BMC Public Health

RESEARCH

Open Access

Exploring factors influencing decision making for colonoscopy in first-degree relatives of patients with colorectal cancer: a mixed-methods study

Hanbin Chen[1†], Yiming Jiang[2†], Jingyi Wang[1], Chen Tang[1], Xinlong Pan[3], Wei Zhang[3], Shuanghui Zheng[3], Jun Zhong[1,4*†] and Bilong Feng[4*†]

Abstract

Background A family history of colorectal cancer among first-degree relatives is recognized as one of the most significant and prevalent risk factors for colorectal cancer in China. Colonoscopy remains the most crucial screening method, as early colonoscopy screening can effectively reduce the risk of advanced colorectal cancer. However, the factors influencing the decision-making behavior of first-degree relatives regarding colonoscopy screening have predominantly been examined through quantitative studies, while mixed-methods research remains scarce. This study aimed to evaluate the decision-making behaviors of first-degree relatives of patients with colorectal cancer and to identify the factors influencing these behaviors.

Methods An explanatory sequential design was adopted within a mixed-methods framework. For the quantitative phase, convenience sampling was used to select 272 first-degree relatives of colorectal cancer patients who were treated at a tertiary hospital's gastrointestinal surgery department in Wuhan, China from March to December 2023, for a questionnaire survey. For the qualitative component, a maximum variation purposive sampling method, guided by the Protection Motivation Theory, was employed to select 16 participants from the initial survey group for semi-structured interviews.

Results Our findings revealed that participants had a high health belief score. Key factors influencing their decision to undergo colonoscopy screening included marital status, average monthly household income, medical payment method, and perceived severity. The qualitative study identified six core themes: perceived susceptibility, perceived severity, internal and external rewards, response efficacy, response costs, and self-efficacy.

Conclusion Medical staff should focus on first-degree relatives of colorectal cancer who are unmarried or widowed, have lower family income, have lower reimbursement rate of medical insurance, and lack of disease severity

†Hanbin Chen and Yiming Jiang contributed equally as co-first authors.

†Jun Zhong and Bilong Feng contributed equally as co-corresponding authors.

*Correspondence:
Jun Zhong
zhongjun@whu.edu.cn
Bilong Feng
fbl1019@126.com
Full list of author information is available at the end of the article

perception. Through establishing social support system, issuing subsidies for colonoscopy screening, increasing reimbursement rate of medical insurance, emphasizing the severity of colorectal cancer, to enhance their health belief level and promote colonoscopy screening decision-making behavior.

Trial registration Not applicable.

Keywords Colorectal cancer, First-degree relatives, Colonoscopy screening, Decision making, Mixed-methods study

Background

Colorectal cancer (CRC) encompassing both colon and rectal cancers, is a prevalent gastrointestinal malignancy. According to the latest global cancer burden data from 2024 [1], CRC ranks third in incidence and second in mortality worldwide. By 2030, the global burden of CRC is projected to increase by 60%, with new cases exceeding 2.2 million and deaths surpassing 1.1 million [2].A positive family history is among the most prevalent risk factors for CRC. Research indicates that approximately 20% of new cases involve first-degree relatives (FDRs) of CRC patients, including biological parents, children, and full siblings [3]. The risk of developing CRC for these individuals is 1.76 to 3 times higher than that of the general population, making them a key target group for screening [4]. CRC screening programs facilitate the early identification and removal of precancerous lesions, significantly decreasing the incidence and mortality rates of CRC, especially among FDRs [5].

A common screening test is colonoscopy, an endoscopic exam that directly removes precancerous lesions. A meta-analysis revealed that colonoscopy screening reduces CRC incidence by 69% and mortality by 68% [6]. Although international guidelines [7–9] recommend colonoscopy screening for age-appropriate FDRs of CRC patients, in the United States, which was the first country to initiate colonoscopy screening, despite the gradual increase in screening rates among FDRs, the overall screening rate remains below 50% [10]. From 2012 to 2015, the Chinese government conducted the "Urban Cancer Screening Program in China" across 16 provinces, with a colonoscopy screening rate of only 14.0% among high-risk individuals for CRC [11].

Existing studies have confirmed that FDRs of CRC patients refuse screening due to negative perceptions of colonoscopy screening [12], misunderstanding of screening modalities [13], lack of guidance from professionals [14], and perceived barriers [15]. In addition, age, gender, race, personal history of disease, family history of CRC, accessibility of healthcare and other factors also affect the decision-making behavior of FDRs in CRC screening [16–18]. There are also some people who give up screening because of fatalism, the painful experience of colonoscopy, fear of harm to the body, worry about detecting CRC, and the cost of colonoscopy [19, 20].

Based on the Protection Motivation Theory (PMT) proposed by Rogers [21] in 1975, this study posits that the colonoscopy screening behavior of FDRs with CRC is influenced by both external environmental factors and personal determinants, which collectively shape their cognitive processes. These cognitive processes, namely threat appraisal and coping appraisal, serve as pivotal mechanisms that foster motivation, which in turn translates into behavior [22, 23]. Threat appraisal encompasses dimensions such as susceptibility, severity, internal and external rewards. Susceptibility refers to an individual's subjective assessment of their likelihood of exposure to risk factors or developing a particular disease. Severity captures one's perception of the serious consequences associated with the disease, including its clinical outcomes and societal impact. Internal rewards denote the subjective gratification derived from engaging in maladaptive behaviors, while external rewards refer to the perceived social approval or recognition associated with such behaviors.Coping appraisal involves response efficacy, response cost, and self-efficacy. Response efficacy reflects an individual's evaluation of the effectiveness of the proposed behavior in promoting health. Response cost pertains to the potential challenges, as well as economic or social sacrifices, that may arise from adopting a health behavior. Self-efficacy represents an individual's confidence in their ability to execute the behavior and achieve the desired outcomes [24–27]. According to PMT, individuals are more likely to develop stronger protective motivation and consequently adopt health-promoting behaviors when they perceive higher levels of susceptibility and severity associated with a threat, derive fewer rewards from maladaptive behaviors, and assess coping factors such as response efficacy and self-efficacy as favorable, while perceiving response costs as minimal.

