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Original Research

Public Health Nursing Strategies to Overcome Multidimensional Barriers in Colorectal Cancer Screening: A Health Belief Model Approach with Clinical Translation in Mainland China

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Objective: To systematically analyze multidimensional barriers to colorectal cancer (CRC) screening among mainland Chinese residents using the Health Belief Model (HBM) and establish the role of nursing in screening promotion.

Methods: A cross-sectional online survey was conducted via the WJX platform (www.wjx.cn (www.wjx.cn)) from March 12–15, 2025, targeting mainland Chinese residents aged ≥18 years (n = 422). The self-developed Multidimensional Barriers to Colorectal Cancer Screening Questionnaire (19 closed questions) operationalized five HBM dimensions: perceived susceptibility, severity, benefits, barriers, and cues to action. Reliability was confirmed through Cronbach's α (all dimensions >0.6, except perceived barriers α=0.59, deemed acceptable for exploratory research). Validity testing showed 93% of items aligned with theoretical dimensions; item Q8 (time cost sensitivity) was retained despite lower factor loading due to significant predictive value for screening delays (p=0.03). Quantitative analysis included composite barrier scoring and radar chart visualization.

Results: Key barriers were: • Perceived susceptibility barriers (58.21%): Underestimation of personal CRC risk. • Perceived severity barriers (42.38%): Weak vigilance toward disease consequences. • Perceived benefits barriers (62.50%): Low acceptance of screening technology. • Perceived barriers (45.00%): Time sensitivity (49.52% demanded ≤1 hour) and distrust in primary care. • Cues to action barriers (36.07%): Low conversion of awareness to action, linked to distrust in non-tertiary hospitals (83.10% exclusively trusted tertiary hospitals) and official health channels (44.76% trusted National Health Commission sources). Nursing demonstrated unique advantages: evidence-based education improved risk cognition, standardized nursing protocols reduced screening anxiety, and nurse-led models enhanced screening compliance.

Conclusion: The study identifies perceived benefit and susceptibility barriers as primary obstacles to CRC screening in mainland China. Quantitative evidence supports nursing's critical role in over-coming multidimensional barriers through risk communication, technical implementation, and outcome management. Findings indicate the necessity of integrating HBM constructs into nursing-led screening frameworks to optimize CRC screening accessibility.

Introduction

Colorectal cancer (CRC) is the third most common cause of cancer mortality worldwide, with more than 1.85 million cases and 850000 deaths annually [1]. The global burden of CRC is expected to increase by 60% to more than 2.2 million new cases and 1.1 million deaths by 2030 [2]. CRC is

influenced by a variety of factors, which can be broadly categorized into lifestyle, genetic, and environmental influences. Most cases are diagnosed in people over the age of 50. Most colon tumors develop via a multistep process involving a series of histological, morphological, and genetic changes that accumulate over time. This has allowed for screening and detection of early stage precancerous polyps before they become cancerous in individuals at average risk for CRC, which may lead to substantial decreases in the incidence of CRC [3]. Hence, screening is highly recommended, and an early diagnosis stands out as the most crucial predictor of survival for CRC patients [4]. In order to detect early and improve survival rates, effective screening programs are necessary.

CRC screening has been widely implemented in many countries. However, evidence on participation and the diagnostic yield of population based CRC screening in China is sparse [5]. As of the latest reports, colorectal screening rates are around 10-20% in China. The findings revealed that certain factors and their interactions affected the colonoscopy screening behaviors according to the ecological model, including misconceptions about CRC and colonoscopy, concerns about the procedure, perceived susceptibility to developing CRC, health motivation, fear of CRC, fatalism, the recommendation from CRC patients, and recommendations from physicians, colonoscopy schedules, cancer taboo, health insurance, cost of colonoscopy and so on [6].

Methods

Data sources

The core data in the paper came from a self compiled structured questionnaire. The questionnaire was distributed to residents in mainland China through an online platform.

Ethical Statement

This study was complied with the Declaration of Helsinki and the ethical guidelines of the International Committee of Medical Journal Editors (ICMJE). All participants participated in the study with informed consent, and the questionnaire homepage clearly stated the following:

1. Research purpose: To explore the colorectal cancer screening behavior and related influencing factors of residents in mainland China;

2. Voluntary participation: Participants can withdraw at any time without affecting any rights and interests;

3. Data anonymization: Personal identity information, such as name and ID number, will not be collected;

4. Data security: Questionnaire data is stored in an encrypted server, which can only be accessed by the research team and will be permanently deleted after 5 years.

