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Knowledge and practice of early gastric cancer screening among adults aged ≥ 45 years in China: a cross-sectional study

Xiaoci He[1], Wei Qi[2], Qian Wang[1*] and Shuping Zhao[2*]

Abstract

Background As the incidence of gastric cancer increases sharply in adults aged over 45 years, a better understanding of gastric cancer screening knowledge and practice is crucial to promote cancer-screening services. This study aimed to evaluate knowledge of early gastric cancer screening, adherence to screening, and perceived barriers hindering screening practices among adults aged ≥ 45 years in China.

Methods A multi-center, face-to-face, cross-sectional study was conducted in community sites in Shijiazhuang, China, through the distribution of structured questionnaires from August to September, 2022.

Results Of the 1053 respondents, only 13.4% demonstrated a good understanding of early gastric cancer screening. While 64.0% knew that gastroscopy is the gold standard for screening ("how to screen"), only 19.9% were aware of the recommended starting age ("when to screen"). Moreover, less than half could correctly identify high-risk groups ("whom to screen"), with awareness ranging from 20.5% for those infected with *H. pylori* to 47.8% for those with gastric diseases. Independent factors related to higher screening knowledge included female sex (OR = 1.55, 95% CI = 1.01–2.38), higher education level (OR = 4.03, 95% CI = 2.68–6.06), being with a personal/family experience of gastric diseases (OR = 1.68, 95% CI = 1.12–2.52). In addition, only 23.4% of respondents underwent GC screening. The dominant barrier to early screening was the "absence of symptoms or signs", followed by "fearing procedural discomfort".

Conclusion This study highlights significant gaps in early gastric cancer screening knowledge and participation among middle-aged and elderly individuals in China. Addressing these gaps through culturally tailored health education campaigns is a critical strategy for increasing public awareness and participation.

Keywords Stomach neoplasms, Public health, Cancer screening, Prevention, Knowledge

Introduction

Gastric cancer (GC) is one of the most common gastrointestinal malignancies [1] .The past decades have seen a rapid decrease in the incidence of GC due to improved dietary habits and treatment for *H. pylori* infection [2, 3]. However, GC remains the fifth most common cancer and the fourth leading cause of cancer death globally. Approximately one million new cases and 769,000 deaths occurred globally in 2020, with more than half of the new cases and deaths occurring in China [4]. One of the most striking reasons for the shockingly high mortality rate is that the early diagnosis rate is less than 10%, which is

*Correspondence:
Qian Wang
chinawq0811@126.com
Shuping Zhao
315965707@qq.com
[1] Department of Health Management, the Second Hospital of Hebei Medical University, Shijiazhuang, China
[2] Department of Gastroenterology, Hebei Key Laboratory of Gastroenterology, Hebei Clinical Research Center for Digestive Diseases, the Second Hospital of Hebei Medical University, Hebei Institute of Gastroenterology, Shijiazhuang, China

much lower than in South Korea (56%) and Japan (50%) [5, 6].

Early diagnosis through population-based screening programs using endoscopic techniques can effectively detect premalignant and cancerous changes, leading to better treatment outcomes and significantly lowering mortality rates [7, 8]. The five-year survival rate for early-stage GC exceeds 90%, in stark contrast to the 30% survival rate for late-stage diagnoses [9, 10]. For example, a study in Japan revealed that early endoscopic screening resulted in a 65% reduction in deaths [11]. Furthermore, a recent synthetic control study, which assessed the effects of Korea's national screening program by constructing a synthetic control group from countries without national screening, such as Chile, Costa Rica, Singapore, and Italy as the comparison group, reported a roughly 40% reduction in GC mortality associated with early screening [12].

To promote early GC screening, the China Cancer Prevention and Control Plan (2019–2022) requires hospitals to establish "Early Screening, Diagnosis, and Treatment Cancer Centers" to conduct opportunistic screening for GC [13]. Nonetheless, the reported participation rates for gastroscopy screening in China remain low at 15.5–26.7%, suggesting obstacles to receiving screening [14, 15]. Several systematic reviews have shown that socioeconomic factors, such as income and limited access to cancer-screening services, as well as psychological factors including fear and anxiety about receiving bad news, influence an individual's decision to engage in GC screening [16, 17]. Additionally, an inadequate understanding of awareness about GC screening methods, risk groups, and timing significantly inhibits individuals' screening behavior [18, 19]. The fastest and most cost-effective approach to boost screening engagement involves raising early screening awareness, necessitating an enhanced assessment of early screening knowledge to tailor public educational programs. However, the present recognition of early GC screening is largely unclear, with the majority of awareness studies concentrating on on the risk factors and warning signs of GC [20, 21].

