Even though a political decision changed the work situation of teachers on a specific day, the association of group belongingness and teacher-specific workload cannot be interpreted as causal. Nonetheless, it is reasonable to suggest that an association was present. On the one hand, this might due to the fact that teachers being less exposed to teacher-specific demands such as large amount of students in class or student misbehaviour. On the other hand, restrictions of school attendance reduced the risk of being exposed to COVID-19 in class, which might explain a reduced stress experiences due to the teacher-specific job demands.

Model 3 showed that, higher teacher-specific workload was related to higher AR and higher PSP. Higher AR was related to higher levels of fatigue the next morning on the within- and between-level. PSP, however, was unrelated to fatigue level. Crucially, the association between teacher-specific workload and fatigue on the between-level was fully explained by AR. On the within-level, this indirect effect was significant as well. The findings emphasize the importance of AR in nonwork time for the negative effect of teacher-specific workload on fatigue level. Higher teacher-specific workload on average appears to be more important for fatigue level than experiencing a higher workload than usual on a specific day, as the between- but not the within-level association was significant in model 2. However, both might be detrimental, as it heightens the possibility of AR, which is related to higher fatigue level on both levels.

With regard to the COVID-19 situation of teachers, the three-path mediation showed that teachers during restrictions indirectly had favourable recovery experience and outcome, as lower levels of teacher-specific workload (in the afternoon) were associated with lower levels of AR in nonwork time (in the evening), which in turn was associated with lower average fatigue levels (in the next morning).

4.1. Theoretical implications concerning work-related rumination

Model 3 showed that higher stress experience due to teacher-specific job-demands can lead to more fatigue, as recovery is hindered due to AR but not PSP. The results on the between- and within-level are further in line with the suggestion, that negative activation due to job demands, is sustained or accompanied by negative cognitions within AR (Sonnentag, 2018), which particularly hinder successful recovery. The present study adds to the recovery research in focusing on the differential effects of the content of work-related thinking in nonwork time (*cf.* Headrick et al., 2019; Jimenez et al., 2021). Especially AR appears to influence fatigue level negatively. Overall, problem-oriented thinking did not relate to fatigue level. This contradicts the suggestions, which anticipated positive effects of problem-oriented thinking on recovery outcomes (Querstret and Cropley, 2012; Syrek et al., 2017; Headrick et al., 2019). However, even though PSP reduces the time for distancing from work, thinking about problem solutions in nonwork time neither lead to a heightened level of fatigue. Furthermore, PSP might not be related to negative recovery experiences or outcomes but could influence positive ones (Vahle-Hinz et al., 2017). The findings concerning AR and PSP are in line with theories in occupational health (Sonnentag, 2018) and clinical psychology (Querstret and Cropley, 2013) contexts indicating that the emotional response, evaluation of thoughts and negative activation, but not work-related cognitions *per se* are problematic.

4.2. Practical implications

Restrictions regarding work in times of pandemics seems to be associated with recovery and stress experiences. It is feasible to suggest that COVID-19 related school restriction were associated with a decrease in teacher-specific workload and unfavourable and maladaptive work-related rumination processes that has short-term positive effects on the fatigue level of teachers. Short-term restrictions and sudden changes, therefore, might not necessarily have maladaptive outcomes in relation to psychological well-being for all occupations (*cf.* Chong et al., 2020). From another perspective, in the present study, teachers appear to be more stressed and rely more on unfavourable work-related thinking processes shortly before the restrictions of school attendance were decided. For example, Ministries of Education can establish regional task-forces who can act quickly in exceptional situations and provide teachers with the necessary information shortly before, as compared to shortly after restrictions. Giving clear information about the next steps might increase controllability, and reduce negative affect and maladaptive thinking processes about tasks that are to be completed.

In the study of work-related thoughts in nonwork time, occupation-specific job demands and workload are rarely included (Türktorun et al., 2020). This makes it difficult to draw conclusions on the impact of specific demands (e.g., teaching in class, working with parents) and how they relate to stress and recovery experience. Including teacher-specific workload and differentiating between the groups before and during the restrictions provided important information and sheds light on an important topic above the COVID-19 situation. Stress experience due to teacher-specific job demands indeed is associated with adverse recovery experience and outcome. Groups with different kinds and presumably varying degrees of stressful school situations experience corresponding recovery experience and outcome. The organization of the school situation therefore appears to matter for the health of teachers. Recently there is growing debate concerning the community level of a possible modification of the situation of teachers (Viac and Fraser, 2020). The present study indicates that on the individual level, teachers should draw attention to techniques that helps in reducing AR. Although limited, there is evidence that for example mindfulness-based interventions reduce (work-related) rumination (Karabinski et al., 2021). Focusing on boundary management and

sleep as well as emotion regulation interventions might be equally favorable, while more intensive trainings appear to be more effective (Karabinski et al., 2021).

4.3. Limitations and further future research directions

This diary study helped in finding differences between the groups in teacher-specific workload, fatigue, and AR throughout working days. Moreover, the diary design provides for a more robust testing of effects on health-related indicators in times of pandemics (*cf.* Rudolph et al., 2021). However, because of the original aim and plan of the study, only short-term effects based on unequal sample sizes in each group could be provided. It has to be noted that the tests of between level effects are based on the whole sample and not on the subsample of the groups and that robust estimators (Muthén and Muthén, 1998-2010) were used. Future research should add data on the long-term effects of restrictions on teachers' and employees' mental health. Besides occupational health, effects on the performance of employees should be considered. Furthermore, even though we found a large effect between the group variable and teacher-specific workload (−0.876), there might be other moderating or influencing factors involved. For example, our data could not provide information on the COVID-19 health anxiety (Trougakos et al., 2020) of teachers. The fear of apprehending COVID-19 might have moderated the effect of the group variable on teacher-specific workload, such as teacher-specific workload appeared even higher for teachers high in COVID-19 health anxierty shortly before the lockdown. Furthermore, acceptance of technology (Venkatesh and Davis, 2000) or information and communication technology skills (Engelhardt et al., 2021) might have acted as a buffering personal resource for teachers when providing digital content during the weeks of school restrictions. Future research should examine, whether workload for teachers providing digital education is different according to person-specific competencies or beliefs.

In the work context of teachers, the effect of asynchronous teaching on students' performances is crucial as well (Kuhfeld et al., 2020; König and Frey, 2022). Both aspects should allow insights into how teaching can be implemented in times of pandemics, and if and under which circumstances distance teaching might have positive community- (e.g., reaching rural area students) and health-related consequences (possible first hints, e.g., American Psychological Association, 2020; Zhang et al., 2020; König and Frey, 2022).

Future research might also add negative affect as an indicator of negative activation, as one central antecedent (*cf.* Sonnentag, 2018), which has not been considered here. Moreover, personality traits have not been considered. In view of the emphasis of negative affective activation, neuroticism might be crucial factors in the relationship of job demands, perseverative cognitions and negative affect (Lahey, 2009). Beside lower levels of teacher-specific workload, working time and the possibility of longer recovery time, daily setbacks (Chong et al., 2020) as well as levels of unfinished goals—due to less school responsibilities, might be the additional factors, which should be worth examining in future research.

5. Conclusion

The present study provides evidence for the association of differences in work situations due to restrictions with the workload and fatigue level and recovery experiences of teachers. Teachers during the school restrictions experienced lower teacher-specific workload and indirectly lower levels of fatigue as compared to the teachers before the restrictions. The results further showed that lower levels of AR explained the effect of teachers-specific workload on the fatigue level. AR appears to be more important for fatigue levels compared with PSP, which did not have a direct effect on the fatigue levels of teachers.

Data availability statement

The dataset used in the present article is not available because the participating teachers were guaranteed that the data would not be passed to third parties. Requests to access the datasets should be directed to weiher@psych.uni-frankfurt.de.

Ethics statement

The studies were conducted in accordance with the local legislation and institutional requirements. All participants provided their written informed consent to participate in this study.

Author contributions

GW and YV were responsible for designing the study, conducting the study, data collection and -management. HH supervised the mentioned process. GW was mainly responsible for writing this article and conducting the statistical analysis. YV and HH helped editing and reviewing this article. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The impact of social support and emotion dysregulation on COVID-19 depressive symptoms

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Introduction: Stress resulting from the global COVID-19 pandemic has been linked to psychological consequences, such as depressive symptoms, for individuals worldwide. Outbreaks and pandemics are known to accentuate stressors or generate new ones owing to health-related worries, reduced mobility, and social activity due to quarantine, and sudden life changes. Although post-lockdown U.S. research findings suggest a greater risk of depression among 18- to 25-year-olds, familiarity with technology and virtual socializing may offer college students some protective effect, warranting research with such groups.

Methods: The current study thus explored emotion dysregulation (ED) and perceived social support (PSS) as potential mechanisms for the relationship between COVID-19 stress and depressive symptoms among students at a southern university in the United States. Participants ($N = 489$) completed a cross-sectional survey assessing their current levels of COVID-19 stress, ED, PSS, and depressive symptoms.

Results: Path analysis showed that PSS buffered the effect of ED on depressive symptoms. The results support the explanatory role of ED in the relationship between COVID-19 stress and depressive symptoms.

Discussion: The perceived social connection may be an essential factor for psychological outcomes during periods of stress and isolation, particularly for those reporting high ED.

