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Online health information seeking and health anxiety in the elderly: The mediating role of perceived information quality

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Abstract

Introduction. This study investigates the impact of online health information seeking modes, self-directed and proxy seeking on health anxiety among the elderly.

Method. A total of 543 valid questionnaires were collected from elderly individuals aged sixty and above who had experienced illness in the past six months. The survey was conducted both online and offline, with data collection primarily carried out in Anhui Province, China. Participants had varied socio-demographic backgrounds and generally lower levels of digital literacy.

Analysis. We employed benchmark regression and propensity score matching to address self-selection bias and estimate causal effects. Mediation analysis was conducted to explore the role of perceived information quality, while subsample regression analyses examined differences based on gender, education level, and perceived physical limitations.

Results. The findings revealed that self-directed online health information seeking exacerbated health anxiety among the elderly, with information quality perception serving as a mediating factor. Conversely, proxy online health information seeking alleviated health anxiety among the elderly, but the mediating effect of information quality perception was not significant in this process. Subsample regression revealed that compared to males, female health anxiety was more susceptible to the exacerbation effect of self-directed seeking and the alleviation effect of proxy seeking. Individuals with higher education levels exhibited a weaker exacerbation effect of self-directed seeking on health anxiety and a stronger alleviation effect of proxy seeking compared to those with lower education levels. Among older adults whose physical condition significantly affected their daily activities, self-directed seeking had a stronger exacerbating effect on health anxiety, while proxy seeking provided a greater alleviating effect.

Conclusions. This study underscores the risks of increased health anxiety associated with self-directed online health information seeking among older adults and highlights the potential of proxy seeking as an effective mitigating strategy.

Introduction

With the continuous advancement of information technology and the public's heightened health awareness, online access to health information has become the primary choice for an increasing number of individuals. Statistics indicate that when experiencing symptoms of illness, over 70% of people utilize the Internet to search for health information and engage in self-diagnosis (Zuccon et al., 2015). Concurrently, the need to obtain health information is one of the motivating factors for 20% of non-internet users to go online (CNNIC, 2015). As the ageing population, commonly defined as individuals aged sixty and above and based on criteria from the World Health Organization and national demographic standards, continues to grow, a number of elderly individuals have turned to the Internet to search for health information (Hong & Cho, 2017). Figures reveal that the percentage of older adults seeking health information online has risen consistently from 14.5% in 2011 to 43.6% in 2020 (Freedman et al., 2021). This trend has become particularly pronounced in the context of the COVID-19 pandemic (Zeng et al., 2022). By seeking online health information, users can more accurately comprehend and apply health-related knowledge, potentially leading to positive impacts on healthy lifestyle practices, early disease diagnosis, disease management, and participation in medical decision-making processes (Poortaghi et al., 2015).

Online health information seeking is often accompanied by psychological responses such as stress, anxiety, or reassurance, and a reciprocal influence exists between the two (Liu, 2020). During the process of seeking relevant information, individuals may experience concerns regarding their inability to control and effectively utilize health information, potentially resulting in an anxious mindset (Jia & Li, 2024). Health anxiety refers to an individual's misinterpretation of bodily sensations and symptoms, leading to excessive worry, panic, and even an excessive focus on a particular physical condition or illness (Fava et al., 2017; Mathes et al., 2018). From a psychological perspective, health anxiety can affect individuals universally, and it is an emotional state arising from internal factors (Landi et al., 2020). Notably, in the uncertain and evolving environment following the COVID-19 pandemic, the feeling of 'being healthy' has diminished among individuals, and health anxiety has transcended being a psychological issue for a few individuals, becoming a prevalent phenomenon in society (Petrocchi et al., 2021). This mindset may be further exacerbated or alleviated by the characteristics of online health information and personal information-seeking behaviour. Consequently, studying the impact of online health information seeking on health anxiety holds significant practical implications.

Self-directed online health information seeking, which refers to individuals actively seeking, obtaining, and interpreting information related to their health conditions, has been shown to have a significant correlation with health anxiety (Jagtap et al., 2021; McMullan et al., 2019; Riaz et al., 2023; Svestkova et al., 2023), particularly during crises such as the COVID-19 pandemic (Li et al., 2023; Zimmerman, 2021). Individuals with high health anxiety may exhibit an excessive focus on disease-related information and a lower tolerance for uncertainty, leading them to more easily fall into a vicious cycle during self-directed seeking, where seeking triggers anxiety, and anxiety drives further seeking (Gong et al., 2023). During the seeking process, low-quality and misleading information may cause individuals to misunderstand their health conditions (Colditz et al., 2018), while information overload and confusion further exacerbate anxiety (Zheng et al., 2023). It is necessary to encourage patients to obtain information from reliable sources and share the information with healthcare professionals to confirm its accuracy (Merati-Fashi et al., 2022). Individual characteristics such as gender, education level, and health literacy level have a significant impact on health anxiety during self-directed online health information seeking (Myrick & Willoughby, 2019; Wilding et al., 2022). Health information disclosure and sharing behaviours, as well as individuals' motivations and attitudes toward the use of health information, are closely related to health anxiety (Wang et al., 2023). Some scholars hold the opposing view, arguing that online health information seeking significantly reduces individual anxiety (Coglianese et al., 2020).

Proxy online health information seeking refers to the process where family or friends conduct health information searches on behalf of an individual (Cutrona et al., 2015; Reifegerste et al., 2017). Proxy online health information seeking is a common phenomenon, with nearly two-thirds of Internet users who seek health information online doing so on behalf of others to provide informational support (Cutrona et al., 2015; Reifegerste et al., 2017; Selwyn et al., 2016). This concept is particularly relevant for the ageing population. Older adults often face challenges such as limited digital literacy, reduced familiarity with online search tools, and potential cognitive decline, which make it difficult for them to independently seek and evaluate health information online (Latulipe et al., 2018). At the same time, ageing is frequently accompanied by increased health concerns and a growing need for timely, accurate health information. This mismatch between heightened information needs and limited ability to navigate digital environments creates a gap that many older adults struggle to bridge. As a result, they tend to rely more heavily on family or friends to perform online searches on their behalf (Baidoo et al., 2024; Petrovčič et al., 2024). In many cultures, especially those with strong familial obligations, proxy seeking becomes a key mechanism through which elderly individuals access and make use of digital health information (Xu et al., 2024). Beyond informational support, this process may provide psychological comfort and strengthen social support networks (Pluye et al., 2013). Current research on proxy online health information seeking primarily focuses on the characteristics of proxy seekers (El., 2022), the factors influencing proxy online health information seeking (Song et al., 2019; Xu et al., 2024), and the consequences of proxy online health information seeking (Reifegerste et al., 2020; Zhang & Liu, 2023). However, there is limited research on the impact of proxy online health information seeking on the psychological factors of the person being represented.

In addition to the process of seeking health information, the quality of the information accessed is a critical factor influencing the emotional and psychological outcomes of individuals. Information quality refers to the accuracy, reliability, comprehensiveness, and clarity of health-related content (Doubleday et al., 2021). Previous research has highlighted that low-quality or misleading health information can exacerbate anxiety and confusion, leading to misinterpretations of health conditions (Betsch et al., 2012; McMullan et al., 2019). Information overload, the exposure to an overwhelming amount of health-related data, can increase stress and uncertainty, which in turn contributes to health anxiety (Chae, 2016). Studies have also demonstrated that individuals who engage with high-quality, accurate, and clear information are more likely to feel a sense of control and confidence, thereby reducing feelings of anxiety (Deng et al., 2023; Najib et al., 2022). This underscores the importance of considering information quality in understanding how online health information seeking impacts psychological well-being.