Within this study, personal factors (e.g., age, educational level, marital status, monthly income), environmental factors (e.g., place of residence, occupation), and individuals' awareness of CRC (e.g., knowledge of CRC symptoms, risk factors, and screening barriers) are examined. These factors are hypothesized to shape the cognitive processes underlying CRC screening motivation by influencing individuals' psychological evaluation of CRC threat severity and their practical assessment of coping abilities. The resulting motivation, in turn, determines

whether they ultimately engage in CRC screening behaviors.

In recent years, cancer screening has garnered significant attention for its crucial role in advancing public health and clinical practice [16]. However, research on the application of PMT to CRC screening intentions and behaviors remains limited [28].Therefore, this study aimed to employ the PMT framework to conduct in-depth interviews with FDRs of CRC patients to explore the facilitators and barriers that influence the decision-making behavior of colonoscopy screening. A detailed theoretical model of the study is presented in Fig. 1.

Most existing studies primarily adopt a quantitative approach to examine the decision-making behaviors of FDRs regarding CRC screening, with limited in-depth analysis of the barriers to screening. In summary, in view of the current situation of high incidence and low screening rate of CRC, in order to investigate the decision-making behavior of CRC FDRs for colonoscopy screening, this study employed an explanatory sequential design within a mixed-methods framework, so as to obtain a more comprehensive research perspective, deeply explore the inner real experience of FDRs, and comprehensively analyze the obstacles and motivations of FDRs for colonoscopy screening. Finally, the goal of increasing the screening rate of FDRs of CRC will be achieved.

Methods

Design

The mixed-methods research incorporated an interpretative sequence design, which included both quantitative and qualitative approaches. The quantitative phase was conducted from March to October 2023, followed by the qualitative phase from November to December 2023. The qualitative findings were utilized to supplement and enrich the quantitative results.

Ethical consideration

Ethical approval for this study was obtained from the Medical Ethics Committee of Zhongnan Hospital, Wuhan University (Approval Number: 2023103 K). All participants were fully briefed about the study's purpose and procedures before signing informed consent forms. Participants were informed that they had the right to decline to participate or withdraw from the study at any time, promising that the data would be kept strictly confidential and used only for academic research.

Quantitative research

Procedure

We employed a convenience sampling method to recruit FDRs of patients diagnosed with CRC and treated in the gastrointestinal surgery department of a tertiary hospital in Wuhan, China. The inclusion criteria were as follows: (1) being a first-degree relative of a patient newly diagnosed with CRC; (2) voluntarily participating in the study. The exclusion criteria included: (1) previous diagnosis of CRC or detection of precancerous lesions; (2) undergoing treatment for another type of existing cancer; (3) suffering from a serious chronic or life-threatening illness, such as renal failure; (4) having consciousness disorders due to brain metastasis, or suffering from mental illness, intellectual or cognitive impairments.

According to the sample size calculation method, the confidence level was 95% (z = 1.96), the estimated proportion (P) was 0.14, and the margin of error (e) was 0.05, then the sample size obtained by the formula " $n = Z^2 * P * (1\text{-}P) / e^2$ " was about 186. Considering the sample shedding rate of 20%, the sample size was at least 232 cases.

Measures

Based on a comprehensive literature review, the researchers designed a general data questionnaire that includes variables such as gender, age, education level, marital

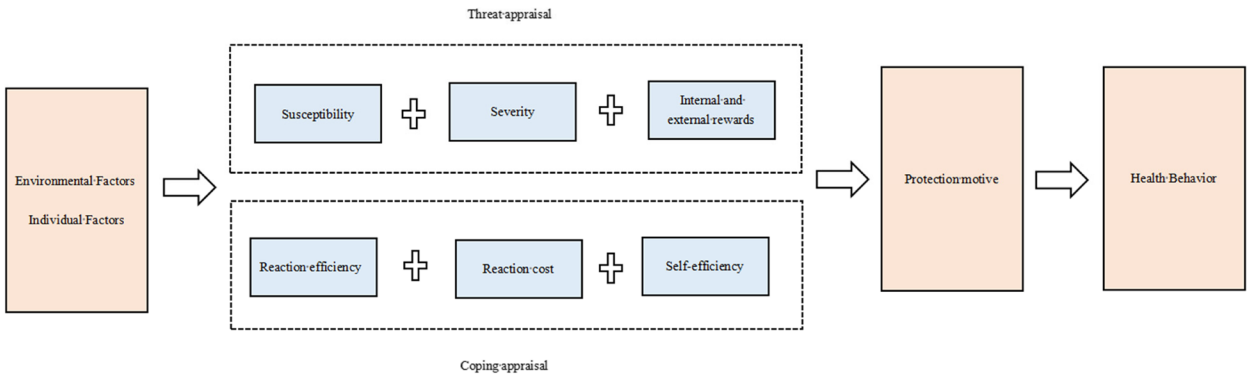

Fig. 1 The model of Protection Motivation Theory

status, occupation, average monthly household income, type of health insurance, and number of relatives diagnosed with cancer. Additionally, the study employed the Chinese version of the CRC Health Belief Scale, developed by scholar Bai Yang in 2019 [29]. The original scale, designed by Green in 2004, was adapted to study the health beliefs of FDRs of CRC patients. Permission to use the scale has been obtained from the author. The scale comprises 6 dimensions and 44 items. In this study, the Cronbach's alpha coefficients for each dimension ranges from 0.728 to 0.803, and the total scale's Cronbach's alpha coefficient is 0.822. All items were measured on a 5-point Likert scale, yielding a total score range of 44 to 220. Higher scores on the scale indicate higher levels of health beliefs.

Data collection

The quantitative study utilized both onsite and online questionnaires. In compliance with the requirements of the Medical Ethics Committee of Zhongnan Hospital of Wuhan University, respondents confirmed their consent for their data to be used in the study. Field investigations were conducted in the gastrointestinal surgery ward, where investigators used standardized language for guidance and collected completed questionnaires immediately to ensure accuracy. An electronic questionnaire was developed using the "Questionnaire Star" platform and distributed to participants through WeChat. Each question was mandatory, and respondents were restricted to a single submission to prevent duplicate entries. To ensure data quality, questionnaires completed in less than five minutes were excluded.

