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## Awareness, Attitude and Barriers of Colorectal Cancer Screening Among High-risk Populations in China: a cross-sectional study

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## Awareness, Attitude and Barriers of Colorectal Cancer Screening Among High-risk Populations in China

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## Awareness, Attitude and Barriers of Colorectal Cancer Screening Among High-risk Populations in China: a cross-sectional study

### Abstract

**Objective:** To assess the awareness, attitude and barriers of colorectal cancer screening among high-risk populations in China.

**Design:** A cross-sectional study was employed.

**Setting:** This study was conducted in ten hospitals in Hunan province, China.

**Participants:** Individuals with high-risk for colorectal cancer were interviewed using a pretested structured questionnaire.

**Primary and secondary outcome measures:** Knowledge, attitude of colorectal cancer screening, sociodemographic factors associated with colorectal cancer screening knowledge and behaviour, barriers of colorectal cancer screening.

**Results:** This study included 648 participants. The mean knowledge score was 11.86/24 (SD 4.84). But over 70% of them held a positive attitude towards screening. Only 13.3% had undergone colorectal cancer screening. Independent factors related to knowledge were education level of college or above, working as a white collar, higher income, having health insurance, having seen a doctor in the past year and with high perceived risk ( $p < 0.05$ ). Factors independently associated with screening behaviour included personal history of colorectal disease, having seen a doctor in the past year, previous discussion of colorectal cancer screening, high perceived risk and better knowledge ( $p < 0.05$ ). Main reasons for not undergoing screening were no symptoms or discomfort (71.1%), never thought of the disease or screening (67.4%), and doctor did not advise me (29.8%).

**Conclusion:** In China, the majority of high-risk people had deficient knowledge and never undergone colorectal cancer screening. But most of them held a positive attitude towards the benefits of colorectal cancer screening. This has promising implications to design targeted educational

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4 campaigns and establish CRC screening programmes to improve colorectal  
5 cancer awareness and screening participation. Health care professionals  
6 should advise high-risk individuals to participate in CRC screening and inform  
7 them about cancer risk.  
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11 **Keywords:** colorectal cancer screening, awareness, barriers, prevention  
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### 15 **Strengths and limitations of this study**

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- 17 ▪ This study assessed the awareness, attitude and behaviour about colorectal  
18 cancer screening and explored the reasons underlying low screening rate  
19 among high-risk populations in China.  
20
- 21 ▪ These findings may be used as a reference for other countries with no  
22 screening programmes.  
23
- 24 ▪ The study achieved a high response rate and through face-to-face interviews  
25 by trained data collectors.  
26
- 27 ▪ The participants' screening history was self-reported, therefore, recall bias  
28 may have occurred.  
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- 30 ▪ We might not cover of all of the barriers regarding screening uptake as only a  
31 quantitative method was used.  
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## Introduction

Colorectal cancer (CRC) is the third most common cancer and the second leading cause of cancer death worldwide<sup>[1]</sup>. The World Health Organization (WHO) showed nearly half of new CRC cases were found in Asia, mostly in China<sup>[2]</sup>. CRC is the fifth most common malignancy in China, with 376,300 new cases and 191,000 deaths occurring in 2015<sup>[3]</sup>. The incidence rates and mortality rates of CRC in China continue to rise due to aging and growing population<sup>[4]</sup>.

Early colorectal cancer has better prognosis than advanced and metastatic colorectal cancer<sup>[5]</sup>. However, most patients are diagnosed during the advanced stage of the disease with a poor prognosis<sup>[6,7]</sup>. In China, the 5-year survival rate of colorectal cancer is lower than in many developed countries such as Korea with a rising cancer burden<sup>[8-10]</sup>, suggesting delays in diagnosis and treatment<sup>[11]</sup>. These studies indicate that there are problems regarding screening and prevention of this disease. High-risk populations are the key target populations of cancer screening<sup>[12]</sup>. To strengthen efforts to promote colorectal cancer prevention and control, it is particularly important to improve screening for prevention and early detection of colorectal cancer for high-risk populations in China. High-risk populations for developing colorectal cancer are individuals with colorectal diseases such as colorectal adenomas, inflammatory bowel disease and hereditary syndromes and those with a family history of colorectal cancer<sup>[13,14]</sup>.

Colorectal cancer screening via colonoscopy is known as an effective method to prevent and detect early-stage CRC and improve survival and prognosis<sup>[15]</sup>. Despite the heavy burden of colorectal cancer in China, however, unlike in other East Asian countries such as Korea, there are no nationwide CRC screening guidelines or programmes<sup>[16]</sup>. As a result of the large populations but with an uneven distribution of health, medical and financial resources, opportunistic screening with colonoscopy in asymptomatic people is widely used in China<sup>[17]</sup>. Opportunistic screening is performed on a



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voluntary basis and dependent on request from a physician or individual<sup>[18]</sup>.

Unfortunately, screening rate of colorectal cancer in China is far away from satisfactory level. The majority (about 85%) of high-risk populations still never have done colorectal cancer screening according to the report by Chen H et al<sup>[19]</sup> in 2018. Key factors contributing to non-participation in colorectal cancer screening could be poor awareness of colorectal cancer screening, negative attitude towards screening and multiple barriers related to screening<sup>[20]</sup>. Previous studies suggested that the general population had deficient knowledge of colorectal cancer and screening<sup>[21,22]</sup>. Moreover, few studies also indicated that screening knowledge and practice were suboptimal among high risk population<sup>[23,24]</sup>. In China, fewer studies reported inadequate public knowledge and screening of colorectal cancer<sup>[25,26]</sup>.

Currently, there are little studies exploring awareness, attitude and identify barriers for colorectal cancer screening among high-risk populations in China. Therefore, it is crucial to assess awareness, attitude and possible barriers that hinder CRC screening so that more effective approaches can be implemented to promote screening uptake. The objectives of this study were to (1) assess awareness, attitude and behaviour of colorectal cancer screening among high-risk populations in China, (2) examine sociodemographic factors associated with colorectal cancer screening knowledge and behaviour, (3) identify the barriers to colorectal cancer screening.

## Methods

### *Setting and sample*

This was a cross-sectional study conducted between April and August 2019. The sample size was calculated based on 15% of prevalence rate of colorectal cancer screening using a formula  $N = [\mu^2\alpha/2 \times \pi \times (1 - \pi)] / \delta^2$ <sup>[27]</sup>, with 0.03 allowable error at 95% confidence interval. Considering the 40% non-response rate, the final sample size was 760.

Ten hospitals were selected from a total of 42 in Hunan province using a

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4 cluster random sampling method. The source population were individuals from  
5 gastrointestinal department of hospitals with a high risk of developing  
6 colorectal cancer according to medical records. With the support of hospitals,  
7 each trained interviewer was accompanied by a medical staff to introduce the  
8 study aim. The inclusion criteria<sup>[13,14]</sup> included: (1) age 18 to 75 years, (2) a  
9 family history of colorectal cancer or adenomas, (3) a personal history of  
10 colorectal cancer or adenomas, (4) a personal history of inflammatory bowel  
11 disease, (5) a personal history of hereditary syndromes. The exclusion  
12 criteria<sup>[13,14]</sup> included: (1) age less than 18 years, (2) being diagnosed with  
13 colorectal cancer, (3) unable to communicate with the investigator, (4) severe  
14 cognitive impairment. Individuals who consented to participate in the study  
15 completed a standardized face-to-face questionnaire, which lasted for  
16 approximately 15 to 20 minutes. Each participants received ¥30 (about \$4.2)  
17 for completing the survey. This study was approved by the Ethic Committee of  
18 the University of XX (No. 4304081009636) and informed consent was obtained  
19 from all participants prior to participation.

