

Exploring how health-related advertising interference contributes to the development of cyberchondria: A stressor-strain-outcome approach

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Abstract

Objectives: Cyberchondria is increasingly recognized as the dark side of digital health, given the pervasive use of the internet as a main source of health information in people's daily lives. While previous studies have identified many factors contributing to cyberchondria, there is a dearth of research on the impact of health-related advertisements. Therefore, this study adopts the stressor-strain-outcome (SSO) model to investigate how health-related advertising interference is directly and indirectly related to cyberchondria.

Methods: To empirically validate the proposed research model, we conducted an online survey with 437 internet users with medical information seeking experience in China. Structural equation modeling (SEM) was employed to analyze the survey data.

Results: Our findings revealed a positive, direct association between health-related advertising interference and cyberchondria. Meanwhile, advertising interference was positively related to both information overload and information irrelevance, with the former further predicting cyberchondria. Moreover, doctor-patient communication weakened the positive effect of information overload on cyberchondria.

Conclusions: The study not only theoretically contributes to the literature by theorizing the relationship between health-related advertising interference and cyberchondria but also practically underlines the pivotal role of effective doctor-patient communication in reducing the development of cyberchondria.

Keywords

Cyberchondria, advertising interference, information irrelevance, information overload, doctor-patient communication

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Introduction

In this digital era, a large and ever-increasing number of individuals are turning to the internet as a major information source of medical information.¹ For example, health-related internet searches in China accounted for 73.8% of all searches in 2019, a notable increase from 66.3% in 2018.² The growing trend of online health research is not surprising, given its benefits like convenience, immediacy, and interactivity.³ However, online health information

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seeking (OHIS) can also have some unintended outcomes, due to the often ambiguous, excessive, and contradictory nature of online health content.⁴ For instance, an estimated 40% of frequent health information seekers report an increase in emotional distress.⁵ This phenomenon, commonly referred to as cyberchondria, is characterized by excessive or repetitive patterns of OHIS associated with heightened levels of negative emotional states, such as health anxiety and distress.⁶ Evidence suggests that cyberchondria can lead to some negative impacts, such as problematic internet usage, functional impairment, and reduced perceived quality of life.^{7–9} As our society becomes increasingly inundated with digital information and more people become proactive about managing their health online, cyberchondria emerges as a prevalent and concerning behavioral pattern.¹⁰ This phenomenon warrants the attention of public health professionals and researchers, as it represents a novel challenge in the realm of digital health management.⁴

Health information seekers frequently encounter numerous advertisements on online platforms during their searches.¹¹ The influence of such exposure can be complex. While online health advertisements have the potential to be a powerful tool for health promotion and education, some may inadvertently lead individuals to perceive common symptoms as indicative of serious illnesses.¹² Yet, to date, no empirical studies have examined how interference by negative health-related advertisements translates into cyberchondria. Drawing upon the stressor–strain–outcome model, this article aims to fill this gap by investigating the relationship between health-related advertising interference and subsequent perceptions of information overload and irrelevance, and how these perceptions may contribute to cyberchondria. Additionally, the study seeks to explore the moderating role of doctor–patient communication in this process. Theoretically, the study contributes to cyberchondria research by proposing a research model that integrates several intrapersonal factors with an important interpersonal factor (i.e. doctor–patient communication). Practically, the findings of this study could be invaluable for health practitioners, providing insights on mitigating the impact of cyberchondria in the general population.

Online health information seeking

The global expansion of internet coverage facilitates the generation and dissemination of health-related information across various online platforms.^{12,13} This accessibility means that people experiencing illness often first seek information regarding their health conditions online before consulting health professionals.¹⁴ OHIS is an active, goal-oriented process through which health consumers acquire knowledge to address their health concerns.¹⁵ As OHIS gains popularity, health communication scholars

have explored this phenomenon from different perspectives. For example, they have applied several theoretical models to understand why and how people seek health information. These models include the Planned Risk Information Seeking Model (PRISM), the Risk Information Seeking and Processing Model (RISP), the Theory of Planned Behavior (TPB), and the Comprehensive Model of Information Seeking (CMIS).^{16–19} These theories view OHIS as a deliberate and reassuring behavior.³ Building on these frameworks, many studies in this area have empirically examined the motivations behind health information seeking, such as psychosocial factors (e.g. subjective norms, risk perception, negative emotions, and knowledge insufficiency), instrumental factors (e.g. utility of the medium and trustworthiness of the channel), and contextual factors (e.g. frequency of internet use).^{3,20–22}

