

Colonoscopy Uptake in First-Degree Relatives of CRC Patients: Challenges and Intervention Strategies

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Objective: Colorectal cancer (CRC) screening is crucial for early detection and prevention. However, the willingness of first-degree relatives of CRC patients to undergo colonoscopy often remains low, impacting early diagnosis and treatment outcomes.

Methods: This article reviewed the relevant concepts, research status, evaluation methods, influencing factors and intervention measures of first-degree relatives of patients with colorectal cancer.

Results: Through the review, it is found that there is still a large gap in the research on the development of assessment tools and intervention programs. Existing intervention programs often fail to address the unique demographic, cognitive, psychological, family dynamic, and social barriers faced by this population. Future research should prioritize the development of specific assessment tools that can accurately measure the willingness of first-degree relatives to undergo colonoscopy, taking into account cultural nuances and contextual factors. By addressing psychological and social factors, researchers can develop more targeted and effective programs that enhance understanding and motivation for colonoscopy screening.

Conclusion: This study provides references for domestic research on the willingness of first-degree relatives for colonoscopy, provide new ideas for formulating intervention methods more suitable for first-degree relatives for colonoscopy, and promote their willingness to perform colonoscopy.

Keywords: colorectal cancer, first-degree relatives, enteroscopy, check intention

Introduction

In 2020, the number of new cases of colorectal cancer (CRC) in the world will be about 1.93 million, accounting for 10.0% of all new cancer cases, ranking third among all cancers. There were about 935,000 deaths, accounting for 9.4% of all cancer deaths, ranking second among all cancer deaths.¹ In 2020, 555,000 new CRC cases were reported in China, accounting for 28.8% of the new CRC cases in the world, ranking second among all cancers in China. There were 286,000 CRC deaths, accounting for 30.6% of the global CRC deaths and ranking fifth among all cancer deaths in China.² Colonoscopy is an important means to diagnose early colorectal cancer and precancerous lesions, and is recognized as the “gold standard” for diagnosis and treatment of intestinal lesions.^{3,4} First-degree relatives (FDRs) of CRC patients are at high risk for CRC development,^{5,6} including biological parents, children, and siblings of CRC patients. Results of a meta-analysis⁶ showed that the risk of first-degree relatives of colorectal cancer patients was 1.76 times that of the general population. Other studies⁷ show that the probability of developing the disease is also affected by the number of relatives with the disease. Current guidelines and studies^{4,5,8,9} strongly recommend colonoscopy screening of first-degree relatives (FDRs) of CRC patients starting at age 40 or 10 years younger than the earliest CRC diagnosis in the family. Research conducted in China primarily targets high-risk groups aged 50 to 75 years,^{10–14} with limited focus on studies specific to first-degree relatives. In China, insufficient public awareness of CRC and traditional cultural values that emphasize social dignity and discourage acknowledging physical discomfort have led to lower participation rates in screening

programs. This psychological resistance is particularly pronounced for procedures such as colonoscopy, which require the exposure of private body areas. Family support plays a crucial role in the decision to undergo screening; however, poor communication within families can reduce screening willingness. Systemic barriers also exist, with high-quality medical resources concentrated in major cities, limiting access for residents in rural and remote areas. Economic burdens and complex health insurance reimbursement processes further hinder CRC screening efforts. Despite governmental and social organization initiatives, public understanding of CRC and its screenings requires further enhancement. Significant advancements have been made in colonoscopy technology and intervention measures in China. Innovations such as virtual colonoscopy and capsule endoscopy offer less invasive or more acceptable screening options, while artificial intelligence-assisted diagnostics enhance the speed and accuracy of image analysis. Intervention strategies include personalized health management plans tailored to individual risk profiles, multidisciplinary team collaborations for comprehensive services, psychological support to help patients overcome fear, and community education to increase public awareness and engagement in CRC prevention. These integrated measures aim to improve screening rates and the quality of care, ultimately enhancing overall prevention and control outcomes for CRC. This study summarized and summarized the concept, research status, assessment tools, influencing factors and intervention methods of colorectal cancer first-degree relatives' willingness to perform colonoscopy, aiming to provide references for domestic research on the willingness of first-degree relatives to perform colonoscopy, and provide new ideas for formulating intervention methods more suitable for first-degree relatives' willingness to perform colonoscopy.

Related Concepts

Colorectal Cancer

Colorectal cancer is a malignant neoplasm of the lower digestive tract originating from the mucosal epithelium of the colorectal lining. Its development typically progresses from adenoma (polyp) to carcinoma over a period of 10 to 15 years, providing ample opportunity for early detection and clinical intervention.¹⁵ In the early stages, colorectal cancer often presents without obvious symptoms. However, as the disease advances, particularly in later stages, symptoms such as hematochezia, melena, lower abdominal cramping, persistent constipation or diarrhea, decreased appetite, and unintended weight loss may emerge.^{16–18} Extensive research^{15,19} indicates that early screening for colorectal cancer in asymptomatic individuals, coupled with the detection of precancerous lesions and timely intervention, can interrupt the carcinogenic process, improve prognosis, reduce mortality, and enhance the quality of life for patients.

Colonoscopy

Colonoscopy is a frequently employed, direct, and effective method for detecting intestinal diseases and is regarded as the most accurate diagnostic tool for early colorectal cancer detection.^{3,20} Colonoscopy serves five primary functions in colorectal cancer screening: early detection of precancerous lesions, identification of asymptomatic adenomatous polyps (primary screening), follow-up on other screening abnormalities (diagnosis), removal of precancerous lesions (prevention), removal of early-stage cancer (treatment), and long-term surveillance of high-risk patients.⁹ The major advantage of colonoscopy lies in its ability to directly visualize the intestinal cavity, offering high accuracy and sensitivity in detecting early cancer and precancerous lesions, including advanced adenomas and intraepithelial neoplasia. A meta-analysis⁴ indicated that colonoscopy screening is associated with a 56% reduction in morbidity (RR=0.44, 95% CI: 0.22–0.88) and a 57% reduction in mortality (RR=0.43, 95% CI: 0.35–0.53) compared to no screening.