### 34 *Instrument*

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36 The questionnaire included items about awareness, attitudes and screening  
37 for colorectal cancer. Survey items were identified from research  
38 literature<sup>[28,29]</sup>, the American Cancer Society and China Anti-Cancer  
39 Association<sup>[30]</sup>. The questionnaire consisted of 4 sections. The first section  
40 comprised socio-demographic characteristics: gender, age, education level,  
41 occupation, marital status, residence, income, health insurance, and perceived  
42 health status, etc. The second part included 24 questions about knowledge of  
43 colorectal cancer: risk factors, warning signs and screening tests. Two items  
44 had multiple answers, so the scoring was 1 point for each correct answer and  
45 0 point for the wrong answer or 'don't know' with a total score of 24 points. The  
46 third section was related to attitudes toward the colorectal cancer screening:  
47 colorectal cancer is preventable, early colorectal cancer is curable,  
48 colonoscopy can help to find colorectal cancer early, colonoscopy can help to  
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4 prevent colorectal cancer, colonoscopy is beneficial, colonoscopy is important  
5 etc. The possible responses were 'yes', or 'no'. In the fourth section,  
6 participants were questioned whether they had ever undergone colorectal  
7 cancer screening with 'yes' or 'no' answer. Participants who answered 'no'  
8 would be asked to choose the reasons for not undergoing screening, and more  
9 than 1 choice was allowed. Mean knowledge scores were calculated based on  
10 the number of correct responses and total scores ranged from 0 to 24 points.  
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17 The reliability of the questionnaire was evaluated by pretesting in 80  
18 people. The test-retest reliability of the second, third and fourth sections were  
19 0.81, 0.83 and 0.79, respectively, while the Cronbach's  $\alpha$  coefficients were  
20 0.83 and 0.76 and 0.67, respectively.  
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### 23 *Statistical analysis*

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27 Data were analysed using SPSS V.23. Descriptive statistics were used to  
28 describe the participants' socio-demographics and responses to each  
29 question. The  $\chi^2$  or Fisher's exact test were used to find association between  
30 demographic factors and knowledge and behaviour of colorectal cancer  
31 screening. Variables with a p value  $\leq 0.15$  in the univariate analysis were  
32 included in multiple linear regression analysis to investigate the independent  
33 factors for screening knowledge, while variables with a p value  $\leq 0.15$  in the  
34 univariate analysis were included in the multivariate logistic regression  
35 analysis to identify the independent factors for screening behaviour. Only the  
36 results of the multivariate analysis were presented using odds ratios (OR) and  
37 95% confidence intervals (CI), a p value of  $<0.05$  was regarded as statistically  
38 significant.  
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### 50 *Patient and public involvement*

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52 No participants were involved in our work. The study results will be made  
53 available to participants interested in this subject.  
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## 58 **Results**

### 59 *Sample characteristics*

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Of the 760 high-risk individuals, 712 consented to involve in the study, of whom 28 completed less than 50% of the questionnaire. Thus, the final response rate was 90.0% (n=684). The mean age of participants was 47.01±7.39 years (range=27-74 years). Of the total sample, more than half (54.5%) of participants were men, 75.6% had high school education or below and 58.0% lived in urban areas. Almost all (94.4%) were married and 86.7% were insured. About 37.9% had low income. The majority (88.7%) had no personal history of colorectal disease and 93.1% had a family history of colorectal cancer or adenomas. Only 14.2% reported previous discussion of screening with the doctor and 13.7% perceived their risk of developing colorectal cancer was high. Other variables are listed in (Table 1).

**Table 1 Participant characteristics(n=684)**

Characteristics	N (%)
Gender	
Male	373 (54.5)
Female	311 (45.5)
Age (years)	
<40	79 (11.5)
40-49	399 (58.3)
50-59	163 (23.8)
>60	43 (6.3)
Mean±SD	47.01±7.39
Education level	
High school or below	517 (75.6)
College or above	167 (24.4)
Occupation	
Farmer	63 (9.2)
Worker	304 (44.4)

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Unemployed	105 (15.4)
White collar	212 (31.0)
Marital status	
Single	38 (5.6)
Married	646 (94.4)
Residence	
Urban	397 (58.0)
Rural	287 (42.0)
Income(¥)	
<3000	259 (37.9)
3000-5000	207 (30.3)
>5000	218 (31.9)
Health insurance	
Yes	593 (86.7)
No	91 (13.3)
Self-reported health status	
Good	274 (40.1)
Fair	363 (53.1)
Poor	47 (6.9)
Personal history of colorectal disease	
Yes	77 (11.3)
No	607 (88.7)
Seen a doctor in the past year	
None	356 (52.0)
1-2 times	230 (33.6)
≥3 times	98 (14.3)
Previous discussion of colorectal cancer screening	
Yes	97 (14.2)

No	587 (85.8)
Family history of colorectal cancer or adenomas	
Yes	637 (93.1)
No	47 (6.9)
Perceived risk	
Low	248 (36.3)
Medium	342 (50.0)
High	94 (13.7)

### *Knowledge of colorectal cancer and screening*

Table 2 presents knowledge of colorectal cancer and screening including risk factors, warning signs and screening tests. The mean total knowledge score was 11.86 (SD 4.84, range 0-24). The mean knowledge for risk factors, warning signs and screening tests were 5.38 (SD 2.70, range from 0-11), 4.60 (SD 2.03, range 0-8) and 1.88 (SD 1.19, range 0-5), respectively. The most well recognised risk factors were inflammatory bowel disease (63.2%), followed by colon polyps (62.1%) and excess alcohol consumption (60.4%). Less well-recognised risk factors included family history of colorectal cancer (49.6%), smoking (48.1%), older age (45.3%), being overweight or obese (44.0%), having an inherited syndrome (40.8%) and diabetes (11.5%). The most highly recognised warning signs were blood in the stool (76.0%), rectal bleeding (74.0%) and change in bowel habits (66.4%). The least recognised symptoms included unexplained weight loss (57.3%), bowel does not empty (55.3%) and tiredness/anaemia (29.5%). Importantly, only 40.9% were aware that colorectal cancer could be asymptomatic. The most commonly heard of screening test is colonoscopy but only 46.6% knew colonoscopy was the gold standard method of colorectal cancer screening. Less than a third were aware of stool DNA test (21.5%) and IFOBT and high-risk factor questionnaire (8.6%).

Table 3 presents the results of multiple linear regression for factors associated with colorectal cancer screening knowledge. In the univariate analysis, education level, occupation, residence, income, health insurance, having seen a doctor in the past year, previous discussion of colorectal cancer screening and perceived risk were significantly associated with colorectal cancer knowledge ( $p < 0.05$ ). These factors plus variables with  $p$  value  $< 0.15$  in the univariate analysis were included in the multiple linear regression model. Factors were independently associated with knowledge were education level, occupation, income, health insurance, having seen a doctor in the past year and perceived risk ( $p < 0.05$ ).

Participants who were found to be more knowledgeable about colorectal cancer and screening included with a college education or above (95%CI 1.54 to 3.28), working as a white collar (95%CI 0.42, 3.36), with higher income (95%CI 0.70, 2.59; 95%CI 0.43 to 2.51), having health insurance (95%CI 0.43, 2.36), having seen a doctor in the past year (95%CI 0.93 to 2.92) and perceiving greater risk (95%CI 0.76 to 2.88).

**Table 2 Knowledge of colorectal cancer and screening (n= 684)**

Category	N	%
<b>Risk factors</b>		
Older age	310	45.3
Low physical activity	384	56.1
High intake of red and processed meat	388	56.7
Smoking	329	48.1
Excess alcohol consumption	413	60.4
Being overweight or obese	301	44.0
Colon polyps	425	62.1
Inflammatory bowel disease	432	63.2
Family history of colorectal cancer	339	49.6

Having an inherited syndrome	279	40.8
Diabetes	79	11.5
<b>Warning symptoms</b>		
Blood in the stool	520	76.0
Rectal bleeding	506	74.0
Change in bowel habits	454	66.4
Tiredness/Anaemia	202	29.5
Unexplained weight loss	392	57.3
Abdominal pain	417	61.0
Bowel does not empty	378	55.3
Colorectal cancer can be present without any symptoms	280	40.9
<b>Screening tests</b>		
FOBT	294	43.0
Colonoscopy/sigmoidoscopy	465	68.0
Stool DNA test	147	21.5
IFOBt and High-risk factor questionnaire	59	8.6
Which of the four choices is the gold standard method of colorectal cancer screening? (Colonoscopy)	319	46.6
Score on knowledge of risk factors (11 points)	5.38 (SD 2.70)	
Score on knowledge of warning symptoms (8 points)	4.60 (SD 2.03)	
Score on knowledge of screening tests (5 points)	1.88 (SD 1.19)	
Mean knowledge score (24 points)	11.86 (SD 1.19)	

**Table 3 Multiple Linear Regression of factors associated with colorectal cancer knowledge (n=684)**

	Knowledge Score			
	$\beta$	SE	95%CI	P



<b>Education level</b>				
High school or below	1 (ref)			
College or above	2.410	0.442	1.542, 3.279	<0.001*
<b>Occupation</b>				
Farmer	1 (ref)			
Worker	1.002	0.645	-0.264, 2.268	0.121
Unemployed	0.786	0.693	-0.573, 2.146	0.257
White collar	1.891	0.750	0.420, 3.363	0.012*
<b>Income(¥)</b>				
<3000	1 (ref)			
3000-5000	1.646	0.480	0.703, 2.589	0.001*
>5000	1.470	0.530	0.429, 2.512	0.006*
<b>Health insurance</b>				
No	1 (ref)			
Yes	1.386	0.493	0.429, 2.364	0.005*
<b>Seen a doctor in the past year</b>				
None	1 (ref)			
1-2 times	0.586	0.368	-0.137, 1.309	0.112
≥3 times	1.925	0.506	0.932, 2.918	<0.001*
<b>Perceived risk</b>				
Low	1 (ref)			
Medium	-0.292	0.364	-1.007, 0.423	0.423
High	1.820	0.540	0.760, 2.879	0.001*

\*Statistically significant at P<0.05.

