

# Dietary supplement usage during pregnancy and lactation: role of online social capital and health information-seeking behaviour

Dietary  
supplement  
usage during  
pregnancy

Yam B. Limbu

*Department of Marketing, Montclair State University,  
Montclair, New Jersey, USA, and*

Marta Giovannetti and Silvio Cardinali

*DIMA – Department of Management, Politecnica delle Marche University,  
UNIVPM, Ancona, Italy*

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## Abstract

**Purpose** – The main objective of this study is to assess the applicability and robustness of the information motivation behavioural skills (IMB) model in determining dietary supplement usage of pregnant and breastfeeding women. More specifically, we examine the indirect effects of online social capital and internet use for health information on dietary supplement usage through self-efficacy and the moderating role of educational attainment.

**Design/methodology/approach** – Data was collected from 415 pregnant and breastfeeding Italian women using a self-administered questionnaire. Hypotheses were tested using Hayes's (2013) PROCESS macro for SPSS.

**Findings** – Internet use for health information is directly associated with dietary supplement usage. Online social capital and internet use for health information positively influence dietary supplement usage through self-efficacy. However, the results from moderated mediation analyses show that the mediation effects are moderated by educational attainment so that indirect relationships were stronger among women with a lower level of education than among those with a higher level of education.

**Practical implications** – Dietary supplement marketers and public health agencies can develop and implement dietary supplement promotional materials and interventions by disseminating information through the internet and social media and by strengthening social ties on online networking sites.

**Originality/value** – The originality of this study lies in the use of the IMB model as a theoretical framework to examine the mediating role of self-efficacy and the moderating role of education in explaining the mechanism of how online social capital and internet use for health information influence dietary supplement usage.

**Keywords** Online social capital, Internet use for health information, Self-efficacy, Dietary supplement usage, Pregnancy

**Paper type** Research paper

## 1. Introduction

Pregnancy and breastfeeding represent peculiar phases in the life of women and for this reason, they usually lead to great evolution and change from the biological, physiological, social, emotional and cognitive points of view (Bianchi *et al.*, 2016). One of the most relevant aspects of pregnancy and lactation is nutrition, due to the fact that these conditions require women to take some precautions and make lifestyle changes, particularly regarding dietary restrictions, as well as nutritional requirements and supplementation. There are specific health recommendations and guidelines to follow regarding nutrition and use of food

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supplements during pregnancy and lactation (De Santis *et al.*, 2013; Haider *et al.*, 2013; Mello *et al.*, 2019); these concerns, in particular, the use of supplements like folic acid, calcium and iron (e.g. Ladipo, 2000; Prentice, 2000; Oliveri *et al.*, 2004) as these contribute to protecting maternal health and preventing issues related to foetal development.

Moreover, pregnant and lactating women tend to be aware of the importance of nutrition and supplementation; consequently, their health awareness and behaviours get enhanced, as these are perceived as areas in which women manage to act and have a measure of control over their own and their children's health (Aaronson *et al.*, 1988). However, the use of diet supplements among pregnant and lactating women has been found to be inconsistent, ascribable to a number of factors including educational attainment and social status (Picciano and McGuire, 2008; Bailey *et al.*, 2010; Branum *et al.*, 2013; Popa *et al.*, 2013; Liu *et al.*, 2019).

In some cases, in fact, general food supplement usage has been attributed more to personal preference than to the recommendation of a healthcare provider (Bailey *et al.*, 2010; Giammarioli *et al.*, 2013; Marra and Bailey, 2018; Clark *et al.*, 2019). Hence, it raises questions in the domain of information access and choice process (Frey and Files, 2006), especially since the spread of the internet has caused an evident shift in women's sources of information on nutrition during pregnancy and lactation (De Jong-Van Den Berg *et al.*, 2005; Lagan *et al.*, 2010; Gao *et al.*, 2013) and has created a social interaction environment, as well. Nevertheless, little is known about how and when women's use of the internet to obtain health information influences their use of dietary supplements during pregnancy and lactation.

Online social capital, which refers to the accessibility to ties on an online network that promotes trust and group norms, is a relatively new concept and only a handful of studies have examined online social capital (Grottke *et al.*, 2018). Apparently, the role of online social capital on dietary supplement use has not yet been explored.

Furthermore, prior research predominantly focused on demographic, sociological and economic determinants of dietary supplement usage. Little is known about why women use or do not use dietary supplements during pregnancy and lactation. Thus, Jasti *et al.* (2003) recommend future research in the area of health beliefs, attitudes and sociodemographic determinants of supplement usage by culture and or ethnicity, particularly among underprivileged groups. More research is warranted to determine the intrinsic motivations for using supplements during pregnancy (Branum *et al.*, 2013).

The health information domain has evidently changed, largely due to the internet which provides rich and varied information and points of view on health and nutrition. Because the World Wide Web has fundamentally reshaped information-seeking and social interaction domains, it is important to examine whether such practices play a role in defining the decision-making processes and dietary practices of pregnant and lactating women. Thus, this work aims to contribute to the food and nutrition literature as well as provide insights and a theoretical framework for social marketers, government agencies and parties engaged in food and nutrition education campaigns to develop and implement effective dietary supplement intervention programs.