Limited information is available on practices and perceived barriers to early screening in specific age groups, yet a significant increase in GC incidence has been observed in people aged 45 years and over, and the first guideline for early GC screening in China, issued in July 2022, suggests that people aged 45 years and over should receive GC screening [22, 23]. The study aims to access knowledge, behavior of early GC screening and perceived barriers to screening practices among adults aged ≥ 45 years in China. This study offers an excellent opportunity to consider which information should be included in educational lists available to the public and which individuals should be the key group of educational campaigns. Furthermore, the findings would lay the groundwork for developing targeted cancer screening promotion campaigns and optimizing cancer screening services to improve screening uptake.

Materials and methods

Study population

A multi-centre, face-to-face, cross-sectional study was performed from August to September, 2022, among adults aged ≥ 45 years in Shijiazhuang, China. As the capital of Hebei Province, Shijiazhuang is a significant urban center in northern China, boasting a population of over 11 million residents. A minimum sample size of 896 was calculated using the formula $n = \frac{z_{\alpha}^2 * \sigma^2}{\delta^2}$ where the standard deviation obtained from the pre-survey was 4.65 (σ), the significance level was 0.05 (α), and the allowable error was 0.03 (δ). Considering a 30% non-response rate, a final target sample of 1200 was identified.

A multistage cluster random sampling was employed in this study. From the eight administrative districts of Shijiazhuang, two community health service centers were randomly selected from each district. Based on the household records of community residents, and using principles of simple random sampling, 75 households were selected from each community health service center. From each household, one eligible resident was then chosen to participate in the survey. Inclusion criteria were: (a) aged between 45 and 74 years; (b) capable of verbal communication; and (c) have lived in the local community for over a year. Of the 1200 individuals who received the questionnaire, 1098 responded; however, 45 respondents out from the questionnaire midway. Thus, a total of 1053 participants were included in the analysis. This study was approved by the Ethics Committee of the Second Hospital of Hebei Medical University (Grant number: 2022-R137) and adhered to the STROBE guidelines for observational studies.

Study instrument

The self-developed questionnaire includes 18 items divided into three main sections: Sociodemographic characteristics (6 items), knowledge of early gastric cancer screening (10 items), screening behavior rand barrier assessment (2 items). (1) Demographic characteristics, including gender, age, educational level, marital status, monthly income, and personal/family experience of gastric diseases. (2) Knowledge of early GC screening, including "early gastric cancer" and "early screening of gastric cancer". Participants were requested to determine the accuracy of the statements below, including the judgment. Each item provides dichotomous response options (true or false, scored with 1 or 0, respectively). Total scores ranged from 0 to 10 points and were divided

into three levels: high knowledge, 7–10 scores; medium knowledge, 4–6 scores; low knowledge, 0–3. (3) Endoscopic screening practice and barrier assessment: (i) Participants were asked the question, 'Have you ever undergone GC screening?' with response options of 'yes' or 'no'. (ii) For participants who had not undergone GC screening, they were asked to indicate the reasons for their non-participation. Response options included "absence of symptoms or signs", "fearing procedural discomfort", "lack of time", "high cost", "Worry about bad results" and 'difficulty in making appointments'. Multiple answers were allowed for this question.

The questionnaires were developed from related guidelines of GC screening and reference articles and were scientifically validated by gastroenterology medical and epidemiology faculty [24, 25].

Data collection

A total of 1200 individuals were interviewed face-to-face by trained community health personnel. The interviewers were selected based on their qualifications, with each having at least 3 years of work experience in public health and conducting the interviews under strict guidelines to maintain neutrality and confidentiality. Each participant was provided with clear instructions before the interview to ensure understanding of the process. The trained personnel filled in the questionnaires on behalf of the participants during the interviews, following protocols to avoid bias. The interviewers underwent a comprehensive three-day training program that covered informed consent, questionnaire administration, and ethical standards. The interviews took place in community centers, with each interview lasting approximately 5 min.