Several limitations within these two research areas require further attention and improvement. First, in the research on online health information seeking, scholars primarily rely on qualitative and experimental studies to explore its impact on health anxiety, while quantitative analyses are relatively scarce and mostly limited to correlation analysis. This methodological approach may have issues such as uneven sample distribution and selection bias (Wang et al., 2019), making it challenging to establish the causal relationship between online health information seeking and health anxiety, thus affecting the reliability of the results. Second, in the research on proxy online health information seeking, studies mainly focus on the behaviour of the proxy seekers themselves or infer the needs and information behaviour of the person being sought based on the proxy seekers' behaviour, given the challenges in directly observing the information behaviour of the person being sought. However, as the core purpose of proxy seeking is to meet the information needs of the person experiencing the health condition, research on this group is particularly important. Third, in practice, individuals can be both self-directed health seekers and health seeking proxies. However, existing research on online health information seeking behaviour has not effectively combined self-directed seeking and proxy seeking to systematically investigate the impact of different health information seeking patterns on health anxiety. Fourth, although

research on online health information seeking among the elderly is increasing, the relationship between online health information seeking and the psychological well-being of the elderly, such as health anxiety, remains understudied. These deficiencies hinder a comprehensive and in-depth understanding of online health information seeking behaviour.

To address this gap, this study aims to:

1. Quantify the distinct effects of self-directed and proxy online health information seeking on older adults' health anxiety, clarifying the degree of influence of each mode.
2. Empirically test whether perceived information quality mediates the relationship between information seeking behaviours and health anxiety and explore its mechanism if applicable.
3. Investigate variations in the effects of information seeking behaviours on health anxiety across demographic groups, such as gender, education level, and perceived physical limitations.
4. Propose practical strategies, such as improving elderly's health information education, building reliable online platforms, and strengthening psychological support, to improve the mental health of the elderly.

Research hypothesis

Self-directed online health information seeking and health anxiety

Self-directed online health information seeking refers to individuals actively searching, obtaining, and interpreting information related to their health conditions on the Internet. Self-directed online health information seeking serves as a persistent factor that contributes to individual health anxiety (Baumgartner & Hartmann, 2011). Firstly, the quality of online health information varies greatly (Starcevic & Berle, 2013). When individuals search for health information, they can be easily influenced by low-quality content, leading to excessive concerns and anxiety about health issues (Baumgartner & Hartmann, 2011). Secondly, some conventional strategies used in health information dissemination, such as fear appeals and emotional appeals, may have negative impacts on individuals, easily causing panic or anxiety (Gu et al., 2023). Finally, the efficiency and accuracy of individuals' information seeking are influenced by their own characteristics and cognitive abilities (Zimmerman et al., 2020). Seeking health information under the influence of cognitive biases often leads to further increases in negative emotions (Azzopardi, 2021).

Although it may provide some temporary relief, this behaviour often leads to the perpetuation of anxiety (Te et al., 2016). Attempting to reduce distress through online searches may exacerbate the level of health anxiety in some individuals. Empirical studies conducted by researchers such as Doherty-Torstrick (Doherty-Torstrick et al., 2016) and Elhai (Elhai et al., 2020) have demonstrated a positive correlation between individuals' online health information seeking and health anxiety. Accordingly, we hypothesize that:

Hypothesis 1: Self-directed online health information seeking exacerbates seekers' health anxiety.

Proxy online health information seeking and health anxiety

Proxy online health information seeking refers to the behaviour in which individuals conduct online health information searches on behalf of another person. Typically, individuals rely on others for proxy online health information seeking to receive explicit social support, driven by internal factors based on social relationships (Jennieet et al., 2007). Social support encompasses informational support, involving the provision of information and advice to aid in understanding and handling problems, and emotional support, entailing the expression of care and encouragement to instil confidence (Albrecht & Goldsmith, 2003 ; Liu et al., 2021). Research has demonstrated that social support offers psychological benefits by fostering connections with others, thereby alleviating psychological distress, pressure, and adverse psychological states (Umberson & Karas, 2010). Compared with other sources, the elderly prefer to consult their family

members, friends, and healthcare professionals (Reynolds et al., 2023). This proxy online health information seeking behaviour enables the proxy to experience the positive impact of intimate relationships, consequently relieving and regulating the individual's psychological pressure and enhancing their sense of happiness (Link et al., 2020). Accordingly, we hypothesize that:

Hypothesis 2: Proxy online health information seeking alleviates the health anxiety of the individual being represented.

The mediating role of perceived information quality

From the perspective of self-directed health information seeking

Perceived information quality refers to an individual's subjective evaluation of the accuracy, reliability, timeliness, and comprehensibility of health-related content available on the internet (Doubleday et al., 2021). As a key factor influencing individual behaviour, this perception significantly contributes to health anxiety (McMullan et al., 2019). In the digital era, information systems have become increasingly complex, and individuals' connection with the information environment has grown closer.

Firstly, people may encounter health-related content during both intentional and unintentional efforts to seek health information, as well as during online activities unrelated to health, potentially triggering health anxiety (Starcevic & Berle, 2013). Secondly, the complexity of online health information poses challenges for individuals in their autonomous efforts to seek useful health information, requiring more time and effort to find relevant content (Park, 2023). Simultaneously, they may rely on subjective experiences and intuition to evaluate health information, increasing the risk of misunderstanding its perceived quality (Liuet al., 2024; Singh et al., 2016).

Research suggests that individuals tend to interpret unclear or ambiguous health information negatively and compare their current physical conditions with known symptoms of diseases, leading to excessive self-diagnosis and reinforcing their health concerns (Kim et al., 2014). Finally, deceptive information, chaotic information sources, and content with low credibility can cause users to doubt the perceived quality of the information they seek, thereby increasing the burden of evaluating it (Chu et al., 2017; Gui et al., 2017; Heylighen, 2002). This exposes them to even more worrying and contradictory information. Accordingly, we hypothesize that:

Hypothesis 3: Perceived information quality exacerbates self-directed online health information seekers' health anxiety.

From the perspective of proxy health information seeking

Older adults tend to have relatively weaker abilities in assessing the quality and utility of online information (Priest et al., 2007), leading to a lack of confidence in independently searching for health information (Ang et al., 2021; Song et al., 2019). Consequently, they tend to rely on friends and relatives as proxy seekers to assess the reliability of online health resources (Reifegerste et al., 2020). Research indicates that individuals frequently seek additional health information through interpersonal channels, such as friends and family, to compensate for potential gaps in their health knowledge and further enhance their understanding of health-related issues (Muse et al., 2020; Zhao et al., 2013). In these cases, the perceived quality of information is shaped not only by the content itself but also by the proxy seeker's ability to filter, explain, and present it.

Effective communication between proxy seekers and the represented individuals during the health information search process can significantly improve the perceived quality of the information obtained (Lagoe & Atkin, 2015). Multiple studies suggest that proxy online health information seeking behaviour is closely related to individuals' social connections (Kubb & Foran, 2020; Reifegerste et al., 2020). Therefore, when dealing with health concerns, individuals are more inclined to trust the health information provided by their friends and relatives than relying solely

on the Internet (Sbaffi & Rowley, 2017; Chen et al., 2018). This trust is rooted in stronger social support relationships.

