Online cancer information seeking and colorectal cancer screening in China: Considering threat and coping Appraisals, and cancer fatalism

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A B S T R A C T

Background: Colorectal cancer is major public health concern in China. This study seeks to explore the role of online cancer information seeking in influencing colorectal cancer screening, by taking into account one's coping appraisals (i.e., self-efficacy, response efficacy), threat appraisals (i.e., perceived severity, cancer worry) and cancer fatalism.
Methods: A cross-sectional survey was conducted with 730 participants in China recruited from a Chinese survey company's online panels. Path analysis was performed to investigate the relationships between the key constructs.
Results: First, online cancer information seeking increased both coping appraisals and threat appraisals. Second, threat appraisal did not significantly influence cancer fatalism, but coping appraisal reduced cancer fatalism. Third, cancer fatalism had no effects on colorectal cancer screening. Lastly, online cancer information also had a direct and positive relationship with cancer screening.
Conclusions: This research emphasises the need for health organisations to offer timely cancer information to people, and educate them about the importance of cancer screening. Health authorities may also regulate online cancer information to ensure that the information is accurate and appropriate in improving people's cancer prevention and cancer screening knowledge.

1. Introduction

Colorectal cancer (CRC) is the third most common cancer in men and women around the world in 2022 (Ferlay et al., 2024b, Ferlay et al., 2024a, Sung et al., 2021, Torre et al., 2015). As of 2022, CRC ranks as the third most common cancer diagnosis and fourth leading cancer death in China (Han et al., 2024). Cancer screening is one of the most effective ways to detect CRC early. A pooled analysis of various randomised controlled trials concluded that screening tests can reduce CRC incidence by 18 % and mortality by 28 % (Brenner et al., 2014, Bevan and Rutter, 2018). Other case-control and prospective cohort studies across the United States and Europe showed CRC mortality to be 65 % to 88 % lower in people who went for colonoscopy than those who did not (Brenner et al., 2011, Dan Jørgensen et al., 2007, Kahi et al., 2009, Neugut and Lebwohl, 2010). Nonetheless, few Chinese people have gone for CRC screening. A cross-country study showed only 17.3 % of Chinese people have participated in CRC tests, as compared to 38 % and 32.4 % in developed countries like Australia and Japan respectively (Koo et al., 2012). The low screening rate may be attributed to people's deficient

knowledge of CRC and CRC tests (Huang et al., 2021), with 35.8 % of Chinese citizens not knowing any forms of CRC tests (Koo et al., 2012).

An essential step to increase people's awareness of CRC and motivation for CRC screening is exposure to information about CRC and benefits of screening. In today's digital age, the Internet is a key source of health information, empowering individuals to find cancer-related information from various platforms, like medical websites, online support groups, and social media. Despite the potential of online cancer information seeking in increasing cancer screening, the mechanism underlying this relationship is unclear. Previous research produced mixed results. For example, in a survey study amongst Chinese women, cancer information seeking increased cancer screening intention (Zhang et al., 2019). Another survey study among Nepalese immigrants in Japan showed that cancer information seeking was positively related to cancer screening behaviours (Bhandari et al., 2020). However, other survey studies based in the United States demonstrated insignificant relationship between cancer information seeking and cancer screening (Kim et al., 2018, Shneyderman et al., 2016, Tan et al., 2014), or even more concerning, a reduction effect of cancer information on screening

intention (Gibson et al., 2016). The mixed findings may be due to two key reasons. First, as individuals' health behaviour (e.g., cancer screening) are influenced by socio-cultural factors (Brofenbrenner, 1989), studies conducted in different social contexts may give rise to distinct results. Second, most research only investigated the direct relationship between health information acquisition and screening behaviour, which ignores the complex effects of people's media use on health outcomes. Scholars highlighted the importance of examining *indirect* or *mediated* influences of media use on health behaviours, to better understand the cogs and wheels illustrating 'how' or 'why' the relationship occurs (Street, 2003). Without mediators, it is challenging to understand why outcomes do not occur or operate effectively in particular situations (Merton, 1968). The identification of mediators is especially crucial for health research as it enables the prioritisation of efforts in specific therapeutic aspects that improves wellbeing above less relevant others (Kazdin, 2007).