KEYWORDS

social support, emotion regulation, depression, pandemic, emerging adults

Introduction

The SARS coronavirus disease that emerged in December 2019 (COVID-2019) was declared an international pandemic by the World Health Organization in March 2020 (Cucinotta and Vanelli, 2020). There is a crucial need to examine the impacts of COVID-19 on mental health to inform intervention and policy (Gruber et al., 2020). Studies have found that COVID-19 is associated with a significant increase in depressive symptoms in emerging adults (Hawes et al., 2022), with a longitudinal study by Alzueta et al. (2021) finding that the risk for clinical depression tripled among emerging adults. However, there is a need for further investigation to fully understand the underlying mechanisms of this relationship. From the literature on affective disorders and depression, difficulties in emotion regulation (e.g., Visted et al., 2018) and social support (e.g., Alsubaie et al., 2019) have been identified as factors involved in symptomatology and functioning. The current study aimed to understand how emotion regulation and perceived social support (PSS) may promote resilience and mitigate the long-term psychological impacts of stressful events.

Emotion dysregulation (ED) has been identified as a transdiagnostic process across various mental health outcomes (Beauchaine and Cicchetti, 2019). Depression is one such mental health outcome that has been attributed to biological stress system dysregulation (Vinkers et al., 2021). Prior studies have established that ED mediates

the stress–psychopathology relation (Mclaughlin and Hatzenbuehler, 2009; Moriya and Takahashi, 2013). According to the stress-buffering hypothesis, PSS is another factor that may reduce adverse outcomes related to stress (Cohen and Wills, 1985). A meta-analysis of 16 studies from different countries' college students found that the prevalence of depressive symptoms was the highest among U.S. students (Chang et al., 2021), further underscoring the necessity to investigate underlying mechanisms for the relationship between COVID-19 stress and depressive symptoms. To the best of our knowledge, the current study is among the first to explore potential mechanisms for the relationship between COVID-19 and depressive symptoms in college students in the USA.

Many interacting influences are thought to serve as pathways to depression, including genetic risk, with heritability estimates ranging from 30 to 45% (Sullivan et al., 2000; McMahon, 2018). Genetic vulnerability influences neurobiological processes that shape early temperament consisting of sensitivity to harmful stimuli, disposition to feeling negative affect, and high negative emotionality, with these vulnerabilities likely interacting with environmental events to account for substantial variance (Sullivan et al., 2000). Environmental stressors serve as the catalyst or trigger for a depressive disorder to be expressed (diathesis-stress model). There is an abundance of evidence that exposure to environmental stressors, including potentially traumatic events (PTEs), is associated with increased symptoms of depression. Examples include PTEs related to natural disasters (Goldmann and Galea, 2014), terrorist events (Galea et al., 2002), and other epidemics such as Ebola (Jalloh et al., 2018), severe acute respiratory syndrome (Hawryluck et al., 2004), and most recently—the COVID-19 pandemic (Hawes et al., 2022).

Extant literature has demonstrated that ED mediates the stress–psychopathology relation (Mclaughlin and Hatzenbuehler, 2009; Moriya and Takahashi, 2013). A developmental framework for depression includes a series of neurobiology-related factors, including individual differences in temperament, information processing biases, stressful events, executive functioning, and self-regulation (Hankin, 2012). A significant amount of research supports that ED plays a role in the onset, overlap, and maintenance of depressive symptoms (Fitzgerald et al., 2019). Furthermore, experimental manipulation, resulting in improved emotion regulation, can predict subsequent improvements in symptom severity (Radkovsky et al., 2014). These findings are further supported by meta-analyses, indicating that individuals with remitted major depressive disorder (MDD) report improved emotion regulation abilities (e.g., Visted et al., 2018), emphasizing emotion regulation as a potential strategy to prevent depressive symptoms from reaching clinically significant levels. In light of the COVID-19 pandemic, more recent research has demonstrated the protective role of emotion regulation in mitigating the relationship between COVID-19-related stress and psychological symptoms ratings, including ratings of depression (Russo et al., 2022).

According to the stress-buffering hypothesis, initially proposed by Cassel (1976), social support is another factor that may reduce adverse outcomes related to stress (Cohen and Wills, 1985). A literature review by Gariepy et al. (2016) found that social support is associated with lower levels of depressive symptoms among adults. However, according to the stress-mobilizing hypothesis (Barrera, 1986), stress can also encourage individuals to seek support, warranting further research to understand the association. To date, social support has been broadly construed in two ways: perceived social support (PSS) and received social support (Eagle et al., 2019). PSS refers to an individual's subjective perception of support (material, psychological, etc.) from others and has been shown to be more strongly associated with mental health outcomes when compared to associations with received social support (Santini et al., 2015). PSS may be particularly important during periods of social distancing due to the COVID-19 pandemic. For instance, research demonstrates a positive association between PSS and individuals' self-ratings of resilience (Killgore et al., 2020). Furthermore, research on depressive symptoms during the COVID-19 pandemic found that individuals with lower PSS, compared to those endorsing high PSS, were at double the risk for elevated depressive symptoms (Grey et al., 2020). This finding is further supported by previous research showing that PSS is a significant predictor of depressive symptoms (Alsubaie et al., 2019). Additionally, previous research indicates that PSS can reduce the association between exposure to disasters, such as flood exposure and depressive symptoms (e.g., Dar et al., 2018). To the best of our knowledge, however, whether PSS could moderate (i.e., reduce the strength of) the relationship between COVID-19-related stress in particular and depressive symptoms has yet to be examined.

Prior studies have established that ED mediates the stress–psychopathology relation (Mclaughlin and Hatzenbuehler, 2009; Moriya and Takahashi, 2013) and that social support may moderate/buffer the risk for depression (Cohen and Wills, 1985). Emerging adulthood, a period of developing emotion regulation capacity, may be a susceptible period for developing depression (see Kuwabara et al., 2007). Furthermore, a recent study revealed that participants without depressive symptoms showed a greater increase in symptoms during the COVID-19 pandemic, while those with pre-existing mental health disorders showed a slight symptom increase (Pan et al., 2021). This finding suggests that the impact of the COVID-19 pandemic on depressive symptoms in individuals without pre-existing symptoms is multifaceted and requires further investigation. Thus, the current study explored potential mechanisms for the relation between COVID-19 stress and depressive symptoms in undergraduate students since college is traditionally a period of emerging adulthood. In particular, the current study proposed the following hypotheses: (1) COVID-19 stress would increase the risk for depressive symptoms, (2) ED would mediate the relationship between COVID-19 stress and depression, and (3) PSS would moderate the stress–depression association. This study aimed to help identify modifiable risk factors involved in mental health outcomes during pandemics by exploring these mechanisms.

Method

Participants

Kline (2015) suggested that a sample size of 200 or more is appropriate for path analysis. The current sample included 489

participants (341 women, 148 men, and no others) ranging in age from 18 to 58 years ($M = 20.18$, $SD = 4.35$) attending a large university in the southern region of the United States. Although the participant pool sampled for the current study included 16 participants older than the traditional threshold for emerging adulthood, all participants (mainly in their 20s) were undergraduate college students and are thus referred to as emerging adults (Arnett, 2007). Much of the sample reported their race as Caucasian/white (77.9%), followed by African American/Black (18.6%), Asian (3.9%), American Indian/Alaska Native (2.0%), and Native Hawaiian/Pacific Islander (0.4%), or others (1.0%). See Table 1 for the sociodemographic characteristics of the participants.

TABLE 1 Sociodemographic characteristics of participants.

Characteristics	*n*	%
Sex		
Female	341	69.7%
Male	148	30.3%
Academic year		
Freshman	262	53.6%
Sophomore	82	16.8%
Junior	68	13.9%
Senior	75	15.3%
Race		
Caucasian/white	381	77.9%
African American/Black	91	18.6%
Asian/Pacific Islander	19	3.9%
American Indian/Alaska Native	10	2.0%
Native Hawaiian/Pacific Islander	2	0.4%
Other	5	1.0%
Ethnicity		
Hispanic/Latino	21	4.3%
Non-Hispanic/Latino	466	95.7%
Parents yearly income		
Less than $10,000	15	3.1%
$10,000–$19,999	15	3.1%
$20,000–$29,999	16	3.3%
$30,000–$39,999	37	7.6%
$40,000–$49,999	23	4.7%
$50,000–$59,999	38	7.8%
$60,000–$69,999	44	9.0%
More than $70,000	34	7.0%

$N = 489$. Participants were on average 20.18 years old, ranging from 18 to 58 years.

Procedure

Upon approval by the university's Institutional Review Board, participants were recruited through an undergraduate research pool at a southern university in the United States between November 2020 and April 2021. Participants completed all procedures remotely using their computers due to COVID-19 restrictions. Thus, some participants may have been attending classes in person at school, whereas others may have been at home attending classes virtually. Participants accessed the survey using a link to Qualtrics. Qualtrics has been used in several COVID-19-related studies (Czeisler et al., 2021; Johnson, 2021; McFadden et al., 2022). First, informed consent was obtained *via* Qualtrics. Next, the participants provided demographic data, including gender, age, and race/ethnicity. The participants then completed the battery of measures. Each measure was presented in a randomized order to account for order effects. After the participants completed the survey, they were provided information about on-campus psychological services. The participants received course credit as compensation for their participation.

Measures

The online questionnaire included the COVID Stress Scale (CSS; Taylor et al., 2020), the Difficulties with Emotion Regulation Scale (DERS; Gratz and Roemer, 2004), the Child and Adolescent Social Support Scale-College version (CASSS-C; Malecki et al., 2000), Beck Depression Inventory-II (BDI-II; Beck et al., 1996), and a demographic questionnaire.

The CSS (Taylor et al., 2020) is a 36-item self-report measure assessing COVID-19-related stress and anxiety symptoms. It includes subscales for COVID-19 danger and contamination fears, COVID-19 fears about economic consequences, COVID-19 xenophobia, COVID-19 compulsive checking and reassurance seeking, and COVID-19 traumatic stress symptoms. Items are scored on a 5-point scale: 0 (*not at all*), 1 (*slightly*), 2 (*moderately*), 3 (*very*), and 4 (*extremely*). The CSS has demonstrated good psychometrics, with the internal consistency of the scales ranging from 0.86 to 0.95, plus good convergent and discriminant validity (Taylor et al., 2020). The current study used the overall CSS score to measure participants' COVID-19 stress. The CSS demonstrated good internal consistency ($\alpha = 0.87$) in our sample.