Statistical analysis

SPSS V. 25.0 was used to analyze all data. Both sociodemographic characteristics and answers to each question were presented as frequencies and proportions. Univariable logistic regression was applied to identify the association between demographic characteristics and early screening scores. Variables with a p-value ≤ 0.15 in the univariate logistic regression were entered into the multivariate logistic regression analysis to investigate the independent factors influencing scores. For the early screening score model, the dependent variable was categorized into two dichotomous options of "low/medium score" and "high score". The results of the multivariate logistic analysis were expressed as OR and 95% CI. Double-tailed P values < 0.05 were recognized as significant statistically.

Results

Demographic characteristics of the participants

The demographic characteristics of the 1053 participants in this survey are shown in Table 1.

Knowledge of early gastric cancer screening

Table 2 presents the participants' knowledge of early GC screening. Of the 1053 participants, 418 (39.7%), 494 (46.9%), and 141 (13.4%) had low, medium, and high knowledge of early GC screening, respectively. While 64.0% of participants knew the screening method (how to screen), only 19.9% were aware of the screening timing (when to screen). Moreover, and less than 50% correctly identified the high-risk group (whom to screen), with awareness ranging from 20.5% for those infected with *H. pylori* to 47.8% for those with with gastric diseases.

Factors associated with early gastric cancer screening knowledge

Table 3 shows the factors relating to knowledge of early GC screening in univariate analysis. In the univariate logistic regression, age (OR = 0.66, 95% CI = 0.53–0.83), education level (OR = 5.21, 95% CI = 3.56–7.61), monthly income (OR = 1.80, 95% CI = 1.40–2.32), and personal/family history of gastric diseases (OR = 2.47, 95%

Table 1 Sociodemographic characteristics of participants ($n = 1053$)

Characteristics	Number (%)
Gender	
Female	687 (65.2)
Male	366 (34.8)
Age(years)	
45–54	221 (21.0)
55–64	381 (36.2)
65–74	451 (42.8)
Educational Level	
Uneducated or elementary school	195 (18.5)
High school	753 (71.5)
College or above	105 (10.0)
Marital status	
Single	54 (5.1)
Married	999 (94.9)
Monthly income	
<¥3000	741 (70.4)
¥3000–5000	238 (22.6)
>¥5000	74 (7.0)
Personal/family experience of gastric diseases	
Yes	248 (23.6)
No	805 (76.4)

Table 2 Participants' knowledge about early gastric cancer screening ($n = 1053$)

Questions	Correct sample, *N* (%)	95%CI
1. Early gastric cancer		
☐ Early gastric cancer is often asymptomatic.	322 (30.6)	0.28 to 0.34
☐ The survival rate of early gastric cancer is significantly higher than that of advanced gastric cancer.	404 (38.4)	0.59 to 0.65
☐ Regular screening is an effective method for detecting gastric cancer at an early stage.	607 (57.6)	0.55 to 0.61
2. Early screening of gastric cancer		
2.1 Whom to screen at the screening age?		
☐ Individuals infected with *H. pylori*	216 (20.5)	0.18 to 0.23
☐ Individuals with a history of gastric cancer in first-degree relatives	419 (39.8)	0.37 to 0.43
☐ Individuals with unhealthy lifestyle habits (such as high salt intake, pickled diet, smoking, heavy drinking, etc.)	459 (43.6)	0.41 to 0.47
☐ Individuals residing in areas with a high incidence of gastric cancer	490 (46.5)	0.44 to 0.50
☐ Individuals with gastric diseases (such as chronic atrophic gastritis, gastric ulcer, gastric polyps, etc.)	503 (47.8)	0.45 to 0.51
2.2. When to screen?		
The starting age for early gastric cancer screening in China is 45.	210 (19.9)	0.78 to 0.82
2.3. How to screen?		
Gastroscopy is the gold standard for early screening of gastric cancer.	674 (64.0)	0.61 to 0.67
Total knowledge level (10 points)		
Low (0–3)	418 (39.7)	
Medium (4–6)	494 (46.9)	
High (7–10)	141 (13.4)	

Table 3 Factors determining knowledge of early gastric Cancer screening ($n = 1053$)