While this line of research has identified factors contributing to regular OHIS, few studies have explored the negative outcomes associated with OHIS.²³ Regular OHIS indicates the process of health-related knowledge acquisition online to manage uncertainty or to cope with anxiety.^{1,12} However, this regular pattern may become pathological if it fails to satisfy users' health information needs.¹ For example, evidence suggests that regular OHIS can escalate into excessive and harmful practice, driven by the need to find a more convincing and comforting explanation.¹⁰ Starcevic and colleagues proposed a hybrid model to describe the positive and negative outcomes of regular OHIS.¹⁴ In particular, they describe online searches that alleviate distress or anxiety as “classical” reassurance-seeking. Conversely, online searches that amplify increased distress or anxiety can lead to either avoidance of subsequent searches or repeated, excessive, and distressing searching, a condition known as “cyberchondria.” This term defines a pathological state where some individuals persist in searching for medical information online despite not finding reassurance.²⁴ This problematic pattern is distinct from regular OHIS and becomes a counterproductive cycle of OHIS.²⁵ In this cycle, OHIS itself becomes a source of stress, potentially impacting the person's mental and physical well-being. Therefore, it is crucial for health communication scholars and practitioners to investigate the factors that lead to cyberchondria in our digitally connected society.⁴

Research on cyberchondria

The concept of cyberchondria was initially proposed by the news media to describe the negative aspects of digital health and subsequently received attention from many scholars.²⁵ Notably, a working definition of cyberchondria was developed by Vismara and colleagues based on a systematic review of 61 empirical studies: “excessive online health searches that are compulsive and may serve the purpose of seeking reassurance, whilst leading to a worsening of

anxiety or distress and further negative consequences” (p. 1).²⁶ In summary, the phenomenon of cyberchondria consists of two core elements: excessive OHIS and heightened levels of emotional distress.²⁷

Thus far, there are a number of studies investigating the development of cyberchondria, but this field of research is still nascent. Extant cyberchondria research mainly focuses on psychological predictors such as intolerance of uncertainty,^{28,29} health anxiety,^{30,31} and metacognitive beliefs.^{7,21,24} More specifically, a meta-analysis study reported that there is a strong positive relationship between health anxiety and cyberchondria as well as a moderate positive relationship between health anxiety and OHIS.³⁰ Afrin and Prybutok³² found that affective responses and health anxiety serially mediate the relationship between intolerance of uncertainty and cyberchondria among the US internet users.

Besides that, a few studies have assessed the association between personal traits and cyberchondria. To illustrate, neuroticism is a positive predictor of cyberchondria, and optimism is only related to cyberchondria among the elderly participants.³³ Bajcar and Babiak³⁴ revealed that cyberchondria is directly influenced by self-esteem and that obsessive–compulsive symptoms and health anxiety serve as parallel mediating factors in this relationship. Moreover, several studies have identified the role of information-related factors in the cyberchondria development. For example, during the pandemic, Laato et al.³⁵ revealed information trust and information overload increase cyberchondria. Additionally, through a three-wave panel study, Zheng et al.²⁷ further confirmed that when people seek general health information online, information-related trust and overload are two important predictors of cyberchondria.

Our literature review on cyberchondria indicates that prior research has examined various factors associated with this phenomenon. However, we have observed a scarcity of studies investigating the role of health-related advertisements on the internet in triggering the development of cyberchondria. When individuals access health information online, encountering advertisements is quite common. These advertisements can have both positive and negative impacts. On the positive side, online health advertisements can raise awareness about various health conditions, treatments, and preventive measures, thereby educating the public on important health topics.³⁶ Also, legitimate advertisements can inform the public about beneficial health products and services, which they might not have been aware of otherwise.³⁷ However, some advertisements may have detrimental effects.³⁸ For example, advertisements have the potential to divert users’ attention from valuable health-related content.³⁹ This occurrence is not uncommon, as many users express dissatisfaction with the presence of advertisements, often questioning why certain advertisements seem to persistently follow them throughout the

searching process.⁴⁰ Additionally, some advertisements may feature content that exacerbates fears, portraying common symptoms as signs of severe illnesses.^{6,12} The combination of low-quality health content and these fear-inducing ads compels people to spend additional time searching for and selecting specific information they need. This additional search process negatively affects individuals’ emotions, and potentially intensifying feelings of stress, which are closely associated with cyberchondria.¹⁰ Therefore, while the impact of health advertisements can be both beneficial and harmful, our study particularly focuses on the negative aspects of these advertisements and their potential impact on individuals. Previous studies have indicated that advertising interference can result in individuals perceiving information overload and engaging in discontinuous behavior.^{41,42} However, there exists a research gap concerning the impact of health-related advertising interference on cyberchondria. Consequently, our study builds upon previous studies in this area in order to theorize the link between the two concepts.