The present study endeavours to describe the process related to the use of nutritional supplements by pregnant and lactating women, using the information motivation behavioural skills (IMB) model (Fisher and Fisher, 1992). This model was conceived for describing risk prevention and health promotion behaviours and has been applied to various fields (Anderson *et al.*, 2006; Limbu *et al.*, 2019), but it has not yet been applied to the area of dietary supplement usage. Therefore, the present study assesses the applicability and robustness of the IMB model, by predicting and explaining dietary supplement usage by pregnant and breastfeeding women. More specifically, the study examines the mediating effects of self-efficacy, an individual's ability to change her/his behaviour and the moderating role of educational attainment in explaining the mechanism of how online social capital and internet use for health information influence dietary supplement usage.

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## 2. Literature review

### 2.1 *Pregnancy and health information-seeking*

Scholars have long studied pregnant women's main topics of information sought (e.g. birth, breastfeeding, sport and nutrition during pregnancy). Concerning nutrition, pregnancy represents an important occasion in a woman's life in which to become more aware and knowledgeable about nutrition in general and supplement usage, in particular. In fact, it has been found that women willing to have children seek little nutrition information before pregnancy, while already pregnant women and new mothers look for nutrition information from different sources, depending on how early (e.g. internet, books, midwives and other experts) or late (midwives and own common sense) they realize that they are to become mothers. Previous studies that have explored preferences for sources of health information show that the majority of middle class, Caucasian and highly educated women prefer to receive information mainly from their primary physician or obstetrician/gynaecologist, and only marginally from other sources (Frey and Files, 2006). Moreover, women at their second or third pregnancy mainly rely on their experience, a midwife and books for specific questions (Szwajcer *et al.*, 2005).

Previous studies have also reported that healthcare providers are the main source of nutrition information for pregnant women. However, the quality of the information depends on the professional's experience and the amount of time (Lucas *et al.*, 2014) he/she is willing to dedicate to imparting it. This is why women often look for, and find, information on their own, particularly by going online. Moreover, the widespread use of the internet by pregnant women has caused an evident shift in information sources; they have gone from consulting healthcare providers, books, other media and important people in their lives (Aaronson *et al.*, 1988; Lewallen, 1989) to mainly perusing online sources (Lagan *et al.*, 2010; Gao *et al.*, 2013).

In fact, with the development of new technology and Web 2.0 and 3.0 the field of eHealth, in which health services and information are delivered or enhanced through the internet and related technologies, has emerged as a new opportunity for individuals and pregnant women (Marra and Bailey, 2018; Papa *et al.*, 2018; Gootjes *et al.*, 2019) to access and exchange health information, manage their health through electronic platforms and participate in "peer-to-peer health care" (Fox and Duggan, 2013; Wallwiener *et al.*, 2016). These online opportunities have been identified as a means to better enable patient empowerment and self-management of care (Kontos *et al.*, 2014), particularly because the internet, YouTube and social media are technology-based information sources (Marlina *et al.*, 2019).

Prior studies indicate that pregnant and lactating women use the internet for many reasons, seeking information on a wide range of pregnancy-related topics including nutrition, complications, prescriptions and breastfeeding (Lagan *et al.*, 2010; Gao *et al.*, 2013). For example, a study by Lagan *et al.* (2010) found that all respondents to their survey used the internet at least once to search for general pregnancy-related information and nearly all (97%) reported going online at least once to search for information on pregnancy products, to seek a second opinion (67.4%) and some to bring information to a health professional (36.8%).

In general, eHealth (Kontos *et al.*, 2014; Paolino *et al.*, 2015; Narasimhulu *et al.*, 2016; Funnell *et al.*, 2018) has become established and widely accepted as a source of information and means of interaction with healthcare providers and other health-related people: pregnancy and lactation are no exception (Bert *et al.*, 2013; Sayakhot and Carolan-Olah, 2016; Funnell *et al.*, 2018). On the other hand, although research has shown that pregnant and lactating women seek nutrition information and show increased nutrition awareness, relatively little research has been carried out about nutrition-related information-seeking behaviours before and during pregnancy (Picciano, 2003; Picciano and McGuire, 2008).

### 2.2 *Determinants of dietary supplement usage during pregnancy*

Pregnant and lactating women perceive specific nutrition information as important because taking care of themselves in this way is one of the things they can actively do to improve their

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health and protect their foetus (Szwajcer *et al.*, 2005); therefore, women generally pay particular attention to their nutrition and dietary supplementation during and after pregnancy (Konuk, 2018). It is also worth mentioning that the dietary behaviours of pregnant women are largely influenced by interpersonal, institutional and community factors (Arrish *et al.*, 2017).

Prior studies report that, in general, pregnant women make use of dietary supplements during pregnancy. However, supplement usage appears to vary among ethnic and socioeconomic groups, which indicates that disparities might exist among subgroups. Therefore, although dietary supplementation is recommended during pregnancy and lactation, and the majority of women do take some form of supplement, the resulting usage depends on a set of social, ethnic and other demographic variables (De Jong-Van Den Berg *et al.*, 2005; Picciano and McGuire, 2008; Branum *et al.*, 2013), including social status and education level.