To identify the process through which online cancer information use is linked to cancer screening, we proposed a mediation model based on the stimulus-organism-response (SOR) framework to be tested in a Chinese sample (Mehrabian and Russell, 1974). The stimuli (S) represents a series of sensory factors in a particular environment. In our study, we focused on the information environment and examined online cancer information as the S factor. Organism (O) conditions refer to the emotional reactions to the environmental stimuli. Drawing from the protection motivation theory (PMT) which posits that the adoption of protective health behaviour (e.g., cancer screening) depends on threat and coping appraisals (Rogers, 1975), we explored threat and coping appraisals as the O factors. The PMT posits that threat and coping appraisals occur simultaneously, and this multi-dimensional psychological process functions as an antecedent to adaptive responses. Threat appraisals involve an individual's evaluation of the chance of getting cancer (perceived susceptibility) and the negative affective reaction to this threat (worry). Coping appraisals depend on one's assessment of the efficacy of the protective behaviour in preventing cancer (response efficacy), and one's belief in his or her personal ability in carrying out the protective behaviour (self-efficacy) (Ezati Rad et al., 2021). Finally, the O stage triggers psychological or behavioural responses (R), which was respectively examined as cancer fatalism and CRC screening. The next sections briefly elaborate on the rationale for the proposed mediation pathways.

In line with the SOR model, we posited that information seeking can have an effect on threat and coping appraisals. When people search for information about healthy lifestyle and cancer treatment options, they may feel more knowledgeable and empowered about taking preventive actions (Ngien and Jiang, 2022), increasing coping appraisal. In addition, when the cancer information emphasizes on fear appeals, users may perceive their health situation as more risky or severe (Ort et al., 2021), increasing threat appraisals. Past research documented the effects of health information on both coping and threat appraisals (Go and You, 2018, Hanson et al., 2021).

Next, coping and threat appraisals can lead up to two 'R' responses. First, low coping appraisal and high threat appraisal may increase the negative *psychological* response of cancer fatalism, or the belief that cancer occurs as a result fate or luck and cannot be prevented (Molaei-Zardanjani et al., 2019). When one feels little control over health situations, he or she may believe that his or her cancer outcomes are predetermined, enhancing fatalism (Miles et al., 2008). Past research has demonstrated that low coping appraisals and high threat appraisals of health situations (e.g., COVID-19, Ebola) resulted in negative emotions like anxiety or fear, and such emotional state is positively associated with fatalism (Yang and Chu, 2018, Li et al., 2020). Fatalism is especially prevalent in China, where the Confucian idea of *Ming* (i.e., destiny, mandate) suggests one's health is determined by fate (Ngien and Jiang, 2022). Second, fatalism can subsequently reduce CRC screening, a *behavioural* response. As fatalistic people believe that cancer diagnosis is due to fate and beyond control, or that death is inevitable with cancer

(Miles et al., 2008), they may be reluctant to adopt protective behaviours (e.g., cancer screening). Previous research documented that cancer fatalism decreased participation in cancer screening (Peek et al., 2008).

As such, by drawing on the SOR and PMT frameworks, we proposed a mediation model (Fig. 1) that sheds light on how online cancer information seeking might influence cancer screening outcomes. In doing so, this study tests a novel conceptual framework by integrating the SOR theory and PMT model, and addresses the lack of studies on the indirect effects of online cancer information seeking on cancer screening. By testing mediated pathways, we may better understand the micro psychological processes leading up to cancer screening. If validated, subsequent research may employ our conceptual framework to test the effects of diverse forms of digital health information on a range of health behaviours.