Theoretical background

In our current research, we utilize the SSO model,⁴³ a concept from cognitive psychology, to explore the emergence of cyberchondria. The SSO model describes that stressors (S)—environmental stimuli perceived as annoying and disruptive—can lead to psychological strains (S) in individuals, ultimately triggering behavioral or psychological outcomes (O). Since its development, the model has been widely applied in multiple research contexts, particularly in studies examining the dark side of information system use.^{44,45} For example, using the SSO model as a theoretical lens, Fu et al.⁴⁶ found that three types of social media overload (information, social, and system feature) (S) have a positive impact on users’ fatigue (S), which subsequently results in discontinuance intention (O). Similarly, guided by this model, Cao et al.⁴⁷ showed excessive social media use and cognitive–emotional preoccupation (S) directly influence users’ privacy invasion, life invasion, and techno-exhaustion (S), culminating in poor academic performance (O).

Given that cyberchondria represents a repetitive and pathological behavioral pattern of OHIS, influenced by a range of factors at various stages,²⁷ the employment of the SSO model is suitable for investigating its development. In this study, we view cyberchondria as a behavioral and emotional outcome (O) stemming from health-related advertising interference (S), mediated by individuals’ perceptions of information overload and information irrelevance (S). Specifically, during the health-related information search process, individuals often experience advertising interference, a disruptive element in the online environment.⁴² This interference makes individuals feel the information as overwhelmed and irrelevant, aligning

with the strain component in the SSO model. Consequently, these beliefs or perceptions exert an influence on cyberchondria, representing the outcome component of the SSO model. Furthermore, we extend the SSO framework to examine how doctor–patient communication moderates the relationship between information overload and cyberchondria, as well as the relationship between information irrelevance and cyberchondria. Doctor–patient communication serves as a contextual factor that may attenuate the association between psychological strains and behavioral outcomes. We elaborate on the rationale behind each relationship in the next subsection.

Research hypotheses

Advertising interference is concerned with how a person perceives advertisement clutter, which has been linked to reactance.⁴⁸ With the advent of big data, numerous businesses frequently disseminate targeted advertisements on online platforms to attract potential customers, consequently resulting in advertising interference.⁴⁹ According to the cognitive load theory, individuals possess a finite capacity for processing information.⁴⁷ When the volume of information surpasses their cognitive limits, individuals may encounter cognitive overload.⁵⁰ Within the context of OHIS, individuals are confronted with a substantial quantity of health-related search results, some of which take the form of commercial advertisements.⁴²

Engaging in the process of filtering out irrelevant health advertisements and meticulously examining search results consumes considerable time and effort. This information-processing endeavor can engender a perceived state of information overload, wherein individuals are exposed to an overwhelming information environment. Prior investigations have corroborated the positive association between advertising interference and information overload. For instance, Wiedmann et al.⁴¹ concluded that there is a positive relationship between advertising interference and perception of information overload. Similarly, Xie and Tsai⁴² found that advertising interference can exert a positive influence on information overload among Chinese social media users.

The degree to which online content is irrelevant, unimportant, or inappropriate for fulfilling information consumers' needs is referred to as information irrelevance.⁵¹ Owing to the internet's broad penetration, numerous advertisers use the internet as their major source to target users.⁵² Many enterprises engage in advertising campaigns that have no connection to the effective health information that individuals need. These irrelevant advertisements could hinder information seekers from obtaining the desired health-related content. Consequently, individuals who find themselves inundated with such advertisements are more likely to perceive a sense of information irrelevance. Therefore, we propose the following hypotheses:

H1

Health-related advertising interference will be positively related to information overload.

H2

Health-related advertising interference will be positively related to information irrelevance.

In line with the SSO model, people who perceive information overload are more inclined to exhibit subsequent behaviors as a consequence. The internet is replete with a vast array of health information, encompassing both authentic and deceptive contents. Information seekers are burdened when encountering contradictory health information, prompting them to conduct additional searches for more definitive evidence.⁵³ This process of excessively seeking health information online and attempting to discern its authenticity contributes to heightened health anxiety, a hallmark characteristic of cyberchondria.⁵⁴ Scholars have found the impact of information overload on cyberchondria in prior studies. To illustrate, Zheng and Jiang⁵⁵ revealed that perceived information overload with COVID-19 vaccine information on the internet is positively associated with cyberchondria. Therefore, we hypothesize that:

H3

Information overload will be positively related to cyberchondria.

There has been no research on the effect of information irrelevance on cyberchondria, despite earlier studies looking into information-related factors such as information trust and overload.^{27,35} Guo et al.⁵⁶ introduced the concept of information irrelevance into the study of users' discontinuous behavior and demonstrated that information irrelevance directly contributes to information avoidance. However, it remains unclear whether individuals, when perceiving information irrelevance, tend to disregard the information or continue seeking more relevant health information on various websites. The latter scenario is more likely to occur when health anxious users actively search for specific health-related information, thereby entering a cycle of subsequent searches that aligns with the pattern of cyberchondria.²⁵ Consequently, we propose the following hypothesis:

H4

Information irrelevance will be positively related to cyberchondria.