However, colonoscopy is an invasive procedure that can lead to complications such as perforation and bleeding.³ The preparation for colonoscopy often requires consuming large amounts of laxatives, which some individuals may find challenging, potentially leading to inadequate bowel preparation and affecting the examination's efficacy.²¹ Additionally, the skill level of the endoscopist can influence the procedure's outcome. These limitations contribute to reduced compliance with colonoscopy and reluctance among patients to undergo the procedure.

Wishes for Colonoscopy

The willingness of first-degree relatives of colorectal cancer patients to undergo colonoscopy is a behavior intention. Behavioral willingness refers to the subjective likelihood or inclination of an individual to engage in certain behaviors,

and is closer to behaviors than factors such as beliefs, attitudes, and affection.²² And there is a high willingness to do these behaviors, and when this willingness is explained correctly, the behavior of doing cancer screening increases.^{23,24} The intention of first-degree relatives to undergo colonoscopy, that is, the behavioral intention of first-degree relatives to undergo colonoscopy, can predict the outcome of their actual behavior in undergoing colonoscopy.

Current Status of Colonoscopy Screening for First-Degree Relatives

Current Situation in Foreign Countries

At present, foreign scholars have conducted a number of studies on the status quo of colonoscopy screening of first-degree relatives of colorectal patients. A cross-sectional study conducted by Weigl et al²⁵ in three German cities showed that 45.2%, 52.4% and 61.4% of first-degree relatives of colorectal cancer patients aged 40–44, 45–49 and 50–54 had received colonoscopy, respectively. Overall, there are about 54.5% of first-degree relatives had undergone a colonoscopy, compared with 25.7% of those without a family history; A study in the United States²⁶ showed that 74.7% of first-degree relatives with colorectal cancer had received colonoscopy in the past 10 years, and 56.6% of those with no family history had received colonoscopy. The colonoscopy screening rate of first-degree relatives of colorectal cancer patients in developed countries such as Europe and the United States is relatively high, and the screening rate is maintained at 45–75%.

Current Status of China

Domestic scholars have gradually paid attention to the status quo of colonoscopy screening of first-degree relatives of colorectal cancer patients. A study by Bai²⁷ showed that the self-reported participation rate of first-degree relatives of colorectal cancer patients in colonoscopy screening was 15.6%; A study by Sun Yan²⁸ showed that 22.4% of first-degree relatives with colorectal cancer had “colonoscopy in the past 5 years”; Du et al²⁹ conducted a survey on 201 first-degree relatives of colorectal cancer patients, showing that only 18.9% of first-degree relatives had participated in colonoscopy. According to a study by the National Cancer Clinical Research Center of China,³⁰ only 20.9% of first-degree relatives received colonoscopy. A qualitative study³¹ showed that even among first-degree relatives who were recommended for colonoscopy screening, their colonoscopy rate was only 25%. Wu’s³² study showed that 23% of first-degree relatives had received colonoscopy screening. The colonoscopy screening rate of first-degree relatives of colorectal cancer patients in China is low, and the screening rate is maintained at 15–25% (Table 1).

A Study Tool on the Willingness of First-Degree Relatives of Colorectal Cancer Patients to Undergo Colonoscopy

Belief Tool for Colorectal Cancer Screening Based on HBM

Colorectal Cancer Cognition Scale (CRCPS)

CRCPS was developed by Green³³ in 2004, and included 35 items in four dimensions: perceived susceptibility, perceived severity, perceived impairment and perceived benefit of colorectal cancer. Du et al²⁹ translated it into Chinese after obtaining Green’s permission, and the Chinese-language scale was applicable to relatives of patients with colorectal cancer. 7 items were deleted to form a Chinese-language cognitive scale of colorectal cancer consisting of 28 items in 4 dimensions, with Cronbach’s α coefficient >0.70 for each dimension. The Cronbach’s α coefficient of the total volume table is 0.74, indicating that the revised scale has good reliability and validity. Leung et al³⁴ translated CRCPS from English into traditional Chinese. After exploratory factor analysis and confirmatory factor analysis, items related to perceived severity were classified into severe perceived fear and severe perceived life impact. The items related to perceptual disorders were divided into perceptual psychological disorders and perceptual knowledge disorders, and verified in the sample of community elderly people. The Cronbach’s α coefficients of the six subscales ranged from 0.74 to 0.88. An epidemiological study of the traditional Chinese version of CRCPS has been conducted in Hong Kong. Given that the tool was developed for CRC screening tests, some entries in the perception disorders dimension are not specific when applied to colonoscopy.

Table 1 Current Status of Colonoscopy Screening for First-Degree Relatives

Country	Current Situation
Foreign countries	At present, foreign scholars have conducted a number of studies on the status quo of colonoscopy screening of first-degree relatives of colorectal patients.
1. German	A cross-sectional study conducted by Weigl et al ²⁵ in three German cities showed that 45.2%, 52.4% and 61.4% of first-degree relatives of colorectal cancer patients aged 40–44, 45–49 and 50–54 had received colonoscopy, respectively. Overall, there are about 54.5% of first-degree relatives had undergone a colonoscopy, compared with 25.7% of those without a family history.
2. the United States	A study in the United States ²⁶ showed that 74.7% of first-degree relatives with colorectal cancer had received colonoscopy in the past 10 years, and 56.6% of those with no family history had received colonoscopy. The colonoscopy screening rate of first-degree relatives of colorectal cancer patients in developed countries such as Europe and the United States is relatively high, and the screening rate is maintained at 45–75%.
3. China	Domestic scholars have gradually paid attention to the status quo of colonoscopy screening of first-degree relatives of colorectal cancer patients. ① A study by Bai ²⁷ showed that the self-reported participation rate of first-degree relatives of colorectal cancer patients in colonoscopy screening was 15.6%. ② A study by Sun Yan ²⁸ showed that 22.4% of first-degree relatives with colorectal cancer had “colonoscopy in the past 5 years”. ③ Du et al ²⁹ conducted a survey on 201 first-degree relatives of colorectal cancer patients, showing that only 18.9% of first-degree relatives had participated in colonoscopy. ④ According to a study by the National Cancer Clinical Research Center of China, ³⁰ only 20.9% of first-degree relatives received colonoscopy. ⑤ A qualitative study ³¹ showed that even among first-degree relatives who were recommended for colonoscopy screening, their colonoscopy rate was only 25%. ⑥ Wu's ³² study showed that 23% of first-degree relatives had received colonoscopy screening. The colonoscopy screening rate of first-degree relatives of colorectal cancer patients in China is low, and the screening rate is maintained at 15–25%.