The DERS (Gratz and Roemer, 2004) is a 36-item scale that measures the following facets of ED: non-acceptance, goal-directed behavior, impulsivity, emotional awareness, strategy, and clarity. Participants responded on a 5-point scale (1 = almost never; 5 = almost always). Scores ranged from 0 to 180, with higher scores indicating greater emotion dysregulation. Based on physiological and neural indicators of emotion regulation, the DERS total score represents a reliable global index of overall ED (Gratz et al., 2006; John and Eng, 2014). The DERS demonstrates high internal consistency with Cronbach's alpha ranging from 0.77 to 0.93 (Gratz and Roemer, 2004; Dhruve and Oliveros, 2022). Conversely, discriminant validity evidence for the DERS subscales is limited (John and Eng, 2014). Thus, the DERS total score was used in the present study to measure ED.

The CASSS-C (Malecki et al., 2000) is a modified version of the CASSS; it has been utilized in a prior COVID-19 study (Balkundi and Fredrick, 2023). The CASSS-C is a 60-item self-report measure

that assesses the perceived frequency and importance of support from four sources: family, other adults (e.g., professors and coaches), peers, and close friends. The current study utilized frequency items to measure participants' overall PSS. Frequency items are scored on a 6-point scale (1 = never and 6 = always). Frequency scores ranged from 60 to 360, with higher scores representing a greater perceived frequency of social support. The CASSS-C demonstrated good internal consistency ($\alpha = 0.87$) in our sample.

The BDI-II is a 21-item self-report measure (Beck et al., 1996) that assesses depressive symptoms. The BDI-II has been used in several COVID-19-related studies (Bashir et al., 2020; Leão et al., 2023; Zabel et al., 2023). Items are scored on a Likert scale from 0 to 4, with higher scores specifying more depressive symptoms. The severity of depressive symptoms is represented as follows: 0–13 is the minimal range, 14–19 is the mild range, 20–28 is the moderate range, and 29–63 is the severe range. The BDI-II demonstrated excellent internal consistency ($\alpha = 0.94$) in our sample.

Statistical analysis

Categorical variables were described using frequencies and percentages. Continuous variables were described using means and standard deviations. Path analyses were performed to evaluate the relationship between COVID-19 stress, emotion regulation, social support, and depression. Standardized regression coefficients were calculated, and R2 measures for each exogenous variable were estimated. Goodness-of-fit criteria were calculated to assess model fit with comparative fit index (CFI) ≥ 0.90, Tucker–Lewis index (TLI) ≥ 0.90, and root mean square error of approximation (RMSEA) < 0.10 indicating acceptable model fit. Analysis was performed using IBM SPSS AMOS (version 27.0). Missingness occurred at less than 5% and was handled by imputation. Data were checked for normality and multicollinearity and were found to be within normal limits. All skew, kurtosis, and variance inflation factor statistics were < 1.2.

Results

Table 2 provides an overall characterization of the sample. Participants reported low levels of COVID-19 stress although there was considerable variability in responses ($M = 26.63$, $SD = 23.73$). On average, participants endorsed moderate levels of PSS ($M = 257.59$, $SD = 56.29$), but ratings ranged from 60 to 360, indicating that the full range of this measure is reflected in our current sample. ED scores ranged from 36 to 163, which reflects most of the possible range of scores on this measure (DERS maximum = 180). Despite there being no clinical cutoffs for the DERS, 53% of participants reported DERS scores in the second percentile, indicating that at least 20 out of 36 items were endorsed as causing difficulties most of the time. All variables correlated as expected.

As shown in Table 2, correlational analyses revealed that COVID-19 stress was positively associated with depressive symptoms ($r = 0.25$, $p < 0.001$) and ED ($r = 0.31$, $p < 0.001$). As expected, PSS was negatively correlated with COVID-19 stress ($r = -0.19$, $p < 0.001$), depressive symptoms ($r = -0.38$, $p < 0.001$), and ED ($r = -0.32$, $p < 0.001$). Depressive symptoms were positively correlated with ED ($r = 0.58$, $p < 0.001$).

TABLE 2 Descriptive statistics and bivariate correlations.

Variable	*M*	*SD*	1.	2.	3.	4.
1. COVID-19 stress	26.63	23.73	1	–	–	–
2. Perceived social support	257.59	56.29	−0.13*	1	–	–
3. Emotion dysregulation	88.48	25.48	0.31*	−0.29*	1	–
4. Depressive symptoms	12.76	11.25	0.25*	−0.38*	0.58*	1

$n = 489$.
*$p < 0.01$.

All hypotheses were tested using the structural model in Figure 1. Hypothesis 1, COVID-19 stress would increase the risk for depressive symptoms and be partially supported as COVID-19 stress had an indirect effect on depressive symptoms through ED [$b = 0.14$, 95% BCa (0.09, 0.18), $p < 0.001$]. Although COVID-19 stress did not have a significant direct effect on depressive symptoms, the modern method for mediation analysis does not require evidence of a simple association between the predictor and outcome variables to estimate and test hypotheses about indirect effects (Hayes and Rockwood, 2017). This result fully supported hypothesis 2, that ED would mediate the association between COVID-19 stress and depression. Contrary to hypothesis 3, that PSS would moderate the stress–depression association, PSS did not moderate the relationship between COVID-19 stress and ED. However, PSS significantly moderated the interaction between ED and depressive symptoms ($b = -0.09$, $p < 0.05$), resulting in moderated mediation in an unexpected way. As shown in Figure 2, lower PSS increased the risk of depressive symptoms for those with higher ED, even for those with lower ED, however, lower PSS was associated with higher levels of depressive symptoms.

Discussion

The current study investigated ED and PSS as potential mechanisms in the relationship between COVID-19 stress and depressive symptoms. The present findings highlight the role of ED as a mechanism between COVID-19 stress and depressive symptoms, supported by previous research that describes ED as a transdiagnostic risk factor for adverse psychological outcomes (e.g., Beauchaine and Cicchetti, 2019). In concordance with the stress-buffering hypothesis (Cassel, 1976), in the current study, the effect of ED on depressive symptoms varied as a result of PSS. Specifically, participants with high ED and low PSS were at greater risk of reporting depressive symptoms than those with high PSS.

Although correlational analyses demonstrated that PSS negatively correlated with COVID-19 stress and ED, regression analysis suggested that PSS did not moderate the relation between COVID-19 stress and ED. Thus, the effect of COVID-19 stress on ED did not vary across differing levels of PSS. Stated differently,

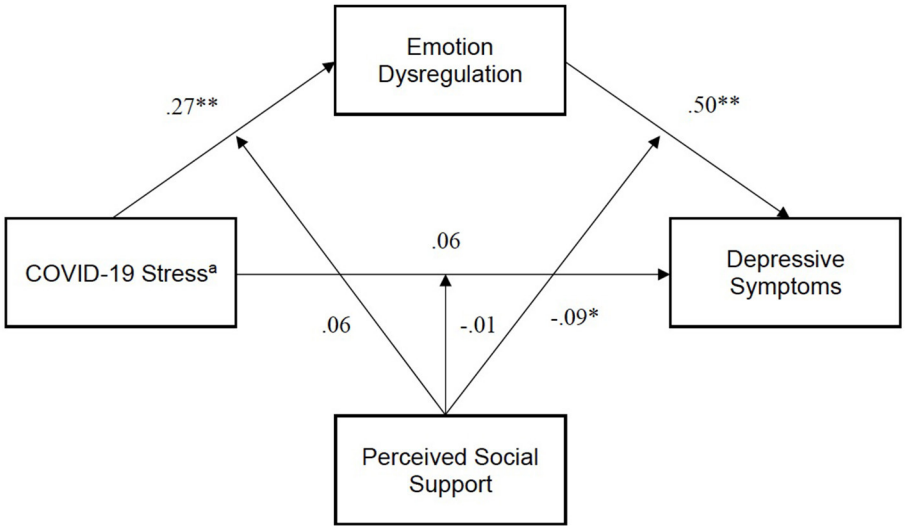

FIGURE 1
Path analysis model. $\chi^2(1) = 3.70$, $p = 0.54$, CFI = 0.99, SRMR= 0.02. Errors omitted for clarity. Exogenous variables freely correlated. aIndirect effect of COVID-19 stress on depressive symptoms = 0.14, 95% CIs (0.09, 0.18). $*p < 0.05$, $**p < 0.01$.

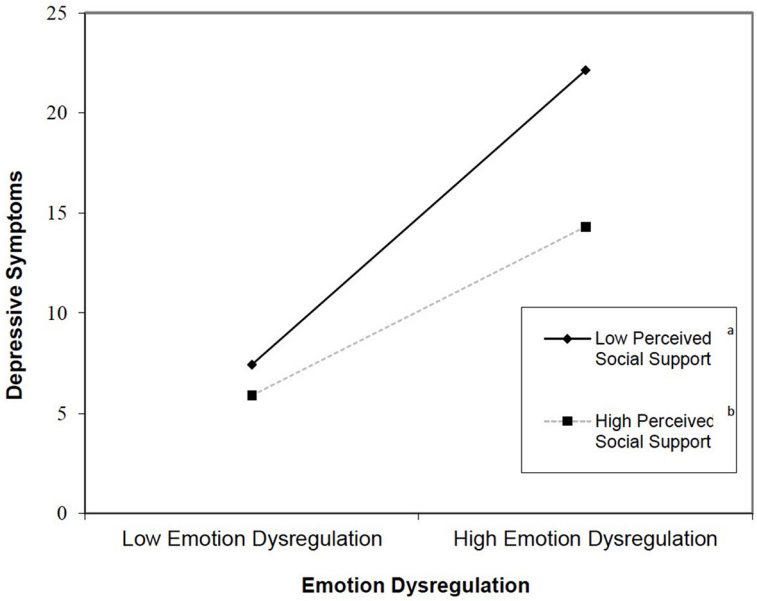

FIGURE 2
Plot of interaction effect of emotion dysregulation and social support on depressive symptoms. $^a m$ =0.29. $^b m$ = 0.17.