Variable	Low/moderate, *N* (%)	Higher, *N* (%)	OR	*P*-value	95%CI
Gender			0.71	0.08	0.48 to 1.05
Female	586 (64.3)	101 (71.6)			
Male	326 (35.7)	40 (28.4)			
Age(years)			0.66	< 0.001*	0.53 to 0.83
45–54	179 (19.6)	42 (29.8)			
55–64	324 (35.5)	57 (40.4)			
65–74	409 (44.8)	42 (29.8)			
Educational Level			5.21	< 0.001*	3.56 to 7.61
Uneducated or elementary school	187 (20.5)	8 (5.7)			
High school	667 (73.1)	86 (61.0)			
College or above	58 (6.4)	47 (33.3)			
Marital status			0.88	0.75	0.41 to 1.91
Single	46 (5.0)	8 (5.7)			
Married	866 (95.0)	133 (94.3)			
Monthly income			1.80	< 0.001*	1.40 to 2.32
<¥3000	662 (72.6)	79 (56.0)			
¥3000–5000	197 (21.6)	41 (29.1)			
>¥5000	53 (5.8)	21 (14.9)			
Personal/family experience of gastric diseases			2.47	< 0.001*	1.70 to 3.59
Yes	192 (21.1)	56 (39.7)			
No	720 (78.9)	85 (60.3)			

* = Significant at $p < 0.05$ level

Table 4 Multivariate analysis of factors associated with early screening knowledge ($n=1053$)

Characteristics	Group	B	SE	Wald x^2	*P*-value	OR	95%CI
Gender	Female	0.44	0.22	4.01	0.04*	1.55	1.01 to 2.38
	Male					1(Ref)	
Age(years)		-0.14	0.13	1.25	0.26	0.87	0.68 to 1.11
Educational Level		1.39	0.21	45.00	< 0.001*	4.03	2.68 to 6.06
Monthly income		0.23	0.16	2.10	0.15	1.26	0.92 to 1.71
personal/family history of gastric diseases	Yes	0.52	0.21	6.22	0.01*	1.68	1.12 to 2.52
	No					1(Ref)	

Note:1 = reference group; * = Significant at $p<0.05$ level

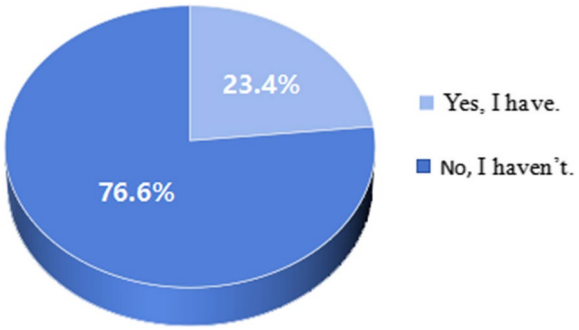

Fig. 1 Have you undergone early GC screening? ($n=1053$)

CI = 1.70–3.59) were significantly associated with early screening knowledge.

Table 4 shows factors associated with knowledge of early screening in multivariate analyses. These variables with *P* values ≤ 0.15 in the univariate analysis were included in the multivariate logistic regression model. The independent variables associated with screening knowledge included sex (OR = 1.55, 95% CI = 1.01–2.38), education level (OR = 4.03, 95% CI = 2.68–6.06), and personal/family experience of gastric diseases (OR = 1.68, 95% CI = 1.12–2.52).

Screening behaviors and perceived barriers to non-participation

Figure 1 shows that Of 1053 participants, only 246 (23.4%) individuals had undergone GC screening. Among participants who did not undergo GC screening ($n=807$, 76.6%), perceived barriers to screening were illustrated in Fig. 2. The most common barrier was the "absence of symptoms or signs" (90.4%), followed by "fearing procedural discomfort"(18.8%).

Discussion

The latest Chinese guidelines now recommend implementing early GC screening for individuals aged 45 and older who are at high risk, which could play a pivotal role in reducing mortality. Thus, understanding current perceptions, screening practices, and perceived barriers to early screening in this age group is essential for improving public health outcomes.

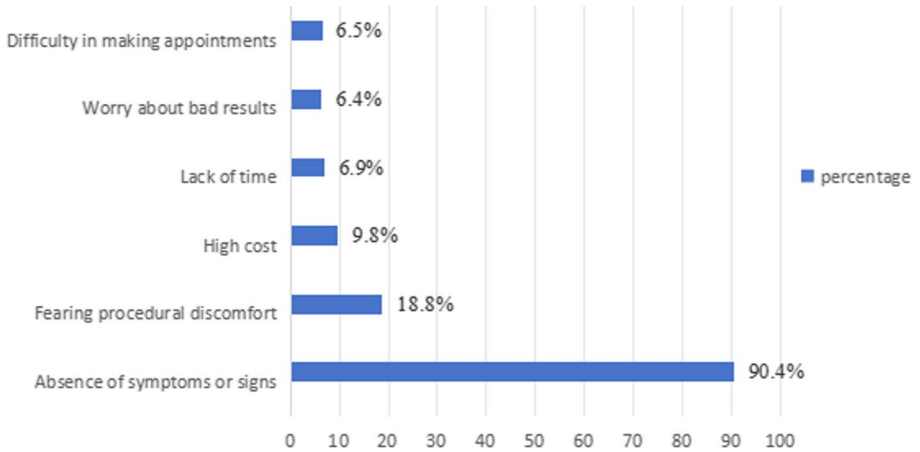

Fig. 2 Perceived barriers to non-participation in screening ($n=807$)