Moreover, it is important to consider sociocultural factors, especially where women do not make decisions about their own healthcare, as these can limit women's access to healthcare services (World Health Organization, 2004) and restrict their access to nutrition and health education. Clearly, pregnant women need to be provided with information that will enhance their nutrition knowledge, assess the quality of their diet and underscore the need for supplements (Ladipo, 2000; Funnell *et al.*, 2018).

Previous studies have shown that nutrition knowledge is positively associated with maternal dietary behaviour (Williams *et al.*, 2012; Bookari *et al.*, 2017) and use of supplements (Popa *et al.*, 2013). Although pregnant women seem aware and appear motivated to pursue a healthy diet and nutrition, this does not necessarily imply that they will follow dietary guidelines. This may be due to misconceptions or knowledge gaps in a wide range of areas, including standard serving sizes, nutrients and the importance of compliance with supplement recommendations in pregnancy (Lucas *et al.*, 2014; Bookari *et al.*, 2016).

In summary, although previous studies have established various determinants of dietary supplement usage among pregnant and lactating women and focused on demographic, sociological and economic determinants, the roles of online health information-seeking behaviour and online social capital play in determining dietary supplement usage have received little scholarly attention. The current study endeavours to bridge this gap.

### 3. Theoretical background and hypotheses

Previous works have examined the health behaviours of pregnant and lactating women, using various theoretical frameworks that include Ajzen's (1991) Theory of Planned Behaviour (TPB) (Parkinson *et al.*, 2018) and the Model of Goal-directed Behaviour (MGB) (Perugini and Bagozzi, 2001), which have contributed to the literature by describing the process of behavioural outcome and antecedents, not only regarding the rational aspects but also the added emotional perspective and the measurement aspect. However, these approaches have demonstrated conflicting evidence of the relationship between attitudes, intentions and behaviour. Another model adopted to explain factors that contribute to nutrition behaviours of pregnant and lactating women is the Health Belief Model (HBM) (Athearn *et al.*, 2004; Kloeblen and Batish, 1999). It defines the behaviour based on the assumption that individuals will take action to protect their health if they (1) regard themselves as susceptible to a health condition with serious consequences (threat); (2) believe that action would reduce their susceptibility and/or severity of the health condition and that the benefits or motivators of action are greater than the barriers (outcome expectations); and (3) are confident in their ability to carry out the action (efficacy expectations) (Rosenstock *et al.*, 1986).

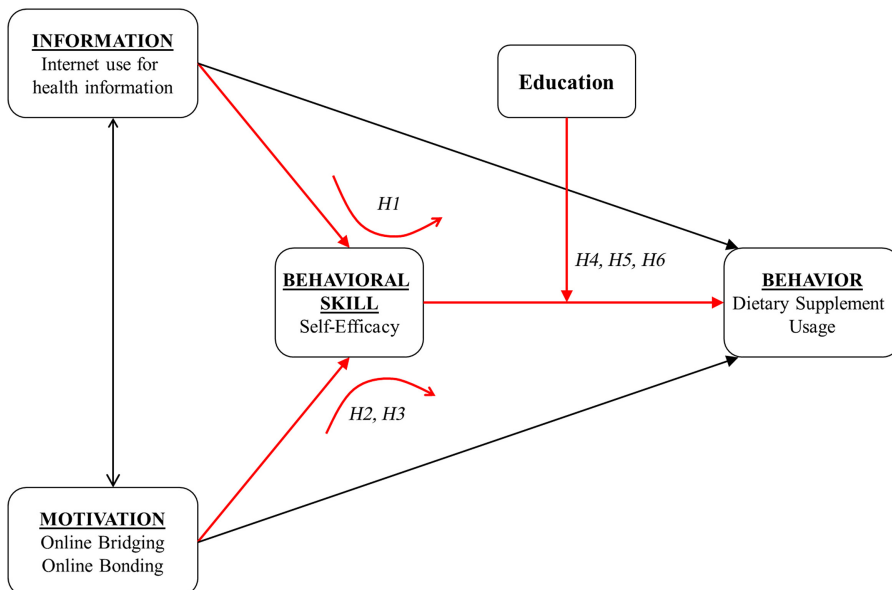
Some scholars have theorised the behaviour within the Capability, Opportunity, Motivation, Behaviour (COM-B) model, which proposes that behaviour can be understood as a result of the interaction among three factors, namely capability, opportunity and

motivation (Grant *et al.*, 2019). This model has helped to explain the differences in pregnancy-related health behaviours among socio-economic groups who have different capabilities and opportunities to change behaviour, regardless of motivation.