Data analysis

The data were analyzed using SPSS 26.0 software. Categorical variables were presented as frequencies and percentages, while normally distributed continuous variables were expressed as means ± standard deviations. T-tests, one-way ANOVA, and logistic regression analysis were used to analyze the influencing factors, with statistical significance set at $P < 0.05$.

Qualitative research

Procedure

The sampling method for the purpose of maximizing difference was adopted to select a part of the research objects of quantitative research as the interview objects, with the sample size based on the principle of information saturation.

Measures

In alignment with the objectives of this study, an interview guide was meticulously designed based on the PMT framework following a comprehensive literature review and expert consultation. Preliminary interviews were conducted with 2–3 FDRs of CRC patients to refine the guide. After multiple iterations and adjustments, the finalized interview protocol was established, as detailed below.

Susceptibility: (1) What is your attitude towards CRC? (2) Do you have any prior knowledge about CRC-related information? (3) How does having a relative with CRC affect you? (4) Do you worry about the possibility of developing CRC or similar gastrointestinal conditions yourself? *Severity*: (5) Is the level of worry severe, and do you have negative associations when thinking about it? *Response Efficacy*: (6) Have you learned any available preventive measures for preventing CRC? (7) What do you think about doing stool examination or colonoscopy? *Internal and External Rewards*: (8) Do you hope to have regular CRC screening? What are the reasons you haven't chosen to undergo a colonoscopy screening? *Response Costs*: (9) What factors hinder you from undergoing CRC screening? *Self-Efficacy*: (10) What factors make you more willing to undergo CRC screening? (11) What kind of assistance or support would encourage you to have regular CRC screening?

Data collection

Qualitative research was conducted using semi-structured interviews. Participants were informed of the study's purpose, provided consent to participate, and signed informed consent forms before audio recording commenced. Each interview lasted between 25 and 40 min and followed an interview guide to ensure the application of appropriate interviewing techniques. These techniques included avoiding interruptions, refraining from evaluating responses, and eliminating inductive or suggestive language. Within 24 h of each interview, two researchers independently reviewed and coded the transcribed data using NVivo software (version 11.0) for thematic analysis and data organization. To ensure coding consistency, Cohen's Kappa coefficient was calculated (kappa = 0.85), indicating high agreement between the coders in theme selection. Discrepancies in coding were resolved through consensus meetings, where coders thoroughly reviewed and discussed inconsistent codes to reach agreement. If consensus could not be achieved, a third researcher served as an arbiter. Additionally, the research team conducted weekly group discussions to review the analytic process. The team comprised a nursing professor, an expert in nursing psychology, and two

graduate nursing students with qualitative research experience. This team collaboratively reviewed the coding results to ensure reliability in the coding process and theme generation.

Data analysis

For the qualitative study, Colaizzi's seven-step analysis method [30] was employed for integrative analysis, which includes: familiarizing with the data, identifying significant statements, formulating meanings, clustering themes, providing a comprehensive description, developing a basic structure, and validating the basic structure.

Results

Quantitative research

Demographic characteristics of FDRs of patients with CRC A total of 285 questionnaires were distributed, and 272 valid questionnaires were recovered, with an effective rate of 95.4%. The demographic characteristics of the participants are summarized in Table 1. There

Table 1 Differences in colonoscopy screening behavior among FDRs of CRC with different demographic characteristics

Item	Not screened(%)	Screened(%)	χ^2	*P*
FDRs			2.144	0.342
Parents	24(11.21)	3(5.17)		
Siblings	37(17.29)	9(15.52)		
Children	153(71.50)	46(79.31)		
Gender			5.048	0.025
Male	90(42.06)	34(58.62)		
Female	124(57.94)	24(41.38)		
Age(years)			7.693	0.021
18 ~ 40	75(35.05)	18(31.03)		
41 ~ 60	111(51.87)	39(67.24)		
>60	28(13.08)	1(1.72)		
Education level			12.665	0.013
Primary school or below	23(10.75)	1(1.72)		
Middle school	66(30.84)	12(20.69)		
High school/Vocational school	60(28.04)	19(32.76)		
Junior college	45(21.03)	13(22.41)		
Bachelor's degree or above	20(9.35)	13(22.41)		
Marital status			7.157	0.028
Married	178(83.18)	56(96.55)		
Unmarried	22(10.28)	2(3.45)		
Divorced/Widowed	14(6.54)	0(0.00)		
Occupation			7.787	0.020
Employed	144(67.29)	49(84.48)		
Unemployed	48(22.43)	4(6.90)		
Retired	22(10.28)	5(8.62)		
Average monthly household income			16.176	0.000
< 5000	88(41.12)	13(22.41)		
5000 ~ 10,000	114(53.27)	33(56.90)		
> 10,000	12(5.61)	12(20.69)		
Type of health insurance			25.387	0.000
New rural cooperative medical insurance	78(36.45)	9(15.52)		
Urban Resident/Employee Medical Insurance	105(49.07)	30(51.72)		
Commercial Insurance	12(5.61)	15(25.86)		
Others	19(8.88)	4(6.90)		
Number of Relatives Diagnosed with Cancer			2.421	0.120
1	187(87.38)	46(79.31)		
≥ 2	27(12.62)	12(20.69)		

Table 2 Health belief score of colonoscopy screening in FDRs of CRC patients

Items		Scores(_x±s)	Average scores(_x±s)	Cronbach's α
Perceived severity	9	34.49 ± 5.74	3.83 ± 0.98	0.774
Perceived susceptibility	4	10.94 ± 2.26	2.73 ± 0.92	0.801
Perceived benefits	6	21.79 ± 3.97	3.63 ± 0.93	0.728
Perceived barriers	18	52.40 ± 4.33	2.91 ± 0.97	0.779
Self-efficacy	4	14.81 ± 3.09	3.70 ± 0.96	0.754
Cues to action	3	11.36 ± 2.50	3.79 ± 0.94	0.803

Table 3 Comparison of the difference of health belief level scores in firs-degree relatives with CRC screening behavior

Variable	Scores		*F*	*P*
	Not screened($n = 224$)	Screened($n = 48$)		
Perceived severity	34.17 ± 6.10	35.98 ± 3.27	3.953	0.048
Perceived susceptibility	10.69 ± 2.26	12.08 ± 1.84	15.876	0.000
Perceive benefits	21.49 ± 4.06	23.17 ± 3.24	7.192	0.008
Perceive barriers	52.31 ± 4.49	52.81 ± 3.46	0.527	0.468
Self-efficacy	14.61 ± 3.16	15.71 ± 2.58	5.056	0.025
Cues to action	11.30 ± 2.52	11.60 ± 2.43	0.570	0.451

were significant differences in the colonoscopy screening behavior of FDRs of CRC among different gender, age, education level, marital status, occupation, average monthly household income and type of health insurance ($P < 0.05$).

