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How online searches fuel health anxiety: Investigating the link between health-related searches, health anxiety, and future intention

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ABSTRACT

The Digital revolution has changed the way in which health information is accessed. While some people feel empowered and less anxious after online searches, others are more anxious or puzzled, which may affect their health-related behaviors. By taking into account health anxiety, this paper examines the processes by which people transition from online health searches to the pursuit of healthcare assistance. Based on Stimulus Organism Response (S–O-R) framework, a research model was developed to illustrate the psychological mechanisms of how searching experience shapes users' healthcare behavior. Using partial least squares-structural equation modeling (PLS-SEM) approach, the results support that the online searches trigger different features of health anxiety, which in turn reinforce further healthcare utilization intention. Results also show that response efficacy positively moderates the relationship between perceived illness likelihood and healthcare utilization intentions, while self-efficacy positively moderates the relationship between perceived illness likelihood and further search intention. Three major recommendations are suggested. Information seekers should rely less on internet searches to alleviate anxiety, and become more aware of, self-monitor, and reduce excessive online health searching. Different stakeholders should orient people to high-quality sources. Healthcare practitioners should engage in improving patient-centered information skills and patients' health information literacy.

1. Introduction

The continuous growth of Internet use and the proliferation of health information available online are shifting the landscape of healthcare. More than half (53.4%) of American adults aged 18–64 use the Internet as their first stop to diagnose specific diseases or subsequently learn about a health concern (National Cancer Institute, 2018). Information is available at people's fingertips. The freely available online health information has become a common method used by the general public to become better informed about health problems, self-care and prevention (Kim & Park, 2012).

Notwithstanding the potential benefits, there are also some disadvantages associated with health information online searches. Empirical evidence suggested that online health information searching is a potential risk factor for the development of health anxiety (Norr et al., 2014; Starcevic, 2017; te Poel et al., 2016). Several meta-analyses have concluded that the overall quality of online health information remained problematic (Zhang et al., 2015). Most of the online health information is inaccurate, misleading, conflicting, or incomplete (Eysenbach et al., 2002; Singh & Brown, 2016). Individuals seeking reassurance about health concerns may fail to feel reassured, yet feel overwhelmed when facing a plethora of unregulated lacking-quality information (Swar et al., 2017). Moreover, information seekers may spend considerable time and effort attempting to analyze, appraise and interpret online health information, which is a further anxiety-driving process (McMullan et al., 2019). There has been an increasing concern that the abundance of online information and increase in online health information searches might actually threaten an individual's self-care more than improve it (Brown et al., 2020).

Health anxiety refers to excessive unwarranted worry provoked by the perceived health threat (Abramowitz & Braddock, 2008). Excessive reassurance seeking may exacerbate already existing health anxiety, resulting in an escalating pattern of worries and compulsive online searches, a condition known as cyberchondria (Starcevic & Berle, 2013). Health anxiety and cyberchondria have been shown to be both related and distinct (McMullan et al., 2019; Starcevic et al., 2019). Cyberchondria refers not only to the exacerbated anxiety caused by online health searches (Fergus & Dolan, 2014; Fergus & Russell, 2016; McElroy & Shevlin, 2014), but also to an abnormal behavioral pattern characterized by excessive health-related internet searches driven by health

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anxiety (Barke et al., 2016; Norr et al., 2015; te Poel et al., 2016). The divergent conceptualizations of the term cyberchondria impedes a comprehensive understanding of the association between online health searches and health anxiety (Brown et al., 2020). Therefore, we avoid using the term "cyberchondria" when investigating the specific health anxiety arise from online health searches.

Existing research recognizes the critical role played by health anxiety on consequential reassurance seeking behaviors. Health anxious individuals may engage in repeated online health searches hoping that they would be reassured (Starcevic & Berle, 2013). Consistent with this, cognitive behavioral models show that health anxious individuals would seek reassurance from healthcare providers in the form of medical utilization (Deacon et al., 2008; Fergus et al., 2017). An increased level of health anxiety may be advantageous and protective, as it may facilitate the appropriate use of internet and medical resources when health risks arise. However, health anxiety can be detrimental when excessive. Dysfunctional health anxiety may lead to a compulsive pattern of excessive online health information searching or a vicious cycle of excessive worry and frequent medical consultation (Mathes et al., 2018; Starcevic & Berle, 2013). Extensive research has shown that efficacy beliefs could influence how individuals cope with health anxiety (Bandura, 1990; Lagoe & Atkin, 2015), and therefore we set out to investigate the link between self-efficacy, health anxiety and subsequent behaviors after online searches.

The evidence is still inconclusive of the behavior mechanism between the health information online searches and further safety-seeking behavior. The work by Eastin and Guinsler (2006) is the first analysis to examine the moderating role of health anxiety between the online searches and healthcare utilization behaviors by viewing health anxiety as a stable personality characteristic. We propose that the post-search health anxiety, as outcome of searching, is a key determinant of future information-seeking and healthcare-seeking behavior intention. It is critical to understand the association between online searches and post-search health anxiety, as well as the association between post-search health anxiety and subsequent behaviors, so that potential mechanisms and influencing factors can then be explored. This research is motivated by a need to address the above-discussed research gaps, and to illustrate the psychological mechanisms of how searching experience shapes user's behavior by taking into account the moderating role of efficacy beliefs.