Furthermore, it is reasonable to postulate that health-related advertising interference serves as a direct determinant of cyberchondria. Exposure to a high volume of advertisements can elicit individuals' perception of advertising clutter.⁵⁷ Making sense of these advertisements becomes

challenging, often leading individuals to experience distress or a sense of helplessness. In addition, some unscrupulous advertisers may employ fear-based marketing tactics, employing exaggerated advertisements to evoke individuals' health anxiety and fear.⁵⁸ They market health products that prevent terminal illness by linking common symptoms with incurable diseases. When people encounter such ads, they are likely to experience the feeling of discomfort and health worries. In an effort to alleviate their sense of uncertainty, individuals are prone to engaging in excessive searching for health information, which aligns with the pattern of cyberchondria. Accordingly, we propose the following hypothesis:

H5

Health-related advertising interference will be positively related to cyberchondria.

The paradigm of patient-centered interpersonal communication in clinical medicine emphasizes several key principles, including holistic understanding of the patient, active listening, empathy and compassion, and shared decision-making between doctors and patients.^{59,60} Effective doctor-patient communication plays a crucial role in the provision of healthcare.⁶⁰ It facilitates doctors' better understanding of patients' preferences and needs while also enhancing patients' comprehension of health-related issues.⁶⁰⁻⁶² Individuals who experience high-quality doctor-patient communication receive valuable psychological support, which can alleviate health anxiety and uncertainty.⁶³ Within the context of this study, when individuals perceive information overload or irrelevance, the presence of effective doctor-patient communication can assist them in discerning genuine health-related information and regulating their negative emotions. Moreover, discussions between doctors and patients regarding patients' online search results may decrease the frequency of subsequent OHIS and alleviate health anxiety. In other words, it is presumed that individuals who experience a high quality of doctor-patient communication exhibit a weaker association between information overload and cyberchondria, as well as between information irrelevance and cyberchondria. Therefore, we propose the following hypotheses:

H6

Doctor-patient communication will negatively moderate the relationship between information overload and cyberchondria.

H7

Doctor-patient communication will negatively moderate the relationship between information irrelevance and cyberchondria.

Method

Participants and procedure

In order to validate our proposed model, we carried out an online survey with a cross-sectional design in China. Respondents were recruited via online panels maintained by a market research firm named *Wenjuanxing*. Adults who had previously searched for medical information online and were at least 18 years old were eligible to participate in the research. Participants were informed that the study was anonymous and were guaranteed that all responses to the survey would be kept confidentially. Prior to data collection, participants' online informed consent was obtained as well. To ensure validity and reliability, we set up three trap questions and those who got one question wrong were eliminated. A total of 806 respondents were randomly invited to participate in the survey, and 437 participants completed the questionnaire, attaining 54.22% response rate.

Measures

This study employed measurement instruments derived from previous literature, with minor adjustments to align them with the specific research context. Table 1 presents item wording and descriptive statistics. There were five constructs included in this survey: advertising interference,⁶⁴ information irrelevance,⁶⁵ information overload,³⁵ doctor-patient communication,⁶³ and cyberchondria.⁶⁶ Five-point Likert-type scales ranging from 1 ("strongly disagree") to 5 ("strongly agree") were adopted in the questionnaire. Participants were initially prompted to recall common symptoms experienced in their daily routines, such as cough, stomachache, and headache. Subsequently, all their responses to the questionnaire were based on their experiences with online information seeking of these symptoms.

Data analytical approach

This study adopted the structural equation modeling (SEM) to test the proposed research model as it can analyze the relationship between the study variables simultaneously. Four demographic factors including age, gender, income and OHIS frequency were entered as control variables predicting cyberchondria. Model fits for the measurement and structural models were assessed using the following fit indices criteria: $\chi^2/df < 3$, CFI $> .95$, RMSEA $< .05$, and SRMR $< .08$.⁶⁷ If all above conditions were met, it was considered a good fit.

Results

Sample demographics

The demographic information about the 437 respondents was presented in Table 2. Among them, 42.6% were male

Table 1. Item wording and descriptive statistics.