2. Methods

2.1. Sampling

We conducted an online survey with 730 participants aged 18 and above in China in January 2021. The participants were recruited by a survey company (https://www.wjx.cn) with over 2.6 million online panel members in diverse geographical locations in China. Convenience sampling was adopted where the survey linked was sent to eligible participants until sample size requirements were met. The study met the authors' institution's guidelines for protection of human subjects concerning safety and privacy, and ethics approval was obtained from the institution's Ethics Review Committee. Survey respondents provided online informed consent before participation.

2.2. Measurement

Online cancer information seeking was measured by one item asking respondents if they have used the Internet to look for cancer-related information. As per Table 1, this item was dichotomous (1 = Yes, No = 0) and adapted from past research (Ngien and Jiang, 2022).

Perceived susceptibility was assessed by two items drawn from the Health Information National Trends Survey (HINTS) (National Cancer Institute, 2003). Respondents indicated their agreement with the statements on a 7-point Likert scale (1 = Very Unlikely to 7 = Very Likely). The items were "How likely do you think you will get cancer at some point in your lifetime?" and "How likely do you think that others of your age, gender and race will get cancer at some point in their lifetime?". (Cronbach's alpha = 0.76).

Cancer worry was measured by four items (e.g., "I worry about my health because of my chances of getting cancer") (1 = Strongly Disagree to 7 = Strongly Agree) as drawn from previous research (Chae, 2015). (Cronbach's alpha = 0.88).

Self-efficacy was evaluated by a single item that measured participants' belief that going for cancer screening to decrease their chances of getting cancer is easy to do. Respondents rated their agreement on a 7-point Likert scale (1 = Strongly Disagree to 7 = Strongly Agree), and their responses were calculated. This item was drawn from prior research that also used single item to assess this variable (Miles et al., 2008).

Response efficacy was assessed by one item ("I believe going for cancer screening is effective in preventing cancer"), drawn from past research (Miles et al., 2008). Participants provided their agreement to this statement on a 7-point Likert scale (1 = Strongly Disagree to 7 = Strongly Agree).

Cancer fatalism was assessed by seven items measuring respondents' beliefs about the inevitability of getting cancer (e.g., "I belief if someone is meant to get cancer, they will get it no matter what they do) on a 7-point Likert scale (1 = Very Unlikely to 7 = Very Likely) (Jensen et al., 2014). (Cronbach's alpha = 0.92).