The present study applies the IMB model (Fisher and Fisher, 1992), which is often adopted in studies predicting health behaviours related to avoiding health risks and, in recent years, increasingly used in other fields. The IMB model has often proven to be a useful framework for developing health promotion and intervention (Anderson *et al.*, 2006; Limbu *et al.*, 2019) while investigating the cognitive and social dimensions of the individual. Moreover, this model is parsimonious, has specific measurement references and specifies the causal relations between its theoretical determinants as well as their relation to a certain health-related behaviour (Giammarioli *et al.*, 2013). The IMB model is based on three main assumptions. First, individuals require accurate prevention information regarding the desired behaviour change. Second, individuals must be motivated to engage in the target health behaviour (e.g. possess positive attitudes or present strong normative support towards the behaviour). Third, with appropriate information and motivation, individuals will engage the behavioural skills (e.g. those skilled behaviours necessary to effectively perform the behaviour over time, even in challenging circumstances) to achieve the target behaviour (Tuthill *et al.*, 2017).

In particular, the IMB model consists of three antecedents of behaviour change: information, motivation and behavioural skills (see Figure 1). The model predicts that individuals must have the necessary information, motivation and behavioural skills to engage in and maintain behaviour change. The rationale for applying the model is to observe the consequence of having relevant and specific information about the outcome behaviours that act as antecedents for behavioural change (i.e. dietary supplement usage in line with medical guidelines).

The construct “information” refers to knowledge about performing specific behaviours. Past research has referred to nutrition knowledge and healthcare providers’ guidelines as antecedents to guideline compliance. Nevertheless, other studies have posited that the



**Figure 1.**  
Conceptual framework

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efficacy of those types of information and the related behavioural outcome could be improved, particularly when taking into account eHealth information sources and content, in order to better and more efficiently reach pregnant and lactating women, who are supposed to use the recommended supplements.

The second antecedent to behaviour in the IMB model is motivation, viewed as a prerequisite for behavioural change, which includes two different sub-dimensions: personal motivation and social motivation. To address the issue of motivation in the context of eHealth, in addition to the aim of addressing the social interaction within that environment, this work focuses on two types of online social capital (bridging and bonding). Online bonding social capital describes online connections within a group or community characterized by high levels of similarity in demographic characteristics, attitudes and available information and resources. Examples include family members, close friends and neighbours. Online bridging social capital, instead, describes connections that link people across a cleavage that typically divides society (such as race, or class or religion). It is comprised of associations that “bridge” between communities, groups or organizations.

The current study, based on the aforementioned theory and literature, hypothesizes that internet use for health information and online social capital influence dietary supplement usage indirectly through self-efficacy, as shown in [Figure 1](#). In other words, pregnant women and new mothers who seek health information online and engage in online social networks and interactions are more likely to feel confident using dietary supplements; this, in turn, enhances their dietary supplement usage.

### *3.1 Mediation effect of self-efficacy*

Self-efficacy theory holds that individuals with high levels of self-efficacy are more likely to believe that they can follow or pursue specific behaviours that will result in the individual successfully achieving or succeeding (and persevering) in the behaviour they set out to complete ([Strecher et al., 1986](#)). According to the IMB model, information or motivation alone may not be sufficient to drive behaviour change; behavioural skills are needed as intervening determinants of behaviour change. Previous research has demonstrated that knowledgeable and motivated individuals who possess the relevant behavioural skills are more likely to put into practice the recommended guidelines and behaviours ([Anderson et al., 2006](#); [Hearld et al., 2019](#)). In this study, in line with the IMB model, self-efficacy as a behavioural skill has been predicted to mediate the relationships between antecedent factors (online social capital and internet use for health information) and dietary supplement usage. Thus, the following hypotheses are advanced.

- H1.* Self-efficacy mediates the relationship between internet use for health information and dietary supplement usage so that internet use for health information positively predicts self-efficacy which, in turn, positively predicts dietary supplement usage.
- H2a.* Self-efficacy mediates the relationship between online bridging and dietary supplement usage so that online bonding positively predicts self-efficacy which, in turn, positively predicts dietary supplement usage.
- H2b.* Self-efficacy mediates the relationship between online bonding and dietary supplement usage so that online bridging positively predicts self-efficacy which, in turn, positively predicts dietary supplement usage.

### *3.2 Education as a moderator*

Previous research has shown that education is positively associated with supplement usage in pregnancy ([Branum et al., 2013](#)). One such study shows that dietary supplement usage

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differs across different education levels, with the highest use in those with more than a high school education (61%) and lowest use in those with less than a high school education (37%) (Bailey *et al.*, 2010). Similar findings were reported in other studies in which the most typical female supplement user seems to be a well-educated woman whose diet offers a nutritional intake that is close to the nutritional recommendations (Karttinen *et al.*, 1997; Ervin *et al.*, 1999; Kirk *et al.*, 1999; Frey and Files, 2006). Prior literature has also shown that self-efficacy is more strongly related to behaviour among individuals with lower educational attainment, indicating that education may interact with self-efficacy (Zahodne *et al.*, 2015). Hence, this study attempts to examine whether or not education moderates the aforementioned hypothesized mediating effects.

- H3.* Education moderates the mediation effect of self-efficacy between internet use for health information and dietary supplement usage. Specifically, the mediating effect would be much stronger (weaker) among women with a lower level of education (a higher level of education).
- H4a.* Education moderates the mediation effect of self-efficacy between online bridging and dietary supplement usage. Specifically, the mediating effect would be much stronger (weaker) among women with a lower level of education (a higher level of education).
- H4b.* Education moderates the mediation effect of self-efficacy between online bonding and dietary supplement usage. Specifically, the mediating effect would be much stronger (weaker) among women with a lower level of education (a higher level of education).