PSS did not protect individuals from the dysregulating impact of COVID-19 stress. Since PSS does not significantly alter the relationship between COVID-19 stress and ED, this suggests that other factors, such as coping strategies or personality traits, may be more important in determining how individuals respond to COVID-19 stress and its impact on ED (Al-Omiri et al., 2021; Liu et al., 2021; Chankasingh et al., 2022). In contrast, the risk of depressive symptoms was lower for those with more PSS, even when endorsing higher levels of ED. Individuals with high ED may perceive social support as less supportive, even if they have equal social support as someone with low ED. The stress-mobilizing hypothesis (Barrera, 1986) suggests that stress can encourage individuals to seek support, while the stress-buffering hypothesis (Cassel, 1976) explains that social support can reduce negative outcomes associated with stress. This means that the association between COVID-19 stress and PSS could be positive for some (i.e., more stress leading to more support seeking) and negative for others (i.e., more support seeking to lead to less stress).

Clinical implications

Given the known increase in loneliness among students and young adults during the COVID-19 lockdown and the social distancing required by public health guidelines (Bu et al., 2020), the protective role seen here for PSS, decreasing the risk for depressive symptoms, highlights the importance of increasing perceived social connection during periods of stress. Even when physical health requires social distancing and quarantining, the mental health needs of individuals merit health communication/campaigns that balance physical safety with psychological functioning. The current findings indicate that perceived social connection may be a critical consideration for those endorsing higher ED.

It should be noted that PSS does not significantly lessen the pathway from COVID-19 stress to ED. This suggests an enduring relationship between stress and ED. Given this finding, mental health messaging should also raise awareness of emotion regulation. Whereas most people talk about depression, fewer may know to pay attention to fluctuations in emotion regulation, and the framing of health information is known to impact people's attitudes and behaviors, including public stigma and help-seeking (Devendorf et al., 2020). Increasing awareness about emotion regulation skills and their role in mental health may help mitigate the long-term psychological impact of pandemics on college students.

Incorporating virtual group skills sessions to cultivate emotion regulation skills among college students may benefit universities. Research in the field has established the utility of group therapy in enhancing emotion regulation abilities (Joormann and Stanton, 2016; Wimmer et al., 2019; Carroll et al., 2023). Furthermore, providing virtual group sessions may engender a sense of enhanced PSS that can help offset the deleterious impact of quarantine measures during a pandemic (Marmarosh et al., 2020). Virtual group sessions may also help foster emotion regulation skills and social connection among other populations, including those who have experienced disasters. For example, virtual group sessions may benefit those living in rural areas with limited access to services.

Limitations

These associations should be considered within the context of their limitations. Considering its correlational, cross-sectional design, the current study cannot explain the directionality of the relations between the variables or infer causation. However, it offers insight into the mechanisms underlying pandemic-related stress and depressive symptoms. As the current study utilized a convenience sample, the results may not generalize across all college campuses or adults. Additionally, we cannot conclude that COVID-19 stress caused perceived social isolation nor that it was the sole reason for higher depressive symptoms. However, the interplay of these variables appears to explain a significant amount of variance, which can inform future research and intervention. Additionally, being from a rural region in the United States, the responses from participants in this sample may differ from those from urban areas since rural counties are associated with higher case and mortality rates (Huang et al., 2021).

Future research directions

Future studies should select a sample characterized by diversity in race and ethnicity, geographic regions, socioeconomic status, and educational status to determine if such factors impact the relationship between stress, ED, PSS, and depressive symptoms. The question of whether the combination of contextual and intra-individual factors, e.g., may lead to differing appraisals of social support, or differing forms of emotion regulation, remains unanswered. Furthermore, the role of race and ethnicity may be critical factors to investigate (Dyer, 2020; Lopez et al., 2020) since cultural display rules (Malatesta and Haviland, 1982) may inform emotion regulation processes, and the cultural meaning of social support has been demonstrated to affect one's willingness to rely on social networks during stressful times (Taylor et al., 2004; Bareket-Bojmel et al., 2021). Finally, future studies should consider utilizing longitudinal designs to clarify the directionality of the relations between the variables or to infer causation.

Conclusion

The current study sheds light on the potential mechanisms involved in the relationship between COVID-19 stress and depressive symptoms among college students. The findings suggest that ED plays a significant role in this relationship, and PSS can buffer the effect of ED on depressive symptoms. These results highlight the importance of increasing perceived social connection during periods of stress, as it may decrease the risk of depressive symptoms, especially for those with high ED. The current findings have important implications for mental health interventions during pandemics and periods of stress. Health communication campaigns should balance physical safety with psychological functioning and emphasize the importance of both social connection and emotion regulation skills. By doing so, we may be able to mitigate the long-term psychological impact of pandemics on college students and promote better mental health outcomes.

Data availability statement

The datasets presented in this article are not readily available because the data are available from the authors upon reasonable request. Requests to access the datasets should be directed at: AO, aoliveros@psychology.msstate.edu.

Ethics statement

The studies involving human participants were reviewed and approved by Mississippi State University Institutional Review Board. The patients/participants provided their written informed consent to participate in this study.

Author contributions

DD: conceptualization and methodology. DD, JR, and AO: manuscript drafting, review, and editing. AO and JR: data

analysis. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Well-being and internal resources during the COVID-19 pandemic in relation to meaning in life and existential anxiety

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The COVID-19 pandemic represents an event that placed humanity in a context where confrontation with uncertainty, isolation, life threats, and significant changes in one's life were on a scale that exceeded by far any previous individual or community crises. The interest of the present research was to investigate the relationship between meaning in life (MiL) and existential anxiety (EA) with personal internal resources such as creativity, playfulness, well-being, and personal meaning. A total of 451 participants from 48 countries (mean age 34.93 years, standard deviation 12.62, 31.9% men, 67.4% women) were questioned via online questionnaires between May and June 2020. Cluster analysis was performed on the meaning in life and existential anxiety that generated four categories of persons: Reactive, Superficial, Preoccupied, and Dedicated. Well-being and internal resources were associated mostly with the Dedicated type and less with the Reactive one. Arguments relying on the existential positive psychology suffering model and the hostile world scenario are presented to support the results and plead for interventions that elicit meaning, stimulate creativity, and guide people in finding purpose in order to ultimately promote psychological and mental health.

KEYWORDS

meaning in life, existential anxiety, well-being, creativity, playfulness, COVID-19

1. Introduction

Life was disrupted worldwide in the spring of 2020 when the coronavirus spread far enough to threaten the health and lives of humans across the globe. Lockdown was decided by many governments, and social distancing, wearing masks, and multiple hygienic measures were also strongly imposed. The COVID-19 pandemic was declared, and people were confronted with an unknown situation. The novelty was not accompanied by excitement or joy, quite the opposite, it induced uncertainty, fear, and isolation. Life was changed from 1 day to another; new habits and new routines had to be formed and a chain of effects started to unfold. Consequences intruded every aspect of life: physical, social, professional, and economic (WHO, 2022, Impact-of-COVID-19-on-people; Lekagul et al., 2022), but the effects were at the same time general and country specific. More than 700 million people tested positive and more than 6.5 million people died (as of December 2022 WHO statistics), numbers that support the extension COVID-19 pandemic had global and personal consequences.

On a personal level, the COVID-19 pandemic felt like a veritable existential crisis, implying isolation, lack of freedom, the salience of death and loss, and a gradually diminished sense of comprehension while chaos and uncertain feelings and thoughts developed (Van Tongeren and Showalter Van Tongeren, 2021). It activated existential questions about life and the meaning of life and favored existential anxiety.

The present study focuses on how the two constructs, meaning in life and existential anxiety, coexisted in times of predicament and their associations with inner resources such as psychological well-being (eudaimonic side), creative potential, playfulness, and personal meaning profile. A review of the constructs is presented below.

Meaning in life (MiL) has long been an interesting topic, discussed and explored from more than one angle. The most down-to-earth denotation of meaning is the lexical one—to make sense, identify patterns with some kind of significance, and make connections between events and situations in order to understand them. And with this—the understanding part, the essence of meaning becomes more philosophical, relates to awareness, to our need to see existence as fit and worthwhile. Kierkegaard and Nietzsche, existentialist philosophers, were both concerned with what brings meaning to life—transcendent values or living one's life with authenticity and power to make your own decision. There were even questions about the most suitable phrase: meaning *of* life (like in what is the point of existence) or meaning *in* life (what gives significance and value in someone's life). In psychology, the appeal of the construct is connected with attention given to Frankl's theory of man in search for meaning and grew in several directions: cognitive, motivational, and affective perspectives (Batthyany and Russo-Netzer, 2014; Martela and Steger, 2016). Eagelton (2007) differentiates between the meaning of existence and the meaning of life, with the last construct underlying the self-reflection on the degree of fulfillment in life, closer to the psychological perspective, and the first one closer to the philosophical understanding.