Status of health beliefs of FDRs of CRC patients undergoing colonoscopy screening Based on the survey results, the average scores of health belief components regarding CRC screening among FDRs, ranked from highest to lowest, were perceived severity, cues to action, self-efficacy, perceived benefits, perceived barriers, and perceived susceptibility. The total scores and individual items for each dimension are presented in Table 2.

Monofactor analysis of colonoscopy screening behavior among FDRs of patients with CRC Whether to perform colonoscopy screening was taken as the dependent variable, and all dimensions of health belief scale were taken as independent variables. The results of monofactor analysis showed that different levels of perceived severity, perceived susceptibility, perceived benefits, and self-efficacy had significant differences in colonoscopy screening behavior ($P < 0.05$). Refer to Table 3 for detailed results.

Multifactor analysis of colonoscopy screening behavior in FDRs of patients with CRC In order to further analyze the factors related to the colonoscopy screening behavior of FDRs of patients with CRC, 11 variables with statistical significance in the monofactor analysis were used as independent variables, and whether to perform colonoscopy screening was used as dependent variable. After collinearity diagnosis, VIF values were all less than 5, indicating that there was no multicollinearity problem in the regression equation. The results showed that marital status, average monthly household income, type of health insurance, and perceived susceptibility were the main factors affecting the screening of FDRs with CRC ($P < 0.05$). See Table 4.

Table 4 Logistics regression analysis of factors influencing bowel screening behavior in FDRs of CRC

Variable	*B*	*S.E*	*β*	*t*	*P*
	1.094	0.306	-	3.571	0.000
Age	0.031	0.040	0.051	0.777	0.438
Gender	0.060	0.046	0.078	1.294	0.197
Education level	0.009	0.014	0.040	0.674	0.501
Marital status	−0.126	0.046	−0.167	−2.724	0.007
Occupation	−0.028	0.036	−0.049	−0.775	0.439
Average monthly household income	0.077	0.036	0.131	2.152	0.032
Type of health insurance	−0.064	0.026	−0.146	−2.432	0.016
Perceived severity	0	0.005	−0.007	−0.094	0.925
Perceived susceptibility	0.040	0.011	0.239	3.592	0.000
Perceive benefits	0.006	0.009	0.067	0.733	0.464
Self-efficacy	0.006	0.011	0.051	0.574	0.566

Note: $R^2 = 0.153$, adjusted $R^2 = 0.111$, $F = 3.600$, $P = 0.000$

Qualitative research

Demographic characteristics of interviewees A total of 16 FDRs of CRC were included in the qualitative study for interview, coded P1 ~ P16. The general information of the interviewees is shown in Table 5.

Interview results

Susceptibility perception

According to the threat appraisal framework in the PMT, perceived susceptibility is an important prerequisite for individual behavior change. In this study, only three respondents were aware that CRC has a hereditary component. The majority of FDRs in this study recognized poor lifestyle habits as a risk factor for CRC but were unaware of its familial inheritance.

> *"After witnessing my brother's battle with CRC and seeing his condition deteriorate, I decided to quit smoking." (P15).*

> *"I was unaware that CRC could run in families, and I had never encountered the concept of FDRs." (P3).*

Due to limited awareness of CRC, some respondents failed to recognize the potential for developing the disease, even when experiencing symptoms such as intestinal discomfort.

> *"I occasionally experience bowel discomfort and notice blood in my stool, but I attribute it to hemorrhoids and do not give it much attention." (P6).*

> *"I have frequently experienced episodes of diarrhea and constipation in recent years, and I believe my bowel function has deteriorated with age." (P13).*

Severity perception

The severity perception of CRC by FDRs is one of the factors influencing their decision to undergo colonoscopy screening. In this study, five respondents believed that CRC is a serious disease that could lead to severe consequences.

> *"There is no difference between having this disease and dying." (P9).*

Some respondents, on the other hand, believe that the prognosis of CRC is more favorable and are optimistic about the outcomes.

> *"I am highly confident that CRC is more treatable than other types of cancer." (P4).*

Internal and external rewards

The internal rewards for not undergoing colonoscopy screening among the respondents in this study were primarily manifested as:

Table 5 General information of the respondents ($n = 16$)

ID	Relationship with the patient	Age	Gender	Education level	Marital Status	Monthly income	Place of residence	Occupation	CRC screening
P1	father and son	24	male	undergraduate	unmarried	< 5000	town	student	no
P2	father and son	23	male	undergraduate	unmarried	< 5000	town	student	no
P3	father and son	27	male	high school	married	5000 ~ 10,000	town	other	yes
P4	father and son	30	male	doctor	single	≥ 10,000	town	other	no
P5	brothers	65	male	polytechnic school	married	5000 ~ 10,000	town	labor	no
P6	sister and brother	62	female	junior high school	married	< 5000	town	farmer	no
P7	mother and daughter	40	female	high school	married	< 5000	town	individual	no
P8	father and son	34	male	undergraduate	married	5000 ~ 10,000	town	other	no
P9	mother and son	39	male	high school	married	< 5000	town	individual	no
P10	father and son	35	male	elementary school	married	< 5000	countryside	farmer	no
P11	father and son	62	male	elementary school	married	< 5000	countryside	farmer	yes
P12	mother and son	35	male	undergraduate	divorced	≥ 10,000	town	individual	no
P13	father and son	43	male	polytechnic school	married	5000 ~ 10,000	town	individual	no
P14	brothers	47	male	college	married	5000 ~ 10,000	town	other	no
P15	brothers	45	male	elementary school	married	< 5000	countryside	farmer	no
P16	sisters	43	female	elementary school	married	< 5000	town	individual	yes

(1) Psychological relief and stress alleviation

"Although I know I am in a high-risk group, avoiding colonoscopy screening temporarily alleviates my anxiety and fear of the disease. Once I start screening, I might worry more about discovering a problem." (P10).