CI, confidence interval; SE, standard error; ref, reference.

#### *Attitudes towards colorectal cancer screening*

Table 4 shows the attitudes towards colorectal cancer screening. A majority of participants held a positive attitude towards screening with more than 70% of

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4 them thinking colorectal cancer was preventable, early colorectal cancer was  
5 curable, colonoscopy could help to find colorectal cancer early, colonoscopy  
6 could help to prevent early colorectal cancer, colonoscopy was beneficial and  
7 colonoscopy was important. But only 58.7% thought they needed colonoscopy  
8 even if felt well. Of all the participants, only 91 (13.3%) had undergone  
9 colorectal cancer screening. There was a significant portion of participants  
10 (86.7%) who had not participated in colorectal cancer screening.  
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17 Table 5 shows the results of multivariate analysis for factors associated  
18 with colorectal cancer screening behaviour. In the univariate analysis, factors  
19 significantly associated with colorectal cancer screening behaviour were  
20 personal history of colorectal disease, having seen a doctor in the past year,  
21 previous discussion of colorectal cancer screening and perceived risk  
22 ( $p < 0.05$ ). These factors plus variables with  $p$  value  $< 0.15$  in the univariate  
23 analysis were included in the multivariate logistic regression model. The  
24 independent variables associated with colorectal cancer screening behaviour  
25 included personal history of colorectal disease, having seen a doctor in the  
26 past year, previous discussion of colorectal cancer screening, perceived risk  
27 and knowledge ( $p < 0.05$ ). Participants with a personal history of colorectal  
28 disease were more likely to have attended colorectal cancer screening  
29 compared with those without colorectal disease (OR 2.33; 95%CI 1.12 to  
30 4.87). Participants who had seen a doctor in the past year were more likely to  
31 have undergone colorectal cancer screening than those who had never seen a  
32 doctor in the past year (OR 3.20, 95%CI 1.80 to 5.68; OR 2.41, 95%CI 1.17 to  
33 4.96). Moreover, participants had previous discussion of colorectal cancer  
34 screening were more likely to have been screened for colorectal cancer (OR  
35 2.42; 95%CI 1.25 to 4.66). Further, those with a higher perceived risk of  
36 developing colorectal cancer tend to have undergone screening than the other  
37 groups (OR 4.03; 95%CI 1.95 to 8.32). Additionally, those who had more  
38 knowledge were more likely to have done colorectal cancer screening (OR  
39 1.06; 95%CI 1.00 to 1.12).  
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**Table 4 Colorectal cancer screening perceptions (n=684)**

Question	N	%
Colorectal cancer is preventable	524	76.6
Early colorectal cancer is curable	595	87.0
Colonoscopy can help to find colorectal cancer early	615	89.9
Colonoscopy can help to prevent colorectal cancer	521	76.2
Colonoscopy is beneficial	567	82.9
Colonoscopy is important	496	72.5
You need colonoscopy even if you feel healthy	402	58.8
Have you ever participated in colorectal cancer screening?	91	13.3

**Table 5 Multivariate analysis of factors associated with colorectal cancer screening behaviour (n=684)**

Variable	Screened N(%)	Unscreened N(%)	OR	95%CI	P
<b>Personal history of colorectal disease</b>					
No	60 (9.9)	547 (90.1)	1 (ref)		
Yes	31 (40.3)	46 (59.7)	2.337	1.121, 4.874	0.024*
<b>Seen a doctor in the past year</b>					
None	23 (6.5)	333 (93.5)	1 (ref)		
1-2 times	43 (18.7)	187 (81.3)	3.195	1.799, 5.676	<0.001*

≥3 times	25 (25.5)	73 (74.5)	2.409	1.170, 4.958	0.017*
<b>Previous discussion of colorectal cancer screening</b>					
No	57 (9.7)	530 (90.3)	1 (ref)		
Yes	34 (35.1)	63 (64.9)	2.416	1.254, 4.655	0.008*
<b>Perceived risk</b>					
Low	17 (6.9)	231 (93.1)	1 (ref)		
Medium	38 (11.1)	304 (88.9)	1.246	0.666, 2.333	0.491
High	36 (38.3)	58 (61.7)	4.029	1.951, 8.320	<0.001*
<b>Knowledge score, mean(SD)</b>	13.9 (4.6)	11.6 (4.8)	1.060	1.001, 1.121	0.044*

\*Statistically significant at P<0.05.

CI, confidence interval; OR, odds ratio; ref, reference.

#### *Barriers to participate in colorectal cancer screening*

Table 6 reported reasons why participants did not undergo colorectal cancer screening. There were 71.1% of the participants pointed out that screening was not needful due to no symptoms or discomfort, 67.4% said that they never thought of the disease or screening, and 29.8% mentioned that lack of recommended by physicians. There was a significant number of participants who thought screening was too painful, unpleasant or embarrassing (20.0%) and some answered that they were not at risk for colorectal cancer (19.0%). Other reasons were lack of time (15.3%), difficult to assess medical facilities (12.4%), fear of bowel preparation (12.3%), unawareness of the benefits of screening (11.2%) and financial problem (9.6%).

**Table 6 Reasons for not undergoing colonoscopy (n=684)**

Reasons	N	%
Never thought of	400	67.4
Doctor did not advise me	177	29.8
No symptoms or discomfort	422	71.1
Afraid of detecting CRC	39	6.5
Lack of time	91	15.3
Fear regarding bowel preparation	73	12.3
Too painful, unpleasant or embarrassing	119	20.0
Financial problem	57	9.6
Unawareness of the benefits of screening	67	11.2
Difficult to access medical facilities	74	12.4
Believed risks outweigh benefits	17	2.8
Lack of support from others	4	0.6
I am not at risk for colorectal cancer	113	19.0

## Discussion

Understanding and recognizing awareness and attitude regarding colorectal cancer screening and reasons towards low screening uptake among high-risk populations could help in developing appropriate policies for prevention and control of colorectal cancer. The study found that majority of the participants had deficient knowledge and never done colorectal cancer screening, but held a positive attitude towards screening and its benefits. Main reasons for not seeking screening included no symptoms and never thought of the disease or screening.

### *Colorectal cancer and screening awareness*

Participants' knowledge of colorectal cancer and screening was insufficient, which was similar to a study conducted in Hong Kong<sup>[31]</sup> but lower than that found in the Australian studies<sup>[32]</sup>. Moreover, while participants had relatively

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4 good awareness of warning symptoms, they had a poorer awareness of risk  
5 factors and screening tests. Less than half of participants identified risk factors  
6 such as smoking, older age, being overweight or obese, having an inherited  
7 syndrome and diabetes. This result indicates that people are unfamiliar with  
8 cancer related risk factors.  
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13 Two of thirds of participants identified the main warning signs, whilst  
14 nonspecific symptoms such as tiredness/anaemia, bowel does not empty and  
15 unexplained weight loss were less likely to identified. This would delay in  
16 seeking medical help<sup>[33]</sup>. Importantly, less than half of participants knew  
17 colorectal cancer can be asymptomatic, which was below the rate among  
18 Australians (56.5%)<sup>[32]</sup>, implying a gap in educational interventions.  
19 Furthermore, approximately a quarter of the participants indicated that they  
20 had never heard of even one screening test. This result shows that poor  
21 awareness of screening test is a factor contributing to low participation rate of  
22 colorectal cancer screening, and indicates that screening test could be a good  
23 target for cancer awareness-raising initiatives<sup>[34]</sup>.  
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35 Our finding found that respondents with lower education level and income,  
36 and who worked as farmers had worse awareness. Further, those who had no  
37 health insurance, had never seen a physician within the past year and with  
38 lower perceived risk of colorectal cancer showed lower knowledge. There is  
39 possibility that they have insufficient access to social resources and are less  
40 aware of information about colorectal cancer screening<sup>[35]</sup>. Studies have  
41 reported similar findings that socially disadvantaged groups were less  
42 knowledgeable<sup>[31][36]</sup>. Evidence also suggests that the socially disadvantaged  
43 groups were less likely to have undergone screening<sup>[22][35]</sup>. Thus, educational  
44 interventions should target to these underserved and socially disadvantaged  
45 individuals.  
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#### 56 *Colorectal cancer screening attitude*

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58 Participants held positive attitudes towards screening and early diagnosis of  
59 colorectal cancer, implying that they were aware of the value of early diagnosis  
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4 and the benefits of screening, while only less than 60% of the participants  
5 agreed that they needed colonoscopy even if they felt healthy. Therefore, it is  
6 necessary to educate the public about the importance and necessity of  
7 screening. Only a small percentage of participants (13.3%) had undergone  
8 colorectal cancer screening at least once, which was similar to that reported in  
9 the Hong Kong studies (14%)<sup>[26]</sup> but lower than that in the Korean and Iranian  
10 studies (>45%)<sup>[23][37]</sup>. This difference might be because in China colonoscopy  
11 is conducted via opportunistic screening, and thus it relies on individuals  
12 voluntarily requesting it and shouldering the expenses<sup>[16,17]</sup>. It is noteworthy  
13 that the majority of participants had never done colonoscopy screening  
14 possibly due to low-risk perception, poor awareness towards screening or  
15 other reasons which may limit access to screening<sup>[23]</sup>. Therefore, it is crucial to  
16 explore the important barriers of colonoscopy screening among Chinese  
17 high-risk populations<sup>[19]</sup>.