From the cognitive perspective, meaning is seen as a mental representation that everything is coherent and makes sense: the world and life have stability, coherence, and consistency and offer fulfillment (Baumeister, 1991). Another perspective on meaning in life underlies its motivational function. Meaning is seen as establishing purpose, goals that can be reached or at least pursued, in order to flourish and be productive. Meaning in life also includes an affective dimension, which is linked to satisfaction and happiness and contentment with one's life.

A recent framework for meaning in life concentrates on three dimensions of the construct: purpose, coherence, and significance (Martela and Steger, 2016). The purpose was sometimes considered synonymous with meaning in life, involving the setting of long- and short-time goals and taking action in order to accomplish these goals. Coherence implies the belief that life is predictable and makes sense and that it fits into a broader context (interpersonal, societal, historical, or cultural). In other words, this ability to understand the environment and to recognize patterns is a cognitive experience that contributes to the meaning in life (MacKenzie and Baumeister, 2014). It has a descriptive nature and supports the capacity to construct mental models of the world. Significance is associated with a life worth living, that has value. It is also considered an evaluation made by individuals regarding the mattering of their life in the world, not only for their own consideration but as valuable individuals in the eyes of others (George and Park, 2014). Significance and purpose have an evaluative nature and confer positive or negative connotations of events or life, the sense of right or wrong, directing or blocking future actions (Crescioni and Baumeister, 2013). The three dimensions are entangled with coherence being necessary for finding significance, purpose also contributing to significance, and significance employing motivation in life, aka purpose (Martela and Steger, 2016).

Meaning in life is seen also dichotomous—as the presence of meaning or search for meaning (Steger et al., 2011). People with high presence and high search are more satisfied with their life compared with any other category, and those with low presence and low search are the most dissatisfied with their life.

Wong (2010) makes an interesting proposal for bringing together the existential viewpoints of the meaning of life with the positive perspective which was referred to as existential positive psychology. This standpoint combines the focus on human strength with a focus on the finitude of the human condition in the face of death to explore the potential of identity crises or discontent in life for cultivating authenticity and happiness. The quest for purpose generates meaning, and death anxiety allows self-transcendence. Wong proposes the PURE model to understand meaning as four components: Purpose, Understanding the demand of a situation, taking Responsible action, and Evaluating the actions in order to assure authenticity. Exploring more on the existential and positive perspective, Van Tongeren and Showalter Van Tongeren (2021) describe the existential positive psychology suffering model (EPPSM) where suffering, as a life component, disturbs beliefs about the world, and it is chronic and implies profound consequences. When suffering occurs, it also brings existential anxiety that impairs the ability to understand life and give meaning to existence, losing indicators of a positive perspective on life. To overcome suffering, efforts should be made to elicit meaning that will mitigate existential anxiety.

The attention given to meaning in life also has to do with its role in interaction with other factors that explain behavior or emotional outcomes in people. Aversive contexts that life brings are studied in connection with meaning in life seen as a reservoir of strengths, beliefs, values, and goals. The content of the reservoir inclines to change and varies or remains stable and protects a person's well-being (Martela and Steger, 2016; Seidel et al., 2023). Feeling lonely and not able to control and decide for yourself can yield diminished meaning in life (Kim et al., 2014). The social isolation imposed by the COVID-19 pandemic in the early months of 2020 increased loneliness as it interfered with one of the main sources of meaning and well-being, namely with individuals' significant social relationships. On the other hand, life purposes and values may contribute to overcoming difficulties (Wong, 2010; McDonald et al., 2012; Kim et al., 2014). Personal and professional goals, alongside social responsibility, contribute to finding meaning in life (Bhattacharya, 2011).

One interaction particularly studied was the relationship between the meaning in life and well-being, as well as a multidimensional construct that is not reduced to happiness and positive affect. Diener (1984) defines well-being as a subjective

construct that resides within the experience of the individual (p. 543), is a positive integrated judgment of a person's life (p. 544), and is not only the absence of negative affect. This approach is closer to the hedonic view of well-being, which includes also life satisfaction (Diener et al., 1985). Psychological well-being (Ryff and Keyes, 1995; Ryff et al., 2004) is a multifaceted concept, seen as the eudaimonic model of well-being that is not a trait-like dimension, but a dynamic one, depending on life events and transitions.

Smotkin and Shira (2013) propose two models of interaction between meaning in life and subjective well-being: the amplification model, with both variables at high levels, which sustain mobilization of internal resources (SWB and MiL will overlap), and the compensation model (when one variable is low, the other will increase in order to balance the needs of the person). Both variables interact with each other, high meaning in life and subjective well-being favor adaptive behaviors. The same authors introduce the hostile world scenario model (HWS, Shmotkin, 2011; Smotkin and Shira, 2013), which represents a system of appraisal that a person activates to detect potential or real threats to physical or mental integrity. When confronted with danger (COVID-19 pandemic corresponds to HWS event), meaning in life supports construction/reconstruction of life by interpreting/reinterpreting life adversities and has a protective role, while subjective well-being supports positive appraisal of life even in negative conditions, so crises become manageable and anxiety regulated.

Difficult times such as the recent pandemic elicit existential anxiety (Popovic, 2002; Weems et al., 2004) consisting of unresting feelings about the future, the world, and self-existence. It involves fear of death, feelings of emptiness and lack of meaning, guilt, and self-condemnation. Existential anxiety manifests when people become overwhelmed by the awareness that fate is circumstantial and death is unavoidable, when their beliefs are no longer valid or important and rules and principles that governed their actions make no sense anymore and when there is a sense that the life they lived did not meet the expectation of a good life or did not satisfy personal or universal standards. It builds up in times of uncertainty, insecurity, and isolation, "the perfect storm" during the COVID-19 quarantine. A way to face adversity is to focus on meaning in life, at both a micro level (terrestrial meaning) and macro level (cosmic meaning). Meaning in life represents a buffer of existential anxiety, helping people tolerate or cope with the hardship of existence and the awareness of one's mortality (Kesebir and Pyszczynski, 2014). Is the sense of understanding and believing that "life and death exist simultaneously, not consecutively" as Yalom clearly puts it (Yalom, 1980, p. 29).

When confronted with adversity, internal strengths such as creativity or playfulness as resources may contribute to and associate with higher meaning in life and lower pathology. Creativity is defined as underlying at least two simultaneous characteristics: originality and value/usefulness (Lubart and Guignard, 2004; Runco and Jaeger, 2012). It manifests as Big C when the impact of creativity is on a societal level, or as little c—displayed at an individual level translating into the ability to solve everyday challenges in novel ways. Little c manifests spontaneously or after a time of preparation and commitment (Richards, 2007). Furthermore, creativity becomes a resource to find meaning by expressing yourself and gaining some control in the face of existence coercions. Creativity gives an individual freedom and a way to master the situation as Cozzolino and Blackie (2013) included it in the specific—existential system which activates positive features of a person (Cozzolino and Blackie, 2013).

The role creativity plays in confrontation with crises that activate existential anxiety is explained by the terror management theory (TMT, Greenberg et al., 1986). This model implies that being aware of one's own mortality and life's implacable end generates terror (anxiety). In order to manage anxiety and promote survival needs, a person activates beliefs and values that consolidate life meaning and even offer the possibility to transcend death. Combined with internal resources such as creativity, symbolic immortality can be achieved. As such, creative achievement was established as an anxiety-buffering mechanism, in the context of death awareness (Perach and Wisman, 2019). Death awareness is the same cognitive process that elevates existential anxiety.

Finally, another internal resource that helps a person to overcome difficulties in life and that we included in our study is playfulness. It is defined as "the predisposition to frame (or reframe) a situation in such a way as to provide oneself (and possibly others) with amusement, humor, and/or entertainment" (Barnett, 2007 p. 955). Playfulness was conceptualized in several studies as an inner strength, and playful adults are more inclined to follow inner goals instead of external ones and to be intuitive and ingenious (Proyer, 2012). Humphrey and Vari (2021) showed that intrinsic aspiration is a positive predictor of meaning in life, connecting in this way playfulness to meaning.

2. Research questions

The current study focuses on how people addressed the existential concerns activated by the COVID-19 pandemic. We founded our study on the assumption that the pandemic activated existential concerns and questions regarding one's own meaning in life which, in turn, affected general well-being and drove people to activate internal resources that helped them cope with the situation. As shown, several theoretical models and previous studies have tried to explain the relationship between existential anxiety, meaning in life, and different internal resources in confrontation with adverse life events indicating that adversity and threat to one's own life usually activate existential anxiety while meaning in life, well-being, and internal resources may act as buffers. From a positive psychology perspective, in this study, we conceptualized creativity, playfulness, and sources of personal meaning as internal resources. We were mostly interested in identifying the relationships between these variables in the specific context of the pandemic. Therefore, the main research questions of our study were as follows:

- How did existential anxiety concerns and people's meaning in life interact during the peak of COVID-19?
- What role did existential anxiety and meaning in life play in people's well-being?
- What were the significant differences in people's activation of internal resources (namely, creativity, playfulness, and personal meaning profile) in relation to existential anxiety and meaning in life?

TABLE 1 Participant demographics.

	N (%)		%
Region		**Relationship status**	
Europe	345 (76.49%)	Married	37.25%
US and Canada	62 (13.74%)	Single, never married	28.82%
Asia	35 (7.76%)	Single, divorced or widowed	3.55%
South America	6 (1.33%)	In a relationship, not married	27.27%
Africa	2 (.04%)	Prefer not to say	3.10%
Australia	1 (.02%)	**Employment status**	
Residence		Full-time employed	51.00%
In the country of citizenship	334 (74.05%)	Part-time employed	7.76%
Expats	117 (25.94%)	Self-employed	8.65%
Level of education		Not employed	3.77%
Less than high school degree	1.55%	Lost employment since the start of Covid-19 Pandemic	1.77%
High school degree or equivalent	13.97%	Retired	1.55%
Bachelor degree	33.04%	Student	23.50%
Master degree or equivalent	34.15%	Another situation	2.00%
PhD or higher	17.29%	**Infection with SARS-CoV2**	
Religion		Yes, myself	0.90%
Catholic	15.74%	Yes, a member of the family	4.28%
Orthodox	33.70%	Yes, a friend or acquaintance	35.14%
Islam	2.88%	I don't know anyone infected	59.68%
Other	18.40%		
Non-religious/ Atheism	24.39%		
Prefer not to say	4.88%		

- Were there any associations between people's changes in daily activities and consumption habits related to existential anxiety and meaning in life?