Revised Colorectal Cancer Perception Tool (RCRCPS)

RCRCPS is a combination of 35 items in the Colorectal Cancer Perception Scale (CRCPS)³³ and 3 items in the Perceptual Disorders Questionnaire, which is used for colonoscopy, by Bai³⁵ in 2020. There were 38 items in 4 dimensions, including susceptibility to CRC, perceived severity of CRC, perceived barriers to colonoscopy and perceived benefits of colonoscopy. Likert 5-level scores were used, ranging from “strongly disagree” to “strongly agree” with 1–5 points respectively. CRCPS scores ranged from 38 to 190 points. The higher the score, the higher the cognitive level. The Cronbach's α coefficient was 0.74–0.87 in 197 immediate family members of Chinese patients with colorectal cancer, and the retest reliability was 0.53–0.84 within 4 weeks. The S-CVI ranges from 0.92, and the I-CVI ranges from 0.80 to 1.00. The 38-item simplified Chinese version of RCRCPS has good reliability and validity. It provides an effective tool for health care professionals to assess people at high risk of colorectal cancer, while also laying the foundation for the development of effective colorectal cancer screening interventions.

Colorectal Cancer Health Belief Model Scale (CCHBMS)

CCHBMS was adapted by Jacobs³⁶ in 2002 based on the Champion Health Belief Model for Breast Cancer Patients (CHBMS)³⁷ to assess the population's health beliefs about colorectal cancer and its screening. There were 36 items in 6 dimensions, including perceived susceptibility to CRC, perceived severity of CRC, perceived barriers to CRC screening, perceived benefit of CRC screening, health motivation and self-efficacy of CRC screening. A Likert 5-level score ranging from “strongly disagree” to “strongly agree” was used to calculate the perceived barrier dimension score for colorectal cancer screening using a reverse scoring method. A higher score indicates a higher belief in appropriate health behaviors. The Cronbach's α coefficient of the colorectal cancer health Belief Scale ranged from 0.54 to 0.88, and the retest reliability ranged from 0.72 to 0.91. The Turkish version of CHBMS was compiled by Ozsoy et al³⁸ in 2007 based on the Champion health belief model. There were 33 items in 5 dimensions, including perceived CRC susceptibility (6 items), perceived CRC severity (5 items), perceived CRC screening barriers (6 items), perceived CRC screening benefits (11 items), and health motivation (5 items). Cronbach's coefficient of the five subscales ranged from 0.54 to 0.88. The retest

reliability ranges from 0.72 to 0.91. The results show that the Turkish version of Champion Health Belief Pattern Scale has good reliability and validity, and can be used to measure colorectal cancer related beliefs. Wu et al³⁹ introduced CCHBMS into China in 2020 and translated it into the Chinese version of the Colorectal Cancer Health Belief Scale. The Cronbach's α coefficient of the total volume table was 0.881 and the Cronbach's α coefficient of the 6 dimensions was 0.801~0.944 in 210 relatives of patients with colorectal cancer. The retest reliability is 0.848. S-CVI (0.98) and I-CVI (0.84~1.00) showed good reliability and validity, confirming that the six-factor structure is suitable for the Chinese cultural background, and can be used as an effective tool to evaluate the health belief level of high-risk groups of colorectal cancer in China. Although the scale is not as detailed as the Four-factor colorectal Cancer Screening Belief Scale in measuring the psychological structure of screening, it is widely used and has sufficient reliability.

Four-Factor Colorectal Cancer Screening Belief Scale (CRCSBS)

The four-factor Colorectal Cancer Screening Belief Scale (CRCSBS) was developed by Murphy⁴⁰ in 2013 based on the relevant four-factor model,⁴¹ which is used to specifically measure people's beliefs about CRC screening and is a tool to evaluate the psychosocial structure of CRC screening. The scale consisted of 33 items in 4 dimensions, including: perceived benefits of CRC screening (6 items), perceived barriers to CRC screening (11 items), self-efficacy (10 items), and optimism (6 items). A Likert 5-point scale was used, ranging from "strongly disagree" to "strongly agree", with an overall scale score between 33 and 165. The higher the score, the more positive the belief in screening. The Cronbach's α coefficient of each dimension was 0.822~0.964, LiuYang⁴² equivalent to introducing CRCSBS into China in 2022 and translating it into the Chinese version of the Four-factor Screening Belief Scale for colorectal cancer. In 425 colorectal cancer patients and their relatives, the McDonald's omega of the whole scale is 0.939, the McDonald's omega of four dimensions is 0.774 to 0.948, the retest reliability of the scale is 0.719, and the retest reliability coefficient of each dimension is 0.664 to 0.768. The broken half reliability is 0.646. The Chinese version of the four-factor colorectal cancer screening Belief Scale has good reliability and validity. The translation and validation of psychosocial assessment tools for colorectal cancer screening across languages, cultures and countries will contribute to further international research cooperation, provide a prerequisite for healthcare professionals to improve the population's belief in colorectal cancer screening, and have important significance in promoting screening behavior and preventing the occurrence of colorectal cancer.