## 4. Method

### 4.1 Sample and data collection procedure

Data was collected from a convenience sample of pregnant and breastfeeding Italian women (24 months post-partum) through a self-administered online survey taken between December 2018 and January 2019. The potential participants were invited via email and social media and a link to the questionnaire was posted in the email and on social networking sites such as Facebook and Instagram.

The survey questionnaire was originally prepared in English and then translated into Italian by experienced researchers (native speakers) to ensure both the comprehensibility and the quality of the translation. The questionnaire was then translated back into English following Brislin's (1990) back-translation method by a different bilingual translator to ensure that both versions reflected the same content and meaning. The process was repeated until the original and back-translated versions agreed. The questionnaire rendered in Italian was pre-tested for ambiguity, content and clarity on five pregnant women.

Four hundred and twenty-one women completed the survey. Of the total, six surveys were removed due to incomplete responses, resulting in 415 useable responses. Table 1 shows the average respondents' age to be 34 yrs. Of these, 73.3% were pregnant and 26.7% were new mothers, most women had one child, 60% had a college degree and 56.1% had full-time jobs.

### 4.2 Measurement

To measure internet use for health information, we used the scale developed by Kontos *et al.* (2014) that includes 12 binary items (possible answers: yes or no), such as "In the last 12 months, I used the internet to keep track of personal health information" and "In the past 12 months, I used the internet to look for health or medical information for myself". Additionally, a 10-item measurement tool, adapted from Williams (2006), was used to assess online bridging; it included items such as "Interacting with people online makes me interested

		%
Are you currently pregnant	Yes	26.7
	No	73.3
Total number of children	1	59.0
	2	34.0
	3	6.1
	4	0.9
Average age	34 years	
Highest education	Postgraduate (master's degree)	37.6
	Bachelor degree	22.4
	High school	35.9
	Middle school	3.9
	Elementary	–
Employment status	No formal schooling	–
	Full time	56.1
	Part time	4.8
	Self-employed	5.4
	Retired	8.4
	Housewife	25.3

**Table 1.**  
Sample  
characteristics  
( $n = 415$ )

in things that happen outside of my town” and “Interacting with people online makes me feel like part of a larger community.” The answer options ranged from 1 (strongly disagree) to 5 (strongly agree), factor loadings ranged from 0.541 to 0.863 and the scale had good reliability ( $\alpha = 0.91$ ). Online bonding was measured through a 10-item measure also on a 5-point scale (1 being strongly disagree and 5 being strongly agree) that was adapted from Williams (2006). The sample items included were: “There are several people online I trust to help solve my problems” and “There is someone online I can turn to for advice about making very important decisions.” Factor loadings ranged from 0.560 to 0.802 and the reliability of the scale was good ( $\alpha = 0.85$ ).

A two-item self-efficacy measure, adapted from Kloeblen and Batish (1999), was used to assess confidence in one's ability to use dietary supplement. The items were: “I am confident that I could eat a diet high in folic acid all of the time if I tried” and “I feel that I would be able to follow a diet high in folic acid if I wanted to.” The answer options ranged from 1 (strongly disagree) to 5 (strongly agree), factor loadings of the two items were from 0.917 to 0.918 respectively, and the scale had good reliability ( $\alpha = 0.90$ ). Dietary supplement usage was assessed through binary questions (possible answers: yes or no), adapted from Giammarioli *et al.* (2013), to which participants responded if they had taken dietary supplements (vitamins and minerals) in the last two years.

## 5. Findings

### 5.1 Preliminary analyses

The descriptive statistics and correlation matrix are presented in Table 2. Internet use for health information and self-efficacy was significantly and positively correlated with other variables ( $p < 0.05$ ). Both online bridging and bonding were significantly and positively correlated with self-efficacy.

### 5.2 Testing mediation effects

The data was analysed using Hayes's (2013) PROCESS macro for SPSS, as the procedure has been found to be useful in testing complex mediation and moderated mediation effects



(Preacher and Hayes, 2008; MacKinnon, 2008; Krause *et al.*, 2010; Zhao *et al.*, 2010; Hayes, 2013). It provides bootstrapped confidence intervals for the conditional effects. Prior studies (MacKinnon, 2008; Preacher and Hayes, 2008) have recommended bootstrapping as an appropriate procedure for testing mediation effects. Thus, the hypotheses associated with mediation effects were tested using PROCESS macro with Model 4. Hypothesis 1 predicted that self-efficacy would mediate the relationship between internet use for health information and dietary supplement usage. The findings revealed that internet use for health information was significantly and positively related to self-efficacy,  $t = 0.083$ ,  $p < 0.01$  and dietary supplement usage,  $t = 0.187$ ,  $p < 0.01$  (see Table 3). In addition, self-efficacy significantly and