3. Methods

3.1. Participants and procedure

For this study, 451 participants filled in an online survey posted on social media or sent via email. The sample is a convenient one consisting of participants from all over the globe. The survey was posted on several social media international groups relating to the COVID-19 pandemic topics between May and June 2020, the peak of the first wave of the pandemic in Europe. Respondents come from 48 countries (mostly Europeans-−76.49%), with a mean age of 34.39 years (SD = 12.62). In total, 67.4% of the participants were women (31.9% were men, whereas 0.7% did not mention their sex). All participants completed the survey in English. We also collected data on several demographic characteristics such as level of education, employment status, relationship status, religion, and diagnosis of SARS-CoV-2 infection within their social network (Table 1).

3.2. Measures

Meaning in life was measured with the *Meaning in life questionnaire* (Steger et al., 2006). The 10-item scale assesses on a 5-point Likert scale the meaning in life as the sense and significance felt regarding one's own life and existence on two dimensions: the presence of meaning (Cronbach's alpha = 0.90) and searching of meaning (Cronbach's alpha = 0.90). The overall Cronbach's alpha coefficient for the scale was 0.78.

For measuring existential anxiety concerns, we used the *Existential anxiety questionnaire* (Weems et al., 2004), a 13-item measure on a 5-point Likert scale. The EAQ assesses anxiety concerns about fate and death (Cronbach's alpha = 0.68), anxiety about emptiness and meaningless (Cronbach's alpha = 0.68), and anxiety related to guilt and condemnation (Cronbach's alpha = 0.68). The overall Cronbach's alpha coefficient for the entire scale was 0.84 showing good internal consistency.

TABLE 2 Correlation matrix between the investigated variables.

	M	SD	1	2	3	4	5	6
1. Existential anxiety	2.43	0.75	1					
2. Meaning in life	4.83	1.01	−0.16**	1				
3. Well-being	5.24	0.75	−0.53**	0.32**	1			
4. Creativity	3.55	0.68	−0.07	0.27**	0.36**	1		
5. Playfulness	3.53	0.92	−0.08	0.18**	0.28**	0.42**	1	
6. Personal meaning	5.06	0.81	−0.32**	0.55**	0.58**	0.27**	0.26**	1

**Correlations are significant at $p \leq 0.001$.

Psychological Well-being was measured using Ryff's scales (Ryff, 1995) comprising 18 items on a 7-point Likert scale grouped in five subscales: autonomy, environmental mastery, personal growth, positive relations with others, and purpose in life with Cronbach's alpha coefficients varying from 0.68 to 0.71. Cronbach's alpha coefficient for the overall scale was 0.81.

We conceptualized three internal resources in this study, creativity, playfulness, and personal meaning. *Creativity* as internal potential was measured with a 12-item questionnaire developed by Fürst and Grin (2018). It assesses the generation and selection of creative ideas in everyday work or leisure activities, on a 5-point Likert scale. The Cronbach's alpha coefficient for the scale was 0.89. Playfulness as an internal resource was measured with the *Short measure for adult playfulness* (Proyer, 2012). It comprises five items on a 5-point Likert scale assessing internal disposition to engage in playful activities and interactions, as a unidimensional measure. The Cronbach's alpha coefficient for the scale was 0.89. Finally, *Personal meaning profile* (McDonald et al., 2012) was used to assess the participants' perceptions of their own sources of a meaningful life. It comprises 21 items on a 7-point Likert scale measuring achievement, relationship, religion, self-transcendence, self-acceptance, intimacy, and fair treatment (with Cronbach's alpha coefficients between 0.63 and 0.88). The Cronbach's alpha coefficient for the overall scale was 0.85.

Additionally, the survey included several items designed to measure potential changes in everyday activities and consumption habits as a result of the COVID-19 pandemic. Participants were asked about: changes in the time allocated to work/academic tasks, cooking and cleaning, online and in-store shopping, volunteering, hobbies, family, watching TV/movies/streaming services, social media, online gaming, and time spent alone; and changes in their consumption of alcohol, non-alcoholic substances (such as nicotine or caffeine), psycho-active drugs, and psycho-active substances. For all these items, we used a nominal scale with the following response options: time/consumption decreased, time/consumption stayed the same, time/consumption increased, prefer not to say, and non-user.

4. Findings

The first step of data analysis revealed significant correlations between existential anxiety, meaning in life, and well-being. Creativity, playfulness, and personal meaning significantly correlate with meaning in life and well-being, while only personal meaning profile is associated with existential anxiety (Table 2). As expected, existential anxiety negatively correlates with meaning in life and well-being showing that individuals expressing more existential concerns tend to have lower levels of well-being and a decreased sense of meaning in their lives. Meaning in life positively and moderately correlates with well-being. Correlations also show that people with high levels of internal resources tend to report a greater presence of meaning and greater well-being.

4.1. Existential anxiety and meaning in life

The main objective of the article was to study the interaction between existential anxiety and meaning in life, on one side, and internal resources, on the other side during the COVID-19 outbreak. Given the heterogeneity of the sample, we performed a cluster analysis to identify homogenous groups within the sample based on the overall scores on existential anxiety (EAQ) and meaning in life (MLQ). Cluster analysis was performed using SPSS version 24. Following Milligan's (1980) recommended technique, we first used a hierarchical clustering method that allowed us to visualize how the data may be clustered together. Squared Euclidean distances were used to measure similarity. From this analysis, by examining the dendrogram, we generated a solution with four clusters and conducted k-means clustering with average linkage between groups. Table 3 highlights the characteristics of each cluster—the number of allocated cases, and mean values for the two variables included in the analysis.

The first cluster has the highest number of participants (149, 33% of all participants in the study). This cluster includes participants that have above-mean scores for existential anxiety and below-mean scores for meaning in life. We labeled this cluster as *Reactive*. The respondents in this group tend to manifest reactivity in relation to COVID-19 as their existential anxiety is rather high but they do lack a strong presence of meaning in life that could buffer their emotional reaction. The second cluster, labeled as *Superficial*, includes 115 participants (25.5.%) with very low scores on EAQ and below-mean scores on MLQ. This group of participants is characterized by a low activation of existential anxiety and a weak meaning in life, which suggest that these participants tend to rarely concern about death, life, and its purpose. The third cluster includes 58 participants (12.9%) with above-mean scores for both EAQ and MLQ. We labeled this group

TABLE 3 Characteristics of the four-cluster solution.

Cluster	Number of cases included	% of cases included	EAQ mean value	MLQ mean value	Name of the cluster
1	149	33%	3.04 (↑)	4.43 (↓)	Reactive
2	115	25.5%	1.96 (↓)	3.81 (↓)	Superficial
3	58	12.9%	3.03 (↑)	5.85 (↑)	Preoccupied
4	127	28.2%	1.85 (↓)	5.74 (↑)	Dedicated

(↑) = high levels, (↓) = low levels, EAQ, Existential Anxiety; MLQ, Meaning in life.

TABLE 4 Differences in well-being, creativity, playfulness and personal meaning between clusters.

Variables	C1—Reactive		C2—Superficial		C3—Preoccupied		C4—Dedicated		F	η^2
	M	SD	M	SD	M	SD	M	SD		
Well-being	4.85	0.70	5.38	0.80	5.11	0.64	5.63	0.56	31.28**	0.17
Creativity	3.42	0.72	3.46	0.69	3.73	0.58	3.69	0.63	5.40**	0.03
Playfulness	3.39	0.92	3.47	0.94	3.53	0.83	3.76	0.91	4.00*	0.02
PMP	4.72	0.65	4.84	0.87	5.33	0.75	5.52	0.65	32.97**	0.18

**Correlations are significant at $p \leq 0.001$, *Correlations are significant at $p \leq 0.05$; PMP, Personal meaning.

of respondents as *Preoccupied*. These participants seem to have a strong sense of meaning in life but, at the same time, they are deeply preoccupied with death, fate, meaningless, or condemnation. The fourth cluster includes 127 participants (28.2%) with low existential anxiety and a strong meaning in life. These participants seem to be the *Dedicated* ones who are searching for or have found a strong purpose in their life during the COVID-19 pandemic but are not emotionally overwhelmed by anxious concerns. When testing the intercorrelation between each cluster and exposure to SARS-CoV-2 infection within the social network, no significant association was found (Pearson's chi-square = 8.86, $p = 0.45$).

4.2. Well-being and internal resources within each cluster

The second and third research questions of our study referred to identifying significant differences in people's activation of internal resources in relation to existential anxiety and meaning in life. To test this, we performed an analysis of variance between the four clusters for well-being, creativity, playfulness, and personal meaning, followed by *post-hoc* comparisons to show the significant differences. The four groups of respondents—the Reactive, Superficial, Preoccupied, and Dedicated—significantly differ on each tested internal resource (Table 4).