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Multivariate analysis showed that personal history of colorectal disease, having seen a doctor in the past year, previous discussion of colorectal cancer screening, perceived risk and knowledge were significantly associated with better screening behaviour. We found that only a minority (14%) of participants reported previous discussion about screening with physicians and thought that they had a high risk of developing colorectal cancer, which was below the estimates (28%–55%) from studies in Iran and USA<sup>[23,24]</sup>. This finding indicated that the participants were underestimate their risk of colorectal cancer and not aware of the importance of screening. It is therefore urgent to plan health education intervention to correct public perception of their self-risk of developing colorectal cancer and emphasize the significance of screening.

Similar to our findings, a study found that individuals with gastrointestinal tract diseases were more likely to undergo gastrointestinal cancer screening than individuals without diseases, which may because the onset of uncomfortable symptoms motivate them to seek medical help and participate in screening<sup>[38]</sup>. A study that assessed beliefs, knowledge and screening

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4 among Asian Americans in California, found that participants had seen their  
5 physician within the past year were more likely to attend colorectal cancer  
6 screening<sup>[22]</sup>. Furthermore, participants who received a physician's advice for  
7 screening were associated with higher adherence to cancer screening<sup>[39]</sup>. Choi  
8 et al found that those who with a greater perceived risk of colorectal cancer  
9 were also significantly more likely to be screened than those who with lower  
10 perceived risk<sup>[40]</sup>. Wong et al found that participants with better knowledge  
11 concerning colorectal cancer screening were associated with performing  
12 screening<sup>[26]</sup>. Therefore, physicians should emphasize screening and risk  
13 education for high-risk individuals.  
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### 15 *Colorectal cancer screening barriers*

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17 'No symptoms or discomfort' was the most common reason for not undergoing  
18 screening, consistent with previous studies<sup>[38][41]</sup>, implying that participants  
19 mistakenly convinced that screening is only required upon symptoms or feel ill  
20 and they go to health facilities to seek medical help, which can be worrying  
21 because the disease only becomes symptomatic at an advanced stage<sup>[42]</sup>.  
22 Therefore, there is a strong need to address such misconception and educate  
23 people about the indications of cancer screening.  
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26 Moreover, 'never thought about the disease or screening' was another  
27 major barrier for participation in screening, which further reflects the lack of  
28 knowledge about CRC and its screening. This may be partly because  
29 colonoscopy for colorectal cancer screening is not covered by Chinese routine  
30 medical check-up<sup>[16]</sup>. In addition, it may also be because in Chinese culture  
31 and traditional beliefs, cancer is a taboo topic and Chinese people are  
32 reluctant to think or speak about it. The notion of detecting hidden or  
33 asymptomatic disease by screening does not exist in traditional Chinese  
34 beliefs<sup>[12]</sup>. This result emphasizes the need to increase awareness of the  
35 importance of CRC screening for this preventable disease and design  
36 culturally tailored education to reduce adverse beliefs or attitudes towards  
37 cancer.  
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4 'Lack of recommendation from physician' was found to be a key reason for  
5 not participating in screening. This suggests that clinicians need to pay more  
6 attention to screening education of patients as well as improve  
7 patient-physician communication. Physicians should also play an active role in  
8 delivering early screening information to high-risk populations. Other barriers  
9 observed included 'too painful, unpleasant or embarrassing' and 'I am not at  
10 risk for colorectal cancer'. As reported, the majority of barriers are related to a  
11 lack of understanding and awareness of CRC screening, some were health  
12 system and health professional related. Therefore, it is imperative to conduct  
13 awareness campaigns to bring out public attention, correct these  
14 misconceptions and overcome psychological barriers. Better communication  
15 with participants regarding the screening procedure could potentially remove  
16 the perception of embarrassment and fear. Health care professionals should  
17 encourage high-risk individuals to participate in CRC screening and inform  
18 them about cancer risk.  
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### 33 *Implications*

34 In Korea, a country with high incidence rates of colorectal cancer, has  
35 implemented a nationwide screening program and set up institutions  
36 responsible for providing comprehensive cancer information to promote public  
37 awareness and screening uptake<sup>[10]</sup>. In China, the government has started to  
38 pay attention to awareness and screening about cancer. Health China Action:  
39 Cancer Prevention and Control Implementation Plan and Healthy China 2030  
40 Strategy set a series of goals of attaining more than 70% awareness rate of  
41 cancer prevention knowledge, making public aware of their cancer risk and  
42 promoting cancer screening for high-risk groups<sup>[43,44]</sup>. However, data to  
43 evaluate the effectiveness of such initiatives are lacking, therefore, this study  
44 could be used as a basis to measure the effectiveness of further health  
45 promoting campaigns.  
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58 Our results has indicated that Chinese high-risk people have deficient  
59 awareness, some misconceptions and barriers regarding colorectal cancer  
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4 screening. Moreover, they are still not aware of their cancer risk and the need  
5 for undergoing screening. Our findings suggest that strategies to improve  
6 awareness and screening uptake in high-risk populations should include three  
7 components. First, the government should learn from initiatives in different  
8 countries, appropriate and effective educational campaigns should be  
9 conducted, using web-based education tools to broadcast scientific colorectal  
10 cancer prevention information<sup>[45,46]</sup>. Moreover, the government should  
11 establish an organised colorectal cancer screening programme and  
12 incorporate screening into healthcare system in the future<sup>[23]</sup>. Second, health  
13 care professionals should be trained to play an active role in improving  
14 high-risk people's awareness, perceptions and behaviour about colorectal  
15 cancer screening. Less-known risk factors, screening tests and major barriers  
16 discovered in this study need to be emphasized during education  
17 interventions. Further, health promotion campaigns should focus on those who  
18 do not see their physician regularly, without colorectal disease, with low  
19 perceived risk and poor knowledge.

### 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 *Strengths and limitations*

36 To our knowledge, this is the first study in mainland China aiming to assess  
37 awareness, attitude and behaviour about colorectal cancer screening and  
38 explore the reasons underlying low screening rate among high-risk  
39 populations. The study achieved a high response rate and through  
40 face-to-face interviews by trained interviewers strengthened the validity of the  
41 study results. Our study had some limitations. First, as the participants'  
42 screening history was self-reported, recall bias may have occurred. However,  
43 respondents were given a brief description of screening tests before asking if  
44 they had ever undergone screening. Second, we might not cover of all of the  
45 barriers regarding screening uptake as only a quantitative method was used.  
46 Further study is warranted to use qualitative or mixed-method to  
47 comprehensively explore the related factors. Moreover, We assume that  
48 respondents who visit hospitals tend to have better health awareness.  
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## Conclusion

This study indicates that the majority of high-risk people had deficient knowledge and never undergone colorectal cancer screening. But most of them held a positive attitude towards the benefits of screening. Being asymptomatic and never thought of the disease or screening were the main reasons for not undergoing screening. Our study gives insight into the development of strategies to improve screening of colorectal cancer in China.

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4 **Contributors** Ying Zeng, Xi Zeng, Ruo-lin Huang and Qi Liu conceived and  
5 designed the study. Ruo-lin Huang, Qi Liu, Ying-xin Wang, Jin-yu Zou, Li-feng  
6 Hu, Wen Wang, Ying-hui Huang, Yi-zhuo Wang and Bo Zeng carried out the  
7 data collection. Ying-xin Wang and Wen Wang analysed the data. Ying Zeng,  
8 Ruo-lin Huang and Qi Liu drafted the manuscript. Ying Zeng and Xi Zeng  
9 reviewed and edited the manuscript.  
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17 **Data availability statement** Data are available by contacting Ying Zeng by  
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# Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

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		Reporting Item	Page Number
<b>Title and abstract</b>			
Title	<a href="#">#1a</a>	Indicate the study's design with a commonly used term in the title or the abstract	4
Abstract	<a href="#">#1b</a>	Provide in the abstract an informative and balanced summary of what was done and what was found	4
<b>Introduction</b>			
Background / rationale	<a href="#">#2</a>	Explain the scientific background and rationale for the investigation being reported	6