Latent construct and item wording	M (SD)	Loading	AVE	CR
<i>Advertising interference</i>				
AIF1: "Many health-related advertisements on the internet disturbed me."	3.01 (1.11)	.64	.55	.78
AIF2: "I feel bored for unnecessary health-related advertisements and notifications on the internet."	3.80 (1.17)	.74		
AIF3: "Health-related advertisements usually bothered me when I use the internet."	3.63 (1.12)	.83		
<i>Information overload</i>				
IO1: "I am often distracted by the excessive amount of information on the Internet."	3.31 (1.11)	.84	.68	.87
IO2: "I find that I am overwhelmed by the amount of information that I process on a daily basis from the Internet."	3.06 (1.31)	.82		
IO3: "I receive too much information regarding my symptom to form a coherent picture of what's happening."	3.22 (1.22)	.82		
<i>Information irrelevance</i>				
IIR1: "I find it hard to get the health information that is relevant to my needs."	2.92 (1.06)	.68	.56	.83
IIR2: "Health information on the internet is useless to me."	2.29 (0.94)	.77		
IIR3: "Health information on the internet is not applicable to me."	2.60 (1.00)	.82		
IIR4: "Health information on the internet is not related to my interests."	2.61 (1.05)	.71		
<i>Doctor-patient communication</i>				
DPC1: "Give you the chance to ask all the health-related questions you had."	3.66 (0.89)	Deleted	.52	.80
DPC2: "Give the attention you needed to your feelings and emotions."	3.39 (0.99)	.82		
DPC3: "Involve you in decisions about your health care as much as you wanted."	3.57 (0.95)	.72		
DPC4: "Make sure you understood the things you needed to do to take care of your health."	3.76 (0.92)	.67		
DPC5: "Spend enough time with you."	2.74 (1.17)	.68		
DPC6: "Help you deal with feelings of uncertainty about your health or healthcare."	3.62 (0.90)	.69		
<i>Cyberchondria</i>				
CYB1: "After searching for information about my symptom on the internet, I feel frightened."	3.36 (1.15)	.82	.58	.84
CYB2: "After searching for information about my symptom on the internet, I feel frustrated."	3.20 (1.23)	.81		
CYB3: "After searching for information about my symptom on the internet, I feel confused."	3.49 (1.14)	.68		
CYB4: "Once I start searching for information about my symptom on the internet, it is hard for me to stop."	3.22 (1.26)	.72		

M: mean; SD: standard deviation; AVE: average variance extracted; CR: composite reliability

and 57.4% were female. Their age was between 18 and 58 years old ($M = 31.8$, $SD = 6.5$). Most respondents in our sample (86.3%) had a bachelor's degree. Nearly half of the respondents (48.1%) reported they sometimes searched for health information online when they suffered from some common symptoms in their daily lives.

Table 2. Respondents' demographic information ($n = 437$).

Measure	Item	Frequency	Percentage
Gender	Male	186	42.6
	Female	251	57.4
Age	Measured in years, M (SD)	31.8 (6.5)	
Education	Primary school	0	0
	Secondary school	3	0.7
	High school/ pre-university	39	8.9
	Undergraduate	377	86.3
	Postgraduate and above	18	4.1
OHIS frequency	Never	0	0
	Rarely	18	4.1
	Sometimes	210	48.1
	Often	158	36.2
	Always	51	11.6

M : mean; SD : standard deviation.

Table 3. Correlation between the constructs.

Construct	(1)	(2)	(3)	(4)	(5)
(1) Advertising interference	.74				
(2) Information overload	.59***	.82			
(3) Information irrelevance	.43***	.36***	.75		
(4) Doctor-patient communication	-.17**	.06	-.10**	.66	
(5) Cyberchondria	.64***	.65***	.39***	-.02	.76

Note: The AVE square root is in bold typeface.

* $p < .05$; ** $p < .01$; *** $p < .001$.

Model testing

The correlation among the study variables is presented in Table 3. First, confirmation factor analysis showed that the measurement model had a good fit: $\chi^2/df = 1.39$, $p < .001$, CFI = 0.94, RMSEA = .053 with 90% CI [.045, .060], and SRMR = .052. In the measurement model, standardized factor loadings of the items were all above .60, ranging from .61 to .84. Besides that, the composite reliabilities (CRs) of all variables were above .70, and their values of average variance extracted (AVE) were higher than .50. The square root of each construct AVE was larger than its correlation with other constructs. All the above shows that the measurement model had good reliability and convergent and discriminant validity. Similarly, the structural model had a good fit: $\chi^2/df = 2.04$, $p < .001$, CFI = .94, RMSEA = .049 with 90% CI [.042, .055], and SRMR = .063.

The full structural model explained 85% of the variance in the dependent variable cyberchondria. The results of SEM are illustrated in Figure 1. First, there was a strong and positive relationship between advertising interference and information overload ($\beta = .60$, $p < .001$), which supported H1. In addition, advertising interference was positively related to information irrelevance ($\beta = .45$, $p < .001$). Hence, H2 was supported. Further, in support of H3, information overload was positively associated with cyberchondria ($\beta = .80$, $p < .001$). However, information irrelevance was not related to cyberchondria ($\beta = .06$, $p = .15$). The result therefore did not support H4. In support of H5, advertising interference was directly associated with cyberchondria ($\beta = .15$, $p = .004$).