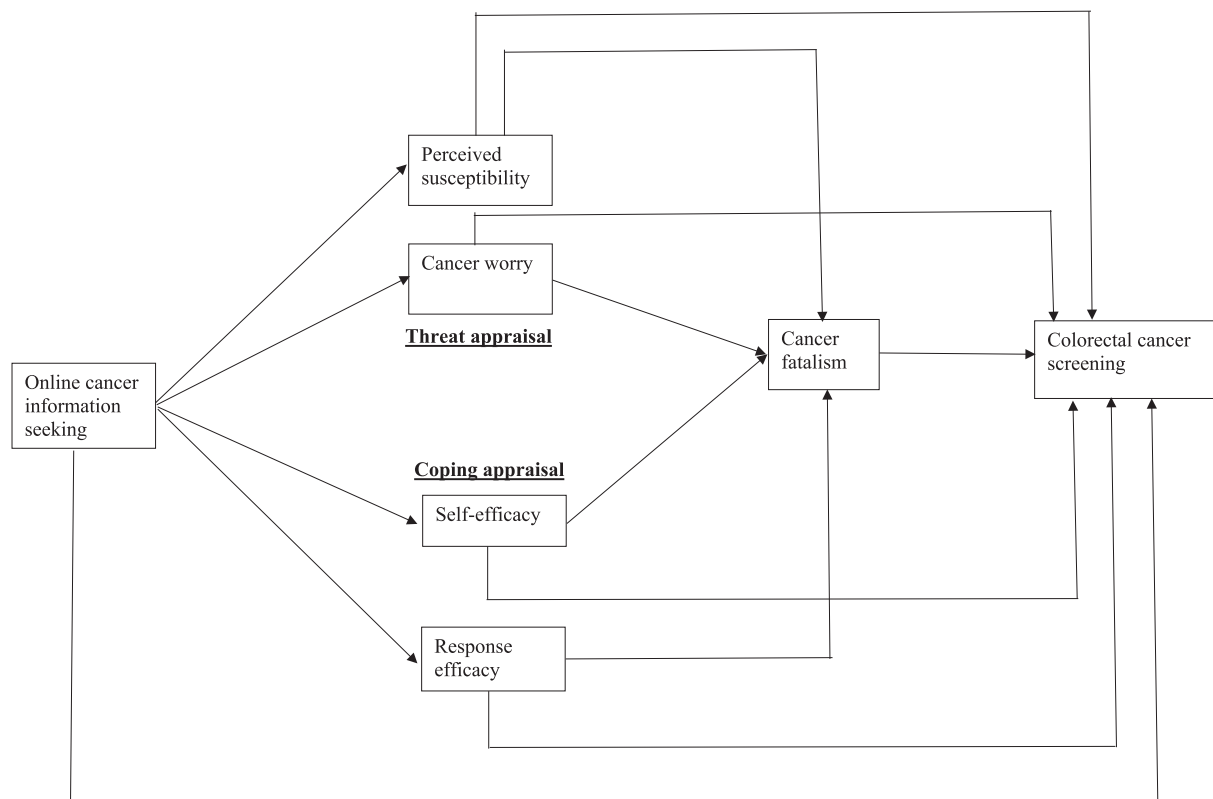*CRC screening* was measured by asking respondents whether they had

Fig. 1. Conceptual framework.

Table 1
Descriptive statistics of an adult Chinese sample in 2021.

Variables	N = 730		
	M	*SD*	*Range*
Age	39.72	10.14	19–83
Gender (being male)	50 %		
Household income			
Less than ¥50,000	4.8 %		
¥50,000 to ¥79,999	11.2 %		
¥80,000 to ¥129,999	17.3 %		
¥130,000 to ¥189,999	20.5 %		
¥190,000 to ¥249,999	17.8 %		
¥250,000 to ¥299,999	11.6 %		
¥300,000 to ¥399,999	8.8 %		
¥400,000 to ¥599,999	5.9 %		
¥600,000 to ¥799,999	1.6 %		
Above ¥800,000	0.4 %		
Education			1–6
Less than 8 years	0.1 %		
8 through 11 years	2.3 %		
12 years or completed high school	7.3 %		
Some college or technical school degree	16.3 %		
College graduate	67.7 %		
Postgraduate (e.g., Masters, PhD)	6.3 %		
Online cancer information seeking (Yes)	61.4 %		0–1
Perceived susceptibility	4.12	1.12	1–7
Cancer worry	5.06	1.26	1–7
Self-efficacy	5.33	1.33	1–7
Response efficacy	5.82	1.12	1–7
Cancer fatalism	3.35	1.34	1–6.86
CRC screening (Yes)	48.6 %		0–1

any of these tests to check for colon cancer – a colonoscopy, sigmoid-oscopy or stool blood test (1 = Yes, No = 0). This question was drawn from the HINTS (National Cancer Institute, 2003).

Control variables included age, gender, annual household income (1

= less than ¥50,000 to 10 = above ¥800,000) and education (1 = less than eight years to 6 = postgraduate).