Regarding well-being, we identified a significant difference between the groups [$F_{(3,445)} = 31.28$, $p \leq 0.001$]. The Games–Howell test for multiple comparisons showed that the mean value of well-being was significantly higher for C4—Dedicated than for C1—Reactive [$p \leq 0.001$, 95% C.I. = (0.57, 0.97)], for C2—Superficial [$p = 0.036$, 95% C.I. = (0.01, 0.47)], and for C3—Preoccupied [$p \leq 0.001$, 95% C.I. = (0.25, 0.76)] (Figure 1). C2—Superficial have higher level of well-being than C1—Reactive [$p \leq 0.001$, 95% C.I. = (0.28, 0.77)]. As the results show, participants high in existential anxiety and with a medium or low sense of meaning seem to be most affected in their well-being during adverse situations such as the pandemic.

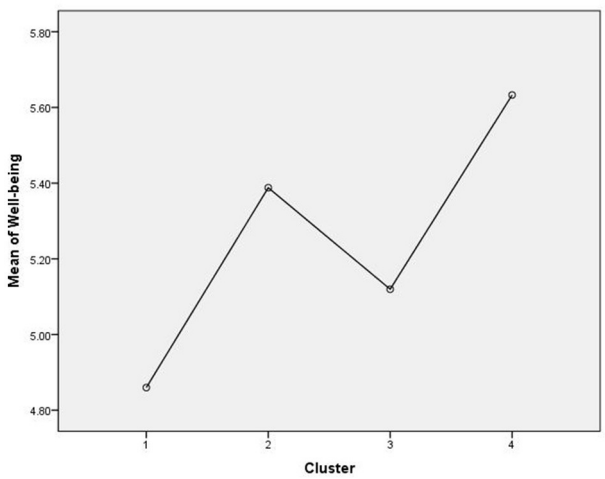

FIGURE 1
Differences in well-being between the four clusters.

Furthermore, the relationship between the identified clusters and the internal resources showed that people with high existential anxiety and low meaning in life lack creativity and playfulness as assets to cope better in times of disruption, while those with low existential anxiety and high meaning in life have higher levels of creativity and playfulness [for creativity $F_{(3,445)} = 5.40$, $p = 0.001$; for playfulness $F_{(3,445)} = 4.02$, $p = 0.008$] (Figure 2). The Games–Howell test for multiple comparisons found that the mean value of creativity was significantly different between C3 and C1 [$p = 0.012$, 95% C.I. = (0.05, 0.55)], C3 and C2 [$p = 0.41$, 95% C.I. = (0.01, 0.53)], respectively, C4 and C1 [$p = 0.009$, 95% C.I. = (0.04, 0.47)], C4 and C2 [$p = 0.46$, 95% C.I. = (0.01, 0.44)]. The Preoccupied

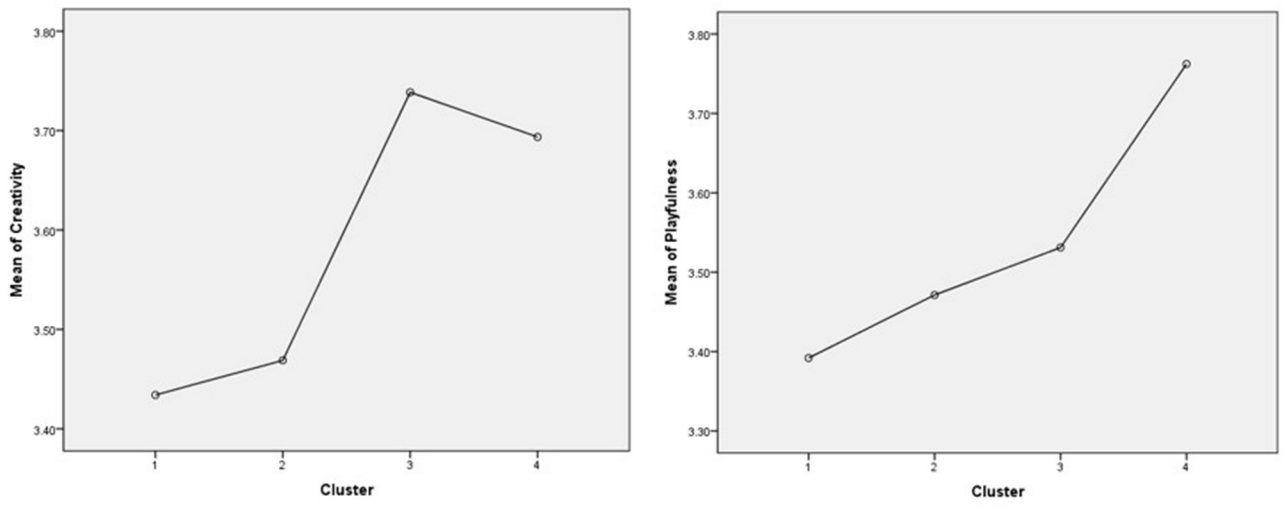

FIGURE 2
Differences in creativity **(left)** and playfulness **(right)** levels between clusters.

cluster and the Dedicated one had the highest levels of creativity, which confirm that people better cope with adversity when they can find meaning in those times and have internal resources which facilitate functional coping. Playfulness showed a significant difference only between Reactive and Dedicated participants [$p = 0.005$, 95% C.I. $= (-0.65, -0.08)$], but the pattern seems consistent with the idea that less existential anxiety and higher meaning in life is associated with playfulness as a habitual behavior pattern and attitude (Figure 2).

Finally, we tested the differences for personal meaning profile which is a comprehensive measure of the meaning in life, implying seven sources of meaning: Achievement, Relationship, Religion, Self-transcendence, Self-acceptance, Intimacy, and Fair treatment. When analyzed, we identified a similar pattern as for the other individual resources. There were significant differences between the groups [$F_{(3,445)} = 32.97$, $p \leq 0.001$]. The Games–Howell test for multiple comparisons showed that higher scores were reported in the Dedicated and Preoccupied groups and lower in the Superficial and Preoccupied groups. There were no significant differences between C4 and C3 ($p = 0.34$), and between C1 and C2 ($p = 0.63$) (Figure 3). These results show that finding meaning in different areas of life or from different sources is associated with existential concerns about life and its meaning and it may be a strong resource in coping with traumatic events.

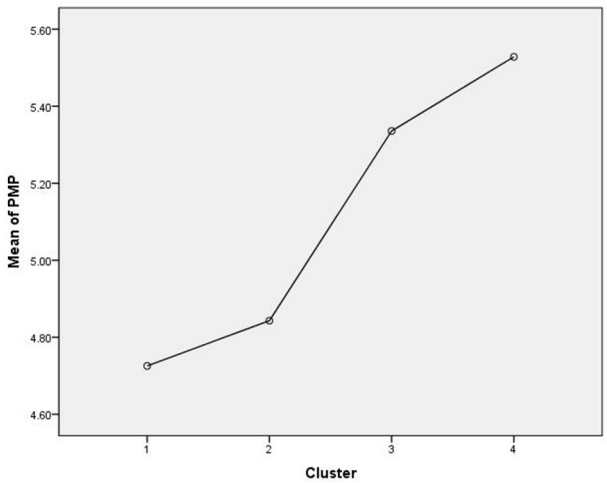

FIGURE 3
Differences in personal meaning profile between clusters.

4.3. Changes in social media and substances consumption

A final set of analyses was performed to test the association between the four clusters and the consumption of social media, online gaming, and substances during the pandemic. As previously mentioned, these variables were measured on nominal scales, with participants reporting increases or decreases in their habitual use of social media or substances since the beginning of the pandemic. We used Pearson's chi-squared to test the relationships.

The results showed a significant relationship between clusters and social media consumption [$\chi^2_{(6,N=149)} = 17.43$, $p = 0.008$]. C1 cluster—Reactive included the most participants who reported an increase in their consumption of social media (Figure 4). Online and video gaming also showed significant differences in occurrence among the four groups [$\chi^2_{(6,N=149)} = 13.69$, $p = 0.03$]. Cluster 4—Dedicated included the larger number of participants who decreased their gaming activity during the pandemic, while most participants in the other groups declared that time allocated to gaming stayed the same (Figure 4).

No significant differences were found between the groups in terms of alcohol consumption or caffeine consumption [χ^2

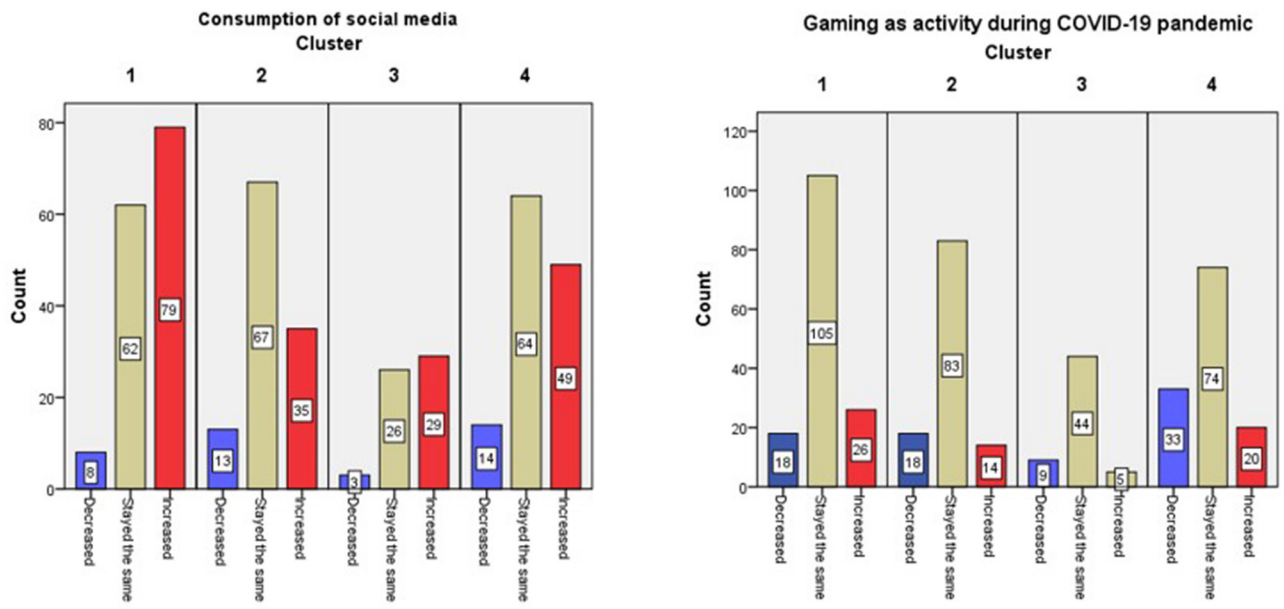

FIGURE 4
Changes in social media use **(left)** and gaming **(right)** among four clusters.