1	Objectives	<a href="#">#3</a>	State specific objectives, including any prespecified hypotheses	7
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5	<b>Methods</b>			
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9	Study design	<a href="#">#4</a>	Present key elements of study design early in the paper	7
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12	Setting	<a href="#">#5</a>	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7,8
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18	Eligibility criteria	<a href="#">#6a</a>	Give the eligibility criteria, and the sources and methods of selection of participants.	8
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23		<a href="#">#7</a>	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
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29	Data sources / measurement	<a href="#">#8</a>	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	8,9
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38	Bias	<a href="#">#9</a>	Describe any efforts to address potential sources of bias	
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41	Study size	<a href="#">#10</a>	Explain how the study size was arrived at	7,8
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44	Quantitative variables	<a href="#">#11</a>	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	
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50	Statistical methods	<a href="#">#12a</a>	Describe all statistical methods, including those used to control for confounding	9
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55	Statistical methods	<a href="#">#12b</a>	Describe any methods used to examine subgroups and interactions	9
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1	Statistical	<a href="#">#12c</a>	Explain how missing data were addressed	
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5	Statistical	<a href="#">#12d</a>	If applicable, describe analytical methods taking account of	
6	methods		sampling strategy	
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10	Statistical	<a href="#">#12e</a>	Describe any sensitivity analyses	
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15	<b>Results</b>			
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18	Participants	<a href="#">#13a</a>	Report numbers of individuals at each stage of study—eg	10
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20			confirmed eligible, included in the study, completing follow-	
21			up, and analysed. Give information separately for for	
22			exposed and unexposed groups if applicable.	
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27	Participants	<a href="#">#13b</a>	Give reasons for non-participation at each stage	
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30	Participants	<a href="#">#13c</a>	Consider use of a flow diagram	
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33	Descriptive data	<a href="#">#14a</a>	Give characteristics of study participants (eg demographic,	10,11
34			clinical, social) and information on exposures and potential	
35			confounders. Give information separately for exposed and	
36			unexposed groups if applicable.	
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41	Descriptive data	<a href="#">#14b</a>	Indicate number of participants with missing data for each	
42			variable of interest	
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46	Outcome data	<a href="#">#15</a>	Report numbers of outcome events or summary measures.	
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52	Main results	<a href="#">#16a</a>	Give unadjusted estimates and, if applicable, confounder-	12,13,14,15,
53			adjusted estimates and their precision (eg, 95% confidence	
54			interval). Make clear which confounders were adjusted for	16,17,18
55			and why they were included	
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1	Main results	<a href="#">#16b</a>	Report category boundaries when continuous variables were categorized	12,13,14,15, 16,17,18
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6	Main results	<a href="#">#16c</a>	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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11	Other analyses	<a href="#">#17</a>	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	
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16	<b>Discussion</b>			
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19	Key results	<a href="#">#18</a>	Summarise key results with reference to study objectives	19
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22	Limitations	<a href="#">#19</a>	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	24
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28	Interpretation	<a href="#">#20</a>	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	19,20
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34	Generalisability	<a href="#">#21</a>	Discuss the generalisability (external validity) of the study results	21,22,23
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39	<b>Other</b>			
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44	Funding	<a href="#">#22</a>	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	25
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# BMJ Open

## Awareness, Attitude and Barriers of Colorectal Cancer Screening Among High-risk Populations in China: A Cross-sectional Study

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## Awareness, Attitude and Barriers of Colorectal Cancer Screening Among High-risk Populations in China: A Cross-sectional Study

### Abstract

**Objective:** To assess the awareness, attitude and barriers of colorectal cancer screening among high-risk populations in China.

**Design:** A cross-sectional study was employed.

**Setting:** This study was conducted in nine hospitals in Hunan province, China.

**Participants:** Individuals with high-risk for colorectal cancer were interviewed using a pretested structured questionnaire.

**Primary and secondary outcome measures:** Knowledge, attitude of colorectal cancer screening, sociodemographic factors associated with colorectal cancer screening knowledge and behaviour, barriers of colorectal cancer screening.

**Results:** This study included 684 participants. The mean knowledge score was 11.86/24 (SD 4.84). But over 70% of them held a positive attitude towards screening. Only 13.3% had undergone colorectal cancer screening. Independent factors related to knowledge were education level of college or above, working as a white collar, higher income, having health insurance, having seen a doctor in the past year and with high perceived risk ( $p < 0.05$ ). Factors independently associated with screening behaviour included personal history of colorectal disease, having seen a doctor in the past year, previous discussion of colorectal cancer screening, high perceived risk and better knowledge ( $p < 0.05$ ). Main reasons for not undergoing screening were no symptoms or discomfort (71.1%), never thought of the disease or screening (67.4%), and doctor did not advise me (29.8%).

**Conclusion:** In China, the majority of high-risk people had deficient knowledge and never undergone colorectal cancer screening. But most of them held a positive attitude towards the benefits of colorectal cancer screening. This has promising implications to design targeted educational

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4 campaigns and establish CRC screening programmes to improve colorectal  
5 cancer awareness and screening participation. Health care professionals  
6 should advise high-risk individuals to participate in CRC screening and inform  
7 them about cancer risk.  
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11 **Keywords:** colorectal cancer screening, awareness, barriers, prevention  
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### 15 **Strengths and limitations of this study**

- 16  
17 ▪ These findings may be used as a reference for other countries with no  
18 screening programmes.  
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- 20  
21 ▪ The study achieved a high response rate and through face-to-face interviews  
22 by trained data collectors.  
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- 24  
25 ▪ The participants' screening history was self-reported, therefore, recall bias  
26 may have occurred.  
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29 ▪ We might not cover of all of the barriers regarding screening uptake as only a  
30 quantitative method was used.  
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## Introduction

Colorectal cancer (CRC) is the third most common cancer and the second leading cause of cancer death worldwide<sup>[1]</sup>. The World Health Organization (WHO) showed nearly half of new CRC cases were found in Asia, mostly in China<sup>[2]</sup>. CRC is the fifth most common malignancy in China, with 376,300 new cases and 191,000 deaths occurring in 2015<sup>[3]</sup>. The incidence rates and mortality rates of CRC in China continue to rise due to aging and growing population<sup>[4]</sup>.

Early colorectal cancer has better prognosis than advanced and metastatic colorectal cancer<sup>[5]</sup>. However, most patients are diagnosed during the advanced stage of the disease with a poor prognosis<sup>[6,7]</sup>. In China, the 5-year survival rate of colorectal cancer is lower than in many developed countries such as Korea with a rising cancer burden<sup>[8-10]</sup>, suggesting delays in diagnosis and treatment<sup>[11]</sup>. These studies indicate that there are problems regarding screening and prevention of this disease. High-risk populations are the key target populations of cancer screening<sup>[12]</sup>. To strengthen efforts to promote colorectal cancer prevention and control, it is particularly important to improve screening for prevention and early detection of colorectal cancer for high-risk populations in China. High-risk populations for developing colorectal cancer are individuals with colorectal diseases such as colorectal adenomas, inflammatory bowel disease and hereditary syndromes and those with a family history of colorectal cancer<sup>[13,14]</sup>.

Colorectal cancer screening via colonoscopy is known as an effective method to prevent and detect early-stage CRC and improve survival and prognosis<sup>[15]</sup>. Despite the heavy burden of colorectal cancer in China, however, unlike in other East Asian countries such as Korea, there are no nationwide CRC screening guidelines or programmes<sup>[16]</sup>. As a result of the large populations but with an uneven distribution of health, medical and financial resources, opportunistic screening with colonoscopy in asymptomatic people is widely used in China<sup>[17]</sup>. Opportunistic screening is performed on a voluntary

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4 basis and dependent on request from a physician or individual<sup>[18]</sup>.

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6 Unfortunately, screening rate of colorectal cancer in China is far away  
7 from satisfactory level. The majority (about 85%) of high-risk populations still  
8 never have done colorectal cancer screening according to the report by Chen  
9 H et al<sup>[19]</sup> in 2018. Key factors contributing to non-participation in colorectal  
10 cancer screening could be poor awareness of colorectal cancer screening,  
11 negative attitude towards screening and multiple barriers related to  
12 screening<sup>[20]</sup>. Previous studies suggested that the general population had  
13 deficient knowledge of colorectal cancer and screening<sup>[21,22]</sup>. Moreover, few  
14 studies also indicated that screening knowledge and practice were suboptimal  
15 among high risk population<sup>[23,24]</sup>. In China, fewer studies reported inadequate  
16 public knowledge and screening of colorectal cancer<sup>[25,26]</sup>.

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27 Currently, there are little studies exploring awareness, attitude and identify  
28 barriers for colorectal cancer screening among high-risk populations in China.  
29 Therefore, it is crucial to assess awareness, attitude and possible barriers that  
30 hinder CRC screening so that more effective approaches can be implemented  
31 to promote screening uptake. The objectives of this study were to (1) assess  
32 awareness, attitude and behaviour of colorectal cancer screening among  
33 high-risk populations in China, (2) examine sociodemographic factors  
34 associated with colorectal cancer screening knowledge and behaviour, (3)  
35 identify the barriers to colorectal cancer screening.