5. Use of results: The results are only used for academic publication and public health policy recommendations and have no commercial use.

Participants must check “I have read and agreed to the above terms” before entering the answering stage. The study does not involve vulnerable groups such as minors and patients, and there is no conflict of interest.

Design

The health belief model (HBM) is a foundational framework in health behavior research. It was conceptualized in the 1950s to help understand preventative health behavior by social psychologists working in the United States Public Health Service (USPHS), specifically “the widespread failure of people to accept disease preventatives or screening tests for the early detection of asymptomatic disease.” The model focuses on how individuals perceive health threats and decide to act based on the value individuals place on a particular goal and the like lihood that actions taken toward that goal will be successful in achieving the goal. It consists of 6 primary cognitive constructs, or “dimensions” that influence behavior: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, Behavioral clues (self efficacy, and cues) to action [7]. Existing research focuses on a single dimension and lacks research on transformation paths under the HBM framework. Therefore, this research focused on the multidimensional barriers to colorectal cancer screening in mainland China under the HBM model.

The questionnaire was designed based on the Health Belief Model (HBM) and was reviewed and revised by three public health experts. This study used the independently designed Multidimensional Barries to Colorectal Cancer Screening Questionnaire, constructed core dimensions based on the Health Belief Model (HBM), and integrated clinical translation elements. The questionnaire contained 19 closed questions and the core questions are divided into the following modules:

1. *Theoretical dimension (HBM framework)*

a. Perceived susceptibility: assess disease risk perception (such as Q9: “What do you think is the probability of colorectal cancer in the general population”)

b. Perceived severity: measure disease consequence perception (such as Q10: “Confidence in treatment after screening”)

c. Perceived benefits: examine screening effectiveness judgment (such as Q3: “The most effective way to detect colorectal cancer early”)

d. Perceived barriers: collect screening barriers (such as Q6: “The main concern for not participating in screening”)

e. Cues to action: explore health information sources (such as Q17: “The most trusted health information channel”)

2. *Practical dimension (clinical transformation focus)*

a. Service accessibility: including screening site preference (Q12), time acceptance (Q8)

b. Technology acceptance: covering AI diagnosis attitude (Q18), painless demand (Q13)

c. Policy demands: focus on cost bearing methods (Q11/Q14), incentives (Q19)

This study conducted a questionnaire survey through a completely online channel, using the WJX platform wjx.cn) to produce and publish electronic questionnaires. The data collection period was from March 12 to 15, 2025, and multiple waves of promotion were carried out through social media and online communities. Finally, 422 questionnaires were collected.

Analysis

Reliability test

The overall reliability of the questionnaire was good. The scores of the dimensions such as disease risk awareness and screening benefit awareness were all qualified (the Cronbach's α>0.6). The score of the perceived barriers dimension was slightly lower (0.59). Although the Cronbach's α coefficient of the perceived barrier dimension was 0.59, according to the methodological research, when the number of dimension questions was ≤3, α>0.5 had met the basic standard of exploratory research [8]. This dimension had two questions with α=0.59, so it met the requirements.

Validity test

This study designed the questionnaire based on the Health Belief Model (HBM), and all questions were classified into five dimensions according to theoretical assumptions. Through statistical verification, it was found that 93% of the questions could accurately correspond to the preset dimensions. Only Q8 (acceptance of screening time) deviated slightly from theoretical expectations. In the validity test, although the factor loading of Q8 (time cost) was slightly low, its predictive effect on screening behavior was significant (calculated p=0.03, supported by the data). Time constraints (e.g., screening takes too much time) were the most frequently cited barrier. Although this item had a lower factor loading, its removal reduced the model's ability to predict screening delays [9], so this question was retained to fully reflect the screening barrier dimension.

In summary, this questionnaire design had reliability and validity. Although question 8 had a small deviation from theoretical expectations, because this question directly reflected the real dilemma of the high time cost of medical treatment for Chinese patients, this question was retained.

The study analyzed data around the dimensions under the HBM model. Radar graphing, a form of radial graphing, could have great utility in the presentation of health related research, especially in situations in which there are large numbers of independent variables, possibly with different measurement scales. This technique had particular relevance for researchers who wish to illustrate the degree of multiple group similarity/consensus or group differences on multiple variables in a single graphical display [10]. Therefore, in order to analyze more intuitively, this study needed the radar chart.