When assisting those being represented in seeking health information, proxy seekers often demonstrate greater perseverance and patience (Reifegerste et al., 2020). They conduct searches with a more cautious attitude compared to when searching for themselves, reflecting their sense of responsibility for others' health decisions, and are willing to invest more time and effort in finding satisfactory health information (Zorh, 2021). Additionally, proxy seekers serve as information gatekeepers, filtering information for those being represented to reduce stress caused by information overload (El et al., 2022). Proxy seekers also tend to provide high-quality, positive online health information along with detailed health explanations and recommendations to better meet the needs of those they are assisting (Mcinnes & Haglund, 2011). This high-quality and positive health information enables those being represented to deeply appreciate the value of the information, gain a clearer perception of their health status, and effectively alleviate psychological anxiety (Deng et al., 2023; Huang et al., 2019). Accordingly, we hypothesize that:

Hypothesis 4: Perceived information quality alleviates the health anxiety of represented individuals in proxy online health information seeking.

Research design

Model specification

Benchmark model

This study examines the influence of self-directed online health information seeking（sohis）and proxy online health information seeking（pohis）on health anxiety. The following basic measurement model is adopted:

$$\mathrm{ha}_i = \alpha + \alpha_1 \mathrm{sohis}_i + \alpha_c x_i + \varepsilon_i \quad (1)$$

$$\mathrm{ha}_i = \alpha + \alpha_1 \mathrm{pohis}_i + \alpha_c x_i + \varepsilon_i \quad (2)$$

$\mathrm{ha_i}$represents the degree of health anxiety experienced by an individual, $\mathrm{sohis_i}$ and $\mathrm{pohis_i}$ represent self-directed online health information seeking and proxy online health information seeking, respectively,$\mathrm{x_i}$represents the control variable(s), α 、 $\alpha_1$and λ are the parameters to be estimated.

Propensity score matching

To mitigate potential self-selection bias in regression analyses, we utilize propensity score matching to construct a control group with comparable characteristics that simulate the counterfactual outcome of the treated group. This method allows for a comparative analysis of the differential effects on health anxiety between individuals in the treated and control groups. Let $\mathrm{hfa_{1i}}$represent the health anxiety indicator for the treated group, $\mathrm{hfa_{1i}}$represent the health anxiety indicator for the control group, and $\mathrm{hfa_{1i}}$ denote the treatment variable. The causal impact of self-directed online health information seeking and proxy online health information seeking on health anxiety, precisely the average treatment effect for the treated group, can be expressed as:

$$\mathrm{ATT}_i = \mathrm{E}(\mathrm{hfa}_{1i}|\mathrm{D}_i = 1) - \mathrm{E}(\mathrm{hfa}_{0i}|\mathrm{D}_i = 1) = \mathrm{E}(\mathrm{hfa}_{1i} - \mathrm{hfa}_{0i}|\mathrm{D}_i = 1) \quad (3)$$

The analysis steps of the potential outcomes framework for causal modelling (PSM) encompass estimating propensity scores, selecting matching methods, testing the common support assumption, conducting balance tests, and estimating average treatment effects. Propensity scores are typically estimated using a logistic regression model, which can be expressed as:

$$\mathrm{P}(\mathrm{E}_i) = \mathrm{P}(\mathrm{D}_i = 1|\mathrm{E}_i) = \mathrm{E}(\mathrm{D}_i|\mathrm{E}_i) \quad (4)$$

In Equation (4), $P(D_i = 1|E_i)$ represents the propensity matching score, and E_i stands for the matching variable.

Mediating effect model

According to the theoretical analysis in the previous section, the perceived quality of online health information is a mediating variable that influences individuals' health anxiety through their self-directed and proxy seeking for online health information. Consequently, the mediating model is designed through the following four steps:

Step 1: Initially, we examine the direct effects of individuals' self-directed and proxy seeking for online health information on their health anxiety by testing the significance of the regression coefficient α_1 in models (1) and (2).

Step 2: Furthermore, we investigate the relationship between self-directed and proxy seeking for online health information and the mediating variable, the perceived quality of online health information, by testing whether the regression coefficient β_1 is significant.

$$V_i = \beta + \beta_1 \text{sohis}_i + \beta_c x_i + \varepsilon_i \quad (5)$$

$$V_i = \beta + \beta_1 \text{pohis}_i + \beta_c x_i + \varepsilon_i \quad (6)$$

Step 3: We study the potential mediating effect of perceived online health information quality between self-directed and proxy seeking for health information and health anxiety by testing whether the regression coefficient λ_2 is significant.

$$\text{hfa}_i = \lambda + \lambda_1 \text{sohis}_i + \lambda_2 V_i + \lambda_c x_i + \varepsilon_i \quad (7)$$

$$\text{hfa}_i = \lambda + \lambda_1 \text{pohis}_i + \lambda_2 V_i + \lambda_c x_i + \varepsilon_i \quad (8)$$

If both β_1 and λ_2 are insignificant, it indicates that there may be no mediating effect in the model, and further bootstrap testing is required to determine it (Liu et al., 2020). If both β_1 and λ_2 are significant, it suggests a mediating effect.

Variable selection

Dependent Variable

The dependent variable is health anxiety (ha). In this study, the Chinese version of the Short Health Anxiety Inventory (Zhang et al., 2015), with good reliability and validity, is utilized to measure individual health anxiety. The scale comprises eighteen items, scored on a 0-3 scale, with a total score ranging from 0 to 54. A higher score indicates a higher degree of individual health anxiety.

Independent Variables

The independent variables are self-directed online health information seeking (sohis) and proxy online health information seeking (pohis). Proxy online health information seeking is measured by referring to the research of Song et al. (2022) with the measurement item being 'In the past six months, did you ask someone (family or friends) to proxy for you in searching for health information online when facing health problems?' with a response of yes = 1 and no = 0. Self-directed online health information seeking is measured by referring to the research of Zhao et al. (2019) with the measurement item being 'In the past six months, how often did you seek health information online on your own when facing health problems?' The options range from 1 to 5, indicating 'almost never (searched only once or twice in the past six months), occasionally (searched multiple times in half a year), sometimes (searched multiple times a month), often (searched multiple times a week), and always (searched multiple times a day).'

Mediating Variable

The mediating variable is perceived information quality (piq). Drawing on the research of Wang et al., (2021) the measurement items are set as 'the health information searched through the Internet is uneven and ambiguous in expression,' 'the health information searched through the Internet is dazzling and difficult for me to digest,' and 'for the same health problem, there are often inconsistencies in the health information searched through the Internet.' The options range from 1 to 5, indicating 'strongly disagree' to 'strongly agree.' Since the items reflect information quality in a reverse manner, the reciprocal of the mean of the three measurement items is taken as the measurement data. A higher value indicates a better individual perception of online health information quality.

Control Variables

Drawing on the research of Wheaton et al., (2022) and Pieh et al., (2020), gender, age, education level (edu), monthly income (income), intolerance of uncertainty (iu), whether the individual is not receiving any treatment (disease), whether there is only one child (oc), and whether they live with their family (family) are selected as relevant control variables that affect individual health anxiety. Among them, the Intolerance of Uncertainty Scale was compiled by Carleto et al., (2007). The scale contains twelve items, and the mean is used as the measurement data. A higher value indicates a higher intolerance of uncertainty.