Adapted Health Literacy Management Scale HeLMS (Health Literacy Management Scale)

The adapted version of HeLMS was translated and revised by Sun Haolin⁴³ in 2012 using the HeLMS scale prepared by Jordan et al⁴⁴ of the University of Melbourne, Australia, to assess the health literacy level of the study subjects. The scale consists of 4 dimensions and 24 items, including the ability to obtain health information (10 items), the ability to communicate and interact (8 items), the willingness to improve health (4 items), and the willingness to provide economic support (2 items). The Cronbach's α coefficient of the total volume table was 0.894, and the retest reliability was 0.683, both of which were greater than 0.60, indicating that the scale had good reliability and validity. The adapted version of HeLMS was evaluated for reliability and validity by Peng Hui et al.⁴⁵ The Cronbach's α coefficient of the scale was 0.961, and the Cronbach's α coefficient of each dimension was 0.834~0.929. At the same time, the correlation coefficient between the score of the four dimensions and the total score of the scale is 0.517~0.916, which has good validity and reliability in the positive population of colorectal cancer. Muzaibel Muhetal⁴⁶ applied it to the study on the impact of health literacy on colonoscopy compliance of colorectal cancer positive primary screening population, and the results showed that community residents' HeLMS communication and interaction ability and willingness to improve health were influencing factors for colonoscopy compliance of colorectal cancer positive primary screening population.

Intention Questionnaire for Colorectal Cancer Screening Based on Protective Motivation Theory

The intention questionnaire for colorectal cancer screening based on the theory of protective motivation was developed by Wei Wenshuang et al⁴⁷ in 2021 through literature review, expert consultation and pre-investigation. To evaluate colorectal cancer screening intention and behavior of urban residents. The questionnaire consisted of 6 dimensions and

16 items, including risk perception (2 items), severity perception (2 items), fear perception (2 items), response efficacy (3 items), response cost (3 items), and self-efficacy (4 items). The cumulative variance contribution rate of the extracted common factors was 67.657%, the Cronbach's α coefficient of the total questionnaire was 0.763, and the Cronbach's α coefficient of each dimension was 0.584 ~ 0.771. The correlation coefficient between items in the six dimensions ranged from 0.089 to 0.534, and the correlation coefficient between each dimension and the total questionnaire ranged from 0.165 to 0.586. The results show that the questionnaire has good reliability and validity, which can help clinical nurses to understand the barriers of colorectal cancer screening in Chinese urban residents, and provide scientific guidance for nursing staff to carry out health education and other activities to encourage screening (Table 2).

Table 2 Research Tool for Colonoscopy in First-Degree Relatives of Colorectal Cancer Patients

Research Tool Name	Author	Year	Number of Dimensions	Number of Items	Rating Scale	The Reliability and Validity of the Questionnaire
Colorectal Cancer Knowledge Scale (CRCPS)	Green	2004	Four dimensions: perceived susceptibility, perceived severity, perceived barriers, and perceived benefits.	35	Likert 5-point scale, from "strongly disagree" to "strongly agree" scored 1–5 respectively	Good
Revised colorectal cancer perception tool (RCRCPS)	Bai	2020	Four dimensions: susceptibility to CRC, perceived severity of CRC, perceived barriers to colonoscopy, and perceived benefits of colonoscopy	38	Likert 5-point scale, from "strongly disagree" to "strongly agree" scored 1–5 respectively	Good
Colorectal Cancer Health Belief Model Scale (CCHBMS)	Jacobs	2002	Six dimensions: perceived susceptibility to CRC, perceived severity of CRC, perceived barriers to CRC screening, perceived benefits of undergoing CRC screening, health motivation, self-efficacy for undergoing CRC screening.	36	Likert 5-point scale, from "strongly disagree" to "strongly agree" scored 1–5 respectively	Good
Four-factor colorectal cancer screening belief scale (CRCSBS)	Murphy	2013	Four dimensions: Perceived benefits of CRC screening, Perceived barriers to CRC screening, Self-efficacy, Optimism	33	Likert 5-point scale, from "strongly disagree" to "strongly agree" scored 1–5 respectively	Good
Revised Health Literacy Management Scale (HeLMS)	Sun Haolin	2012	Four dimensions: ability to access health information, ability to interact and communicate, intention to improve health, and intention to provide economic support	24	Likert 5-point scale, where "not at all" is scored 1, "very difficult" is scored 2, "somewhat difficult" is scored 3, "a little difficult" is scored 4, and "not difficult" is scored 5	Good
Colorectal Cancer Screening Intention Questionnaire Based on Protection Motivation Theory	Wei Wenshuang	2021	Six dimensions: risk perception, severity perception, fear perception, response efficacy, response cost, and self-efficacy	16	Likert 5-point scale, from "strongly disagree", "disagree", "neither agree nor disagree", "agree" to "fully agree", with values ranging from 1 to 5	Good

Factors Influencing the Willingness of First-Degree Relatives to Undergo Colonoscopy in Patients With Colorectal Cancer

Personal Factors

Demographic Factors

The willingness of first-degree relatives of colorectal cancer patients to undergo colonoscopy was correlated with age, sex, education, marital status, working status, residence and medical insurance. ① Age. A study by Du et al²⁹ showed that the colonoscopy compliance of first-degree relatives of colorectal cancer patients aged 35–54 years (16%) was higher than that of first-degree relatives over 54 years (3%). A study by Weigl et al²⁵ showed that the proportion of first-degree relatives receiving colonoscopy was negatively correlated with the age of diagnosis of the affected relatives. The younger the age of diagnosis of colorectal cancer patients, the higher the proportion of their first-degree relatives receiving colonoscopy; the higher the age of diagnosis of colorectal cancer patients, the lower the risk of colorectal cancer their first-degree relatives thought. Sun Yan's²⁸ study showed that first-degree relatives older than 50 years had a serious lack of awareness of their own risk of colorectal cancer and colonoscopy screening. ② Gender. The results of a study in the United States²⁶ showed that among first-degree relatives of colorectal cancer patients, women were more likely to adhere to colonoscopy than men, which is consistent with Wu's⁴⁸ study, possibly because women are more concerned about their health than men; Another study by Wu³² showed that men were more willing to accept colonoscopy than women, possibly because women were more likely to have fear and embarrassment about colonoscopy. ③ Education level: The higher the education level, the higher the willingness of first-degree relatives of colorectal cancer patients to undergo colonoscopy.^{29,32} According to the study of Sun Yan et al,²⁸ the higher the education level of first-degree relatives, the higher their cognition level of colonoscopy. ④ Marital status. Married first-degree relatives' intention to undergo colonoscopy was higher than unmarried and divorced ones.^{29,32} ⑤ Working status. A study by Du et al²⁹ showed that first-degree relatives of colorectal cancer patients with stable jobs had a higher willingness to undergo colonoscopy. ⑥ Residence. First-degree relatives of colorectal cancer patients living in urban areas are more willing to undergo colonoscopy than those in rural areas,^{29,32} and their awareness level of colonoscopy is also higher than that in rural areas.²⁸ ⑦ Medical insurance. A study by Shapiro et al⁴⁹ found that only 44% of uninsured people aged 50–64 received a colonoscopy, compared to 57% of those with insurance; The willingness of first-degree relatives with medical insurance to undergo colonoscopy was significantly higher than that of those without medical insurance.³²