2.3. Statistical analysis

We first performed descriptive statistics and bivariate correlations of the variables with SPSS (v20). Next, we performed path analysis on SPSS Amos (v24) to examine the proposed mediation pathways. Path analysis is a regression-based technique that enables the simultaneous investigation of multiple direct and indirect associations between variables (Valenzuela and Bachmann, 2017), which aligns with our model consisting of both direct and indirect paths linking online cancer information seeking to CRC screening. Maximum likelihood of estimation was adopted. As per Fig. 1, we drew paths from online cancer information seeking to perceived susceptibility, cancer worry, self-efficacy, response efficacy, from these four variables to cancer fatalism, and finally from cancer fatalism to CRC screening. The direct path from online cancer information seeking to CRC screening was also examined. We tested the model with 95 % confidence intervals and 5,000 bootstrap samples with replacement.

3. Results

3.1. Descriptive analyses

As per Table 1, the average age of our participants is 39 years. Our sample consisted of 50 % males, and 74 % of the participants have undergraduate degree or above. The bivariate correlations between our study variables are presented in Table 2. The median age of our participants is 39 years, in line with China's average of 38.4 years (National Bureau of Statistics, 2020). 50 % of our sample are male, fitting with the Chinese population with a relatively equal gender ratio. Most of our participants (55.6 %) have an annual household income from ¥80,000 to ¥249,999, which is higher than the median household income of

Table 2
Bivariate correlation matrix of model variables drawn from a survey questionnaire by a sample of Chinese participants in 2021.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Gender	–										
2. Age	0.16***	–									
3. Education	−0.04	−0.32**	–								
4. OCIS	−0.06	−0.11**	0.14**	–							
5. Household income	−0.01	−0.04	0.39**	0.13**	–						
6. Perceived susceptibility	0.05	0.01	0.05	0.17**	0.11*	–					
7. Cancer worry	−0.05	−0.10**	0.07	0.15**	0.04	0.40**	–				
8. Self-efficacy	−0.06	−0.01	0.08*	0.11**	0.15**	−0.004	−0.03	–			
9. Response efficacy	−0.01	−0.07	0.02	0.09*	0.08*	0.02	0.14**	0.21**	–		
10. Cancer prevention fatalism	0.03	0.08*	0.01	−0.04	−0.004	0.07	0.06	−0.13**	−0.24**	–	
11. CRC screening	−0.003	−0.09*	0.09*	0.20**	0.14**	0.05	0.02	0.24**	0.09*	−0.08*	–

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

¥39,218 (National Bureau of Statistics, 2024). 74 % of the participants have a undergraduate degree or above, which is higher than the population's education level (60.2 % with university education (Ministry of Education, 2024).

3.2. Hypothesis testing

As shown in Fig. 2, online cancer information seeking had a positive effect on perceived susceptibility ($\beta = 0.38$, $p < 0.001$) and cancer worry ($\beta = 0.36$, $p < 0.001$). Online cancer information seeking also increased coping appraisals, where it had positive effects on self-efficacy ($\beta = 0.23$, $p < 0.05$) and response efficacy ($\beta = 0.18$, $p < 0.05$). The more one engages in online cancer information seeking, the higher his or her threat appraisals and coping appraisals are.

Both perceived susceptibility ($\beta = 0.05$, $p = 0.27$) and cancer worry ($\beta = 0.08$, $p = 0.05$) had insignificant effects on cancer fatalism. On the other hand, self-efficacy ($\beta = -0.08$, $p < 0.05$) and response efficacy ($\beta =$ -0.28, $p < 0.001$) were negatively related to cancer fatalism, suggesting that the higher one's coping appraisal, the lower his or her cancer fatalism, while threat appraisal is not a significant predictor of cancer fatalism.

Our results also indicated that cancer fatalism had no statistically significant effects on CRC screening. The coefficient ($\beta =$ -0.01) indicates a negative relationship between the two variables, but this association is not statistically significant in this sample ($p = 0.31$).