"I believe I am healthy and have no obvious symptoms, so I probably don't need a colonoscopy. This thought gives me a sense of relief." (P7).

(2) Avoid physical discomfort

"I've heard that the bowel preparation for a colonoscopy is very uncomfortable, and the procedure itself might be painful. By skipping it, I can avoid any physical discomfort." (P8).

(3) Saving time and financial costs

"Colonoscopy screening requires spending money and taking time off work or setting aside time to visit the hospital. Skipping the screening saves me these resources." (P3).

The external rewards for not undergoing colonoscopy screening among the respondents in this study were primarily manifested as:

(1) Aligning with family or cultural expectations

"In my family and culture, it is believed that young individuals or those without symptoms do not require a colonoscopy. By choosing to forgo screening, I align with these expectations and avoid potential conflicts." (P1).

(2) The herd mentality shaped by social and cultural factors

"Many people around me do not regularly undergo colonoscopy screenings, and they seem fine. I feel that this choice is normal and not particularly concerning." (P5).

(3) Alleviating undue concern among family members

"If I undergo colonoscopy screening, my family might worry excessively about me. I don't want to cause them unnecessary tension and stress." (P10).

(4) Avoiding Social Stigma

"If friends or colleagues find out that I had a colonoscopy, they might speculate that I have health issues. I don't want to be labeled as "unhealthy" because of the screening." (P2).

(5) Avoid the impact of a positive result on employment or insurance

"If the colonoscopy results are unfavorable, it might affect my career prospects or insurance applications. I don't want to be flagged as "high risk" and face discrimination or financial burdens because of one screening." (P3).

Response effectiveness

Some respondents in this study believe that colonoscopy plays a critical role in the early detection of CRC.

"As doctors have noted, the five-year survival rate of CRC is favorable if detected early" (P1).

"Only by having a colonoscopy can CRC be detected early. Early detection leads to early treatment." (P13).

Some participants perceive cancer as an inevitable fate, leading them to dismiss the value of preventive measures and screening.

"Cancer is also a gift from God. No one can refuse it. We should accept it." (P16).

Reaction costs

According to the PMT theory, a high perception of "response cost" can weaken an individual's motivation to undergo screening.

(1) Financial cost

"What worries me more is the cost. If it were free, I would definitely go (for the colonoscopy screening), because my gut isn't in very good condition to begin with." (P6).
"I have too many things to consider right now, including covering my father's medical expenses and caregiving costs, as well as my child's tuition and living expenses. The financial pressure is quite overwhelming." (P10).

(2) Time cost

"I mainly feel that it's a waste of time. If I don't have any symptoms of (CRC) myself, then spending an entire afternoon (on a colonoscopy screening) seems unnecessary." (P2).

"Colonoscopy requires bowel preparation, it's a little troublesome.I am so busy at work that I can't spare the time." (P4).

"Now I have to take care of her every day>, I don't think about it." (P7).

(3) Physical cost

"If it (the colonoscopy screening) were as simple as a blood test, everyone would be willing to do it. But inserting a long tube through the anus into the intestines is still somewhat uncomfortable. Moreover, the need for bowel preparation beforehand makes it even less appealing—just thinking about it makes me not want to do it." (P8).

(4) Psychological cost

"Getting a colonoscopy not only means I might discover something wrong, but it could also lead to excessive worry about my health." (P9).

(5) Social and cultural cost

"In our area, many people don't really think much about getting a colonoscopy. They usually believe that if there are no symptoms, there's no need to get checked. Even though I know it would benefit me, I feel a bit pressured by the possibility of facing misunderstanding from my family and friends." (P1).

Self-efficacy

The stronger an individual's self-efficacy, the more likely they are to undergo colonoscopy screening. The majority of respondents continued to hold the belief that colonoscopy screening was unnecessary.

"I believe that whatever is meant to happen will happen, and I'll face it when the time comes." (P16).

Only a few respondents voiced strong beliefs regarding colonoscopy screening, emphasizing the importance of prioritizing personal health.

"Even if it's not free, I would still go for a colonoscopy. Money is important, but when it comes to my health, my body should be the priority." (P13).

"I had never paid attention to this (colonoscopy screening) before. This time, after he (the patient) got sick, even if no one reminded me, I would still go for a colonoscopy." (P8).

"I believe I can undergo the colonoscopy. Although I've heard that some people feel uncomfortable during the procedure, I think it's something I can endure for the sake of my health." (P3).

Discussion

According to our survey results, the scores of perceived severity, cues to action, self-efficacy and perceived benefits were all at a high level, indicating that FDRs of CRC had a good cognition of disease severity, could perceive the health benefits brought by colonoscopy screening, could take effective actions to perform colonoscopy screening, and could have sufficient confidence to complete colonoscopy screening. Perceiving barriers was a major factor affecting disease prevention behaviors and had a negative impact on people's adoption of health behaviors [31]. In this study, FDRs of CRC had a relatively low perceive barriers score, indicating that FDRs were more likely to accept colonoscopy screening. However, perceived susceptibility scored the lowest among health belief dimensions, reflecting insufficient awareness of personal risk among FDRs. This aligns with Bai Yang's findings [29] and highlights a critical gap in risk communication. Our qualitative interviews revealed that many participants associated gastrointestinal symptoms with benign conditions, such as hemorrhoids, rather than CRC. This misconception underscores the need for targeted educational campaigns to improve risk perception. Strategies to mitigate this could include community-based awareness campaigns emphasizing familial risk and leveraging relatable narratives. In general, according to our survey results, the level of health belief of FDRs with CRC was significantly higher than that of Zhao Dongqin [32] and Zhou Jingru [33].This could be attributed to an increasing public awareness of health, the reputation of our hospital as a top-tier facility in Central China attracting patients nationwide, and the generally good adherence to medical advice by patients and their families. Additionally, our department's continuous efforts to promote colonoscopy screening among FDRs of CRC patients may have subtly influenced their health beliefs, leading to these higher scores.This suggests that the popularization of colonoscopy screening is a persistent and necessary work, and we should explore more innovative means, such as artificial intelligence technology [34], telephone intervention [35], and personalized risk assessment [36], so that more high-risk groups can understand the purpose and significance of early screening, and improve the health belief level of first-degree relatives of colorectal cancer.