## 36 37 38 39 40 41 42 43 44 45 46 **Methods**

### 47 48 *Setting and sample*

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50 This was a cross-sectional study conducted between April and August 2019.  
51 The sample size was calculated based on 15% ( $\pi$ ) of prevalence rate of  
52 colorectal cancer screening using a formula  $N = [\mu^2_{\alpha/2} \times \pi \times (1 - \pi)] / \delta^2$ <sup>[27]</sup>, with 0.03  
53 allowable error ( $\delta$ ) and  $u_{\alpha/2} = 1.96$  at 95% confidence interval. Considering the  
54 40% non-response rate, the final sample size was 760.

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60 Nine hospitals were selected from a total of 42 in Hunan province using a

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4 cluster random sampling method. The source population were individuals from  
5 gastrointestinal department of hospitals with a high risk of developing  
6 colorectal cancer according to medical records by convenience sampling. With  
7 the support of hospitals, each trained interviewer was accompanied by a  
8 medical staff to introduce the study aim. The inclusion criteria<sup>[13,14]</sup> included: (1)  
9 age 18 to 75 years, (2) a family history of colorectal cancer or adenomas, (3) a  
10 personal history of colorectal cancer or adenomas, (4) a personal history of  
11 inflammatory bowel disease, (5) a personal history of hereditary syndromes.  
12 The exclusion criteria<sup>[13,14]</sup> included: (1) age less than 18 years, (2) being  
13 diagnosed with colorectal cancer, (3) unable to communicate with the  
14 investigator, (4) severe cognitive impairment. Individuals who consented to  
15 participate in the study completed a standardized face-to-face questionnaire,  
16 which lasted for approximately 15 to 20 minutes. Each participants received  
17 ¥30 (about \$4.2) for completing the survey. This study was approved by the  
18 Ethic Committee of the University of South China (No. 4304081009636) and  
19 informed consent was obtained from all participants prior to participation.

### 34 *Instrument*

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36 The questionnaire included items about awareness, attitudes and screening  
37 for colorectal cancer. Survey items were identified from research literature<sup>[28,29]</sup>,  
38 the American Cancer Society and China Anti-Cancer Association<sup>[30]</sup>. The  
39 questionnaire consisted of 4 sections. The first section comprised  
40 socio-demographic characteristics: gender, age, education level, occupation,  
41 marital status, residence, income, health insurance, and perceived health  
42 status, etc. The second part included 24 questions about knowledge of  
43 colorectal cancer: risk factors, warning signs and screening tests. Two items  
44 had multiple answers, so the scoring was 1 point for each correct answer and  
45 0 point for the wrong answer or 'don't know' with a total score of 24 points. The  
46 third section was related to attitudes toward the colorectal cancer screening:  
47 colorectal cancer is preventable, early colorectal cancer is curable,  
48 colonoscopy can help to find colorectal cancer early, colonoscopy can help to  
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4 prevent colorectal cancer, colonoscopy is beneficial, colonoscopy is important  
5 etc. The possible responses were 'yes', or 'no'. In the fourth section,  
6 participants were questioned whether they had ever undergone colorectal  
7 cancer screening with 'yes' or 'no' answer. Participants who answered 'no'  
8 would be asked to choose the reasons for not undergoing screening, and more  
9 than 1 choice was allowed. Mean knowledge scores were calculated based on  
10 the number of correct responses and total scores ranged from 0 to 24 points.  
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17 The reliability was evaluated by pretesting in 80 people. The internal  
18 consistency of the questionnaires was accomplished by estimating the  
19 Cronbach's alpha based on the recommendation of >0.70. The Cronbach's  
20 alpha calculated was 0.88. Face validity was performed to assess the  
21 comprehension towards understanding of the questionnaire and to assess how  
22 important it was to target study participants. Finally, the questionnaire was  
23 modified and re-evaluated to fit the study population based on the feedbacks  
24 of the pilot study.  
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### 32 *Statistical analysis*

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34 Data were analysed using IBM SPSS V.23.0. Descriptive statistics were used  
35 to describe the participants' socio-demographics and responses to each  
36 question. The t test and analysis of variance test were used to investigate the  
37 association of demographic factors with knowledge. The  $\chi^2$  or Fisher's exact  
38 test were used to find association between demographic factors and behaviour  
39 of colorectal cancer screening. Variables with a p value  $\leq 0.15$  in the univariate  
40 analysis were included in multiple linear regression analysis to investigate the  
41 independent factors for screening knowledge, while variables with a p value  
42  $\leq 0.15$  in the univariate analysis were included in the binary logistic regression  
43 analysis to identify the independent factors for screening behaviour. Only the  
44 results of the bivariate and multivariate analysis were presented using odds  
45 ratios (OR) and 95% confidence intervals (CI), a p value of <0.05 was  
46 regarded as statistically significant.  
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### 60 *Patient and public involvement*

No participants were involved in our work. The study results will be made available to participants interested in this subject.

## Results

### *Sample characteristics*

Of the 760 high-risk individuals, 712 consented to involve in the study, of whom 28 completed less than 50% of the questionnaire. Thus, the final response rate was 90.0% (n=684). The mean age of participants was 47.01±7.39 years (range=27-74 years). Of the total sample, more than half (54.5%) of participants were men, 75.6% had high school education or below and 58.0% lived in urban areas. Almost all (94.4%) were married and 86.7% were insured. About 37.9% had low income. The majority (88.7%) had no personal history of colorectal disease and 93.1% had a family history of colorectal cancer or adenomas. Only 14.2% reported previous discussion of screening with the doctor and 13.7% perceived their risk of developing colorectal cancer was high. Other variables are listed in (Table 1).

**Table 1 Participant characteristics(n=684)**

Characteristics	N (%)
Gender	
Male	373 (54.5)
Female	311 (45.5)
Age (years)	
<40	79 (11.5)
40-49	399 (58.3)
50-59	163 (23.8)
>60	43 (6.3)
Mean±SD	47.01±7.39
Education level	

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High school or below	517 (75.6)
College or above	167 (24.4)
Occupation	
Farmer	63 (9.2)
Worker	304 (44.4)
Unemployed	105 (15.4)
White collar	212 (31.0)
Marital status	
Single	38 (5.6)
Married	646 (94.4)
Residence	
Urban	397 (58.0)
Rural	287 (42.0)
Income(¥)	
<3000	259 (37.9)
3000-5000	207 (30.3)
>5000	218 (31.9)
Health insurance	
Yes	593 (86.7)
No	91 (13.3)
Self-reported health status	
Good	274 (40.1)
Fair	363 (53.1)
Poor	47 (6.9)
Personal history of colorectal disease	
Yes	77 (11.3)
No	607 (88.7)
Seen a doctor in the past year	
None	356 (52.0)



1-2 times	230 (33.6)
≥3 times	98 (14.3)
Previous discussion of colorectal cancer screening	
Yes	97 (14.2)
No	587 (85.8)
Family history of colorectal cancer or adenomas	
Yes	637 (93.1)
No	47 (6.9)
Perceived risk	
Low	248 (36.3)
Medium	342 (50.0)
High	94 (13.7)

### *Knowledge of colorectal cancer and screening*

Table 2 presents knowledge of colorectal cancer and screening including risk factors, warning signs and screening tests. The mean total knowledge score was 11.86 (SD 4.84, range 0-24). The mean knowledge for risk factors, warning signs and screening tests were 5.38 (SD 2.70, range from 0-11), 4.60 (SD 2.03, range 0-8) and 1.88 (SD 1.19, range 0-5), respectively. The most well recognised risk factors were inflammatory bowel disease (63.2%), followed by colon polyps (62.1%) and excess alcohol consumption (60.4%). Less well-recognised risk factors included family history of colorectal cancer (49.6%), smoking (48.1%), older age (45.3%), being overweight or obese (44.0%), having an inherited syndrome (40.8%) and diabetes (11.5%). The most highly recognised warning signs were blood in the stool (76.0%), rectal bleeding (74.0%) and change in bowel habits (66.4%). The least recognised symptoms included unexplained weight loss (57.3%), bowel does not empty (55.3%) and tiredness/anaemia (29.5%). Importantly, only 40.9% were aware

that colorectal cancer could be asymptomatic. The most commonly heard of screening test is colonoscopy but only 46.6% knew colonoscopy was the gold standard method of colorectal cancer screening. Less than a third were aware of stool DNA test (21.5%) and IFOBT and high-risk factor questionnaire (8.6%).

Table 3 presents the results of multiple linear regression for factors associated with colorectal cancer screening knowledge. In the univariate analysis, education level, occupation, residence, income, health insurance, having seen a doctor in the past year, previous discussion of colorectal cancer screening and perceived risk were significantly associated with colorectal cancer knowledge ( $p < 0.05$ ). These factors plus variables with  $p$  value  $< 0.15$  (personal history of colorectal disease) in the univariate analysis were included in the multiple linear regression model. Factors were independently associated with knowledge were education level, occupation, income, health insurance, having seen a doctor in the past year and perceived risk ( $p < 0.05$ ).