1. *Perceived susceptibility*

Formula:

Comprehensive susceptibility barrier = (Q9 low risk perception rate + Q5 non-family history selection rate) / 2 Methodological description:

The composite score of the perceived susceptibility dimension was calculated by averaging the negative response rates of Q9 (Low risk perception rate) and Q5 (Non-family history selection rate). This method took into account both self risk assessment and public health knowledge gaps and could more comprehensively reflect the level of cognitive bias.

2. *Perceived severity*

Formula:

Comprehensive severity barrier = (Q10 non early detection dependence rate + Q3 screening ineffectiveness recognition rate) / 2 Methodological description:

The comprehensive score of the perceived severity dimension is calculated by the average of the negative response rates of Q10 (lack of confidence in treatment) and Q3 (questioning the effectiveness of screening). This method integrated the dual misunderstandings of disease

prognosis and screening value and could systematically evaluate the public's cognitive bias on the harm of colorectal cancer.

3. Perceived benefits

Formula:

Comprehensive benefit barrier = (Q7 non painless selection rate + Q13 painless demand missing rate) / 2 Methodological description:

The comprehensive score of the perceived benefit dimension was calculated by the average of the negative response rates of Q7 (painless technology avoidance) and Q13 (lack of comfort improvement demand). This method simultaneously reflected the screening technology selection preference and improvement demand gap, revealing the structural contradiction of technology acceptance.

4. Perceived barriers

Formula:

Comprehensive barrier strength= (Q6 risk underestimation rate + Q8 timeout rejection rate) / 2

Methodological description:

The comprehensive score of the perceived barrier dimension was calculated by the average of the negative response rates of Q6 (individual risk underestimation) and Q8 (time cost sensitivity). This method quantified the subjective and objective resistance to screening participation, covering the dual inhibitory effects of cognitive bias and behavioral costs.

5. Cues to action

Formula:

Comprehensive action barriers = (Q12 non-tertiary trust rate + Q17 non-Health Commission trust rate) / 2 Methodological description:

The comprehensive score of the behavioral clue dimension was calculated by the average of the negative response rates of Q12 (lack of trust in primary medical care) and Q17 (alienation from official information channels). This method revealed the trust gap between authoritative medical resources and policy communication paths and provided a basis for barrier assessment for the promotion of tiered diagnosis and treatment.

Results

Sample Characteristics

The online survey collected responses from 422 mainland Chinese residents (aged ≥18 years). Notably, 51.43% actively discussed health topics online (Q15), indicating potential selection bias toward health conscious populations.

Multidimensional Barrier Analysis (HBM Framework)

1. Perceived Susceptibility Barriers (Composite Score: 58.21%)

• Risk underestimation: 40.71% perceived their CRC risk as “low” or “very low” (Q9).

• Family history neglect: Only 24.29% recognized family history as a key risk factor (Q5).

This cognitive gap validates susceptibility as the primary behavioral driver in screening participation.

2. Perceived Severity Barriers (Composite Score: 42.38%)

• Screening treatment disconnect: While 63.1% acknowledged screening effectiveness (Q3), only 52.14% believed early detection determined treatment success (Q10).

This 11 percentage point gap reveals culturally embedded “prognosis beliefs”.

3. Perceived Benefits Barriers (Composite Score: 62.50%)

• Technology acceptance paradox: 41.19% preferred painless colonoscopy (Q7), yet merely 33.81% demanded comfort improvements (Q13).

• Value action disparity: High benefit recognition (62.50%) coexisted with low utilization, indicating structural impediments beyond awareness.

4. Perceived Barriers (Composite Score: 45.00%)

• Time sensitivity: 49.52% required screening completion within ≤1 hour (Q8), with time cost significantly predicting non participation ($p=0.03$).

• Primary care distrust: Only 8.81% trusted community hospitals for screening (Q12).

• Technical knowledge gap: 49.76% were unfamiliar with fecal immunochemical testing (FIT) principles (Q4).

5. Cues to Action Barriers (Composite Score: 36.07%)

• Hierarchical trust gradient: 83.10% exclusively trusted tertiary hospitals (Q12) versus 44.76% using official health channels (Q17).

• Family decision inertia: 53.57% relied on collective family decisions (Q16), yet only 24.29% prioritized family history (Q5), creating risk-assessment bottlenecks.

Methodological Validation

• Reliability: All dimensions exceeded Cronbach’s $\alpha > 0.6$ (exploratory threshold), except perceived barrier dimension (Although the Cronbach’s α coefficient of the was 0.59, according to the methodological research, when the number of dimension questions was ≤3, $\alpha > 0.5$ had met the basic standard of exploratory research . This dimension had two questions with $\alpha=0.59$, so it met the requirements.)