Data sources and descriptive analysis

This study incorporated both online and offline questionnaire survey methods. Online surveys were disseminated by the research team members to participants via questionnaire links, while offline surveys were primarily conducted through the distribution of paper questionnaires to outpatients at the Affiliated Hospital of Anhui Medical University. Respondents were required to meet the following criteria:

1. Belong to the elderly population, aged sixty or above, as this demographic exhibits a relatively low level of information literacy and may encounter difficulties in seeking online health information, necessitating assistance in accessing such information.
2. To ensure the relevance and reliability of responses, participants were required to have experienced a health issue within the past six months. Individuals are more likely to engage in online health information seeking during or following personal health events, which provides them with a more concrete basis for reflecting on the behaviours and perceptions addressed in this study.

The formal questionnaire distribution period spanned from March to May 2024, yielding a total of 614 collected questionnaires. After careful data preprocessing, which involved excluding questionnaires with incomplete or improperly completed responses, as well as those with duplicate internet protocol (IP) addresses, 543 valid questionnaires were retained, representing an effective rate of 88.44%. The statistical results are presented in Table 1.

Variables	Variable declaration	Mean	SD	Min	Max
ha	Each item is scored from 0 to 3, and the total score is calculated.	16.00	5.482	4	30
sohis	Each item is scored from 1 to 5, and the average score is calculated.	2.888	1.099	1	5
pohis	1=Yes; 0=No	0.692	0.462	0	1
age	Age in full years	64.60	0.14	60	75
gender	1=Male; 0=Female	0.519	3.15	0	1
edu	1=High school / Secondary specialized school or below; 2=Associate degree or bachelor's degree; 3=Master's degree or above	1.291	0.526	1	3
income	1=Below 2000 yuan; 2=2000-4000 yuan; 3=4000-6000 yuan; 4=6000-8000 yuan; 5=Above 8000 yuan	2.674	1.272	1	5
Family	1=Yes; 0=No	0.718	0.450	0	1
oc	1=Yes; 0=No	0.363	0.481	0	1
disease	1=Yes; 0=No	0.293	0.455	0	1
iu	Each item is scored from 1 to 5, and the average score is calculated.	2.843	0.998	1.420	4.580
piq	Each item is scored from 1 to 5, and the reciprocal of the average value is calculated.	0.369	0.134	0.200	1

Table 1. Descriptive statistics.

Results

Before conducting empirical analysis, the variance inflation factor (VIF) between variables is analysed to assess the issue of multicollinearity. The results show that the max{vif1,vif2...,vifk}=1.27, and the mean{vif1,vif2...,vifk}=1.10, both of which are less than 10. This indicates that there is no multicollinearity problem among the variables.

Benchmark regression

Empirical tests were conducted using stepwise regression to investigate the influence of Self-directed online health information seeking and proxy online health information seeking on health anxiety. The results are summarized in Table 2.

Column (1) exhibits the net effect of Self-directed online health information seeking on health anxiety, revealing a significant positive association between the two. After introducing control variables such as gender, age, and intolerance of uncertainty in Column (2), the positive impact of self-directed online health information seeking on health anxiety remains consistent. This finding suggests that self-directed online health information seeking exacerbates individuals' health anxiety, supporting hypothesis 1.

Column (3) demonstrates the net effect of proxy online health information seeking on health anxiety, revealing a significant negative association between the two. Even after accounting for

control variables in Column (4), the negative impact of proxy online health information seeking on health anxiety persists. This indicates that proxy online health information seeking alleviates individuals' health anxiety, supporting hypothesis 2.

Regarding the control variables, the regression analysis reveals that age exhibits a significant negative impact on health anxiety, implying that older individuals tend to experience lower levels of health anxiety. Cohabitation with family members has a significantly negative effect on health anxiety, suggesting that individuals who live with their families tend to have lower health anxiety levels. Intolerance of uncertainty demonstrates a significant positive impact on health anxiety, indicating that individuals with a higher intolerance for uncertainty are more likely to experience heightened health anxiety.

	(1)	(2)	(3)	(4)
Variables	ha	ha	ha	ha
sohis	2.909***	1.646***		
	(0.174)	(0.153)		
pohis			-3.914***	-2.134***
			(0.482)	(0.358)
age		-0.054***		-0.059***
		(0.020)		(0.022)
gender		0.388		0.260
		(0.299)		(0.319)
edu		-0.229		-0.291
		(0.304)		(0.325)
income		-0.074		0.016
		(0.132)		(0.141)
family		-0.917***		-0.800**
		(0.335)		(0.358)
oc		-0.066		-0.271
		(0.315)		(0.337)
disease		-0.337		-0.394
		(0.330)		(0.353)
iu		2.974***		3.556***
		(0.169)		(0.167)
Cons	7.597***	6.809***	18.707***	11.552***
	(0.538)	(1.518)	(0.401)	(1.597)
Obs	543	543	543	543
R2	0.340	0.606	0.109	0.550

Note: Standard error is in parentheses. *P< 0.1, **P< 0.05, ***P< 0.01 .

Table 2. Benchmark regression results.

Propensity score matching

Individuals' choices to conduct online health searches are not entirely random but influenced by various complex factors, apart from the endogenous issues arising from reciprocal causality. Consequently, to investigate more accurately the impacts of self-directed online health information seeking and proxy online health information seeking on health anxiety, we employed the Propensity Score Matching method. This method selects samples from the control group with similar or identical propensity scores to those in the treated group, enabling the construction of a counterfactual framework. This framework corrects potential self-selection issues and addresses endogeneity problems caused by self-selection biases, thus facilitating a deeper understanding of the complex relationship between online health information seeking behaviours and health anxiety.

Propensity score matching estimation of proxy online health information seeking

The samples were divided into a treated group and a control group based on whether a proxy online health information seeking had occurred. Within these two groups, we searched for results with similar measurable variable values for matching to further examine the causal relationship between variables. Table 3 presents the standardized bias test results for the balanced matched samples. After matching, the covariates' absolute standard deviation values decreased significantly compared to those before matching, with all variables showing standardized bias absolute values below 10%, indicating satisfactory balance. Additionally, the t-tests' p-values for the covariates after matching were all above 0.1, confirming no significant differences between the treated and control groups. This implies that after propensity score matching, the overall bias in the samples was significantly reduced, effectively eliminating differences in population characteristics between those who had engaged in proxy online health information seeking and those who had not, consequently improving the comparability of the matched variables.

Variables	Unmatched	Mean		%bias	%reduct|bias|	t-test	
	Matched	treated	control			t	p>|t|
age	U	55.551	52.707	35.8		3.78	0.000
	M	55.059	54.84	2.8	92.3	0.37	0.708
edu	U	1.2793	1.3174	-7.1		-0.78	0.437
	M	1.2829	1.2793	0.7	90.6	0.09	0.926
income	U	2.5851	2.8743	-22.6		-2.46	0.014
	M	2.6246	2.6416	-1.3	94.1	-0.18	0.856
family	U	0.74468	0.65868	18.8		2.06	0.040
	M	0.7395	0.71399	5.6	70.3	0.76	0.445
oc	U	0.33511	0.42515	-18.6		-2.02	0.044
	M	0.34734	0.33886	1.7	90.6	0.24	0.812
disease	U	0.28723	0.30539	-4.0		-0.43	0.669
	M	0.29412	0.30313	-2.0	50.3	-0.26	0.793
iu	U	2.7056	3.1508	-45.5		-4.90	0.000
	M	2.739	2.7248	1.4	96.8	0.19	0.846

Table 3. Propensity score matching balance test.