Individual Cognitive Factors

The cognitive level of first-degree relatives of colorectal cancer patients is positively correlated with screening intention.^{32,48} A study by Bai²⁷ showed that 31.4% of first-degree relatives did not understand the process of colonoscopy, and a qualitative study by Zhang³¹ showed that for first-degree relatives of colorectal cancer, cancer is equivalent to terminal illness and death, and people usually avoid discussing cancer-related topics. Influenced by cancer fatalism, some first-degree relatives believe that their risk of cancer is not affected by their own behavior, that everything is predestined and cannot be escaped or changed, and that screening is meaningless if they are destined to get cancer. There are also people who believe that the disease is related to heredity and there is no way to change it, even if it is checked. Still others believe that the absence of symptoms is healthy,^{28,50–52} and that normal annual physical examination results mean good health,²⁸ which takes them away from the perception of disease and makes them feel that deliberate colonoscopy screening is not necessary. A study by Sun Yan²⁸ showed that 73.5% of first-degree relatives did not consider themselves to be a high-risk group for colorectal cancer. This is consistent with the findings of McGarragle et al⁵³ that first-degree relatives consider their risk of CRC to be low or negligible.

Personal Psychological Factors

First-degree relatives of colorectal cancer patients think that colonoscopy will be very painful and fear that they will detect colorectal cancer.^{27,28,51} A study in Saudi Arabia⁵⁴ showed that fear was a common barrier to colonoscopy. The possible adverse consequences of screening will directly break the current “healthy” state, or even the balance of a good life, and let them fall into fear and worry;³¹ 81.6% of first-degree relatives were afraid of the colonoscopy process,²⁸ such as the preparation of colon cleansing before the examination, embarrassment during the examination, pain and adverse reactions to anesthesia. Some immediate family members^{53,55} indicated that they preferred to be kept in the dark about CRC and feared the bad news that colonoscopy could bring.

Family Factors

The willingness of first-degree relatives of colorectal cancer patients to undergo colonoscopy is also affected by family factors. A qualitative study³¹ showed that although some immediate family members understood the importance of colonoscopy screening, their daily lives were consumed by complex work, parental care, parenting, and other events, often leaving them with a sense of powerlessness. As a result, screening is not a priority in their lives and is often delayed when work - or family-related issues arise at the same time; The suggestion of siblings (encouragement and persuasion) is a motivating factor for their first-degree relatives to undergo colonoscopy.⁵⁰ According to the study of McGarragle et al,⁵³ 25% of colorectal cancer patients did not mention any information about colorectal cancer and colonoscopy to their first-degree relatives. The first reason is that colorectal cancer patients lack relevant information about colorectal cancer and guidelines for colonoscopy screening. The second is the negative expectation of family reaction; The third is that the first degree relatives know the information about colorectal cancer or have undergone colonoscopy; Fourth, they are estranged from first-degree relatives for a long time, do not want to talk about health problems, and do not want first-degree relatives to think that trying to contact them is to gain sympathy; Cultural barriers and strong stigma prevent them from disclosing the increased risk of CRC and the necessity of colonoscopy to their first-degree relatives, which are also important factors influencing their first-degree relatives to undergo colonoscopy.

Social Factors

The willingness of first-degree relatives of colorectal cancer patients to undergo colonoscopy is also affected by social factors. (1) Doctor's advice. A study by Fiala²⁶ showed that: the proportion of first-degree relatives who did not accept the doctor's recommendation to undergo colonoscopy was 74.7%, and 94% of first-degree relatives of patients with colorectal cancer who followed the doctor's screening recommendation received colonoscopy; A domestic study²⁸ showed that 75.5% of FDRs did not get enough information about CRC screening from doctors. According to SalimzadehH,⁵¹ 46.2% of first-degree relatives never received a doctor's recommendation for CRC screening; The physician's recommendation is a motivating factor for first-degree relatives to undergo colonoscopy.^{32,53} However, Ingrand et al's⁵⁶ study showed that physicians' lack of understanding of screening guidelines for colorectal cancer, lack of time, and not thinking of themselves as participants in the information flow about family risk prevented first-degree relatives from undergoing colonoscopy. (2) Inconvenient transportation. A qualitative study³¹ showed that "distance from the hospital and need to be picked up by children" were important factors for their reluctance to undergo colonoscopy. 26.3% of FDRs believe that there is no convenient and trusted medical institution near their place of residence for examination.²⁸ (3) Government subsidies: Tan et al⁵⁰ showed that medical subsidies could promote first-degree relatives to undergo colonoscopy, and they agreed to free colonoscopy. The study of Wu et al³² shows that free medical treatment is a promoting factor for first-degree relatives to perform colonoscopy screening. (4) Social propaganda. Government propaganda through TV and other media and community encouragement are conducive to first-degree relatives to undergo colonoscopy, while the lack of posters in hospitals hinders their awareness of screening.⁵⁰

Screening Technical Factors

Screening technical factors also affect the willingness of first-degree relatives of colorectal cancer patients to undergo colonoscopy. A qualitative study³¹ showed that the complicated and time-consuming process of colonoscopy was an important factor affecting the colonoscopy. A domestic study²⁸ shows that 76.3% of first-degree relatives are busy with daily work, think colonoscopy is cumbersome and have no time to make appointment arrangements, and 60.5% FDRs worry that colonoscopy will cause harm to the body. According to the study of McGarragle et al,⁵³ intestinal preparation before examination, embarrassment of examination site, and sedation during examination are the hindrance factors affecting colonoscopy.