The objectives of this study are to investigate: (1) whether online searching has a positive effect on health anxiety, (2) the role of health anxiety between online searches, healthcare utilization intention, and future online search intention, and (3) the moderating role of efficacy beliefs during the relationships.

2. Theoretical framework

2.1. Stimulus-organism-response model

The Stimulus Organism Response theory (SOR; Woodworth, 1929) was developed upon the stimulus response theory proposed by Pavlov (1927). The stimulus response theory explains individuals' behaviors as responses to external stimuli. However, this theory was accused of not taking into account individuals' mental states. Mehrabian and Russell (1974) developed the SOR model by incorporating the concept of organism between stimulus and response to elucidate how organisms mediate the relationship between stimulation and response. The SOR framework is composed of three constructs: stimulus, organism, and response. The outside forces can act as a stimulus (S) that affects the psychological state of an individual (organism, O), thereby further leading to changes in the individual's behavior (response, R).

Information search is defined as active efforts individuals engage in to search for information to meet their needs or goals (Niederdeppe et al., 2007). The health information searching behavior is often initiated in response to health-related uncertainty (Guillaume & Bath, 2004), which is more likely to trigger the feeling of anxiety about health (Fox & Purcell, 2010). Previous researchers have demonstrated the predictive power of SOR framework in how online information causes psychological and behavioral responses (Farooq et al., 2020; Soroya et al., 2021). In context of this study, adding the concept of the SOR model will help this study explain individuals' psychological changes being stimulated by online searches and their subsequent health behavior intentions. The research model of this paper consists of three parts namely: (1) "stimuli" refers to information searching experience, including information overload, information quality, information conflict, and information processing bias; (2) "Organism" refers to post-search health anxiety, including illness likelihood, body vigilance, and catastrophic misinterpretation; and (3) "responses" refer to future healthcare utilization intention and online search intention.

2.2. Post-search health anxiety

Online health searches and health anxiety evidently covary (Starcevic & Berle, 2015). However, previously published studies failed to specify the direction of causality between health anxiety and online searches. A unique study by te Poel et al. (2016) undertook a longitudinal analysis to investigate the reciprocal relationship between health anxiety and online health searches. They observed a reciprocal relationship over time only in people who had low levels of health anxiety at baseline. Online health searches may be motivated by reasons other than health anxiety, such as diet or medication related questions. It is possible that the features of the information online induce the feeling of health anxiety for individuals without an existing tendency towards health worries. In line with their conclusion, we consider online searches precede increases in health anxiety because the health information found online may be overwhelming, lack quality, contain conflicts and bias, and as an outcome post-search health anxiety could be induced.

According to contemporary cognitive-behavioral models (Asmundson et al., 2012; Taylor & Asmundson, 2004), health anxiety is a categorical construct. Clinically significant expressions of health anxiety include hypochondriasis, and disease phobia and somatic-type delusional disorder. Thus, we conceptualized post-search health anxiety as having three dimensions, namely: (a) illness likelihood (i.e., the perceived likelihood of acquiring an illness or disease); (b) body vigilance (i.e., perceived sensitivity towards changes in bodily sensations); and (c) catastrophic misinterpretation (i.e., misinterpret normal bodily sensations as dangerous).

2.3. Information overload

In this research, *information overload* refers to the situation in which seekers are exposed to excessive information, which exceeds their processing capacity, leading to psychological stress and anxiety (Eppler & Mengis, 2008). The term information overload can be traced back to 1970 which was described by Toffler (1970) as "the excessive flows and amounts of information which lead to detrimental computational, physical, psychological, and social effects" (p.311). The excessive quantity and complexity of health information gained through online searches can cause information overload among patients (Beaudoin, 2008). They may have difficulty interpreting the search results in situations where the relentless flood of information is involved (Trotter & Morgan, 2008). When processing and managing a preponderance of information from various sources become cumbersome, information seekers might panic into a state of anxiety which results in amplifying the health risk perceptions and fear (Khaleel et al., 2020). Scholars identified information overload as a cause of many undesirable health consequences such as negative sentiments, psychological stress and anxiety (Farooq et al., 2020; Swar et al., 2017). Applying these insights, we hypothesize the following:

H1: Information overload is positively related to (a) illness likelihood, (b) body vigilance, (c) catastrophic misinterpretation.

2.4. Information quality

The Internet is not a guaranteed source of health-related information. The information on the internet is varied and largely unregulated, and may provide more reasons to be concerned. It has been found that much of the health-related online information is erroneous, incomplete or misleading (Eysenbach et al., 2002; Singh & Brown, 2016). Recent work has raised concerns about consumers' ability to evaluate the quality and veracity of online information (Diviani et al., 2016; Keselman et al., 2019). According to Baumgartner and Hartmann (2011), individuals would experience greater health anxiety from websites that appear trustworthy. Many sites deliberately prey on vulnerable populations and convince them that common or vague symptoms represent serious medical diagnoses (e.g., linking arm rash to death). Information seekers will deem this kind of information as credible and worry excessively about their health. Thus, we hypothesize:

H2: Perceived information quality is positively related to (a) illness likelihood, (b) body vigilance, (c) catastrophic misinterpretation.