The balance test based on kernel matching, as illustrated in Figure 1, demonstrates that the standardized biases of the covariates fluctuate around zero after sample matching, indicating successful balance attainment. On this basis, propensity score matching also needs to satisfy the common support condition to ensure the validity of the estimation results. Consequently, this section further examines the 'overlap effect' between the treated and control groups, depicted in Figure 2. Most samples fall within the common range of values, suggesting that only a minor proportion will be discarded during propensity score matching.

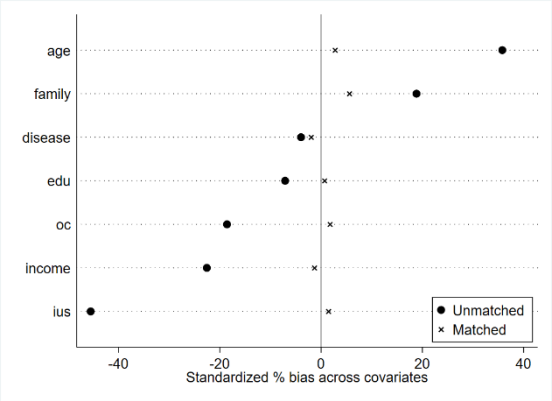

Figure 1. Results of covariate balance test.

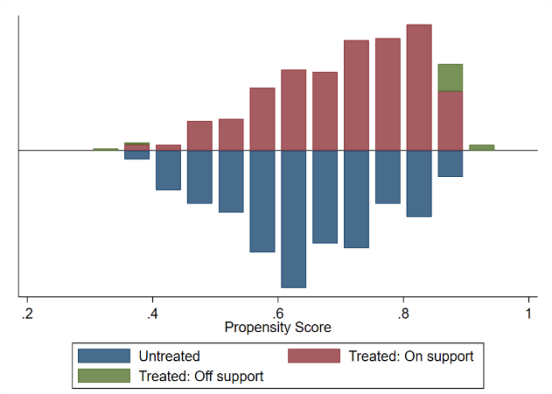

Figure 2. Propensity score distribution.

To enhance the robustness of our results, we employed various propensity score matching methods to match the samples, including one-to-one nearest neighbour matching, radius matching, and Mahalanobis metric matching. We calculated the average treatment effect (ATT) of proxy online health information seeking and found that all six estimation results were consistent and significant (see Table 4). According to the nearest neighbour matching method, the ATT values for the treated and control groups were 15.003 and 16.797, respectively. This discrepancy in the impact of proxy online health information seeking on health anxiety between the treated and control groups suggests a difference level of 1.794. In other words, in the absence of proxy online health information seeking, health anxiety would have increased by 1.794, indicating that proxy online health information seeking significantly mitigates health anxiety among the population.

Matching method		treated	control	ATT	T
	Unmatched	14.793	18.707	-3.914	-8.13***
One-to-one nearest neighbour matching	Matched	15.003	16.797	-1.794	-2.66***
One-to-four nearest neighbour matching	Matched	14.952	16.867	-1.915	-3.27***
Radius matching	Matched	14.952	16.762	-1.810	-3.10***
Kernel matching	Matched	15.003	16.815	-1.812	-3.31***
Local linear regression matching	Matched	15.003	16.776	-1.773	-2.52**
Mahalanobis metric matching	Matched	14.793	17.274	-2.481	-5.32***

Table 4. Propensity score matching results.

Propensity score matching estimation of self-directed online health information seeking

To investigate the causal relationship between self-directed online health information seeking and health anxiety, the sample was divided into treated and control groups based on the frequency of self-directed online health information seeking. Individuals with a frequency higher than the mean level constituted the treatment group, while those with a lower frequency formed the control group. Table 5 presents the standardized bias test results for the balanced matched samples. After matching, the absolute standardized biases of the covariates decreased significantly compared to the pre-matching values. The absolute standardized biases for all variables were generally below 10%, indicating a good balancing effect. Additionally, the t-test p-values were all greater than 0.1, suggesting no significant differences between the treatment and control groups.

Variables	Unmatched	Mean		%bias	%reduct|bias|	t-test	
	Matched	treated	control			t	P>|t|
age	U	53.964	56.123	-26.7		-2.90	0.004
	M	54.318	54.279	0.5	98.2	0.06	0.949
edu	U	1.3132	1.2458	13.2		1.40	0.161
	M	1.289	1.254	6.8	48	0.92	0.36
income	U	2.7967	2.4246	30.4		3.23	0.001
	M	2.7341	2.722	1	96.7	0.13	0.898
family	U	0.70604	0.74302	-8.3		-0.90	0.369
	M	0.71098	0.73324	-5	39.8	-0.65	0.514
oc	U	0.35714	0.3743	-3.6		-0.39	0.696
	M	0.36705	0.38021	-2.7	23.3	-0.36	0.721
disease	U	0.29945	0.27933	4.4		0.48	0.629
	M	0.27746	0.22804	10.9	-145.6	1.50	0.135
iu	U	3.0851	2.3492	80.9		8.61	0.000
	M	3.0265	3.0407	-1.6	98.1	-0.19	0.847

Table 5. Propensity score matching balance test.

The balance test based on kernel matching, as illustrated in Figure 3, demonstrates that the standardized biases of the covariates fluctuate around zero after sample matching, indicating successful balance attainment. As shown in Figure 4, most samples fall within the common range of values, implying that only a small proportion of them will be discarded during the propensity score matching process.

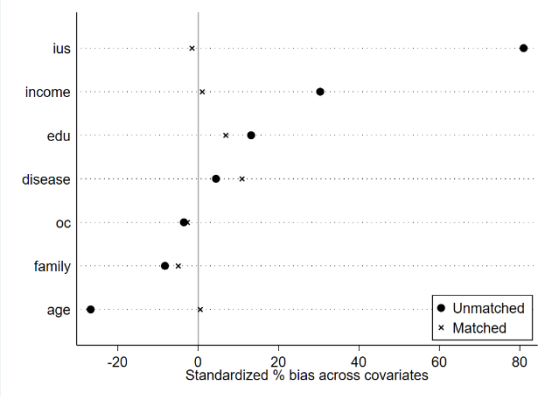

Figure 3. Results of covariate balance test.

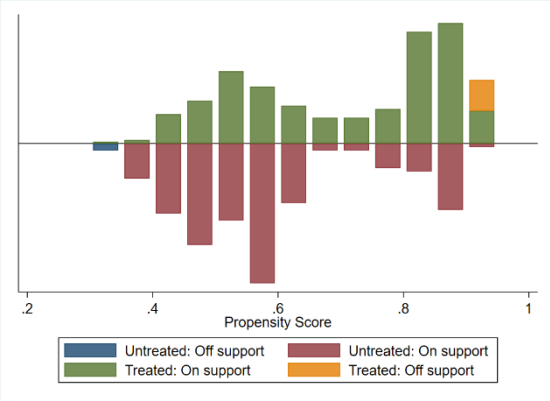

Figure 4. Propensity score distribution.

The results presented in Table 6 demonstrate that the average treatment effect (ATT) on the treated of self-directed online health information searching is statistically significant across various matching methods. Specifically, the one-to-one nearest neighbour matching method indicates that the ATT for the experimental group is 17.650, while the ATT for the control group is 14.155, resulting in a difference of 3.495. This suggests that individuals who engage in high-frequency self-directed searches for health information experience a 3.495 increase in health anxiety compared to those who conduct low-frequency self-directed health information searches. These findings indicate that self-directed online health information searching significantly elevates the health anxiety of this population.