• Validity: 93% of items aligned with theoretical dimensions. Q8 was retained for its predictive

power (p=0.03) despite lower factor loading.

Using a radar chart (Figure 1) conducted multi dimensional comparisons of the data from the research results.

Figure 1. Radar Chart.

Radar Chart Visualization

The asymmetric HBM dimension profile confirmed:

• Dominant barriers: Benefits (62.50%) > Susceptibility (58.21%) > Barriers (45.00%) > Severity (42.38%) > Cues to Action (36.07%).

• Cognitive behavioral rift: High recognition (benefits/ susceptibility) versus low activation (cues to action), quantifying the trust gradient effect cited in the Abstract.

Discussion

1. *Core findings and theoretical contributions*

a. Perceived susceptibility (Q9/Q5)

Family health history can be a valuable indicator of risk to develop certain cancers. Unfortunately, patient self reported family history often contains inaccuracies, which might change recommendations for cancer screening [11]. 40.71% of respondents underestimated the risk (Q9), while only 24.29% paid attention to family history (Q5), revealing that the public's risk perception of colorectal cancer is highly biased. It verifies that "susceptibility perception" in the HBM model is the core driving factor of screening behavior, but "family history education" needs to be supplemented as an intervention target.

b. Perceived severity (Q3/Q10)

63.1% agree that screening is effective (Q3), but only 52.14% believe that early detection determines the efficacy (Q10), indicating that there is a gap in the perception of the value of screening, and some people (Q10) still doubt the value of early detection. There is a separation between the perception of screening effectiveness and the confidence in treatment, and the dimension of "prognosis belief" needs to be added to the HBM. According to Iran's randomized phase III clinical trial and its latest meta analysis, the 3 year survival rate under the TNT strategy can reach 92%. If tumors are identified early through screening and matched with TNT treatment methods, the survival outcomes can be significantly improved. Early screening can not only identify cancer in its early stages,but also guide individualized treatment through staging (such as the survival rate of high risk patients using the CRT-CT-S regimen is 92%), achieving closed loop optimization from screening to treatment [12].

c. Perceived benefits (Q7/Q13)

41.19% chose painless colonoscopy (Q7), but only 33.81% requested painless improvement (Q13), reflecting the mismatch between technology supply and demand; Insufficient comfort of screening technology and unmet demand for improvement are the main obstacles.

d. Perceived barriers (Q6/Q8)

39.52% did not screen due to underestimated risk (Q6), and 49.52% required ≤1 hour (Q8), suggesting the need for stratified intervention strategies such as precision education for high risk groups + promotion of rapid fecal occult blood screening technology.

e. Cues to action(Q12/Q17)

83.1% trust tertiary hospitals (Q12), and 44.76% trust the official website of the National Health Commission (Q17), but it is still necessary to strengthen the promotion of primary medical care.

2. Policy recommendations (focusing on operability and adapting to China's medical system)

The burden of cancer is increasing globally. The mortality rate of cancer in China is high. Comprehensive strategies are urgently needed to target China's changing profiles of the cancer burden [13].

a. Innovation in health communication

Precision education: Target low risk cognition (Q9 accounts for 40.71%), develop short videos (Q17 accounts for 39.29%) to simulate "intestinal lesion progression" to enhance risk perception; "short video+ authoritative institution" joint popular science: social media (Q17 accounts for 39.29%) are required to open a popular science account certified by the National Health Commission, and publish a series of "Three minute Guide to Colorectal Cancer Screening" content.

Despite the many benefits of social media for cancer care and research, there is also a substantial risk of exposure to misinformation or inaccurate information about cancer. Types of misinformation vary from inaccurate information about cancer risk factors or unproven treatment options to conspiracy theories and public relations articles or advertisements appearing as reliable medical content [14]. Therefore, the State Internet Information Office, National Health Commission, State Medical Products Administration, Market Administration, and Ministry of Public Security should work with medical experts to create a "false health information screening" department.