<i>N</i> = 419	<i>M</i>	<i>SD</i>	1	2	3	4	5
1. Internet use of health information	5.600	2.251	1	0.234**	0.240**	0.126*	0.165*
2. Online bridging	2.444	0.923	0.234**	1	0.553**	0.133**	0.047
3. Online bonding	1.405	0.500	0.240**	0.553**	1	0.107*	0.075
4. Self-efficacy	3.125	1.093	0.126*	0.133**	0.107*	1	0.115*
5. Dietary supplement usage	0.843	0.364	0.165*	0.047	0.075	0.115*	1

**Note(s):** \* $p < 0.05$ , \*\* $p < 0.01$  (two-tailed)

**Table 2.** Means, standard deviations and correlations between study variables

	Self-efficacy ( <i>V</i> )		Dietary supplement usage ( <i>Y</i> )	
	<i>B</i>	95% CI [BLLCI, BULCI]	<i>B</i>	95% CI [BLLCI, BULCI]
<i>Model 1</i>				
Internet use for health information ( <i>X</i> )	0.083** (0.028)	[0.03, 0.14]	0.187** (0.061)	[0.07, 0.31]
Self-efficacy ( <i>M</i> )	–	–	1.274* (0.564)	[0.17, 2.38]
Education ( <i>V</i> )	–	–	0.710* (0.366)	[0.007, 1.43]
Self-efficacy × education ( <i>M</i> × <i>V</i> )	–	–	–0.3174* (0.114)	[–0.440, –0.015]
$R^2 = 0.021$ , $F(1, 411) = 8.542$ , $p < 0.005$				
<i>Model 2</i>				
Online bridging ( <i>X</i> )	0.22** (0.071)	[0.08, 0.36]	0.138 (0.161)	[–0.18, 0.45]
Self-efficacy ( <i>M</i> )	–	–	1.381* (0.574)	[0.26, 2.50]
Education ( <i>V</i> )	–	–	0.798* (0.376)	[0.06, 1.54]
Self-efficacy × education ( <i>M</i> × <i>V</i> )	–	–	–0.224* (0.116)	[–0.46, –0.01]
$R^2 = 0.0238$ , $F(1, 391) = 9.544$ , $p < 0.005$				
<i>Model 3</i>				
Online bonding ( <i>X</i> )	0.272* (0.130)	[0.02, 0.53]	0.456 (0.322)	[–0.18, 1.09]
Self-efficacy ( <i>M</i> )	–	–	1.32* (0.562)	[0.22, 2.42]
Education ( <i>V</i> )	–	–	0.708* (0.364)	[0.01, 1.42]
Self-efficacy × education ( <i>M</i> × <i>V</i> )	–	–	–0.219* (0.113)	[–0.44, –0.00]
$R^2 = 0.011$ , $F(1, 400) = 4.391$ , $p < 0.05$				

**Note(s):** \* $p < 0.05$ , \*\* $p < 0.01$ ; Numbers in parentheses are standard errors; NS = Not significant; BLLCI = Boot lower level confidence interval; BULCI = Boot upper level confidence interval

**Table 3.** Direct effects and interaction effects

positively predicted dietary supplement usage,  $t = 1.274$ ,  $p < 0.05$ . As shown in Table 4, the indirect effect of internet use for health information on dietary supplement usage through self-efficacy was estimated as 0.0178, with the 95% bias-corrected confidence interval as 0.0025 and 0.0455. Thus, the indirect effect was statistically significant as the bias-corrected confidence interval did not include zero (Preacher and Hayes, 2008). Therefore, Hypothesis 1 was supported, suggesting that internet use for health information is positively related to self-efficacy which, in turn, positively impacts dietary supplement usage. However, given that internet use for health information remained a significant predictor of dietary supplement usage, the results only reflect partial mediation.

Hypothesis 2a predicted that self-efficacy would mediate the relationship between online bridging and dietary supplement usage. The results showed that online bridging was significantly and positively related to self-efficacy,  $t = 0.22$ ,  $p < 0.01$  and self-efficacy had a strong direct effect on dietary supplement usage,  $t = 1.381$ ,  $p < 0.05$ . In addition, the indirect effect of online bridging through self-efficacy on dietary supplement usage was significant,  $\beta = 0.065$  and 95% CI [0.0067, 0.1784]. This suggests that online bonding social capital positively predicts self-efficacy which, in turn, positively predicts dietary supplement usage. However, the direct effect of online bridging on dietary supplement usage was no longer significant ( $\beta = 0.14$ ,  $p > 0.05$ ), indicating full mediation. Thus, Hypothesis 2a was supported.

Hypothesis 2b predicted that self-efficacy would mediate the relationship between online bonding and dietary supplement usage. The results showed that online bonding was significantly and positively related to self-efficacy,  $t = 0.272$ ,  $p < 0.05$  (see Table 3) and self-efficacy was significantly and positively related to dietary supplement usage,  $t = 1.32$ ,  $p < 0.05$ . As shown in Table 4, the indirect effect of online bonding on dietary supplement usage through self-efficacy was significant,  $\beta = 0.053$  and 95% CI [0.0078, 0.1347], suggesting that online bridging social capital positively predicts self-efficacy which, in turn, positively predicts dietary supplement usage. Thus, Hypothesis 2b is supported. However, the direct effect of online bonding on dietary supplement usage was no longer significant, indicating full mediation.