Matching method		treated	control	ATT	T
	Unmatched	14.793	18.707	-3.914	-8.13***
One-to-one nearest neighbour matching	Matched	17.650	14.155	3.496	5.49***
One-to-four nearest neighbour matching	Matched	17.697	14.193	3.504	6.59***
Radius matching	Matched	17.697	14.260	3.437	6.62***
Kernel matching	Matched	17.659	14.271	3.388	7.22***
Local linear regression matching	Matched	17.607	14.172	3.435	5.35***
Mahalanobis metric matching	Matched	17.887	13.487	4.400	11.76***

Table 6. Propensity score matching results.

Mediation effect test

The preceding section theoretically analysed the mediating effect of self-directed and proxy online health information seeking on health anxiety from the perspective of information quality. Here, perceived information quality refers to individuals' subjective evaluations of the quality of online health information they encounter, including aspects such as accuracy, clarity, trustworthiness, and authority. To empirically verify this hypothesized mechanism, a regression analysis was conducted, with the results presented in Table 7.

As shown in column (1), the coefficient for the impact of self-directed online health information seeking on information quality perception is -0.028, which is significant at the 1% level. This indicates that self-directed online health information seeking has a negative effect on individuals' perception of information quality. Column (2) includes the information quality perception variable

in the basic model, revealing that information quality perception has a significant negative impact on individuals' health anxiety, while the impact of self-directed online health information seeking on individuals' health anxiety remains significantly positive but with a reduced coefficient absolute value. This suggests that self-directed online health information seeking exacerbates individuals' health anxiety by reducing their perceived quality of health information, supporting hypothesis 3.

Column (3) shows that the coefficient for the impact of proxy online health information seeking on information quality perception is 0.015, but it is not statistically significant. To directly test the significance of the indirect effect, the Bootstrap method was used, with results presented in Table 8. The confidence interval includes 0, indicating that there is no mediating effect. In other words, the hypothesis that proxy online health information seeking reduces individuals' health anxiety through information quality perception (hypothesis 4) is not supported by the data. One possible explanation is that when assisting the represented individual in seeking health information, proxy seekers tend to provide more psychological comfort and social support rather than focusing on improving the quality or accuracy of the information. This emotional and relational support may shift the attention of the represented individual away from the informational content itself, thereby weakening their critical evaluation of information quality. As a result, their perception of information quality is less likely to be influenced by the proxy's efforts, and more likely to be shaped by their own self-directed information seeking and prior cognitive frameworks.

Variables	(1) piq	(2) ha	(3) piq	(4) ha
sohis	-0.028***	1.344***		
	(0.005)	(0.146)		
pohis			0.015	-1.943***
			(0.012)	(0.325)
piq		-10.680***		-12.699***
		(1.158)		(1.178)
age	0.001	-0.044**	0.001	-0.044**
	(0.001)	(0.019)	(0.001)	(0.020)
gender	-0.014	0.235	-0.012	0.108
	(0.010)	(0.278)	(0.011)	(0.290)
edu	-0.011	-0.346	-0.009	-0.409
	(0.011)	(0.283)	(0.011)	(0.295)
income	0.011**	0.039	0.009*	0.126
	(0.005)	(0.124)	(0.005)	(0.128)
family	-0.001	-0.925***	-0.001	-0.817**
	(0.012)	(0.311)	(0.012)	(0.325)
oc	-0.001	-0.078	0.001	-0.260
	(0.011)	(0.292)	(0.011)	(0.306)
disease	0.021*	-0.118	0.021*	-0.133
	(0.011)	(0.307)	(0.012)	(0.321)
iu	-0.036***	2.590***	-0.048***	2.948***
	(0.006)	(0.162)	(0.006)	(0.161)
Cons	0.492***	12.060***	0.422***	16.917***
	(0.053)	(1.521)	(0.053)	(1.531)
Obs	543	543	543	543
R2	0.200	0.660	0.160	0.631

Table 7. Mediation effect test.

Effect category	Observed Coef.	Bootstrap Std. Err.	z	P>|z|	Normal-based [95% Conf. Interval]	
Indirect effect	-0.451692	0.314905	-1.43	0.151	-1.06889	0.16551
Direct effect	-12.87497	1.22017	-10.55	0.000	-15.2665	-10.4835

Table 8. Bootstrap test.

Subsample regression

In practice, online health information seeking may have varying impacts on individual health anxiety due to differences in personal circumstances. To explore this heterogeneity more thoroughly, we conducted subsample regressions based on three dimensions: gender, education level, and perceived physical limitations. The results are summarized in Tables 9, 10, and 11.

First, based on gender, both males and females experience a statistically significant increase in health anxiety from self-directed online health information seeking ($p < 0.01$). However, compared to males, females tend to demonstrate a greater susceptibility to the exacerbation of health anxiety when engaging in self-directed online health information searches. Conversely, proxy online health information seeking exerts a statistically significant negative impact on health anxiety ($p < 0.01$), with females more likely to perceive its mitigating effect compared to males.

Second, education-based stratification divides the sample into high and low education groups. Self-directed online health information seeking significantly increases health anxiety in both groups ($p < 0.01$), but the effect is weaker among those with higher education. In contrast, proxy seeking significantly reduces health anxiety in both groups ($p < 0.01$), with a stronger alleviating effect among the highly educated.

The third subsample regression examines differences based on perceived physical limitations. Respondents were divided into a low impact group and a high impact group based on whether their physical condition affected their daily activities, and each group was analysed separately. Results indicate that self-directed seeking significantly increases health anxiety in both groups ($p < 0.01$), but the effect is stronger in the high impact group. In contrast, proxy seeking significantly reduces health anxiety in both groups ($p < 0.01$), with a greater alleviating effect in the high impact group.

	(1)	(2)	(3)	(4)
Variables	Female	Female	Male	Male
sohis	1.643***		1.601***	
	(0.218)		(0.218)	
pohis		-2.571***		-1.671***
		(0.512)		(0.501)
age	-0.029	-0.022	-0.081***	-0.096***
	(0.030)	(0.031)	(0.028)	(0.030)
edu	0.226	0.269	-0.659	-0.828*
	(0.447)	(0.472)	(0.418)	(0.448)
income	0.120	0.300	-0.210	-0.225
	(0.194)	(0.203)	(0.185)	(0.199)
family	-0.480	-0.548	-1.214***	-0.934*
	(0.502)	(0.530)	(0.463)	(0.500)
oc	-0.025	-0.240	-0.114	-0.235
	(0.467)	(0.493)	(0.433)	(0.466)
disease	-0.470	-0.372	-0.271	-0.509
	(0.474)	(0.500)	(0.465)	(0.499)
iu	3.072***	3.591***	2.903***	3.517***
	(0.248)	(0.244)	(0.233)	(0.228)
Constant	3.768*	8.054***	10.131***	15.110***
	(2.161)	(2.276)	(2.126)	(2.213)
Obs	261	261	282	282
R2	0.613	0.568	0.607	0.548

Table 9. Regression results for samples divided by gender.