$_{(6,N=149)} = 17.20$, $p > 0.05$ for alcohol and $\chi^2_{(6,N=149)} = 16.64$, $p > 0.05$ for caffeine].

5. Discussion

Our study investigated the association between meaning in life as a resource in the face of the aversive context imposed by the COVID-19 pandemic and existential anxiety sprouted by the same global event. Four clusters resulted from the combination of the two dimensions: Reactive (low MLQ and high EAQ), Superficial (low MLQ and low EAQ), Preoccupied (high MLQ and high EAQ), and Dedicated (high MLQ and low EAQ). As Schnell and Becker (2006) suggest, meaning and meaningless crises are not a continuum, but rather two independent dimensions, that were also separated in types by Damásio and Koller (2015). Our study is in line with their finding: The Reactive cluster is similar to the so-called crises category, the Superficial cluster is a mirror of the indifference category, the Preoccupied cluster is similar to existential conflict, and the Dedicated clusters are those with meaningful lives. As will be discussed later, intervention can be built to improve meaning and consecutively well-being.

When tested, data about the number of infections per country or proximity with (in terms of knowing about) people who tested positive or died of COVID-19 did not generate any significant differences among clusters. One explanation might be that data was collected in May—June 2020 and not many casualties appeared by then, many respondents had at that time few situations of knowing people getting infected or dying. Adapting to a crisis is a gradual process and is difficult to obtain relevant information through cross-sectional data collection. A similar result was mentioned by Karataş et al. (2021), in the Turkish population: The presence of the coronavirus infection did not predict life satisfaction.

Identifying types of people depending on their level of existential anxiety and meaning in life was not the only goal. An attempt to identify behavior changes since the lockdown revealed that social media consumption increased in the Reactive cluster, while video gaming decreased significantly in the Dedicated cluster. Alcohol and caffeine intake did not significantly differ across the types. Coping styles during the COVID-19 pandemic were investigated by others and passive or avoidant coping styles were recognized in approximately one-third of the respondents (Fu et al., 2020), or more (Ames-Guerrero et al., 2021), both coping styles being associated with lower levels of psychological well-being (Tuason et al., 2021; Kavčič et al., 2022).

The results on well-being are in line with the body of literature which links meaning in life with well-being but also brings some new insights. Lower levels of well-being were found in the Reactive and Preoccupied clusters, the first being described by low levels of meaning in life, while the second one has both elevated meaning and elevated anxiety. The higher levels of well-being were associated with the Dedicated cluster (also high the in meaning in life), but also elevated well-being was found in the Superficial cluster described by low meaning and low anxiety. Similar results, with positive associations between well-being and meaning in life, were confirmed repeatedly in the literature (Dezutter et al., 2014; García-Alandete, 2015). The authors also mentioned better adjustment and lesser maladaptive profile in people with higher meaning in life, analogous with better inner resources such as creativity and playfulness in our study. Meaning in life was a positive predictor for life satisfaction during the COVID-19 pandemic (Karataş et al., 2021) and also a safeguard for distress inflicted by the coronavirus spread in Australian respondents (Humphrey and Vari, 2021). Pre-pandemic meaning in life had a protective role for depression and anxiety measured peri-pandemic but was found to decrease during the difficult 2020 spring and summer months (Seidel et al., 2023). A

direct negative relation was also found between both meaning in life and life satisfaction and fear of COVID-19, MiL mediating the relationship between basic hope and anxiety generated by fear of infection (Trzebiński et al., 2020). Existential anxiety, in light of the EPP model of suffering (Van Tongeren and Showalter Van Tongeren, 2021) activates internal resources in order to overcome distress and negative psychological effects, which translates into higher meaning and higher well-being by the end of the process.

The presence of high levels of well-being in the Superficial type might be explained by a tendency to ignore or neglect reality and to act more for the personal and immediate benefit, which, in the long run, decreases meaning in life but serves to satisfy hedonic tendencies. This finding is in line with Popovic's (2002) view of meaning as having width, depth, length, and temporal dimensions. On the other hand, Bøe et al. (2019) plead for turning attention to "nothings" that matter. They explain the value of superficial, non-sensical, and unidentifiable happenings in our lives, which might lack meaning, but nevertheless are important for the everyday living of normal people.

The relationship between the categories identified and the internal resources showed that people with high existential anxiety and low meaning in life lack creativity and playfulness as assets to cope better in times of disruption. On the other hand, those with low existential anxiety and high meaning in life have higher levels of creativity and playfulness. Positive engagement in the hostile world scenario (as the pandemic might be perceived) is associated with higher well-being and higher meaning in life, while negative engagement exacerbates worries and loneliness (Bergman et al., 2021).

6. Conclusion

Some practical implications could be derived from the results. The clear associations between internal resources and meaning in life, although not clarified in terms of causality, highlight the importance of using strength-based intervention as contributors to well-being, more specifically creativity (considered here as general human potential) and humor (as part of playful personality) (Proyer et al., 2013). To elicit meaning, stimulate creativity, or guide people in finding purpose are all instruments to promote psychological and mental health (Steger and Park, 2012). Wong and Bowers (2018) see meaning as having a pivotal role in cultivating psychological well-being, but only with the provision of embracing the dark part of the human condition on earth.

There are some limitations of the present study. First, no analysis included demographic data such as sex, age, education, and marital status. These variables are important factors that can moderate the results given the fact that well-being, for example, is a dynamic construct that varies with age (Ryff and Keyes, 1995; Damásio and Koller, 2015). Older respondents, married people, and women tend to have higher scores in meaning, while younger people have higher scores in well-being. Participants in this study were a heterogeneous group, both geographic and cultural, and in terms of the impact of COVID-19 infection in the early months of spreading.

Several constructs are multifaceted, and no differences were investigated among them: Eudaimonic well-being has six dimensions; meaning in life has two components: the presence of meaning and searching for meaning (Steger et al., 2011). Our main interest was to identify patterns in order to better understand associations among types, and with respect to the view upon meaning in life as a schema-like mechanism, we translate the findings as proof that those higher in meaning are prone to select positive information from life experiences and use them to increase well-being.

Another limitation was that data were collected one-time only, at the beginning of the pandemic, when lockdown was in place and little knowledge about what would be to come could be foreseen. A one-time measure of variables might also be a weakness because the meaning in life and well-being are known to fluctuate and are flexible constructs (Steger and Kashdan, 2013).

Apart from creativity and playfulness, no other personality traits were measured, and there is evidence that personality is important (Schnell and Becker, 2006; Lavigne et al., 2013). Moreover, negative psychological impacts (such as depression, stress, and negative emotions) other than existential anxiety did not enter our analysis. Future investigation might consider the Big Five model or even self-esteem and self-efficacy.

Another comment worth mentioning is that people tend to report above-average levels in both meaning in life and well-being, and it is rare in normal populations to identify truly low scores for these variables (Damásio and Koller, 2015). It is not possible to estimate the levels of the variables measured in our respondents before the pandemic, and a repeated-measured design might be of interest in the future when investigating people's reactions to an existential crisis.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Faculty of Psychology and Education Sciences, Transilvania University of Brașov. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

LTD and CT equally contributed to the conceptualization and design of the study. LTD organized the database, performed the statistical analysis, and wrote the first draft of the Introduction section. CT wrote the first draft of the Methods section and the Result section. All authors contributed to the manuscript revision, read, and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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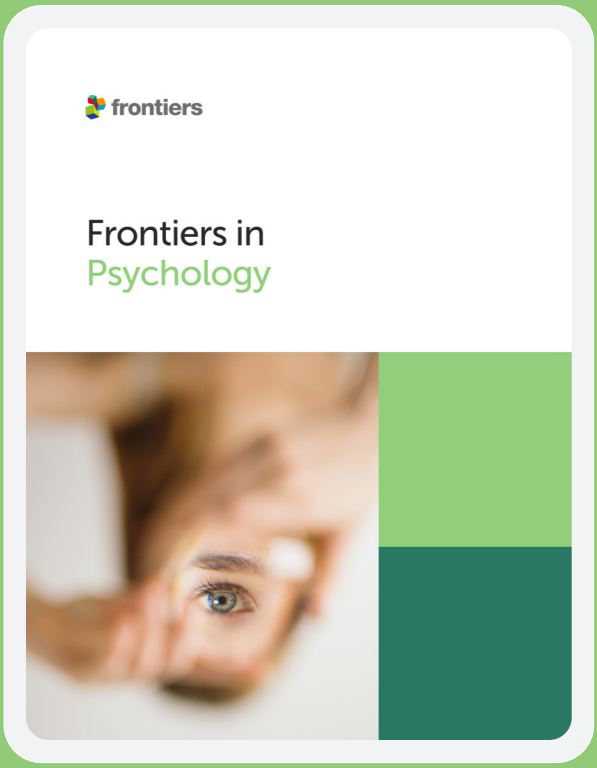

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