2.5. Information conflict

Another particular challenge of handling science-based information is that scientific knowledge is seldom conclusive, often inconsistent, sometimes even conflicting (Kaicker et al., 2010). Cognitive theories have suggested that the conflicting information from different sources is a major anxiety-amplifying factor that raises uncertainty and makes it difficult to manage abundant health-related online information (Beck et al., 2005). Previous scholars criticized that much of health information focuses on conflict and controversies, which can ultimately cause readers negative emotional reactions (e.g., frustration, distress) (Nagler et al., 2019) and undesirable cognitive outcomes such as confusion (i.e., perceived ambiguity about the health topic) (Chang, 2015; Weeks et al., 2012). Failing to obtain the expected reassurance, an individual's health anxiety may be reinforced by conflicting information (Boelen & Carleton, 2012; Miller, 2014; Singh & Brown, 2016). We hypothesize:

H3: Information conflict is positively related to (a) illness likelihood, (b) body vigilance, (c) catastrophic misinterpretation.

2.6. Information processing biases

Health information online searches also involve the risk of *confirmation bias*, which is the propensity to favor information that supports one's existing beliefs and discount that which does not (Hart et al., 2009). This phenomenon may be even more pronounced online because users have greater control over one's own information diet by choosing which sources and messages they are exposed to. Psychological studies have found that people often set out to search on the Internet for the evidence that supports their existing beliefs and ignore messages challenging their beliefs (Meppelink et al., 2019; Westerwick et al., 2017). White (2013) studied health search-related biases and found that searcher biases lead people to settle on incorrect answers around half of the time. Exposure to inaccurate and nonscientific information during online searches can trigger or even exacerbate health anxiety (Ornell et al., 2020). Although researchers have not treated the association between information processing bias and health anxiety in much detail, the evidence reviewed in this section support the hypothesis that:

H4: Information processing biases is positively related to (a) illness likelihood, (b) body vigilance, (c) catastrophic misinterpretation.

2.7. Intention

Behavioral intention is an indication of an individual's perceived likelihood that she/he will perform a specified behavior. In this study, behavioral intention refers to (1) healthcare utilization intention, and (2) future online health information search intention.

Several health behavior theory models present risk perception as a key predictor of health behaviors, like Protective Motivation Theory (Rogers, 1975, 1983), Health Belief Model (Janz & Becker, 1984), Cognitive-Behavioral model (Salkovskis & Warwick, 2001), and Prevention Adaptation Process Model (Weinstein, 1988). Several lines of evidence have shown that the stronger perceived severity of the negative health outcome, the more likely people will be motivated to take preventive health behavior (Paek et al., 2016; Yoo et al., 2018) or seek reassurance via medical consultation or physical examination (Doherty-Torstrick et al., 2016; McManus et al., 2014). It might be assumed that people with genuine health anxiety and concerns would be highly involved in the information and would therefore primarily motivate future healthcare services. Thus, we hypothesize that.

H5: (a) Illness likelihood, (b) Body vigilance, (c) Catastrophic misinterpretation is positively related to healthcare utilization intention.

Previous studies have revealed a correlation between feelings of anxiety and information seeking behaviors. There is a large number of published studies (Kahlor, 2010; Muse et al., 2012; Singh & Brown, 2014) describing health anxiety as a possible motivator for health information seeking. Studies in medical psychology have shown that individuals with higher levels of health anxiety tend to seek health information and reassurance utilizing the Internet (Baumgartner & Hartmann, 2011; Lagoe & Atkin, 2015). Therefore, we hypothesize that.

H6: (a) Illness likelihood, (b) Body vigilance, (c) Catastrophic misinterpretation is positively related to future online health search intention.

2.8. The moderating role of efficacy beliefs

Additional factors, such as efficacious feelings, may also influence one's subsequent behavior following online information searching. According to Bandura (1990)'s self-efficacy theory, efficacy beliefs refer to individuals' judgments of their ability and capacity to accomplish a task or to attain designated types of performance. The coping appraisal consists of response efficacy (i.e., the expectancy that a certain action or response to a given problem is perceived as being effective) and self-efficacy (i.e., the belief in the ability to solve the risk) (Woon et al., 2005). Some preliminary evidence exists in the fear appeals literature (Maddux & Rogers, 1983; Rogers, 1983) and the Extended Parallel Process Model (Witte, 1992) suggesting that threatening messages could produce adaptive, desired responses (e.g., healthcare intention) only when both the intensity of the emotional response and efficacy are high (Witte & Allen, 2000). Otherwise, greater perceived risk and feelings of powerlessness can lead to a defensive reaction, where people avoid thinking or learning about the risk rather than coping with the problem (Maddux et al., 1995). Thus, to make sense of and overcome the challenging situation and consequence of problematic information searches, it is essential to feel capable of properly accessing, understanding and handling information from online searching (Griffin et al., 2008; Zimbres et al., 2021). Recent evidence suggests that dimension of self-efficacy and response efficacy both play critical roles in the performance of healthy behaviors (Tsai et al., 2021; Zhang et al., 2019). Utilizing efficacy beliefs as moderator would help identify an individual's healthcare utilization intention and further search intention more concretely. Thus, we propose that:

H7: Response-efficacy will positively moderate the relationship between (a) illness likelihood, (b) body vigilance, (c) catastrophic misinterpretation and healthcare utilization intention. Specifically, among people with higher levels of post-search health anxiety, individuals who tend to believe getting healthcare will solve their health concerns (response efficacy) would be more likely to generate healthcare utilization intentions.

H8: Self-efficacy will positively moderate the relationship between (a) illness likelihood, (b) body vigilance, (c) catastrophic misinterpretation and health information searching intention. Specifically, among people with higher levels of post-search health anxiety, individuals who

tend to believe they can easily handle health information (self-efficacy) would be more likely to continue health information online searching.

A research model connecting the proposed hypotheses is shown in Fig. 1.

3. Research methodology

3.1. Participants

This study employed a survey approach and we recruited English-speaking respondents (N = 298) through the crowdsourcing marketplace, Amazon Mechanical Turk. After removing two respondents that failed attention checks, 296 respondents remained. Respondents ranged in age from 20 to 72 years old ($M = 39.95$, $SD = 11.97$). Table 1 shows the demographic information. We also asked respondents to rate their current health status. The self-rated health status was as follows: Very good (37.5%), Good (30.7%), Excellent (16.9%), Fair (13.5%) and 1.4% as Poor. For the sources they rely on most for their recent health-related information searches, 69.9% of respondents chose Internet, 22.6% chose Medical doctor, 4.1% chose Physician assistant or nurse, 2% chose Friends and 1.4% chose Family members. 52.7% of respondents spend more than 4 hours each day on the Internet, while others spend 2 hours – 4 hours (27.7%), 1 hour to 2 hours (16.9%) and less than 1 hour (2.7%).

Table 1
Demographic information.

Item	Value	Frequency	Percentage
Gender	Male	127	42.9%
	Female	164	55.4%
	Others	3	10%
	Choose not to answer	2	0.7%
Race/ethnicity	White/Caucasian	202	68.2%
	Black/African American	30	10.1%
	Asian/Pacific Islander	46	15.5%
	Middle Eastern	2	0.7%
	Native American	2	0.7%
	Two or more ethnic/racial categories	8	2.7%
	Other	3	1.0%
	Prefer not to say	3	1.0%
Age	18 to 24	10	3.4%
	25 to 44	204	68.9%
	45 to 64	68	23%
	65 and above	14	4.7%
Education	High school grad or less	36	12.2%
	Some college	70	23.6%
	College and above	189	63.8%
	Choose not to answer	1	0.3%
Household income	Below $24,999	61	20.6%
	$25,000 to $49,999	76	25.7%
	$50,000 to $74,999	77	26%
	$ 75,000 and above	77	26%
	Choose not to answer	5	1.7%
Political affiliation	Democrat	141	47.6%
	Republican	65	22%
	Independent	67	22.6%
	Another party	6	2%
	No preference	11	3.7%
	Choose not to answer	6	2%

3.2. Procedure

The survey was pilot-tested on a group of undergraduate-level students ($n = 60$), and the results were utilized to amend the survey and ensure its validity and reliability. Only minimal changes were necessary. This study was then launched in the Mturk system where respondents can select and access a list of eligible studies. After indicating consent to participate in the study, they accessed the questionnaire via the Qualtrics link in the study information posted in the system. First, they were asked whether they had looked online for health information in the past month. Respondents who answered no are eliminated from this study. Following that, we asked for demographic information. Then, we followed previous studies to ask respondents to recall their recent online health search experience (e.g., Baumgartner & Hartmann, 2011; te Poel et al., 2016). Respondents were asked to evaluate their health information online searching experience including information overload, information conflict, perceived information quality and information processing bias. Following this, respondents were asked to complete measures of illness likelihood, body vigilance, and catastrophic misinterpretation after online searching. We also asked respondents to report the self-efficacy, response efficacy, future healthcare intention, and future health search intention. The survey was launched on October 17, 2021 and data collection was concluded on October 18, 2021. After completing the study, participants received an agreed-upon compensation via the recruitment system. All procedures were approved by the author's institutional review board before the study was launched.