Other Factors

In addition to demographic factors, personal factors, social factors and screening technology factors, there are other factors that affect the willingness of colorectal cancer patients to undergo colonoscopy. (1) Causes of other diseases. A study by PaskettED et al⁵² showed that 33.3% of first-degree relatives did not have a colonoscopy given other priorities or health concerns. (2) Time. A qualitative study⁵³ showed that because of the tight schedule, they were

embarrassed to ask for leave and gave up the colonoscopy; 32.4% of first-degree relatives did not undergo colonoscopy because of insufficient time.⁵² (3) Screening costs. It is believed that the high cost of screening and the financial burden are the hindering factors affecting their first-degree relatives to undergo colonoscopy^{28,50} (Table 3).

Table 3 Factors Influencing the Willingness of First-Degree Relatives to Undergo Colonoscopy in Patients With Colorectal Cancer

Influencing Factors		Literature Support
I. Personal Factors I.1. Demographic factors	① Age	A study by Du et al ³³ showed that the colonoscopy compliance of first-degree relatives of colorectal cancer patients aged 35–54 years (16%) was higher than that of first-degree relatives over 54 years (3%). A study by Weigl et al ²⁹ showed that the proportion of first-degree relatives receiving colonoscopy was negatively correlated with the age of diagnosis of the affected relatives. The younger the age of diagnosis of colorectal cancer patients, the higher the proportion of their first-degree relatives receiving colonoscopy; the higher the age of diagnosis of colorectal cancer patients, the lower the risk of colorectal cancer their first-degree relatives thought. Sun Yan's ³² study showed that first-degree relatives older than 50 years had a serious lack of awareness of their own risk of colorectal cancer and colonoscopy screening.
	② Gender	The results of a study in the United States ²² showed that among first-degree relatives of colorectal cancer patients, women were more likely to adhere to colonoscopy than men, which is consistent with Wu's ⁴⁸ study, possibly because women are more concerned about their health than men; Another study by Wu ³² showed that men were more willing to accept colonoscopy than women, possibly because women were more likely to have fear and embarrassment about colonoscopy.
	③ Education level	The higher the education level, the higher the willingness of first-degree relatives of colorectal cancer patients to undergo colonoscopy; ^{29,32} According to the study of Sun Yan et al, ²⁸ the higher the education level of first-degree relatives, the higher their cognition level of colonoscopy.
	④ Marital status	Married first-degree relatives' intention to undergo colonoscopy was higher than unmarried and divorced ones. ^{29,32}
	⑤ Working status	A study by Du et al ²⁹ showed that first-degree relatives of colorectal cancer patients with stable jobs had a higher willingness to undergo colonoscopy.
	⑥ Residence	First-degree relatives of colorectal cancer patients living in urban areas are more willing to undergo colonoscopy than those in rural areas, ^{29,32} and their awareness level of colonoscopy is also higher than that in rural areas. ²⁸
	⑦ Medical insurance	A study by Shapiro et al ⁴⁹ found that only 44% of uninsured people aged 50–64 received a colonoscopy, compared to 57% of those with insurance; The willingness of first-degree relatives with medical insurance to undergo colonoscopy was significantly higher than that of those without medical insurance. ³²
I.2. Individual cognitive factors		The cognitive level of first-degree relatives of colorectal cancer patients is positively correlated with screening intention. ^{32,48} A study by Bai ²⁷ showed that 31.4% of first-degree relatives did not understand the process of colonoscopy, and a qualitative study by Zhang ³¹ showed that for first-degree relatives of colorectal cancer, cancer is equivalent to terminal illness and death, and people usually avoid discussing cancer-related topics. Influenced by cancer fatalism, some first-degree relatives believe that their risk of cancer is not affected by their own behavior; that everything is predestined and cannot be escaped or changed, and that screening is meaningless if they are destined to get cancer. There are also people who believe that the disease is related to heredity and there is no way to change it, even if it is checked. Still others believe that the absence of symptoms is healthy, ^{28,50–52} and that normal annual physical examination results mean good health, ²⁸ which takes them away from the perception of disease and makes them feel that deliberate colonoscopy screening is not necessary. A study by Sun Yan ²⁸ showed that 73.5% of first-degree relatives did not consider themselves to be a high-risk group for colorectal cancer. This is consistent with the findings of McGarragle et al ⁵³ that first-degree relatives consider their risk of CRC to be low or negligible.
I.3. Personal psychological factors		First-degree relatives of colorectal cancer patients think that colonoscopy will be very painful and fear that they will detect colorectal cancer; ^{27,28,51} A study in Saudi Arabia ⁵⁴ showed that fear was a common barrier to colonoscopy. The possible adverse consequences of screening will directly break the current "healthy" state, or even the balance of a good life, and let them fall into fear and worry; ³¹ 81.6% of first-degree relatives were afraid of the colonoscopy process, ²⁸ such as the preparation of colon cleansing before the examination, embarrassment during the examination, pain and adverse reactions to anesthesia. Some immediate family members ^{53,55} indicated that they preferred to be kept in the dark about CRC and feared the bad news that colonoscopy could bring.
2. Family factors		The willingness of first-degree relatives of colorectal cancer patients to undergo colonoscopy is also affected by family factors. A qualitative study ²⁷ showed that although some immediate family members understood the importance of colonoscopy screening, their daily lives were consumed by complex work, parental care, parenting, and other events, often leaving them with a sense of powerlessness. As a result, screening is not a priority in their lives and is often delayed when work - or family-related issues arise at the same time; The suggestion of siblings (encouragement and persuasion) is a motivating factor for their first-degree relatives to undergo colonoscopy. ⁵⁰ According to the study of McGarragle et al, ⁵³ 25% of colorectal cancer patients did not mention any information about colorectal cancer and colonoscopy to their first-degree relatives. The first reason is that colorectal cancer patients lack relevant information about colorectal cancer and guidelines for colonoscopy screening. The second is the negative expectation of family reaction; The third is that the first degree relatives know the information about colorectal cancer or have undergone colonoscopy; Fourth, they are estranged from first-degree relatives for a long time, do not want to talk about health problems, and do not want first-degree relatives to think that trying to contact them is to gain sympathy; Cultural barriers and strong stigma prevent them from disclosing the increased risk of CRC and the necessity of colonoscopy to their first-degree relatives, which are also important factors influencing their first-degree relatives to undergo colonoscopy.