In terms of the interaction effects, we found that doctor-patient communication negatively moderated the effect of information overload on cyberchondria ($\beta = -.07$, $p = .03$), such that the positive effect of information overload on cyberchondria was weaker when the level of doctor-patient communication increased. Therefore, H6 was supported. This interaction effect was plotted in Figure 2. However, the interaction effect of doctor-patient communication and

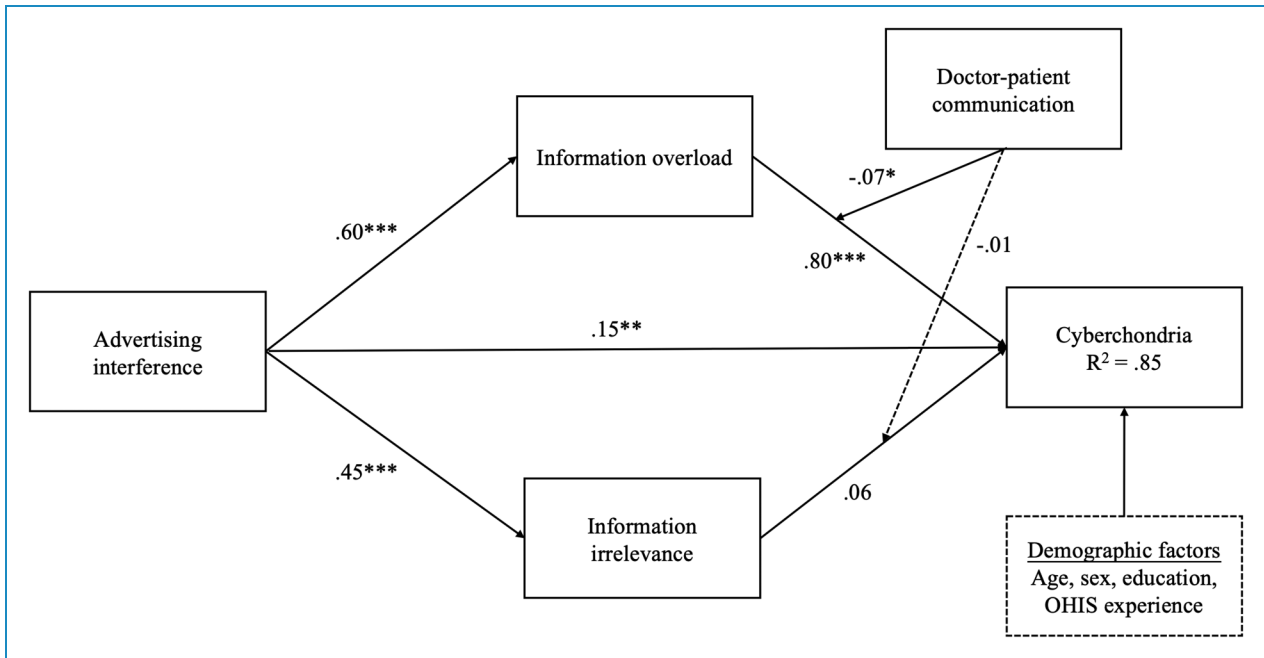


Figure 1. Results of model testing.