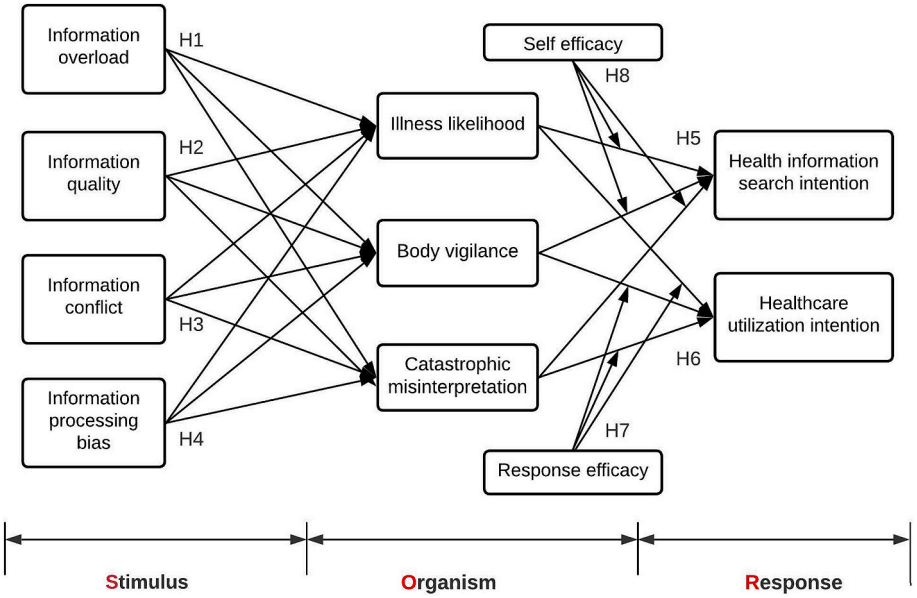

Fig. 1. Research model.

3.3. Measurement

Most of the constructs in the study were measured on a 5-point Likert scale with the anchors of strongly disagree for 1 and strongly agree for 5, unless specified otherwise.

Information overload was accessed by 5 items adapted from Chen et al. (2009) and Matthes et al. (2020). Sample items include "When searching for health information, there was too much information so I was burdened in handling it", "When searching for health information, I feel difficult to read every piece of information on the internet" (M = 2.70, SD = 0.80, α = 0.867).

Information quality was accessed by 3 items from Lee et al. (2002), sample items include "When searching for health information, the information on the web is informative", "When searching for health information, the information on the web is accurate and credible" (M = 3.59, SD = 0.57, α = 0.714).

Information conflict was assessed with 5 items from Gibson et al. (2016), such as "Conflicting health information is widespread throughout many different public health issues" (M = 2.98, SD = 0.70, α = 0.841).

Information processing bias was measured with 5 items from Metzger et al. (2020), such as "I prefer to select health information that is consistent with my own views when I searching for online health information", "I would not like to read in more detail about information which inconsistent with my own opinions" (M = 3.39, SD = 0.77, α = 0.812).

Illness likelihood was measured with items adapted from the Short Health Anxiety Inventory (SHAI; Salkovskis et al., 2002). For each item, participants were presented with a group of four statements reflecting the feared likelihood of becoming ill. Sample statements include "I am sometimes afraid that I have a serious illness after searching for online health information" (M = 1.89, SD = 0.52, α = 0.851).

Body vigilance was measured by 5 items adapted from the Short Health Anxiety Inventory (SHAI; Salkovskis et al., 2002). Sample statements include "If I have a bodily sensation or change, I rarely wonder what it means after health information online searching" (M = 1.79, SD = 0.59, α = 0.833).

Catastrophic misinterpretation was measured with 5 items adapted from the Cognitions about Body and Health Questionnaire (Rief et al., 1998). The items are self-report measures which assess individuals' catastrophizing interpretation of bodily complaints (e.g., "red blotches on the skin are a threatening sign of skin cancer", "The most common reason for discomfort is a serious illness") (M = 2.94, SD = 0.75, α = 0.801).

Self-efficacy was assessed using four items from Chen et al. (2018) measuring self-reported competence and confidence to perform specific tasks, such as "I am confident that I can make correct medical judgments on personal medical issues based on online health information" (M = 3.94, SD = 0.71, α = 0.885).

Response efficacy was measured by 4 items adapted from Rutten et al. (2016), such as "My trust in the physicians as the main information source remains at a very high level, despite the Internet health information searches" (M = 4.14, SD = 0.85, α = 0.823).

Healthcare utilization intention was assessed with 3 items adapted from McElroy et al. (2019), including "After searching for online health information, I think I need to consult with medical specialists", "I want to discuss relevant issues with a doctor to seek professional advice after searching health information on the Internet" (M = 3.23, SD = 1.05, α = 0.849).

Health information searching intention was assessed with 2 items derived from prior research (Agarwal & Prasad, 1999; Venkatesh & Davis, 2000), and adapted to our study context. Items include "I intend to seek health information from the Internet again in a short period", "I plan to seek health information from the Internet again in a short period" (M = 3.19, SD = 0.85, α = 0.832).

Control variables. Exogenous variables expected to influence online health information search experience and health anxiety were controlled. Previous studies have identified differences by various socio-demographic factors (i.e., age, gender, educational attainment, perceived health status) in health information seeking behavior (Mitchell et al., 2019; Rowley et al., 2017; Xiao et al., 2014). Thus, the influence of age, gender, race, ethnicity, education and perceived current health status were controlled for in this study.