### 5.3 Testing moderated mediation effects

Hypothesis 3 predicted that educational attainment would moderate the mediation effect of self-efficacy between internet use for health information and dietary supplement usage. The bootstrapping method of 5000 resamples using Hayes' (2013) PROCESS macro for SPSS with Model 14 was employed to test the hypothesis. As illustrated in Table 3 Model 1, the findings showed that internet use for health information was a significant predictor of self-efficacy ( $t = 0.083$ ,  $p < 0.01$ ) and that internet use for health information ( $t = 0.187$ ,  $p < 0.01$ ) and the interaction of self-efficacy and education ( $t = -0.317$ ,  $p < 0.05$ ) were significant predictors of the dietary supplement usage. The conditional indirect effect test showed that self-efficacy was a significant mediator between internet use for health information and dietary supplement usage (see Table 4). The mediating effect was significant only at two education levels (one standard deviation less than mean, 95% CI [0.01, 0.07] or equal to the mean, 95%

Relationships	$\beta$	Boot SE	Boot 95% CI (L-U)
Internet use for health information → self-efficacy → dietary supplement usage	0.0178	0.0107	0.0025 0.0455
Online bonding → self-efficacy → dietary supplement usage	0.0652	0.0424	0.0067 0.1784
Online bridging → self-efficacy → dietary supplement usage	0.0529	0.0314	0.0078 0.1347

**Table 4.**  
Indirect effects ( $n = 415$ )

CI [0.00, 0.05], suggesting that the magnitude of the mediating effect was stronger among women with a lower level of education than among those with a higher level of education (see Table 5). Therefore, the data provides support for Hypothesis 3.

Hypothesis 4a predicted that education would moderate the mediation effect of self-efficacy between online bridging and dietary supplement usage. The findings showed that online bridging was a significant predictor of self-efficacy ( $t = 0.22, p < 0.01$ ) and that the interaction of self-efficacy and education ( $t = -0.224, p < 0.05$ ) was a significant predictor of dietary supplement usage. The conditional indirect effect test showed that self-efficacy was a significant mediator between online bridging and dietary supplement usage at two education levels (one standard deviation less than mean, 95% CI [0.03, 0.22] or equal to the mean, 95% CI [0.00, 0.13], suggesting that the magnitude of the mediating effect was stronger among women with a lower level of education than among those with a higher level of education. Therefore, the data provides support for Hypothesis 4a.

Hypothesis 4b predicted that education would moderate the mediation effect of self-efficacy between online bonding and dietary supplement usage. The findings showed that online bonding was a significant predictor of self-efficacy ( $t = 0.272, p < 0.05$ ) and that the interaction of self-efficacy and education ( $t = -0.219, p < 0.05$ ) was a significant predictor of dietary supplement usage. The conditional indirect effect test showed that self-efficacy was a significant mediator between online bonding and dietary supplement usage at two education levels (one standard deviation less than mean, 95% CI [0.02, 0.29] or equal to the mean, 95% CI [0.01, 0.18], suggesting that the magnitude of the mediating effect was stronger among women with a lower level of education than among those with a higher level of education (see Table 5). Therefore, the data provides support for Hypothesis 4b.

## 6. Discussion and implications

### 6.1 Theoretical contributions

The purpose of this study was to assess the applicability and robustness of the IMB model in predicting and explaining pregnant and breastfeeding women's dietary supplement usage. In particular, the study examined the mediating role of self-efficacy and the moderating role of education in explaining the dual influence of online social capital and internet use for health information on dietary supplement usage. The results offered strong support for the

Variables	Moderator: education	$\beta$	SE	95% CI [BLLCI, BULCI]	
Independent variable: internet use for health information	Mean - 1 SD	3.99	0.034	0.015	[0.01, 0.07]
Mediator: self-efficacy	Mean	4.94	0.017	0.011	[0.00, 0.05]
Dependent variable: dietary supplement usage	Mean + 1 SD	5.89	-0.001	0.014	[-0.03, 0.03]
Independent variable: online bridging	Mean - 1 SD	3.98	0.099	0.046	[0.03, 0.22]
Mediator: self-efficacy	Mean	4.93	0.050	0.033	[0.00, 0.13]
Dependent variable: dietary supplement usage	Mean + 1 SD	5.88	0.001	0.041	[-0.08, 0.09]
Independent variable: online bonding	Mean - 1 SD	3.99	0.121	0.069	[0.02, 0.29]
Mediator: self-efficacy	Mean	4.93	0.064	0.043	[0.01, 0.18]
Dependent variable: dietary supplement usage	Mean + 1 SD	5.88	0.008	0.048	[-0.08, 0.11]

**Table 5.**  
Conditional indirect effect of internet use for health information, online bridging and online bonding at different levels of education

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pathways identified in the IMB model. Thus, this study contributes to the literature by extending the IMB model in dietary supplement usage settings.