Participants who were found to be more knowledgeable about colorectal cancer and screening included with a college education or above ( $\beta = 2.41$ , 95%CI 1.54 to 3.28,  $p < 0.001$ ), working as a white collar ( $\beta = 1.89$ , 95%CI 0.42 to 3.36,  $p = 0.012$ ), with higher income ( $\beta = 1.65$ , 95%CI 0.70 to 2.59,  $p = 0.001$ ;  $\beta = 1.47$ , 95%CI 0.43 to 2.51,  $p = 0.006$ ), having health insurance ( $\beta = 1.39$ , 95%CI 0.43 to 2.36,  $p = 0.005$ ), having seen a doctor in the past year ( $\beta = 1.93$ , 95%CI 0.93 to 2.92,  $p < 0.001$ ) and perceiving greater risk ( $\beta = 1.82$ , 95%CI 0.76 to 2.88,  $p = 0.001$ ).

**Table 2 Knowledge of colorectal cancer and screening (n= 684)**

Category	N	%
<b>Risk factors</b>		
Older age	310	45.3
Low physical activity	384	56.1

High intake of red and processed meat	388	56.7
Smoking	329	48.1
Excess alcohol consumption	413	60.4
Being overweight or obese	301	44.0
Colon polyps	425	62.1
Inflammatory bowel disease	432	63.2
Family history of colorectal cancer	339	49.6
Having an inherited syndrome	279	40.8
Diabetes	79	11.5
<b>Warning symptoms</b>		
Blood in the stool	520	76.0
Rectal bleeding	506	74.0
Change in bowel habits	454	66.4
Tiredness/Anaemia	202	29.5
Unexplained weight loss	392	57.3
Abdominal pain	417	61.0
Bowel does not empty	378	55.3
Colorectal cancer can be present without any symptoms	280	40.9
<b>Screening tests</b>		
FOBT	294	43.0
Colonoscopy/sigmoidoscopy	465	68.0
Stool DNA test	147	21.5
IFOBt and High-risk factor questionnaire	59	8.6
Which of the four choices is the gold standard method of colorectal cancer screening? (Colonoscopy)	319	46.6

**Table 3 Multiple Linear Regression of factors associated with colorectal cancer knowledge (n=684)**

	Knowledge Score			
	$\beta$	SE	95%CI	P
<b>Education level</b>				
High school or below	1 (ref)			
College or above	2.410	0.442	1.542, 3.279	<0.001*
<b>Occupation</b>				
Farmer	1 (ref)			
Worker	1.002	0.645	-0.264, 2.268	0.121
Unemployed	0.786	0.693	-0.573, 2.146	0.257
White collar	1.891	0.750	0.420, 3.363	0.012*
<b>Income(¥)</b>				
<3000	1 (ref)			
3000-5000	1.646	0.480	0.703, 2.589	0.001*
>5000	1.470	0.530	0.429, 2.512	0.006*
<b>Health insurance</b>				
No	1 (ref)			
Yes	1.386	0.493	0.429, 2.364	0.005*
<b>Seen a doctor in the past year</b>				
None	1 (ref)			
1-2 times	0.586	0.368	-0.137, 1.309	0.112
$\geq 3$ times	1.925	0.506	0.932, 2.918	<0.001*
<b>Perceived risk</b>				
Low	1 (ref)			
Medium	-0.292	0.364	-1.007, 0.423	0.423
High	1.820	0.540	0.760, 2.879	0.001*
<b>Constant</b>	7.365	0.704	5.983, 8.747	0.000*

$R^2 = 0.210$ ,  $F = 17.510$ ,  $P = 0.000$ .

\*Statistically significant at  $P < 0.05$ .

CI, confidence interval; SE, standard error; ref, reference.

### *Attitudes towards colorectal cancer screening*

Table 4 shows the attitudes towards colorectal cancer screening. A majority of participants held a positive attitude towards screening with more than 70% of them thinking colorectal cancer was preventable, early colorectal cancer was curable, colonoscopy could help to find colorectal cancer early, colonoscopy could help to prevent early colorectal cancer, colonoscopy was beneficial and colonoscopy was important. But only 58.7% thought they needed colonoscopy even if felt well. Of all the participants, only 91 (13.3%) had undergone colorectal cancer screening. There was a significant portion of participants (86.7%) who had not participated in colorectal cancer screening.

Table 5 shows the results of bivariate analysis for factors associated with colorectal cancer screening behaviour. In the univariate analysis, factors significantly associated with colorectal cancer screening behaviour were personal history of colorectal disease, having seen a doctor in the past year, previous discussion of colorectal cancer screening and perceived risk ( $p < 0.05$ ). These factors plus variables with  $p$  value  $< 0.15$  (education level) in the univariate analysis were included in the binary logistic regression model. The independent variables associated with colorectal cancer screening behaviour included personal history of colorectal disease, having seen a doctor in the past year, previous discussion of colorectal cancer screening, perceived risk and knowledge ( $p < 0.05$ ). Participants with a personal history of colorectal disease were more likely to have attended colorectal cancer screening compared with those without colorectal disease (OR 2.33, 95%CI 1.12 to 4.87,  $p = 0.024$ ). Participants who had seen a doctor in the past year were more likely to have undergone colorectal cancer screening than those who had never seen a doctor in the past year (OR 3.20, 95%CI 1.80 to 5.68,  $p < 0.001$ ; OR 2.41, 95%CI 1.17 to 4.96,  $p = 0.017$ ). Moreover, participants had previous discussion of colorectal cancer screening were more likely to have been screened for colorectal cancer (OR 2.42, 95%CI 1.25 to 4.66,  $p = 0.008$ ).

Further, those with a higher perceived risk of developing colorectal cancer tend to have undergone screening than the other groups (OR 4.03, 95%CI 1.95 to 8.32,  $p < 0.001$ ). Additionally, those who had more knowledge were more likely to have done colorectal cancer screening (OR 1.06, 95%CI 1.00 to 1.12,  $p = 0.044$ ).

**Table 4 Colorectal cancer screening perceptions (n=684)**

Question	N	%
Colorectal cancer is preventable	524	76.6
Early colorectal cancer is curable	595	87.0
Colonoscopy can help to find colorectal cancer early	615	89.9
Colonoscopy can help to prevent colorectal cancer	521	76.2
Colonoscopy is beneficial	567	82.9
Colonoscopy is important	496	72.5
You need colonoscopy even if you feel healthy	402	58.8

**Table 5 Bivariate analysis of factors associated with colorectal cancer screening behaviour (n=684)**

Variable	Screened N(%)	Unscreened N(%)	OR	95%CI	P
<b>Personal history of colorectal disease</b>					
No	60 (9.9)	547 (90.1)	1 (ref)		
Yes	31 (40.3)	46 (59.7)	2.337	1.121, 4.874	0.024*
<b>Seen a doctor in the past year</b>					

None	23 (6.5)	333 (93.5)	1 (ref)		
1-2 times	43 (18.7)	187 (81.3)	3.195	1.799, 5.676	<0.001*
≥3 times	25 (25.5)	73 (74.5)	2.409	1.170, 4.958	0.017*
<b>Previous discussion of colorectal cancer screening</b>					
No	57 (9.7)	530 (90.3)	1 (ref)		
Yes	34 (35.1)	63 (64.9)	2.416	1.254, 4.655	0.008*
<b>Perceived risk</b>					
Low	17 (6.9)	231 (93.1)	1 (ref)		
Medium	38 (11.1)	304 (88.9)	1.246	0.666, 2.333	0.491
High	36 (38.3)	58 (61.7)	4.029	1.951, 8.320	<0.001*
<b>Knowledge score, mean(SD)</b>	13.9 (4.6)	11.6 (4.8)	1.060	1.001, 1.121	0.044*

\*Statistically significant at P<0.05.

CI, confidence interval; OR, odds ratio; ref, reference.

#### *Barriers to participate in colorectal cancer screening*

Table 6 reported reasons why participants did not undergo colorectal cancer screening. There were 71.1% of the participants pointed out that screening was not needful due to no symptoms or discomfort, 67.4% said that they never thought of the disease or screening, and 29.8% mentioned that lack of recommended by physicians. There was a significant number of participants who thought screening was too painful, unpleasant or embarrassing (20.0%) and some answered that they were not at risk for colorectal cancer (19.0%). Other reasons were lack of time (15.3%), difficult to assess medical facilities

(12.4%), fear of bowel preparation (12.3%), unawareness of the benefits of screening (11.2%) and financial problem (9.6%).