4. Data analysis and results

4.1. Data analysis

Partial least squares structural equation modeling (PLS-SEM) was used to test the research model using SMART-PLS 3 software (Ringle et al., 2015). Compared with traditional SEM, PLS-SEM has greater statistical power to identify key driver constructs and predict target constructs (Hair et al., 2019). The sample size of this study is 296 which is regarded as enough to obtain reliable results in data analysis (Hair et al., 2014). The following sections discuss the assessment of measurement models as well as the structural model.

4.2. Measurement model assessment

We examined the reliability and validity of the measurement model. To establish convergent validity, we used the average variance extracted (AVE) criterion. The AVE of each perspective is higher than 0.5, which are judged to be adequate (Merrilees et al., 2009). Cronbach's alpha and composite reliability (CR) were applied to measure internal consistency reliability. The Cronbach's alpha coefficient values of measurements are all greater than 0.7, demonstrating good internal consistency and strong reliability (Anderson et al., 1987). CRs are higher than 0.8 for all items, exceeding the recommended value of 0.7 by Hair et al. (2014), showing good internal consistency. As shown in Table 2, the CR, factor loadings, and AVEs of all constructs met the expected levels. Therefore, the convergent validity and internal consistency reliability are concluded.

Discriminant validity ensures that different measures are tapping separate constructs, which is evaluated by using the Heterotrait-Monotrait ratio (HTMT). Henseler et al. (2015) suggested that the maximum threshold for HTMT is 0.85. Table 3 shows the compliance of all values with an acceptable.

The collinearity was examined using the variance inflation factor (VIF). The VIF results for each construct were all below the recommended threshold of 5.0 as suggested by Hair et al. (2014), indicating no multicollinearity problems.

4.3. Structural model assessment and hypothesis testing

We used SmartPLS software with the 1000 bootstrap procedures to test the hypotheses in our research model. According to Hair et al. (2014), the R^2 and the path coefficients are the essential measures to evaluate a structural model. The result shows that our model has R^2 value of 35.0% for HUI, and 34.5% for HISI. In terms of path analysis, Table 4 shows the path coefficients and the results of the hypothesis relationships.

As presented in Table 4, the results support thirteen of the twenty-four hypotheses. Regarding the antecedents of post-search health anxiety, the impact of information overload on illness likelihood (β = 0.221, p < .001) and on body vigilance (β = 0.221, p < .001) are both significant, supporting H1a and H1b. Additionally, the impact of information quality on catastrophic misinterpretation is significant (β = 0.158, p < .05), supporting H2c. The results also revealed that information conflict significantly influenced illness likelihood (β = 0.219, p = .001), body vigilance (β = 0.207, p = .001) and catastrophic misinterpretation (β = 0.21, p = .001), supporting H3a, H3b and H3c. Information processing bias was determined to be significant in affecting illness likelihood (β = 0.18, p < .05), body vigilance (β = 0.174, p < .05) and catastrophic

Table 2
Measurement model results.

Construct	Item	Loadings	CA	CR	AVE
Information overload (IFOL)	IFOL 1	0.728	0.867	0.904	0.654
	IFOL 2	0.803			
	IFOL 3	0.83			
	IFOL 4	0.821			
	IFOL 5	0.857			
Information quality (IFQ)	IFQ1	0.925	0.714	0.815	0.6
	IFQ2	0.656			
	IFQ3	0.718			
Information conflict (IFC)	IFC1	0.817	0.841	0.887	0.612
	IFC2	0.774			
	IFC3	0.789			
	IFC4	0.827			
	IFC5	0.697			
Information processing bias (IPB)	IPB1	0.749	0.812	0.87	0.575
	IPB2	0.619			
	IPB3	0.807			
	IPB4	0.852			
	IPB5	0.744			
Illness Likelihood (IL)	IL1	0.75	0.851	0.890	0.576
	IL2	0.841			
	IL3	0.799			
	IL4	0.647			
	IL5	0.719			
	IL6	0.782			
Body vigilance (BV)	BV1	0.653	0.833	0.883	0.602
	BV2	0.791			
	BV3	0.803			
	BV4	0.83			
	BV5	0.792			
Catastrophic misinterpretation (CM)	CM1	0.805	0.801	0.862	0.557
	CM2	0.649			
	CM3	0.808			
	CM4	0.726			
	CM5	0.734			
Response efficacy (RE)	RE1	0.814	0.823	0.879	0.645
	RE2	0.802			
	RE3	0.751			
	RE4	0.843			
Self-efficacy (SE)	SE1	0.858	0.885	0.92	0.743
	SE2	0.890			
	SE3	0.884			
	SE4	0.815			
Healthcare intention (HI)	HI1	0.872	0.849	0.909	0.768
	HI2	0.918			
	HI3	0.838			
Health information search intention (HISI)	HISI1	0.922	0.832	0.922	0.856
	HISI2	0.928			

misinterpretation ($\beta = 0.308$, $p < .001$), supporting H4a, H4b and H4c.