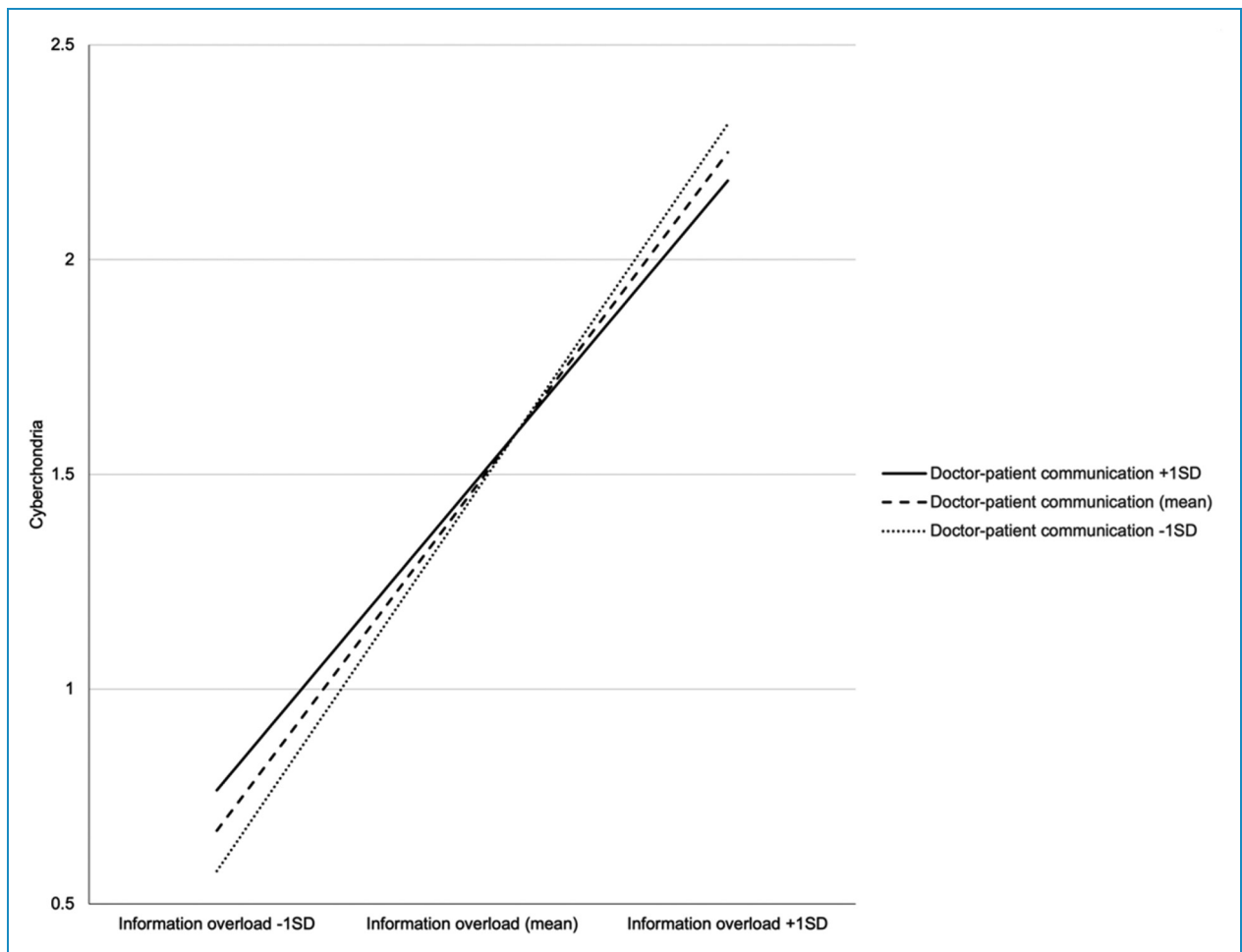


Figure 2. The interaction effect between information overload and doctor-patient communication.

information irrelevance on cyberchondria was not significant ($\beta = -.01, p = .82$). As such, H7 was not supported. Finally, among the control variables, except for OHIS frequency ($\beta = .07, p = .02$), other factors (age, gender, and education) were not significant predictors of cyberchondria.

Discussion and conclusion

Guided by the SSO framework, this study sought to explore how health advertising interference on the internet is related to cyberchondria. An online survey was conducted in China with 437 health consumers to empirically validate the proposed model. Here, we discuss some key findings. First, we found a positive association between information overload and cyberchondria. This finding is consistent with the existing studies which identified information overload as a strong predictor of cyberchondria.^{27,35,55} On the other hand, our study confirmed that information irrelevance did not have a significant impact on cyberchondria. One plausible interpretation is that when individuals perceive the health-related information they acquire from the internet as irrelevant to their specific health concerns, they may opt to discontinue seeking such information online and instead rely on alternative sources, such as advice from friends or healthcare professionals, for their decision-making processes.

Second, the present study elucidated a direct association between health advertising interference and cyberchondria. This finding aligns with several studies that link advertising interference to the dark side of social media (e.g. social media fatigue).^{52,68} Past research has demonstrated that a significant portion of health-related advertisements on the internet are deemed inaccurate and misleading.⁶⁹ This suggests that the public may be exposed to unreliable or false information, which could create misconceptions about health conditions and treatments. In the context of cyberchondria, individuals exposed to recurrent online advertisements that magnify medical conditions may develop a heightened perception of the severity of their own health issues. Consequently, this perception fosters elevated levels of health-related anxiety and more searches for health information.

Third, we observed that health-related advertising interference is positively related to perceived information overload and information irrelevance. These findings highlight that advertising interference may trigger some negative cognitive perceptions about online medical information. In the context of OHIS, some expend a great deal of effort to process the search results. Processing large amounts of search results which mixed with commercial advertisements may exceed the user's limited capacity of dealing with information, creating a sense of information overload.⁵⁵ For example, an integrated study of advertising clutter in online media by Ha and McCann⁷⁰ showed in the process of completing information-oriented tasks,

advertising is perceived as a barrier to obtain the specific information. Users have to exert more effort to ignore advertisements that are not relevant to their goals. In our study, health advertising can be viewed as undesirable and irrelevant information given that it cannot fulfill the users' health information needs.