The direct effect of online cancer information seeking on CRC screening was positive ($\beta = 0.16$, p < 0.001, 95 % CI [.08 to 0.23]). Moreover, as shown in Table 3, the mediation analysis revealed that the indirect effect of online cancer information seeking on CRC screening through self-efficacy was significant ($\beta = 0.02$, 95 % CI [.002 to 0.04]). However, the indirect effect was insignificant through perceived susceptibility ($\beta = 0.005$, 95 % CI [-0.007 to 0.02]), cancer worry ($\beta =$ -0.003, 95 % CI [-0.02 to 0.007]), and response efficacy ($\beta = 0.001$, 95 % CI [-0.004 to 0.01]). Moreover, the indirect effect was insignificant
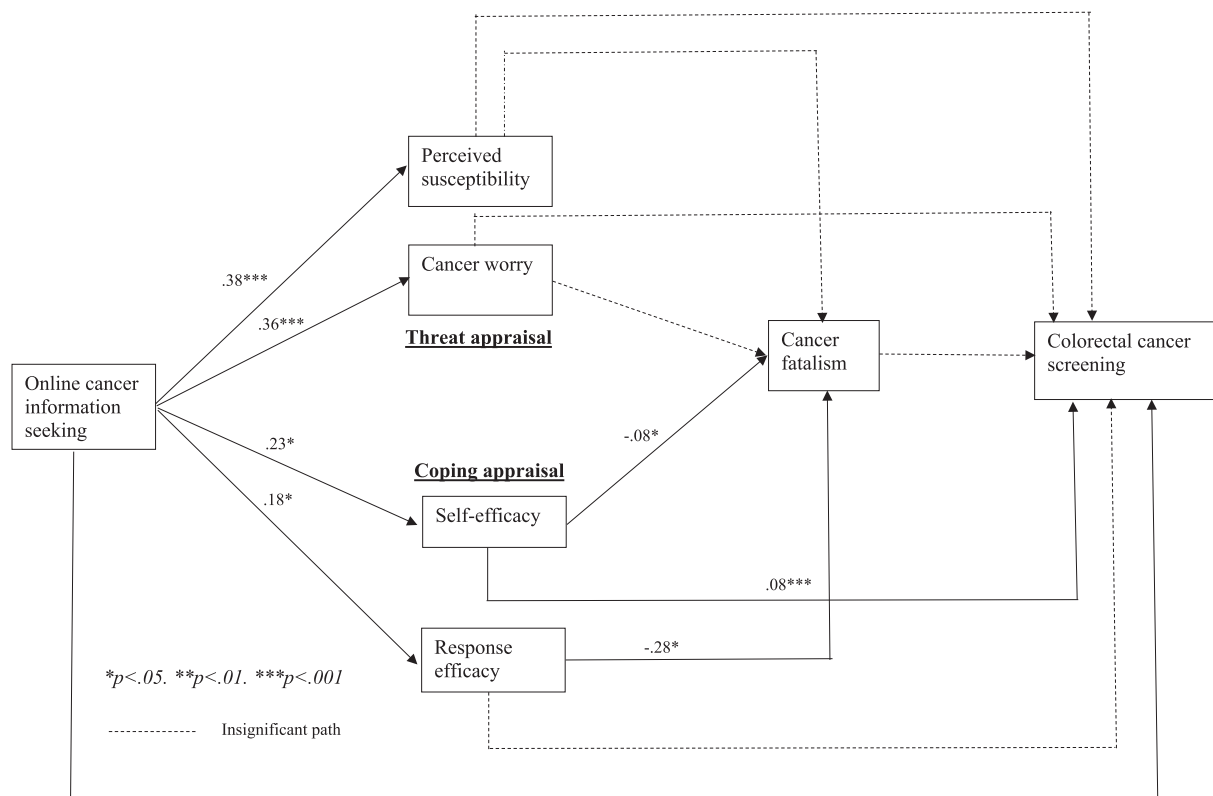

Fig. 2. Model with path coefficients as tested on a sample of Chinese participants in 2021.

Table 3

Mediation effect results drawn from a survey questionnaire by a sample of Chinese participants in 2021.