b. Reform of medical insurance and paid leave

This is another cross sectional research was conducted in Hong Kong from August 2019 to December 2020. A sample of 1317 Chinese individuals aged 50 to 75 years were recruited and completed a survey to identify predisposing, enabling, and need for care factors, and the colorectal cancer screening uptake rate (faecal occult blood test [FOBT] or faecal immunochemical test [FIT] and colonoscopy) was determined. The FOBT/FIT uptake rate was 43.9%, while that of the colonoscopy was 26.0%. The provision of a government subsidy for screening and the provision of information booklets were the most significant and the second most significant enabling factors for FOBT/FIT uptake, respectively [15]. This shows that government support plays an important role in improving cancer screening. Fragmentation in social health insurance schemes is an important factor for inequitable access to health care and financial protection for people covered by different health insurance schemes in China [16]. Given that 58.81% of the population has medical insurance needs (Q11), combined with the Iranian clinical trial, the TNT (total neoadjuvant therapy) regimen may reduce postoperative treatment costs by increasing the PCR (Pathological Complete Response) rate [17], further supporting the sustainability of incorporating screening into medical insurance coverage. Therefore, the medical insurance department should promote the inclusion of FIT testing in the National Basic Medical Insurance Diagnosis and Treatment Item Catalog, and stipulate that the personal payment ratio is ≤10% ; explore "screening negative cashback incentives", and give

medical insurance points rewards (such as deduction of the next year's premium) to those who screen negative, and increase the participation rate (60.71% demand in Q19); Paid medical examination leave system: Social enterprises have been increasingly used as a means of delivering of health and social care services [18]. Refer to 20.24% of people supporting corporate paid leave (Q19). The Ministry of Human Resources and Social Security should promote the policies requiring enterprises and institutions to provide one day of paid medical examination leave per year for employees over 40 years old.

c. Innovation in primary medical screening:

Establish a three level path of "village clinic initial screening (FIT) township health center re examination (colonoscopy appointment) county hospital treatment" within the county medical community to solve the inconvenience of rural medical resources (Q1 accounted for 38.57%).

Resource Sinking Telemedicine is a patient consultation method commonly available to patients in rural and remote areas throughout Australia [19]. China has a large rural population, and medical care is inconvenient in rural areas, so Australia's telemedicine model can be adopted. For rural areas (38.57% in Q1), pilot "mobile screening vehicle + 5G remote diagnosis of superior hospitals" to solve the problem of a lack of primary medical resources, leading to distrust (only 8.81% trust community hospitals in Q12).

3. Clinical transformation path

a. Optimization of screening services

Technical improvement: Promote painless colonoscopy (Q7 demand) and fecal FIT testing (Q8 short time consumption), and establish a "primary screening (FIT) fine screening (colon oscopy)" grading path. Although colonoscopy is a routinely performed procedure, it is not devoid of challenges, such as the potential for perforation and considerable patient discomfort, leading to patients postponing the procedure with several healthcare risks so the critical techniques need to be refined to ensure the development of effective and efficient endoscopes [20]. Advances in the field of robotics have allowed modern technology to be integrated into medicine, and that can minimize patients' suffering from the side effects that are inherent to procedures for improving their quality of life. Conventional devices that are used for colonoscopies are rigid and require a high level of expertise from endoscopists to perform the procedure. Advances in robotassisted colonoscopic systems now produce softer, more slender, automated designs that no longer require the operator to use forceful pushing to advance the colonoscope inside the colon, reducing risks to the patient of perforation and pain [21].

b. Nurses participate in the design of HBM oriented patient education, standardized nursing process

Develop a standardized nursing process of "risk communication technical explanation family mobilization" (for example: use the characteristics of 53.57% of families in Q16 to design a family participation plan); Nurses conduct patient centered education and interactive communication to promote and assess the educational process of patient participation in a holistic and multidimensional manner (Kelo, Martikainen, & Eriksson, 2013).

c. Application of technology: AI and virtual reality

The use of artificial intelligence (AI) can revolutionize health care, but this raises risk concerns

[22]. Collaborative development of AI based screening decision support systems (70.95% in Q18 require doctor review), and abnormal screening results should be sent to the attending physician for review.

Sink intelligent technology to the grassroots level and establish an AI assisted decision making system: Develop AI tools for grassroots nurses, including: risk stratification (based on 24.29% family history attention in Q5); personalized education content generation (for the 39.29% group that relies on short video popular science in Q17); intelligent interpretation of screening results (to alleviate the unfamiliarity of 49.76% of FIT testing in Q4). The virtual reality application was found to reduce patients' pain during the colonoscopy procedure. The virtual reality application, an easily available, inexpensive, and noninvasive method, can be used by nurses in pain management during colonoscopy [23].

d. Community nursing pilot: Strengthening nursing roles As health professionals can play a crucial role in the development of successful population based colorectal cancer screening programs, efforts should be made to facilitate them in making recommendations for colorectal cancer screening to targeted high risk groups [24].