Regarding the antecedents of healthcare utilization intention, the impact of body vigilance and catastrophic misinterpretation on adoption intention were both strong and significant (BV, $\beta = 0.252$, $p < .05$; CM, $\beta = 0.305$, $p < .001$), supporting H5b and H5c. Finally, conditional effects of illness likelihood on healthcare utilization intentions by response efficacy is significant ($\beta = 0.215$, $p < .05$), supporting H7a. The conditional effects of illness likelihood on health information searching intention by self-efficacy is significant ($\beta = 0.244$, $p < .05$), supporting H8a.

5. Discussion

Integrating theoretical models and concepts from psychology and information science, this work extended the existing literature by investigating the role of health anxiety between online health information searching and future healthcare behavior outcomes. We also examined the moderating role of efficacy beliefs between post-search health anxiety and future healthcare intention. This study shows significant relationships between health information searching experience and different feelings of health anxiety.

We found that information overload significantly influences illness likelihood and body vigilance, and the impacts are very similar. When the amount of information is far in excess of one's processing capacities, people tend to overestimate the likelihood of illness. They may feel susceptibility and be more vigilant towards their bodily sensations. This finding broadly supports the work of other studies (Bala et al., 2021; Starcevic, 2017), which showed that information overload resulted in higher perceived vulnerability and increased vigilance.

The result shows that higher-quality information will trigger

Table 4
Hypotheses-testing of the research model.

H	Relationship	Path	SD	T Statistic	P Value	Remark
H1a	IFOL - > IL	0.221	0.062	3.579	0	Supported
H1b	IFOL - > BV	0.221	0.058	3.822	0	Supported
H1c	IFOL - > CM	0.071	0.064	1.105	0.272	Rejected
H2a	IFQ - > IL	−0.029	0.098	0.3	0.765	Rejected
H2b	IFQ - > BV	0.068	0.095	0.718	0.473	Rejected
H2c	IFQ - > CM	0.158	0.076	2.076	0.038	Supported
H3a	IFC - > IL	0.219	0.065	3.374	0.001	Supported
H3b	IFC - > BV	0.207	0.061	3.421	0.001	Supported
H3c	IFC - > CM	0.21	0.066	3.189	0.001	Supported
H4a	IPB - > IL	0.18	0.062	2.896	0.004	Supported
H4b	IPB - > BV	0.174	0.057	3.022	0.003	Supported
H4c	IPB - > CM	0.308	0.065	4.742	0	Supported
H5a	IL - > HUI	0.093	0.092	1.006	0.315	Rejected
H5b	BV - > HUI	0.252	0.083	3.051	0.002	Supported
H5c	CM - > HUI	0.305	0.055	5.547	0	Supported
H6a	lL - > HISI	0.047	0.092	0.507	0.612	Rejected
H6b	BV - > HISI	0.122	0.086	1.416	0.157	Rejected
H6c	CM - > HISI	−0.068	0.049	1.381	0.167	Rejected
H7a	IL * RE - > HUI	0.215	0.104	2.068	0.039	Supported
H7b	BV * RE - > HUI	−0.117	0.105	1.107	0.269	Rejected
H7c	CM * RE - > HUI	0.002	0.067	0.032	0.974	Rejected
H8a	lL * SE - > HISI	0.244	0.103	2.376	0.018	Supported
H8b	BV * SE - > HISI	−0.104	0.112	0.93	0.352	Rejected
H8c	CM * SE - > HISI	0.068	0.069	0.989	0.323	Rejected

Table 3
Heterotrait-Monotrait ratio (HTMT) Results.

	IFOL	IFQ	IFC	IPB	IL	BV	CM	RE	SE	HUI
IFQ	0.103									
IFC	0.561	0.207								
IPB	0.359	0.429	0.267							
IL	0.44	0.139	0.434	0.336						
BV	0.436	0.16	0.405	0.377	0.675					
CM	0.306	0.253	0.344	0.51	0.424	0.417				
RE	0.304	0.615	0.189	0.276	0.176	0.092	0.148			
SE	0.081	0.228	0.11	0.07	0.164	0.149	0.135	0.334		
HUI	0.325	0.128	0.273	0.392	0.428	0.481	0.537	0.107	0.231	
HISI	0.131	0.383	0.08	0.192	0.094	0.098	0.126	0.57	0.238	0.127

stronger catastrophic misinterpretation in the context of health information search. This accords with earlier observations by Baumgartner and Hartmann (2011), which showed that individuals experience great worries from trustworthy websites in online health information search. Although credible health information could help people understand the severity of the situation and motivate people to adopt recommended health measures, it also may unintentionally increase a higher level of severity for people who already perceive the situation to be grave. They would discern the illness as perilous, and overestimate the severity of health issues based on the search result from websites.

Additionally, information conflict and information processing bias were found to cause all three features of health anxiety, supporting evidence from previous observations (e.g., Lau & Waters, 2017; Zimbres et al., 2021). Resources, strategies and advice for any given health concern often present sources that contradict each other. The uncertainty that arises from conflicting information makes it difficult to perceive the situation objectively and increases worry about personal health. These unwarranted worries are also potentially caused by the fact that some individuals are selectively more attentive to information confirming their beliefs and worries. Under these contexts, people would feel more susceptible to the threats of illness, be more hypervigilant to somatic sensations, and catastrophize these symptoms as signs of serious illness.