	(1)	(2)	(3)	(4)
Variables	Higher Education	Higher Education	Lower Education	Lower Education
sohis	1.285***		1.747***	
	(0.321)		(0.176)	
pohis		-2.749***		-1.891***
		(0.655)		(0.428)
age	-0.042	-0.026	-0.062***	-0.071***
	(0.045)	(0.045)	(0.023)	(0.025)
gender	-0.468	-0.533	0.678*	0.561
	(0.603)	(0.598)	(0.348)	(0.380)
edu	-0.376	-0.211		
	(1.016)	(1.011)		
income	0.054	0.041	-0.128	-0.003
	(0.270)	(0.269)	(0.156)	(0.170)
family	-1.265*	-1.634**	-0.879**	-0.593
	(0.716)	(0.704)	(0.383)	(0.419)
oc	0.485	0.150	-0.360	-0.504
	(0.595)	(0.592)	(0.375)	(0.410)
disease	-0.486	-0.611	-0.286	-0.247
	(0.658)	(0.653)	(0.386)	(0.422)
iu	2.974***	3.397***	2.988***	3.621***
	(0.349)	(0.313)	(0.195)	(0.198)
Cons	7.693**	11.451***	6.766***	11.391***
	(3.682)	(3.603)	(1.680)	(1.812)
Obs	139	139	404	404
R2	0.610	0.614	0.611	0.536

Table 10. Regression results for samples divided by education level.

	(1)	(2)	(3)	(4)
Variables	Low Impact	Low Impact	High Impact	High Impact
sohis	1.456***		1.995***	
	(0.199)		(0.236)	
pohis		-1.806***		-2.652***
		(0.451)		(0.603)
age	-0.048*	-0.045	-0.046	-0.068*
	(0.027)	(0.028)	(0.031)	(0.035)
gender	0.329	0.078	0.443	0.672
	(0.389)	(0.407)	(0.460)	(0.517)
edu	-0.295	-0.270	0.029	-0.305
	(0.382)	(0.403)	(0.503)	(0.570)
income	0.087	0.183	-0.358*	-0.287
	(0.169)	(0.177)	(0.212)	(0.240)
family	-0.890**	-0.779*	-0.900	-0.773
	(0.421)	(0.443)	(0.554)	(0.631)
oc	-0.271	-0.432	0.368	0.121
	(0.404)	(0.425)	(0.490)	(0.556)
disease	0.153	0.048	-1.528***	-1.389**
	(0.419)	(0.440)	(0.526)	(0.592)
iu	3.182***	3.691***	2.510***	3.287***
	(0.214)	(0.207)	(0.276)	(0.286)
Constant	6.181***	9.855***	6.877***	13.582***
	(2.036)	(2.123)	(2.212)	(2.411)
Observations	355	355	188	188
R-squared	0.595	0.553	0.649	0.556

Table 11. Regression results for samples divided by perceived physical limitations.

Discussion

This study investigates the impact of self-directed and proxy online health information seeking on health anxiety among older adults and empirically tests the hypothesized causal relationships. The research hypotheses are supported by the data, yielding the following conclusions:

1. Self-directed online health information seeking aggravates health anxiety in older adults, with perceived information quality serving as a mediator. The rapid advancement of information technology has made the Internet a crucial source of health information for older adults (Ahmad et al., 2020). However, due to their generally lower levels of digital literacy, older adults often lack the necessary knowledge and skills to effectively evaluate the authenticity and reliability of the vast, diverse, and variable-quality online health information they encounter (Prodromou & Lavranos, 2019). This discrepancy between their information acquisition ability and the complexity of the information itself can lead to information overload and confusion when older adults independently seek health information online (Fan et al., 2024). Their limited information discernment capabilities may hinder their ability to effectively assess the quality of the health information they find, making them more vulnerable to accepting inaccurate, exaggerated, or misleading health information. Exposure to such low-quality information can result in misconceptions about their health status, consequently heightening their health anxiety.
2. Proxy online health information seeking can effectively mitigate health anxiety among older adults, but the mediating role of perceived information quality is not significant. When faced with health concerns, older adults may actively seek assistance from family and friends, requesting their help in seeking relevant health information. This approach can alter their cognitive processing of health information and subsequently reduce anxiety. In contrast to self-directed seeking, proxy seekers aim to provide beneficial health information support to the individual they are assisting. Recognizing the relatively weaker digital literacy and information processing abilities of older adults, proxy seekers tend to exercise greater caution when seeking health information. Motivated by emotional factors, they are more inclined to provide high-quality, positive, and encouraging health information to the person they assist. To accomplish this, proxy seekers often invest more effort in identifying and interpreting this information, enabling older adults to acquire health information while better evaluating their health status, which can contribute to alleviating psychological anxiety. Proxy seekers also serve as information gatekeepers, filtering information for the individual to minimize stress arising from information overload.
3. It is important to acknowledge that when proxy seekers assist older adults in seeking health information, they tend to prioritize providing positive information related to emotional comfort and social support rather than focusing on enhancing the quality or accuracy of the information. While this social and emotional support may influence the affective state of the person receiving assistance, it may not directly shape their perceptions of the quality of online health information. The perception of online health information quality is more likely influenced by self-directed seeking and an individual's preexisting beliefs about online information.
4. Compared to males, females are more susceptible to the aggravating influence of self-directed online health information seeking on health anxiety. Females are more likely to experience the alleviating effect of proxy online health information seeking on health anxiety. Two potential explanations can be posited for this phenomenon. Firstly, women tend to possess more sensitive and delicate emotional dispositions, rendering them more vulnerable to negative emotions and emotional distress (MacSwain et al., 2009). Additionally, they may be more readily influenced by varying and exaggerated health information, leading to greater emotional fluctuations (Davoudi et al., 2012). Secondly,

women exhibit a stronger inclination towards seeking social support (Chen et al., 2023). They may be more willing to share their health concerns with friends, family, or professionals, and heed their advice and opinions. Proxy online health information seeking provides them with a convenient social channel, enabling them to communicate and share experiences with others, and obtain emotional support and understanding, thus facilitating the alleviation of negative emotions.

5. Compared to groups with lower education levels, the effect of self-directed online health information seeking on exacerbating health anxiety is weaker among highly educated groups. In contrast, the effect of proxy online health information seeking on alleviating health anxiety is stronger. A possible explanation for this finding is that individuals with higher education levels typically demonstrate greater health literacy, possessing stronger abilities to understand, evaluate, and apply health information effectively. When engaging in self-directed seeking, they can better discern the quality of information and are less likely to be misled by inaccuracies, resulting in a smaller negative impact on their health anxiety levels. When seeking through proxies such as friends and family members, highly educated individuals can communicate more effectively with these intermediaries, obtaining targeted answers that better alleviate their anxiety. In contrast, those with lower education levels may have biased risk perceptions and are more easily influenced by superficial information, potentially overestimating disease risks and consequently exacerbating their anxiety levels.
6. Differences based on perceived physical limitations also reveal important heterogeneity in the psychological impact of online health information seeking. The results show that both low and high physical limitation groups experience increased health anxiety when engaging in self-directed online health information seeking. However, the effect is significantly stronger among older adults with higher perceived physical limitations. This suggests that individuals who perceive their physical conditions as more severely affecting their daily activities may be more emotionally vulnerable and more inclined to interpret online health information in a negative light. Additionally, limited physical functioning might restrict their access to offline medical consultations, making them more reliant on online information, which in turn may increase the psychological burden when the information is overwhelming, conflicting, or of low quality. Conversely, proxy online health information seeking significantly reduces health anxiety in both groups, with a more pronounced alleviating effect observed among those with higher perceived physical limitations. This implies that for physically vulnerable older adults, receiving filtered and emotionally supportive information from trusted proxy seekers can play a vital role in reducing anxiety. Proxy seekers may act as not only information gatekeepers but also emotional buffers, helping the elderly interpret health information in a more positive and balanced way. For those who are physically limited, and may already experience feelings of helplessness or isolation, the social support embedded in proxy seeking may be particularly effective in mitigating health-related psychological distress.