The results of this study indicated that key factors influencing the health beliefs of FDRs of CRC patients included marital status, average monthly household

income, medical payment method, perceived severity. Previous studies [37, 38]had consistently shown that marital status significantly affected the likelihood of performing colonoscopy screening, with those having a partner demonstrating higher compliance. This can be attributed to the support provided by spouses, which enhances an individual's self-efficacy and reduces perceived barriers [39]. For instance, a married individual may receive encouragement and logistical support (e.g., transportation to appointments) from their partner, facilitating their decision to undergo colonoscopy screening. On the other hand, unmarried or widowed individuals often lack this support, which may increase the psychological and logistical response costs associated with the screening process.Thus, future interventions should focus on creating social support networks to improve the health behaviors of unmarried and widowed populations. Average monthly household income was the main measure of an individual's socioeconomic status, and a study from the United Kingdom also found that socioeconomic status was the strongest predictor of health behaviors [40]. In this study, the higher the average monthly family income of FDRs, the higher the proportion of colonoscopy screening, which was consistent with the findings of Taha [41]. Qualitative findings further supported this, as participants with limited income expressed concerns about the out-of-pocket expenses associated with colonoscopy, even when insured. Household income plays a pivotal role by directly influencing the perceived response costs of colonoscopy screening. High-income families are better positioned to absorb the financial expenses associated with screening, such as transportation, medical fees, and time off work, thus lowering their perceived barriers. In contrast, low-income individuals may prioritize immediate economic concerns over preventive health behaviors, leading to reduced screening uptake. Furthermore, higher-income individuals often possess higher health literacy, enabling them to recognize the long-term health benefits of screening [42]. Health education campaigns and financial support policies, such as screening subsidies, targeted at low-income groups could significantly improve their screening rates. The type of health insurance was also a significant factor influencing the screening rates of FDRs. In this study, FDRs with urban medical insurance exhibited higher colonoscopy screening rates compared to those with rural medical insurance. Notably, FDRs with commercial insurance demonstrated the highest screening rates, consistent with the findings of Tan et al. [14]. This may be attributed to higher reimbursement rates and broader coverage for diagnostic procedures like colonoscopy. Additionally, commercial insurance often offers more convenient service pathways, facilitating easier access to screening service [43]. Conversely, individuals relying on rural cooperative medical insurance faced higher out-of-pocket expenses, which intensified their financial burden and reduced their perceived self-efficacy [44]. These findings underscore the critical role of healthcare policy in reducing financial barriers and promoting equitable access to colorectal cancer (CRC) screening. Policymakers are encouraged to expand the coverage of rural medical insurance programs while fostering the flexibility and benefits of commercial insurance to improve screening uptake. Perceived severity refers to an individual's awareness of the risk or impact associated with a health problem. This study found that higher perceived severity scores were linked to a greater likelihood of deciding to undergo colonoscopy screening. This heightened severity perception may stem from firsthand experiences with a relative's illness, reinforcing the catastrophic potential of undiagnosed CRC. Our qualitative interviews revealed that some participants equated having this disease with death. Understanding the severity of a condition can enhance an individual's perception of the threat it poses, thereby motivating and empowering them to take action [45]. Future educational campaigns should leverage this awareness by emphasizing the treatability of early-detected CRC.

In this study, the qualitative interview findings effectively complemented the quantitative research by providing deeper insights into the psychological, physiological, economic, and caregiving needs of FDRs of CRC patients. These multidimensional insights reinforced the quantitative results. In the quantitative study, perceived severity scored the highest, and qualitative data further elaborated on the relatives' fear and anxiety regarding the disease. Conversely, perceived susceptibility scored the lowest in the quantitative analysis, a finding corroborated by qualitative interviews, where some relatives displayed a sense of complacency and lacked awareness of the necessity of colonoscopy screening. Some respondents view CRC as a matter of fate or luck, believing that the occurrence of cancer is inevitable and beyond their control, emphasizing that individual behavior has a limited role in disease prevention. According to the PMT, such fatalism weakens the conversion of threat appraisal and coping appraisal, resulting in low screening intentions. Future intervention designs should strengthen the concept of "early screening, early treatment" through health education, enhancing trust in the effectiveness of screening and gradually changing the fatalistic mindset. Additionally, socio-cultural factors significantly modulate screening behaviors. For instance, qualitative data revealed that psychological relief and avoidance of physical discomfort serve as internal rewards for not undergoing screening. Cultural norms and familial expectations act as external

barriers, resulting in a lack of recognition of screening importance among certain groups. To overcome these obstacles, culturally sensitive health education and tailored interventions are essential for creating a supportive environment that encourages screening uptake. While the quantitative study, constrained by its questionnaire format, inadequately captured the full scope of caregiving needs, the qualitative research provided a richer understanding of the inner experiences and thoughts of the participants. Both methods revealed common practical challenges faced by patients, such as financial burdens from treatment and social barriers. Therefore, healthcare providers should offer personalized guidance tailored to the specific psychological, physiological, occupational, and social support needs of patients, ensuring continuous supportive care.

Strengths and limitations

We employed a mixed-methods study to comprehensively investigate the factors influencing the decision-making behaviors of FDRs of CRC patients regarding colonoscopy screening. This research provided a solid foundation for formulating personalized intervention strategies. However, we acknowledged its limitations: the study's participants were all from the same hospital, which might affect the generalizability of the findings. At the same time, the impact of COVID-19 on people's health behavior had been ignored. In the part of qualitative interview, the discussion of emotional issues is not deep enough to fully explore the inner emotions of first-degree relatives of colorectal cancer. Furthermore, the study was limited to the perspective of FDRs, without considering the views of other key decision-makers like spouses or children, which could provide a more holistic understanding of the factors at play. In the future, it is possible to comprehensively explore the decision-making behavior of CRC screening in FDRs from multiple perspectives, and this work is currently being carried out in our team.