Indirect Paths from OCIS to CRC Screening	β	LLCI	ULCI
Perceived susceptibility	0.005	−0.007	0.02
Perceived susceptibility → fatalism	−0.0003	−0.002	0.0002
Cancer worry	−0.003	−0.02	0.007
Cancer worry → fatalism	−0.0004	−0.002	0.0002
Self-efficacy	0.02	0.002	0.04
Self-efficacy → fatalism	0.0003	−0.00008	0.002
Response efficacy	0.001	−0.004	0.01
Response efficacy → fatalism	0.0007	−0.0004	0.004
Fatalism	0.0008	−0.002	0.009

SE: Standard error.

LLCI and ULCI: lower level and upper level of the biased-corrected 95% bootstrap CI.

Statistical controls include: gender, age, household income, education level.

*p<.05. **p<.01. ***p<.001.

through perceived susceptibility (β = -0.0003, 95 % CI [-0.002 to 0.0002]), cancer worry (β = -0.0004, 95 % CI [-0.002 to 0.0002]), self-efficacy (β = 0.0003, 95 % CI [-0.00008 to 0.002]) and response efficacy (β = 0.0007, 95 % CI [-0.0004 to 0.004]) via fatalism.

4. Discussion

Our findings showed that online cancer information seeking increased both threat and coping appraisals. When users find information that increases their knowledge on keeping cancer under control (e. g., information about reducing cancer risk), they feel more self-efficacious in preventing cancer, increasing coping appraisals. In contrast, when information presents cancer as a severe disease, users' fearful feelings cause them to ignore scientific insights about curbing its risk, increasing threat appraisals. Supporting this, the cognitive appraisal theory posits that when individuals are exposed to an event (e. g., cancer) that they evaluate as manageable or easy to control, they have higher coping appraisals (Lazarus and Folkman, 1984). In contrast, a person's threat appraisal increases when the event is assessed as challenging or risky. Past research has similarly validated the effects of health-related information seeking on both threat and coping appraisals (Go and You, 2018, Hanson et al., 2021).

Surprisingly, our findings suggested that threat appraisals did not increase fatalism. One possible explanation could be that concurrent exposure to information about preventing or treating cancer may encourage people to be less fatalistic about cancer, despite understanding that cancer is a threatening disease. At the same time, we found that coping appraisals reduced cancer fatalism, a finding in line with previous studies (Miles et al., 2008). When people have high internal locus of control, they perceive their cancer-related health as being under one's own control instead of being defined by external factors like fate or chance (Reknes et al., 2019), reducing fatalism. Particularly when fatalism is long prevalent in China (Ngien and Jiang, 2022), the need to strengthen patients' coping appraisal is especially pertinent to China. The high fatalistic tendencies can be explained by the lack of control over one's health decisions amongst Chinese patients. For example, during medical consultations, they are expected to play a subordinate role, which may contribute to feelings of helplessness in addressing health needs (Jiang and Street, 2019). Efforts to reduce Chinese patients' fatalism thus should consider increasing their coping appraisal.

Interestingly, our results revealed that self-efficacy had a positive influence on CRC screening. This coincides with past research showing that self-efficacy is an important contributor to cancer screening (Majdfar et al., 2016). Self-efficacy motivates health behaviour by encouraging people to engage in challenging activities (e.g., preventive health behaviour) and exhibit energized persistence when experiencing setbacks. Cost-benefit analysis, a classic heuristic of decision-making, is another possible explanation of this finding. When individuals perceive

important benefits (e.g., cancer prevention) and reduced costs (e.g., task difficulty) of an action (e.g., cancer screening), they are readier to engage in the behaviour (Basten et al., 2010). In this case, when people believe that it is easy to go for cancer screening to decrease their chances of getting cancer, they are more likely to engage in cancer screening.