Conclusions and limitations

This study investigates the impact of two modes of online health information seeking, namely self-directed and proxy seeking, on health anxiety among the elderly population. Additionally, the mediating role of perceived information quality is examined. By employing the propensity score matching method, potential selection bias was effectively controlled, enabling the revelation of the causal relationship between online health information seeking modes and individual health anxiety.

The findings revealed that self-directed online health information seeking exacerbated health anxiety among the elderly, with information quality perception serving as a mediating factor. Conversely, proxy online health information seeking alleviated health anxiety among the elderly,

but the mediating effect of information quality perception was not significant in this process. Subsample regression revealed that compared to males, female health anxiety was more susceptible to the exacerbation effect of self-directed seeking and the alleviation effect of proxy seeking. Furthermore, individuals with higher education levels exhibited a weaker exacerbation effect of self-directed seeking on health anxiety and a stronger alleviation effect of proxy seeking compared to those with lower education levels.

Despite the study's contributions, several limitations and issues arise due to subjective and objective factors, such as the researcher's experience level and the complexity of the research subject. These limitations include:

1. The mediating mechanism between proxy online health information seeking and health anxiety remains unclear and requires further substantiation through follow-up survey research.
2. The influencing factors of individual anxiety are complex, and many representative factors may have been omitted. Future research should consider introducing additional variables and factors to more comprehensively explain the impact mechanism of seeking patterns on health anxiety.
3. The limited amount of data collected relies on questionnaire surveys, potentially leading to results being affected by sample size limitations and subjective bias. Future research should expand the sample size and adopt diversified data collection methods (e.g., mixed-methods research) to improve the study's reliability and validity.

Practical implications

Based on the above findings, this paper proposes the following recommendations:

1. Enhance health information education for the elderly. Provide relevant courses through community centres and elder universities, which are educational institutions specifically designed for older adults, offering various courses to promote lifelong learning and social engagement, to improve older adults' ability to discern the quality of online health information and avoid unnecessary health anxiety caused by misinformation.
2. Establish authoritative online health information platforms for the elderly. The government can take the lead in collaborating with medical institutions and universities to create health information websites and applications specifically designed for older adults. These platforms should provide reliable, easily understandable health knowledge and medical guidance, making it convenient for the elderly to access high-quality health information.
3. Actively support caregivers in proxy health information seeking. The government can encourage and support communities, nursing homes, and medical institutions in assisting caregivers such as family members and friends in their efforts to search for and share reliable health information with older adults. This support may include providing service subsidies and employing professional personnel to guide caregivers in identifying, screening, and interpreting high-quality online health information. By enhancing caregivers' ability to access and process information, these initiatives can indirectly improve the information experience for older adults and help alleviate health anxiety stemming from poor information quality.
4. Strengthen psychological support for health anxiety among the elderly. Local authorities can rely on existing mental health service resources, such as community mental health centres and mental health hotlines for the elderly, to establish psychological counselling services specifically targeting health anxiety in older adults. Mental health education activities focusing on health anxiety can be conducted to popularize relevant psychological coping skills and enhance the mental resilience of the elderly.
5. Regulate the dissemination of online health information and improve the regulatory system for medical information online and intensify the crackdown on false medical

advertisements and wellness-related rumours. Guide self-media platforms to strengthen the review of health-related content and create a positive online health information environment.

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Appendix. Survey questionnaire

Section 1: Demographic information

1. Age: ____ years

2. Gender:

☐ Male ☐ Female

3. Education Level:

☐ High school / Secondary specialized school or below

☐ Associate degree or bachelor's degree

☐ Master's degree or above

4.Monthly Income:

☐ Below 2,000

☐ 2,000–4,000

☐ 4,000–6,000

☐ 6,000–8,000

☐ Above 8,000

5. Do you currently live with your family?

☐ Yes ☐ No

6. Is there only one child in the family?

☐ Yes ☐ No

7. Are you currently not receiving any medical treatment?

☐ Yes ☐ No

8. To what extent does your physical condition affect your daily activities?

☐ No impact

☐ Slight impact

☐ Moderate impact

☐ Severe impact

Section 2: Online health information seeking behaviour

1. In the past six months, how often did you seek health information online on your own when facing health problems?

☐ Almost never (once or twice)

☐ Occasionally (several times in six months)

☐ Sometimes (several times a month)

☐ Often (several times a week)

☐ Always (multiple times a day)

2.In the past six months, did you ask someone (family member or friend) to proxy for you in searching for health information online when facing health problems?

☐ Yes

☐ No

Section 3: Perceived information quality

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The health information searched through the internet is uneven and ambiguous in expression.	☐	☐	☐	☐	☐
The health information searched through the internet is dazzling and difficult for me to digest.	☐	☐	☐	☐	☐
For the same health problem, there are often inconsistencies in the health information searched through the internet.	☐	☐	☐	☐	☐

Section 4: Health anxiety

Statement	Never	Sometimes	Often	Always
I worry about my health.	☐	☐	☐	☐
I experience physical pain in my body.	☐	☐	☐	☐
I am aware of bodily sensations and changes.	☐	☐	☐	☐
I find it hard to control thoughts about being ill.	☐	☐	☐	☐
I am afraid that I have a serious illness.	☐	☐	☐	☐
I imagine what it would be like to be sick.	☐	☐	☐	☐
I find it difficult to stop thinking about my health.	☐	☐	☐	☐
Even if the doctor reassures me that everything is fine, I still can't feel at ease.	☐	☐	☐	☐
When I hear about a certain illness, I believe I have it.	☐	☐	☐	☐
If I notice bodily sensations or changes, I immediately try to figure out what they mean.	☐	☐	☐	☐
I feel that I am at risk of having a serious illness.	☐	☐	☐	☐
I believe I have a serious illness.	☐	☐	☐	☐
If I notice unexplained bodily sensations, I find it hard to think about anything else.	☐	☐	☐	☐
Family and friends think that I worry too much about my health.	☐	☐	☐	☐
If I had a serious illness, I would not be able to enjoy life.	☐	☐	☐	☐
If I had a serious illness, I would think I would not be able to recover.	☐	☐	☐	☐

A serious illness would ruin every aspect of my life.	☐	☐	☐	☐
If I had a serious illness, I would lose my dignity.	☐	☐	☐	☐

Section 5: Intolerance of uncertainty

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Unforeseen events upset me greatly.	☐	☐	☐	☐	☐
It frustrates me not having all the information I need.	☐	☐	☐	☐	☐
One should always look ahead so as to avoid surprises.	☐	☐	☐	☐	☐
A small, unforeseen event can spoil everything, even with the best of planning.	☐	☐	☐	☐	☐
I always want to know what the future has in store for me.	☐	☐	☐	☐	☐
I can't stand being taken by surprise.	☐	☐	☐	☐	☐
I should be able to organize everything in advance.	☐	☐	☐	☐	☐
Uncertainty keeps me from living a full life.	☐	☐	☐	☐	☐
When it's time to act, uncertainty paralyses me.	☐	☐	☐	☐	☐
When I am uncertain, I can't function very well.	☐	☐	☐	☐	☐
The smallest doubt can stop me from acting.	☐	☐	☐	☐	☐
I must get away from all uncertain situations.	☐	☐	☐	☐	☐