Conclusions

Overall, decision-making behaviors regarding colonoscopy screening among FDRs of CRC patients exhibit variability. Influential factors included marital status, average monthly household income, medical payment method, perceived severity. It is suggested that medical staff should focus on first-degree relatives who are unmarried or widowed, have low family income, have low medical insurance reimbursement rate, and have low perception of the severity of colorectal cancer in their daily work, and enhance their awareness of the severity of colorectal cancer by establishing social support systems, providing subsidies for colonoscopy screening, increasing the reimbursement rate of medical insurance, and emphasizing the severity of colorectal cancer. In order to achieve the purpose of early screening and early treatment.

Abbreviations

CRC Colorectal Cancer
FDRs First—Degree Relatives
PMT Protective Motivation Theory

Acknowledgements

We would like to thank the Wuhan University of China for providing funding for this project. We also would like to thank all the participants in this study and medical staff of gastrointestinal surgery department of Zhongnan Hospital of Wuhan University.

Authors' contributions

HBC and YMJ designed and conduct the entire study, and draft the manuscript with the significant contribution and are the first author of this article. JZ and BLF controlled the quality of the study and participated in the screening and analysis. They are the corresponding authors of this paper. JYW and CT conducted interviews with patients and sorted out the interview results. XLP、WZ and SHZ contributed to the quality control, and proof reading and format of the manuscript with the same contribution.

Funding

This study was supported by the Wuhan University Nursing Special Research Incubation Fund: "Construction of a Navigated Care Model Based on a Trans-Theoretical Model to Promote Screening Behavior of First-Degree Relatives for Colorectal Cancer", Grant number: [LCHL202331].

Data availability

All the datasets analysed during the study were included in this published article and its supporting information.

Declarations

Ethics approval and consent to participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.This study was approved by the Medical Ethics Committee of Zhongnan Hospital of Wuhan University (approval number: 2023103 K).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Department of Gastrointestinal Surgery, Zhongnan Hospital of Wuhan University, Wuhan, Hubei, China. [2]Department of Neurosurgery, Zhongnan Hospital of Wuhan University, Wuhan, Hubei, China. [3]Wuhan University, School of Nursing, Wuhan, Hubei, China. [4]Department of Nursing, Zhongnan Hospital of Wuhan University, Wuhan, Hubei, China.

Received: 9 September 2024 Accepted: 6 February 2025
Published online: 25 February 2025

References

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, Jemal A. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74(3):229–63.