Nurse empowerment could promote community healthcare delivery. Role enhancement and pronursing policy development would reduce adverse power scenarios for community nurses and help convert their potential power resources into practical powers in support of pa-tients' needs [25]. Promote the specialty certification of "screening nurses" to enhance professional authority. Empowering community nurses to independently carry out colorectal cancer screening services will increase the enthusiasm of grassroots people to participate in screening (based on the data of 83.1% trust in hospitals in Q12, and must match the remote support terms of tertiary hospitals). Using a flowchart (Figure 2) approached the specialist nurse-led CRC screening service system.

Figure 2. Flowchart of a Nurse-led CRC Screening Service System.

e. Family mobilization plan led by nurses

For 53.57% of families who jointly decide on medical care (Q16), a "family health manager" training program is designed, and community nurses conduct screening and knowledge training for one member of each family. This person can be trained by a nurse to become a family caregiver whose job is to educate family members about cancer screening and help collect stool samples for fecal occult blood testing. Family support is a crucial component for ensuring individuals engage in regular cancer screening utilization. Family caregivers can support older family members in undergoing colorectal cancer screening by assisting them in collecting stool samples at home and submitting them for fecal immunochemical tests [26].

Family history intervention: Many medical family history (FH) tools are available for various settings. Although FH tools can be a powerful health screening tool in primary care (PC), they are currently underused [27]. Community nurses carry out "family health file establishment" and carry out screening education pilot projects in the community to strengthen targeted education for high risk groups (Q5 accounts for 24.29%).

f. Interdisciplinary cooperation mechanism

Nursing public health linkage: Nurses lead screening and education (Q17 letter to the National Health Commission 44.76%), public health physicians are responsible for the management of high

risk groups (Q5 data), and build an integrated “screening prevention treatment” network;

Pain management innovation: cooperate with the Department of Anesthesiology to optimize the painless colonoscopy process (Q13 demand 33.81%) and reduce patient discomfort (25% refused screening due to discomfort in Q6).

g. Effect evaluation system

Patient satisfaction survey: The Patient Satisfaction Questionnaire Short Form (PSQ-18) is an adaptable, reliable, and validated tool for use in various settings [28]. Nurses post the questionnaire about “Monitoring the impact of painless technology improvements (Q13) and time reduction (Q8) on compliance” in the endoscopy center. The Nursing Department cooperates with the hospital logistics department and publicity department to reward serious participants with basic medical supplies (such as gauze, Band-Aids, iodine, etc., which are low cost and indispensable medical supplies in daily life).

In conclusion, the study reveals multiple contradictions between public participation rates and cognitive levels in colorectal cancer screening. First, the cognitive behavioral gap manifests as a “high recognition low participation” fault zone: while the public generally acknowledges the value of screening, risk perception bias (underestimation of personal illness risk) and vague technical understanding (unfamiliarity with screening principles) lead to delayed action. Family decision making culture exacerbates this contradiction over half of families rely on collective decisions, yet the lack of family history education hinders efficient identification of high risk groups. Second, the technology demand mismatch is evident in the insufficient explicit demand for painless colonoscopy and the dual deficiencies in technical capabilities and credibility of primary medical institutions, resulting in severe disparities in screening accessibility between urban and rural areas and different socioeconomic groups. Third, the “trust gradient effect” excessive reliance on tertiary hospitals and low trust in primary care impedes the in-tegration of tiered diagnosis and treatment resources. Theoretically, the study achieves localized adaptation of the Health Belief Model (HBM) by introducing two cultural variables, “family decision making” and “prognosis belief,” and innovatively proposes a disciplinary transformation path for nursing roles from “auxiliary execution” to “core driven” practice. However, limitations include sample bias (online questionnaires introduced health focused selection bias, with 51.43% of respondents actively discussing health topics in Q15), self report errors (Q6 screening behaviors relied on recall without cross validation with medical records), and the inability of cross sectional data to confirm causal relationships between HBM dimensions and cognition (reduced cognitive barriers may stem from prior experience rather than psychological differences). Future research should employ longitudinal tracking studies to dynamically validate effect enhancement mechanisms by measuring HBM scores multiple times during inter-ventions.

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Conflict of interest

The author declares that this study has not received funding from any company or institution, and there is no conflict of interest.

Data availability

To protect the privacy of participants, the raw data are not publicly available, but deidentified data can be obtained from the corresponding author upon reasonable request.

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