The findings of this study contribute to the food and nutrition literature by establishing online social capital and internet use for health information as antecedents of behavioural change and demonstrating their impacts on use of dietary supplements by pregnant and lactating women. More specifically, the results show that online social capital is not directly associated with dietary supplement usage, but that it does influence dietary supplement usage indirectly, through self-efficacy. These findings are consistent with and provide strong empirical support for the IMB model according to which motivation alone may not be sufficient to drive behaviour change, but rather, behavioural skills are needed to serve as intervening determinants of behaviour change. Health information obtained online influences dietary supplement usage directly and indirectly through self-efficacy. These findings are in line with a study by [Anderson \*et al.\* \(2006\)](#), which has demonstrated that knowledgeable and motivated individuals who possess the relevant behavioural skills are more likely to put into practice the recommended guidelines and behaviours.

The moderated mediation analyses indicate that the mediation effects of self-efficacy are moderated by educational attainment. More specifically, the indirect effects of both online social capital and e-health information on dietary supplement usage were stronger among women with a lower level of education than among those with a higher level of education. These findings lend some support to the work of [Zahodne \*et al.\* \(2015\)](#) who found that self-efficacy interacts with education in such a way that associations between self-efficacy and executive abilities are stronger for individuals with lower education. Thus, the results indicate that health information acquisition and motivation may not always lead to improved health outcomes as one's ability to acquire, understand and further use health information may depend on personal characteristics (e.g. age, education level) and situational factors (e.g. social support, socio-economic status) ([Hearld \*et al.\*, 2019](#)).

### *6.2 Practical and social implications*

The outcomes of this study provide important implications for dietary supplement manufacturers and suppliers, social marketers, health agencies, health professionals and healthcare institutions. The findings show evidence for and support the utility and practicality of applying the IMB model to understand and predict dietary supplement usage by pregnant and breastfeeding women. This suggests that the IMB model can be used as a framework and a guide for designing and implementing theory-based interventions and educational programs promoting dietary supplement usage among pregnant and breastfeeding women.

Moreover, the findings indicate that online social capital is associated with pregnant and lactating women's confidence in and ability to use dietary supplements; this, in turn, influences their dietary supplement usage. Thus, social marketing campaigns aimed at promoting dietary supplement usage for pregnant and lactating women can focus on strengthening their social ties on networking sites that promote trust and group norms.

The results also suggest that internet use for the purpose of obtaining health information is a significant determinant of pregnant and lactating women's dietary supplement usage. Prior research also shows that pregnant women use the internet as a source of nutrition information and find online health information to be reliable and useful ([Sayakhot and Carolan-Olah, 2016](#)). Thus, digital marketing campaigns can be a powerful tool for promoting the use of dietary supplements among pregnant and breastfeeding women.

The study has demonstrated that self-efficacy can play a key role in dietary supplement usage. In other words, pregnant women and new mothers who seek health information online and engage in online social networks and interactions are more likely to have confidence in

dietary supplements, resulting in enhanced dietary supplement usage. Therefore, stakeholders engaged in designing educational interventions and promoting dietary supplement usage among pregnant women and new mothers should understand the importance of self-efficacy and aim to increase these women's confidence in and understanding of the importance of dietary supplement usage.

Finally, the study outcomes also indicate that the use of dietary supplements among pregnant and lactating women differs across different levels of educational attainment. Thus, dietary supplement marketers can use different, targeted and more effective strategies to promote dietary supplements to pregnant and lactating women who possess different levels of education.

### *6.3 Limitations and future research*

This study presents some limitations. First, the variables included in the study focused on the online information and interaction domains of pregnant and lactating women. Future studies should explore whether, and to what degree, offline social capital is associated with women's dietary supplement usage behaviour. In addition, this study included only Italian women; therefore, the sample was not only relatively large and socially diverse, but was also limited to finite national and linguistic boundaries. Therefore, the findings cannot be generalized to the broader population. Future studies could replicate and extend these findings in larger and more representative populations. Moreover, cross-cultural research can be useful to explore the factors affecting dietary supplement usage of culturally diverse women, especially from underprivileged neighbourhoods and societies. Finally, this study used a cross-sectional design that could not establish cause and effect relationships and thus, the findings should be interpreted cautiously.

### *6.4 Conclusion*

This study examined whether the information motivation behavioural skills model could predict dietary supplement usage among pregnant and lactating women. The findings indicate that internet use for health information is directly associated with dietary supplement usage. Online social capital combined with eHealth information positively predicts dietary supplement usage through self-efficacy. However, these mediation effects are moderated by educational attainment such a way that indirect relationships are stronger among women with a lower level of education than among those with a higher level of education. These findings have important theoretical and practical implications. From a theoretical perspective, the results confirm that the IMB model can predict dietary supplement usage by pregnant and lactating women. Health professionals, food and dietary supplement marketers and other stakeholders engaged in promoting dietary supplement usage should take these findings into consideration, as they could help further pregnant and lactating women's understanding and acceptance of nutritional supplements.

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#### Corresponding author

Marta Giovannetti can be contacted at: [m.giovannetti@pm.univpm.it](mailto:m.giovannetti@pm.univpm.it)

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