Interestingly, no significant correlation was found between illness likelihood, body vigilance, catastrophic misinterpretation and information searching intention. This finding is consistent with that of Brown et al. (2020) who found that health anxious individuals may experience a conflict between the impulse to alleviate health anxiety by engaging in online search again, and the need to protect their psychological well-being by not doing so. Our findings further indicate that among people who perceived greater levels of illness likelihood, only those who feel more capable of handling online health information are more engaged in repeated online search. As a result, for people who cannot solve this conflict, they may decide not to engage in the repeat online search.

Anxious health seekers still rely on doctors for guidance and fact-checking. We found that heightened body vigilance and catastrophic misinterpretation can lead to greater use of the resources of health services. After online searching, individuals who are more likely to notice changes in their health and those who tend to misinterpret benign physical signs as serious illness would be more likely to seek medical attention. Among people who have higher levels of perceived illness likelihood, individuals who value consultations with physicians are more prone to engage in forgoing treatment-seeking patterns. It is encouraging to compare these findings with the Planned Risk Information Seeking model proposed by Kahlor (2010), which states that risk perception will trigger emotional responses and further generate behavioral intentions. Our results broadly support the association between health-related risk perception, healthcare utilization intention, information searching intention when include the concept of efficacy beliefs.

6. Conclusion

The results imply that online information searches are associated with the increase in health anxiety among health information seekers, and anxious health seekers are more likely to seek medical attention. It is imperative to provide refined knowledge to health website managers on content and system management, to guide the general public to on how to use online information more wisely and use medical resources more appropriately, and to provide insights to healthcare providers on effective health communication. Based on our findings, we categorized the suggestions based on the three perspectives of our research model.

Content and system management. Different stakeholders should orient people to reliable, and high-quality sources. Government agencies and well-known healthcare organizations could provide more authoritative or official platforms for communicating health-related content about symptoms, potential treatments and recommended health measures. Information regulators should improve current methods of producing, managing, checking and filtering when it comes to disposing of and eliminating irrelevant data and information. Social media sites and search engine developers could take measures to create user profiles based on their digital trace data, so that the information can be further extracted, sorted and prioritized according to user needs.

Individual information processing strategies. Health anxiety management is largely based on self-help and the individuals' own abilities to handle online health information. We all live in an information society and we are inundated with information whether we actively seek it or not. It is essential for users to be capable of efficiently searching, filtering, identifying, and evaluating relevant information. We also advise users to take ample time while searching for health advice, to self-monitor their information consumption, to self-evaluate psychological states and take frequent breaks from online search in order to maintain psychological well-being. Individuals suffering from hypervigilance and extreme anxiety can try to manage their symptoms, such as focusing less on health symptoms and worries, re-evaluating worrisome thoughts and reducing excessive checking and reassurance seeking. We should not simply rely on Internet as a tool for self-diagnosis, despite a temptation to use it as such. According to Ji et al. (2014), it is also feasible that people seek advice and share information with trustworthy sources such as family and friends to cope with confusion and distress caused by online searches.

Patient-physician communication. Healthcare practitioners should engage in improving patient-centered information skills and patients' health information literacy. For instance, encouraging patients to do online searches while also empowering them to identify reliable advice. Internet health information seeking is a good sign that patients want to actively engage in self-care since participatory medicine (shared decision-making) leads to improved outcomes (Shay & Lafata, 2015). Healthcare providers could discuss web-based information as part of the medical visit, engage with patients about the information they access, reconcile attentive listening with asking questions that encourage patients to reflect their concerns, and help patients critically appraise online information so that they can evaluate health information better themselves.

7. Limitation

Limitations in this study should be acknowledged. First, the current study was cross-sectional and thus the causal nature of the observed associations remains unclear, even if the use of SEM allows a better understanding of the relations between different factors and the mechanisms underlying their connections. Future work could use more advanced designs like cross-lagged panel designs to interpret causal relationships. Second, anxiety is a time-bound trait. We asked respondents to recall their searching experience in the past month which may introduce the recall bias. Some respondents may still recall their health anxiety strongly, but there is a possibility that some might be unable to recall their levels of health anxiety clearly. Last but not least, we treat health anxiety as an outcome variable of previous health information searching experience, namely post-search health anxiety. This study focused on post-search health anxiety in the general population. Thus, the prevalence of hypochondriasis in the current population is unknown. Future research should integrate more factors in the research model to enhance its explanatory power. For instance, researchers may differentiate between pre-search health anxiety and post-search health anxiety to investigate if health anxious individuals appeared more anxious by problematic online information searching experience and reinforced their health anxiety. Replicating these findings with hypochondriasis individuals would be desirable to further advance this new area of research.

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Author contribution

The author confirms sole responsibility for the following: study conceptualization and design, data collection, analysis and interpretation of results, and manuscript preparation.

Availability of data and materials

The data is available from the corresponding author upon request.

Declaration of competing interest

The authors declare they have no conflict of interest.

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