(Continued)

Table 3 (Continued).

Influencing Factors		Literature Support
3. Social factors	<p>① Doctor's advice.</p> <p>② Inconvenient transportation</p> <p>③ Government subsidies</p> <p>④ Social propaganda</p>	<p>A study by Fiala²⁶ showed that: the proportion of first-degree relatives who did not accept the doctor's recommendation to undergo colonoscopy was 74.7%, and 94% of first-degree relatives of patients with colorectal cancer who followed the doctor's screening recommendation received colonoscopy; A domestic study²⁸ showed that 75.5% of FDRs did not get enough information about CRC screening from doctors. According to Salimzadeh⁵¹ 46.2% of first-degree relatives never received a doctor's recommendation for CRC screening; The physician's recommendation is a motivating factor for first-degree relatives to undergo colonoscopy.^{32,53} However, Ingrand et al's⁵⁶ study showed that physicians' lack of understanding of screening guidelines for colorectal cancer, lack of time, and not thinking of themselves as participants in the information flow about family risk prevented first-degree relatives from undergoing colonoscopy.</p> <p>A qualitative study³¹ showed that "distance from the hospital and need to be picked up by children" were important factors for their reluctance to undergo colonoscopy. 26.3% of FDRs believe that there is no convenient and trusted medical institution near their place of residence for examination.²⁸</p> <p>Tan KK et al⁵⁰ showed that medical subsidies could promote first-degree relatives to undergo colonoscopy, and they agreed to free colonoscopy. The study of Wu et al³² shows that free medical treatment is a promoting factor for first-degree relatives to perform colonoscopy screening.</p> <p>Government propaganda through TV and other media and community encouragement are conducive to first-degree relatives to undergo colonoscopy, while the lack of posters in hospitals hinders their awareness of screening.⁵⁰</p>
4. Screening technical factors	Screening technical factors also affect the willingness of first-degree relatives of colorectal cancer patients to undergo colonoscopy. A qualitative study ³¹ showed that the complicated and time-consuming process of colonoscopy was an important factor affecting the colonoscopy. A domestic study ²⁸ shows that 76.3% of first-degree relatives are busy with daily work, think colonoscopy is cumbersome and have no time to make appointment arrangements, and 60.5% FDRs worry that colonoscopy will cause harm to the body. According to the study of McGarragle et al, ⁵³ intestinal preparation before examination, embarrassment of examination site, and sedation during examination are the hindrance factors affecting colonoscopy.	
5. Other factors	<p>① Causes of other diseases</p> <p>② Time</p> <p>③ Screening costs</p>	<p>A study by PaskettED et al⁵² showed that 33.3% of first-degree relatives did not have a colonoscopy given other priorities or health concerns.</p> <p>A qualitative study⁴⁹ showed that because of the tight schedule, they were embarrassed to ask for leave and gave up the colonoscopy; 32.4% of first-degree relatives did not undergo colonoscopy because of insufficient time.⁵²</p> <p>It is believed that the high cost of screening and the financial burden are the hindering factors affecting their first-degree relatives to undergo colonoscopy.^{28,50}</p>

Interventions

Empirical and theory-oriented individualized communication models: Bai et al⁵⁷ divided first-degree relatives of patients with colorectal cancer into control group and experimental group. Both groups received electronic pamphlets about colorectal cancer screening (risk factors for colorectal cancer, screening recommendations and free CRC screening programs in community Settings). The experimental group then received three carefully designed sessions of tailored communication (tailored based on a health belief model and consisting of two written messages and an oral consultation). Results⁵⁸ showed that at 1 and 3 months after intervention, CRC susceptibility perception, CRC severity perception, colonoscopy benefit perception, colonoscopy self-efficacy perception and colonoscopy action cues were significantly improved. Colonoscopy barriers were significantly reduced. This evidence - and theory-driven, tailored communication approach significantly improves colonoscopy screening rates for first-degree relatives of patients with colorectal cancer.

Motivational interviewing: Motivational interviewing is a patient-centered and motivational method of counseling in which the counselor helps change the patient's behavior by exploring and eliminating ambivalence. Salimzadeh et al⁵¹ randomly divided the first-degree relatives of patients with colorectal cancer into the experimental group and the control group. The first-degree relatives of the control group received information on colorectal cancer screening standards and routine care, while the first-degree relatives of the experimental group received phone-based motivational interview counseling with the participation of trained nurses or medical staff. Comparing the colonoscopy rates of the two groups after 6 months, the results showed that the proportion of colonoscopy screening was 83.5% in the intervention group and 48.2% in the control group. Demonstrated the effectiveness of phone-based motivational interview counseling in increasing colonoscopy for family members of colon cancer patients. Bauer et al⁵⁹ used a computer system to randomly split 261 eligible first-degree relatives into an experimental group and a control group, both of whom were delivered

study documents and information leaflets containing information on familial risk and CRC screening by their relatives with colorectal cancer in person or by mail. FDRS in the treatment group underwent telephone consultations with specially trained caregivers at the study Coordination Center (an average duration of 26.6 minutes), and the purpose of these conversations was to identify barriers to colonoscopy screening and then overcome them through consultations. In addition, information is provided on the sensitivity, specificity, and complications of colonoscopy and other screening methods. First-degree relatives in the control group received only the study document and an information leaflet. Written questionnaires were sent to both groups at 3 and 6 months after the start of the study. The results showed that 99 (79%) of 125 people in the experimental group and 97 (71%) of 136 people in the control group underwent colonoscopy, with no statistically significant difference between the two groups. The possible reason is that there is sample selection bias in contacting first-degree relatives of colorectal cancer patients, which can be further verified by increasing sample size and narrowing selection bias in future studies.