General early gastric cancer screening knowledge

Our results revealed that only 13.4% of participants had a high level of knowledge, which highlights a significant gap in public awareness. Similarly, existing studies in other parts of China, including Southern and Northeastern regions, report that GC risk factors and warning symptoms remain poorly understood [20, 24]. Given GC screening in China is delivered opportunistically, the low level of knowledge is perhaps unsurprising. Individuals typically receive information about GC screening during medical visits for related health issues, which limits the outreach to those who may not actively engage with healthcare services [26]. This knowledge gap is further widen by the increasing reliance on digital platforms such as WeChat and TikTok for health communication [27]. Since elderly individuals—key targets for GC screening—are typically less adept with these technologies, they face greater challenges in accessing health information, contributing to the disparity in knowledge acquisition [28].

To effectively address these gaps, community-based health education programs offer a promising approach. The National Cancer Institute in the United States, through its Integrating Cancer Prevention into Primary Care initiative, provides effective strategies for embedding cancer screening education within routine care [29]. Health educators also conduct both virtual and in-person community education workshops, alongside organizing community events and health fairs, all aimed at raising public awareness about cancer screening services [30]. Similarly, the UK's National Health Service (NHS) "Cancer Champions" program empowers trains community members to educate their peers, which has effectively increased screening awareness, particularly among older populations [31]. By adopting similar strategies—integrating screening education into routine healthcare, emphasizing community involvement, and customizing messages to resonate culturally—China could meaningfully enhance cancer screening awareness, particularly among elderly individuals, creating a sustainable and accessible model for preventive care.

Knowledge disparity about screening methods, timing, and high-risk groups

In assessing awareness of early GC screening, it was clear that their knowledge varied widely on key aspects, including screening timing, methods and high-risk groups. Regarding screening methods, it was noted that 64.0% recognized gastroscopy as the gold standard for early detection, indicating a reasonable level of understanding. However, this level of awareness was slightly lower compared to studies on lung cancer screening [32]. More concerning is that only 19.9% of participants were aware that the recommended starting age for screening in China is 45 years, despite all participants being over this threshold. The low percentage about the appropriate screening age is particularly alarming, as those most at risk may not be taking necessary steps to reduce their risk of gastric cancer.

Understanding "whom to screen" is equally critical for improving the effectiveness of early detection strategies. Identifying high-risk populations can significantly improve screening efficacy and optimize healthcare resource allocation [33]. *Helicobacter pylori* (*H. pylori*) infection, associated with around 90% of non-cardia gastric cancers globally [34], is a notable risk factor for GC. The prevalence of *H. pylori* infection in mainland China was estimated at 44.2% from 1990 to 2019, substantially higher than the prevalence rates of 11–25% observed in developed countries [35–37]. Given this elevated prevalence, early screening and eradiation for *H. pylori* is vital, as it helps mitigate long-term gastric mucosal damage, prevents conditions like atrophic gastritis and intestinal metaplasia, and ultimately reduces GC incidence [38]. Despite this, it is concerning that only 20.5% of respondents recognized individuals infected with *H. pylori* as part of a high-risk population, highlighting a significant deficiency in public awareness regarding the relationship between *H. pylori* and gastric cancer risk.

Factors associated with early gastric cancer screening knowledge

Our findings indicate that knowledge of GC screening varies significantly based on sociodemographic characteristics. Notably, education level emerged as the most influential independent factor associated with early GC screening knowledge, consistent with observations in similar studies [39, 40]. This is not surprising, as individuals with higher education typically have increased exposure to health information through various channels, including formal education, media, and community health programs [41]. Research shows that educational attainment enhances health literacy, enabling individuals to better understand medical information [42].

Additionally, consistent with other research, women exhibited higher knowledge scores about GC than men, which raises concerns given that men are approximately two to three times more likely to develop GC [43]. This discrepancy may stem from women's roles as primary caregivers in the home, providing them with more frequent interactions with the healthcare system and greater opportunities to acquire health-related knowledge [44].