Fourth, this study reveals a negative interaction effect between doctor-patient communication and information overload on cyberchondria. This finding emphasizes the significance of high-quality doctor-patient communication as a contextual element in the process of cyberchondria development. A proficient doctor-patient relationship serves to regulate patients' emotions, enhance comprehension of health-related information, and alleviate concerns regarding health matters.^{71,72} Therefore, even if individuals suffer from information overload in the searching process, those who experience effective doctor-patient communication are less prone to developing cyberchondria. This noteworthy moderation effect of doctor-patient communication aligns with the prevailing paradigm of patient-centered interpersonal communication, which aims to enhance healthcare outcomes.⁶⁰

Theoretical implications

Our study yields significant theoretical implications. First, although previous studies have predominantly focused on various psychological factors influencing cyberchondria, such as health anxiety, anxiety sensitivity, and intolerance of uncertainty,^{31,73,74} the potential impact of online health content quality, particularly advertising, remains inadequately investigated. Accordingly, this study expands upon existing research by theorizing the link between health-related advertising interference and cyberchondria. By revealing both direct and indirect effects, we identified the pivotal role of advertising interference in triggering cyberchondria.

Second, information-related factors (e.g. information overload) have been identified as predictors of cyberchondria in prior studies.^{27,35,55} Building upon this line of inquiry, our study expands the scope by investigating the influence of information irrelevance within this process. Contrary to our expectation, our finding revealed a lack of a significant relationship between information irrelevance and cyberchondria. To strengthen the validity of this effect, future studies could replicate our research using alternative samples.

Third, although a limited number of studies have attempted to identify factors that could mitigate cyberchondria, such as e-health literacy,⁵⁵ to the best of our knowledge, this study is among the first to explore the role of doctor-patient communication in countering the dark side of OHIS. Particularly, it advances the current understanding of cyberchondria development by incorporating an interpersonal factor that may weaken the influence of informational factors on cyberchondria.⁷⁵

Practical implications

The findings of this study also yield some suggestions for effectively managing cyberchondria in the digital era. First, considering the direct association between health advertising interference and cyberchondria, it is advisable for users to proactively limit their exposure to advertising, particularly during periods of public health crises.⁷⁶ Health professionals can play a significant role by directing individuals toward trustworthy websites that offer health-related information devoid of commercial advertisements. In addition, given the widespread presence of exaggerated advertisements, it is crucial for health communicators to educate the general public on how to discern between fraudulent advertisements promoting health information and genuinely valuable search results, as well as critically apply the results to their own health conditions.⁷⁷ This educational initiative will enable individuals to make informed decisions and avoid falling prey to misleading or false claims.

Second, recognizing the positive impact of information overload on cyberchondria, search engine companies can develop ranking algorithms for health-related searches, as well as detecting potential searches escalation. More specifically, one possible way would be to add research-based results regarding the prevalence and possibility of particular diseases into the algorithms, increasing the likelihood of plausible results.⁵ This may reduce the possibility of abundant irrelevant information yielding an unrealistic yet terrifying result. By curating search results and promoting trustworthy sources, search engine companies can contribute to reducing the likelihood of cyberchondria and help users navigate digital health information more confidently.

Third, the findings underscore the crucial role of doctor-patient communication in mitigating cyberchondria. Health professionals should actively foster patient-centered treatment approaches and strive to establish strong relationships with their patients. For instance, doctors can explore patients' internet usage, especially for those who have anxiety about their health, and provide psychoeducation about internet technology and its influence on the potential further searching.^{78,79} Besides that, doctors can also initiate discussions regarding health information obtained through online sources or other channels, actively engage with patients to process information together, and provide contextualized guidance rather than merely impart general information.⁸⁰ This personalized approach can alleviate patient anxiety induced by OHIS and empower individuals to make well-informed decisions about their health.

Limitations and future directions

There are several limitations in the current research that warrant explicit attention in future studies. First, the utilization of a cross-sectional design in our study precludes the

establishment of causal relationships between variables. To overcome this limitation, future research should employ experimental or longitudinal designs to examine the proposed hypotheses more effectively. Second, the concept of health-related advertising interference was assessed from a general perspective. However, it is essential to acknowledge that the detrimental impact of advertising may vary depending on the specific online platforms or channels individuals use. Therefore, it is important for future studies to identify diverse sources of health-related advertisements and further investigate their differential effects on cyberchondria. Lastly, this study focused on a limited set of information-related factors contributing to cyberchondria. Hence, future studies could encompass other types of factors that may provide a more comprehensive picture of cyberchondria development.

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