2. Patel SG, Karlitz JJ, Yen T, Lieu CH, Boland CR. The rising tide of early-onset colorectal cancer: a comprehensive review of epidemiology, clinical features, biology, risk factors, prevention, and early detection. Lancet Gastroenterol Hepatol. 2022;7(3):262–74.
3. Lynch HT, de la Chapelle A. Hereditary colorectal cancer. N Engl J Med. 2003;348(10):919–32.
4. Wong MCS, Chan CH, Lin J, Huang JLW, Huang J, Fang Y, Cheung WWL, Yu CP, Wong JCT, Tse G, et al. Lower relative contribution of positive family history to colorectal cancer risk with increasing age: a systematic review and meta-analysis of 9.28 million individuals. Am J Gastroenterol. 2018;113(12):1819–27.
5. Expert Group on Cancer Prevention and Control NCfCaN-cCaP, Wu J. Expert consensus on community-based colorectal cancer sereening in China. J Environ Hyg. 2024;14(4):273–85.
6. Brenner H, Stock C, Hoffmeister M. Effect of screening sigmoidoscopy and screening colonoscopy on colorectal cancer incidence and mortality: systematic review and meta-analysis of randomised controlled trials and observational studies. BMJ. 2014;348: g2467.
7. Association CCSCoSA-C, Zhao R. Shanghai plan for early screening, diagnosis and treatment of colorectal cancer (2023 edition). China Oncol. 2024;34(1):13–65.
8. Shaukat A, Kahi CJ, Burke CA, Rabeneck L, Sauer BG, Rex DK. ACG clinical guidelines: colorectal cancer screening 2021. Am J Gastroenterol. 2021;116(3):458–79.
9. Tomita N, Ishida H, Tanakaya K, Yamaguchi T, Kumamoto K, Tanaka T, Hinoi T, Miyakura Y, Hasegawa H, Takayama T, et al. Japanese Society for Cancer of the Colon and rectum (JSCCR) guidelines 2020 for the clinical practice of hereditary colorectal cancer. Int J Clin Oncol. 2021;26(8):1353–419.
10. Lowery JT, Ahnen DJ, Schroy PC 3, Hampel H, Baxter N, Boland CR, Burt RW, Butterly L, Doerr M, Doroshenk M, et al. Understanding the contribution of family history to colorectal cancer risk and its clinical implications: a state-of-the-science review. Cancer. 2016;122(17):2633–45.
11. Chen H, Li N, Ren J, Feng X, Lyu Z, Wei L, Li X, Guo L, Zheng Z, Zou S, et al. Participation and yield of a population-based colorectal cancer screening programme in China. Gut. 2019;68(8):1450–7.
12. Tan KK, Lopez V, Wong ML, Koh GC. Uncovering the barriers to undergoing screening among first degree relatives of colorectal cancer patients: a review of qualitative literature. J Gastrointest Oncol. 2018;9(3):579–88.
13. Tan KK, Lim TZ, Chew E, Chow WM, Koh GC. Colorectal cancer patients can be advocates for colorectal cancer screening for their siblings: a study on siblings' perspectives. Psychooncology. 2020;29(12):2028–32.
14. Tan KK, Lim TZ, Chan DKH, Chew E, Chow WM, Luo N, Wong ML, Koh GC. Getting the first degree relatives to screen for colorectal cancer is harder than it seems-patients' and their first degree relatives' perspectives. Int J Colorectal Dis. 2017;32(7):1065–8.
15. Alzoubi MM, Al-Ghabeesh SH. Knowledge, attitude, practice, and perceived barriers regarding colorectal cancer screening practices among healthcare practitioners: a systematic review. Cureus. 2024;16(2):e54381.
16. Zhu X, Weiser E, Griffin JM, Limburg PJ, Finney Rutten LJ. Factors influencing colorectal cancer screening decision-making among average-risk US adults. Prev Med Rep. 2022;30: 102047.
17. Huang Q, Tan LY. Exploring gender disparities in factors influencing colorectal cancer screening compliance in Singapore. Asian Pac J Cancer Prev. 2024;25(3):867–73.
18. Wang H, Roy S, Kim J, Farazi PA, Siahpush M, Su D. Barriers of colorectal cancer screening in rural USA: a systematic review. Rural Remote Health. 2019;19(3):5181.
19. Li R, Li C, Liu L, Chen W, Bai Y. Factors affecting colonoscopy screening among first-degree relatives of colorectal cancer patients: a mixed-method systematic review. Worldviews Evid Based Nurs. 2024;21(3):245–52.
20. Cohen M, Rosenfeld M, Greenblatt-Kimron L. Associations between cancer fatalism, causal attributions, and perceptions of benefits and barriers to screening for colorectal cancer. Int J Behav Med. 2022;29(3):357–66.
21. Rogers RW. A protection motivation theory of fear appeals and attitude change1. J Psychol. 1975;91(1):93–114.
22. Balla J, Hagger MS. Protection motivation theory and health behaviour: conceptual review, discussion of limitations, and recommendations for best practice and future research. Health Psychol Rev. 2024;17:1–27.
23. Cummings CL, Rosenthal S, Kong WY. Secondary risk theory: validation of a novel model of protection motivation. Risk Anal. 2021;41(1):204–20.
24. Karimi M, Khoramaki Z, Faradonbeh MR, Ghaedi M, Ashoori F, Asadollahi A. Predictors of hospital nursing staff's adherence to safe injection guidelines: application of the protection motivation theory in Fars Province, Iran. BMC Nurs. 2024;23(1):25.
25. Ashoori F, Karimi M, Seif M. Comparison of the effect of mothers and students' education on the promotion of oral health behaviours in female students, using the health belief model. Int J Dent Hyg. 2022;20(4):601–8.
26. Sadeghi R, Mazloomy Mahmoodabad SS, Fallahzadeh H, Rezaeian M, Bidaki R, Khanjani N. Predictive factors for preventing hookah smoking and health promotion among young people based on the protection motivation theory. J Educ Health Promot. 2019;8:169.
27. Karimi M, Ghahremani L, Rakhshani T, Asadollahi A, Mohammadi A. Predictors of self-care behaviors in hypertensive patients based on the protection motivation theory. BMC Public Health. 2024;24(1):2974.
28. Li QM. Protective motivation theory in colorectalcancer screening intention among Chineseurban residents. Master. Wuhan University; 2021.
29. Bai Y, Wong CL, Peng X, So WKW. Colonoscopy screening behaviour and associated factors amongst first-degree relatives of people with colorectal cancer in China: testing the health belief model using a cross-sectional design. Int J Environ Res Public Health. 2020;17(14):4927.
30. Liu M. Using an example to itlustrate Colaizzi's phenomenological data analysis method. J Nurs Sci. 2019;34(11):90–2.
31. Rakhshanderou S, Maghsoudloo M, Safari-Moradabadi A, Ghaffari M. Theoretically designed interventions for colorectal cancer prevention: a case of the health belief model. BMC Med Educ. 2020;20(1):270.
32. Zhao DQ. Construction and preliminary application of colorectal cancer screening model for first-degree relatives and spouses of patients with colorectal cancer based on early screening assistant management platform. Master. Chongqing Medical University; 2023.
33. Zhou JR. Status and influencing factors of knowledge, health beliefs. In: Health promotion behavior among populations at high risk for colorectal cancer. Master. North Sichuan Medical College; 2021.
34. Qiu H, Ding S, Liu J, Wang L, Wang X. Applications of artificial intelligence in screening, diagnosis, treatment, and prognosis of colorectal cancer. Curr Oncol. 2022;29(3):1773–95.
35. Selva A, Torà N, Pascual E, Espinàs JA, Baré M. Effectiveness of a brief phone intervention to increase participation in a population-based colorectal cancer screening programme: a randomized controlled trial. Colorectal Dis. 2019;21(10):1120–9.
36. Yen T, Qin F, Sundaram V, Asiimwe E, Storage T, Ladabaum U. Randomized controlled trial of personalized colorectal cancer risk assessment vs education to promote screening uptake. Am J Gastroenterol. 2021;116(2):391–400.
37. Guessous I, Dash C, Lapin P, Doroshenk M, Smith RA, Klabunde CN. Colorectal cancer screening barriers and facilitators in older persons. Prev Med. 2010;50(1–2):3–10.
38. von Euler-Chelpin M, Brasso K, Lynge E. Determinants of participation in colorectal cancer screening with faecal occult blood testing. J Public Health (Oxf). 2010;32(3):395–405.
39. Duan LY. Application of synchronous spouse empowerment education program in discharged pulmonary tuberculosis patients. Master. Xinxiang Medical University; 2022.
40. Al-Dahshan A, Chehab M, Bala M, Omer M, AlMohamed O, Al-Kubaisi N, Selim N. Colorectal cancer awareness and its predictors among adults aged 50–74 years attending primary healthcare in the state of Qatar: a cross-sectional study. BMJ Open. 2020;10(7): e035651.
41. Taha H, Jaghbeer MA, Shteiwi M, AlKhaldi S, Berggren V. Knowledge and perceptions about colorectal cancer in Jordan. Asian Pac J Cancer Prev. 2015;16(18):8479–86.
42. Zhao YN, Zhang N, Liu R, Jin BS, Yue C. Analysis of health literacy status and influencing factors of residents in Xicheng District of Beijing in 2022. J Med Inf. 2024;37(17):23–7.
43. Fendrick AM, Princic N, Miller-Wilson LA, Wilson K, Limburg P. Out-of-pocket costs for colonoscopy after noninvasive colorectal cancer screening among US adults with commercial and medicare insurance. JAMA Netw Open. 2021;4(12):e2136798.

44. Su D, Kang Y, Li X. Analysis of colonoscopy compliance and its influencing factors among 1075 cases of colorectal cancer preliminary screened positive population. Chin J Front Med Sci. 2021;13(07):83–8.
45. Liu C, Wang XF, Li Y, Lu WJ, Qin Y. Visualized literature analysis on evolution and application of health belief model. Chin J Health Educ. 2020;36(02):167–70.

Publisher's note