Aside from sociodemographic characteristics, personal/family experience of gastric diseases was a significant independent factor associated with early GC screening knowledge, in line with another study [45]. Individuals who have had direct encounters with

gastric conditions often develop a heightened sensitivity to health risks, leading to increased engagement with updated information about preventive measures and screening protocols. On the other hand, knowing information about family health history could be an excellent time to discuss these issues with family members and healthcare professionals, leading to an initiative to gain more knowledge about the disease [46]. Consequently, personal and familial experiences of GC significantly contribute to a deeper understanding. This heightened awareness is often driven by their direct interactions with health issues, prompting them to prioritize timely screenings and actively gather information regarding their health.

Screening practice and perceived barriers to non-participation

In our study, the overall participation in gastric cancer screening was notably low, with only 23.4% of participants reporting engagement in screening practices. This figure falls significantly below the already suboptimal cancer screening rates in mainland China, which have been documented at under 40% in previous literature reviews [47]. Despite 57.6% of respondents acknowledging that regular screening could facilitate early detection of stomach cancer in our study, the majority were still reluctant to undergo screening.

Understanding the barriers that impede GC screening uptake is crucial for optimizing public health interventions. Our findings reveal that 90.4% of residents cited the "absence of symptoms" as a primary reason for not participating in GC screening, indicating a widespread lack of awareness that early-stage GC is typically asymptomatic. This misconception fosters a false sense of security and reduces perceived urgency for screening [48, 49]. Additionally, the cultural emphasis in China on treatment over prevention compounds this misunderstanding. Research shows that many Chinese adults primarily seek medical care when symptoms arise, reflecting a reactive healthcare approach [50]. This pattern, observed in other cultures as well, discourages engagement in asymptomatic cancer screenings [51, 52]. Culturally targeted education campaigns that raise awareness about the asymptomatic progression of GC and the value of early detection could help shift the focus from reactive care to proactive screening measures, ultimately reducing GC mortality.

"Fearing procedural discomfort" ranked as the second most cited barrier, reported by 18.8% of respondents. Studies show that residents often associate endoscopy with discomfort, such as uncontrolled pain and nausea, largely due to incorrect information and negative experiences shared by others, which discourages participation [53, 54]. A review of public attitudes toward endoscopy highlighted that effective communication from healthcare providers, including clear explanations of the procedure and available pain management options, significantly alleviates anxiety [55]. Furthermore, another study found that participation rates increased by 88.66% among initially reluctant individuals after the introduction of painless endoscopy, demonstrating its potential to greatly reduce concerns about pain and improve screening compliance [56]. Implementing more transparent procedures and broader access to painless endoscopy could significantly boost participation in GC screening.

Limitations

This study has several limitations that should be acknowledged. Firstly, while Shijiazhuang, the capital of Hebei Province and a key urban center in northern China, offers a representative sample due to its socioeconomic diversity and role as a regional healthcare hub, the findings may not be fully generalizable to other regions in China. For example, rural areas and cities in southern China may exhibit different levels of knowledge and regional obstacles that influence screening behaviors. Therefore, caution is warranted when extrapolating these results beyond similar urban settings in northern China. Future research that includes a broader geographic range would enhance the representativeness of the findings and improve external validity.

Secondly, While our study successfully identifies various factors associated with screening knowledge, the cross-sectional design inherently limits our ability to infer causal relationships between these factors and screening knowledge. Longitudinal studies are essential to explore how both knowledge and associated factors evolve over time. Despite these limitations, the study provides valuable insights into current screening knowledge and highlights critical areas for public health interventions, offering a foundation for future strategies to improve screening participation.

Conclusions

This study highlights significant gaps in early GC screening knowledge and participation among middle-aged and elderly individuals in China. Addressing these gaps through culturally tailored health education campaigns is a critical strategy for increasing public awareness and participation, ultimately contributing to a reduction in GC mortality.

Abbreviations

GC Gastric cancer
CI Confidence interval
OR Odds ratio
ref reference group

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Authors' contributions
Xiaoci He conceived the study, drafted the manuscript, and performed the statistical analysis. Shuping Zhao and Wei Qi assisted with data collection and trained community members. Shuping Zhao and Qian Wang supervised the study and contributed to manuscript review and quality control. All authors have read and approved the final manuscript.

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Data availability
Datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

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.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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