Based on the facilitator intervention, Paskett et al⁵² randomly divided first-degree relatives into an experimental group and a control group, which received only a site-based intervention (complete a survey of demographic characteristics and health-related characteristics via the web, and generate an individual colorectal cancer screening recommendation document based on NCCN guidelines, indicating when colonoscopies are needed and recommendations for individual health behaviors), the study group added facilitators (facilitators provide telephone follow-up based on each participant's barriers and needs, and facilitators call participants 1 month after receiving the website recommendations to assess screening barriers and provide counseling for eliminating these barriers. And assisted participants in scheduling colonoscopies). The intervention of. Both groups received a call from the study staff to give their consent and complete the baseline survey. The findings showed that among first-degree relatives who needed immediate colonoscopy, adding a telephone referral to the website was more effective than colonoscopy compliance among participants who had the website intervention alone. May reduce the future incidence of CRC in first-degree relatives.

For tailored face-to-face or telephone interventions, Esplen et al⁶⁰ randomly divided first-degree relatives who completed baseline assessment into three groups: a control group and two experimental groups. The control group received written information on CRC risk and screening recommendations; Treatment group 1 received advice on CRC risk and screening based on face-to-face counseling; Treatment Group 2 received advice on CRC risk and screening based on a telephone consultation format. The results showed that both telephone and face-to-face interventions improved first-degree relatives' knowledge of CRC, risk perception, and willingness to screen compared with conventional treatment. Face-to-face intervention increased the satisfaction of first-degree relatives with CRC screening. A Meta analysis by Bai⁶¹ showed that a pooled analysis of four included studies showed that tailored communication had a beneficial effect on improving colonoscopy screening rates (OR: 2.21, 95% CI: 1.71–2.85, $p < 0.01$). Telephone plus Print: A pooled analysis of three studies of repeated application of customized interventions through printed materials and telephone consultations showed a benefit in improving colonoscopy participation (OR: 2.39, 95% CI: 1.78–3.21, $p < 0.01$).

Enlightenment

Attention Should Be Paid to the Study on the Willingness of First-Degree Relatives of Patients with Colorectal Cancer to Undergo Colonoscopy

In China, the willingness of first-degree relatives of patients with colorectal cancer is generally low, which seriously affects the compliance rate of colonoscopy screening, thereby increasing the diagnosis rate of advanced colorectal cancer, and seriously affecting the recovery and quality of life of first-degree relatives. One of the important factors affecting the willingness of first-degree relatives to colonoscopy is psychological factors. Future studies should focus on studying the factors affecting the willingness of first-degree relatives to colonoscopy from the perspective of social psychology, so as to open up a new path for psychological nursing of first-degree relatives and provide new ideas for nursing staff to formulate corresponding psychological nursing measures. Most studies on first-degree relatives of patients with colorectal cancer are small samples, and there is a lack of studies on large samples. Future studies should focus on increasing the sample size of first-degree relatives, reducing bias and improving the credibility of the study.

To Develop a Specific Assessment Tool for the Willingness of First-Degree Relatives of Colorectal Cancer Patients to Undergo Colonoscopy

At present, the assessment tools for studying the willingness of first-degree relatives of patients with colorectal cancer are mostly universal or adapted tools, while there are few specific scales for studying the willingness of first-degree relatives to undergo colonoscopy. Bai et al applied the revised Colorectal Cancer Perception Tool (RCRCPS) to first-degree relatives, and found through comparison with domestic and foreign descriptive studies, There are limitations in the dimensions contained in the scale, such as the lack of assessment of fatalism and other dimensions. Future research suggestions should integrate existing domestic and foreign high-quality assessment tools or develop new specific assessment tools on the basis of learning from domestic and foreign assessment tools, fully combining China's cultural background and medical environment, and according to the characteristics of colonoscopy and the psychological characteristics of first-degree relatives. By increasing the sample size, we can improve the validation of the reliability and validity of the evaluation tool.

Explore More Interventions That Can Promote the Willingness of First-Degree Relatives of Patients With Colorectal Cancer to Undergo Colonoscopy

At present, there are few intervention measures for high-risk groups of colorectal cancer in China, and almost zero intervention measures for first-degree relatives of patients with colorectal cancer. Future studies suggest combining factors affecting the willingness of first-degree relatives for colonoscopy, searching for intervention breakthroughs, implementing precise interventions, and focusing on exploring intervention measures that are conducive to improving the screening rate of first-degree relatives for colonoscopy.

Conclusion

Improving the willingness of first-degree relatives to undergo colonoscopy is essential for enhancing colorectal cancer screening rates. Key factors influencing willingness include demographics, cognitive and psychological barriers, family dynamics, and social and technical aspects of screening. Effective interventions, such as tailored communication and motivational interviewing, address these barriers by increasing understanding and motivation. Psychological factors like fear and fatalism, along with insufficient support from healthcare providers, hinder screening. The intervention measures proposed in this study, such as personalized communication and motivational interviewing, hold significant practical implications. These interventions address specific concerns and misconceptions, thereby reducing psychological barriers and enhancing the autonomous decision-making ability of first-degree relatives, which in turn improves screening compliance and outcomes for early detection and treatment. In future research, investigators can introduce innovative intervention methods to enhance the willingness of FDRs to undergo colonoscopy, including personalized health education programs tailored to individual risk factors and psychological states, community support networks utilizing peer education and support groups to bolster confidence and adherence, and digital tools such as mobile applications or online platforms for appointment reminders, health consultations, and follow-up services. Future research should expand sample sizes to validate the effectiveness of these interventions, develop innovative strategies to further increase screening rates, and ultimately improve early detection of colorectal cancer among first-degree relatives.

Data Sharing Statement

All data generated or analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Ethics Approval and Consent to Participate

An ethics statement is not applicable because this study is based exclusively on published literature.

Disclosure

The authors report no conflicts of interest in this work.

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