Contrary to our expectations, our results demonstrated that cancer fatalism had no statistically significant effects on CRC screening. To explain these results, we draw on the uncertainty reduction theory, which argues that uncertainty is anxiety-triggering, prompting individuals to make efforts to reduce uncertainty (Berger and Calabrese, 1974). In this context, regardless of whether people believe cancer is a curable condition, they may desire to know whether they have cancer to reduce uncertainty. For instance, even if an individual believes that cancer is a highly fatal condition, knowing that he or she has cancer may enable one to have a better understanding of his or her prognosis, and make better lifestyle plans (e.g., family plans, job switch) that may reduce uncertainty about the future. Subsequent studies may further validate these propositions through exploring the interaction effects of intolerance of uncertainty in the relationship between fatalism and preventive health behaviour.

Study limitations

Several limitations are present in this study. First, we used a convenience sample recruited from online surveys, which may limit the generalizability of our results in several ways. For instance, our sample consists of a high share of individuals who seek online cancer information (61.4 %) and have gone for cancer screening (48.6 %), indicating that the sample may be biased towards people who are more conscious about their health. As online cancer information seeking and cancer screening may share a common cause (e.g., health consciousness), the relationship between these two variables may be overestimated. Additionally, our sample is highly educated (74 % with at least an undergraduate degree). As critical thinking can empower people to avoid cognitive biases (Poos et al., 2017), certain findings from this sample may not extend to those with lower educational statuses who may be more prone to heuristics-driven evaluations (e.g., threat appraisals may significantly increase sense of fatalism for them). Finally, there may be unobserved confounders, such as urbanicity, that may influence online cancer information seeking and screening participation. Future research should validate our findings by employing probability samples that encompass a more representative range of participants, and including more comprehensive controls. Second, we only measured whether or not participants used the Internet to seek cancer-related information, which fails to capture more nuanced information behaviours, such as the type and amount of information searched for. Future studies should consider more diverse dimensions of health information acquisition and how it eventually leads to protective health behaviour. Relatedly, several other variables (e.g., response efficacy, self-efficacy) were measured using single item. Although these single-item measures are drawn from past research, to have better reliability and validity, further research should ideally use multiple items. Third, the cross-sectional method cannot definitively ascertain causal claims, and future studies can use a longitudinal design.

5. Practical implications

Our paper presents several practical implications for cancer prevention. First, given the positive direct and indirect effects of online cancer information seeking on cancer screening, health education programmes may provide useful cancer-related information to audiences to increase cancer screening. For instance, health campaigns can feature information about how early detection of cancer can enable early treatment which increases survival rates, to motivate audiences to go for cancer screening. Second, as online cancer information increases coping appraisals, health agencies should provide constructive information on the Internet about how cancer is a preventable and treatable disease. This enhances individuals' perceived ability to cope with cancer (i.e.,

coping appraisal) and motivates them to uptake protective cancer strategies (e.g., cancer screening). It is notable that health misinformation is not uncommon on the Internet. Thus, policy-makers should implement regulations that curb the circulation of misleading or exaggerated cancer information, which may increase users' belief that cancer is uncontrollable, dissuading them from engaging in preventive cancer behaviours. Third, as higher coping appraisals can reduce cancer fatalism, health organisations may also conduct campaigns that improve people's coping appraisals. Some strategies include teaching people methods to prevent cancer (e.g., healthy diet, exercising), so they feel more confident about managing cancer risks. Lastly, as self-efficacy increases cancer screening behaviour, health campaigns may highlight the convenience and ease of cancer screening (e.g., fast results). Authorities may also implement measures that enhances access to cancer screening (e.g., subsidised rates) to improve individuals' perception that cancer screening is easy to go for.

CRediT authorship contribution statement

Annabel Ngien: Writing – review & editing, Writing – original draft, Formal analysis, Data curation. **Shaohai Jiang:** Writing – review & editing, Writing – original draft, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Ethics statement

Survey respondents provided informed consent. The study protocol was approved by the Institutional Review Boards in authors' institution.

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