**Table 6 Reasons for not undergoing colonoscopy (n=593)**

Reasons	N	%
Never thought of	400	67.4
Doctor did not advise me	177	29.8
No symptoms or discomfort	422	71.1
Afraid of detecting CRC	39	6.5
Lack of time	91	15.3
Fear regarding bowel preparation	73	12.3
Too painful, unpleasant or embarrassing	119	20.0
Financial problem	57	9.6
Unawareness of the benefits of screening	67	11.2
Difficult to access medical facilities	74	12.4
Believed risks outweigh benefits	17	2.8
Lack of support from others	4	0.6
I am not at risk for colorectal cancer	113	19.0

## Discussion

Understanding and recognizing awareness and attitude regarding colorectal cancer screening and reasons towards low screening uptake among high-risk populations could help in developing appropriate policies for prevention and control of colorectal cancer. The study found that majority of the participants had deficient knowledge and never done colorectal cancer screening, but held a positive attitude towards screening and its benefits. Main reasons for not seeking screening included no symptoms and never thought of the disease or screening.

### *Colorectal cancer and screening awareness*



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4 Participants' knowledge of colorectal cancer and screening was insufficient,  
5 which was similar to studies conducted in Hong Kong and Saudi Arabia<sup>[31,32]</sup>  
6 but lower than that found in the Australian and Iranian studies<sup>[33,34]</sup>. Moreover,  
7 while participants had relatively good awareness of warning symptoms, they  
8 had a poorer awareness of risk factors and screening tests. Less than half of  
9 participants identified risk factors such as smoking, older age, being  
10 overweight or obese, having an inherited syndrome and diabetes. This result  
11 indicates that people are unfamiliar with cancer related risk factors.  
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19 Two of thirds of participants identified the main warning signs, whilst  
20 nonspecific symptoms such as tiredness/anaemia, bowel does not empty and  
21 unexplained weight loss were less likely to identified. This would delay in  
22 seeking medical help<sup>[35]</sup>. Importantly, less than half of participants knew  
23 colorectal cancer can be asymptomatic, implying a gap in educational  
24 interventions. Furthermore, approximately a quarter of the participants  
25 indicated that they had never heard of even one screening test. This result  
26 shows that poor awareness of screening test is a factor contributing to low  
27 participation rate of colorectal cancer screening, and indicates that screening  
28 test could be a good target for cancer awareness-raising initiatives<sup>[36]</sup>.  
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39 Our finding found that respondents with lower education level and income,  
40 and who worked as farmers had worse awareness. Further, those who had no  
41 health insurance, had never seen a physician within the past year and with  
42 lower perceived risk of colorectal cancer showed lower knowledge. There is  
43 possibility that they have insufficient access to social resources and are less  
44 aware of information about colorectal cancer screening<sup>[37]</sup>. Studies have  
45 reported similar findings that socially disadvantaged groups were less  
46 knowledgeable<sup>[31][38]</sup>. Evidence also suggests that the socially disadvantaged  
47 groups were less likely to have undergone screening<sup>[22][37]</sup>. Thus, educational  
48 interventions should target to these underserved and socially disadvantaged  
49 individuals.  
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60 *Colorectal cancer screening attitude*

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4 Participants held positive attitudes towards screening and early diagnosis of  
5 colorectal cancer, implying that they were aware of the value of early diagnosis  
6 and the benefits of screening, while only less than 60% of the participants  
7 agreed that they needed colonoscopy even if they felt healthy. Therefore, it is  
8 necessary to educate the public about the importance and necessity of  
9 screening. Only a small percentage of participants (13.3%) had undergone  
10 colorectal cancer screening at least once, which was similar to that reported in  
11 the Hong Kong studies (14%)<sup>[26]</sup> but lower than that in the Korean and Iranian  
12 studies (>45%)<sup>[23][39]</sup>. This difference might be because in China colonoscopy  
13 is conducted via opportunistic screening, and thus it relies on individuals  
14 voluntarily requesting it and shouldering the expenses<sup>[16,17]</sup>. It is noteworthy  
15 that the majority of participants had never done colonoscopy screening  
16 possibly due to low-risk perception, poor awareness towards screening or  
17 other reasons which may limit access to screening<sup>[23]</sup>. Therefore, it is crucial to  
18 explore the important barriers of colonoscopy screening among Chinese  
19 high-risk populations<sup>[19]</sup>.

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35 Bivariate analysis showed that personal history of colorectal disease,  
36 having seen a doctor in the past year, previous discussion of colorectal cancer  
37 screening, perceived risk and knowledge were significantly associated with  
38 better screening behaviour. We found that only a minority (14%) of participants  
39 reported previous discussion about screening with physicians and thought that  
40 they had a high risk of developing colorectal cancer, which was below the  
41 estimates (28%–55%) from studies in Iran and USA<sup>[23,24]</sup>. This finding indicated  
42 that the participants were underestimate their risk of colorectal cancer and not  
43 aware of the importance of screening. It is therefore urgent to plan health  
44 education intervention to correct public perception of their self-risk of  
45 developing colorectal cancer and emphasize the significance of screening.

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Similar to our findings, a study found that individuals with gastrointestinal tract diseases were more likely to undergo gastrointestinal cancer screening than individuals without diseases, which may be because the onset of

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4 uncomfortable symptoms motivate them to seek medical help and participate  
5 in screening<sup>[40]</sup>. A study that assessed beliefs, knowledge and screening  
6 among Asian Americans in California, found that participants had seen their  
7 physician within the past year were more likely to attend colorectal cancer  
8 screening<sup>[22]</sup>. Furthermore, participants who received a physician's advice for  
9 screening were associated with higher adherence to cancer screening<sup>[41]</sup>. Choi  
10 et al found that those who with a greater perceived risk of colorectal cancer  
11 were also significantly more likely to be screened than those who with lower  
12 perceived risk<sup>[42]</sup>. Wong et al found that participants with better knowledge  
13 concerning colorectal cancer screening were associated with performing  
14 screening<sup>[26]</sup>. Therefore, physicians should emphasize screening and risk  
15 education for high-risk individuals.  
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#### 26 27 *Colorectal cancer screening barriers*

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29 'No symptoms or discomfort' was the most common reason for not undergoing  
30 screening, consistent with previous studies<sup>[40][43]</sup>, implying that participants  
31 mistakenly convinced that screening is only required upon symptoms or feel ill  
32 and they go to health facilities to seek medical help, which can be worrying  
33 because the disease only becomes symptomatic at an advanced stage<sup>[44]</sup>.  
34 Therefore, there is a strong need to address such misconception and educate  
35 people about the indications of cancer screening.  
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43 Moreover, 'never thought about the disease or screening' was another  
44 major barrier for participation in screening, which further reflects the lack of  
45 knowledge about CRC and its screening. This may be partly because  
46 colonoscopy for colorectal cancer screening is not covered by Chinese routine  
47 medical check-up<sup>[16]</sup>. In addition, it may also be because in Chinese culture  
48 and traditional beliefs, cancer is a taboo topic and Chinese people are  
49 reluctant to think or speak about it. The notion of detecting hidden or  
50 asymptomatic disease by screening does not exist in traditional Chinese  
51 beliefs<sup>[12]</sup>. This result emphasizes the need to increase awareness of the  
52 importance of CRC screening for this preventable disease and design  
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4 culturally tailored education to reduce adverse beliefs or attitudes towards  
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6 cancer.

7 'Lack of recommendation from physician' was found to be a key reason for  
8 not participating in screening. This suggests that clinicians need to pay more  
9 attention to screening education of patients as well as improve  
10 patient-physician communication. Physicians should also play an active role in  
11 delivering early screening information to high-risk populations. Other barriers  
12 observed included 'too painful, unpleasant or embarrassing' and 'I am not at  
13 risk for colorectal cancer'. As reported, the majority of barriers are related to a  
14 lack of understanding and awareness of CRC screening, some were health  
15 system and health professional related. Therefore, it is imperative to conduct  
16 awareness campaigns to bring out public attention, correct these  
17 misconceptions and overcome psychological barriers. Better communication  
18 with participants regarding the screening procedure could potentially remove  
19 the perception of embarrassment and fear. Health care professionals should  
20 encourage high-risk individuals to participate in CRC screening and inform  
21 them about cancer risk.  
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### 36 *Implications*

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38 In Korea, a country with high incidence rates of colorectal cancer, has  
39 implemented a nationwide screening program and set up institutions  
40 responsible for providing comprehensive cancer information to promote public  
41 awareness and screening uptake<sup>[10]</sup>. In China, the government has started to  
42 pay attention to awareness and screening about cancer. Health China Action:  
43 Cancer Prevention and Control Implementation Plan and Healthy China 2030  
44 Strategy set a series of goals of attaining more than 70% awareness rate of  
45 cancer prevention knowledge, making public aware of their cancer risk and  
46 promoting cancer screening for high-risk groups<sup>[45,46]</sup>. However, data to  
47 evaluate the effectiveness of such initiatives are lacking, therefore, this study  
48 could be used as a basis to measure the effectiveness of further health  
49 promoting campaigns.  
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4 Our results has indicated that Chinese high-risk people have deficient  
5 awareness, some misconceptions and barriers regarding colorectal cancer  
6 screening. Moreover, they are still not aware of their cancer risk and the need  
7 for undergoing screening. Our findings suggest that strategies to improve  
8 awareness and screening uptake in high-risk populations should include three  
9 components. First, the government should learn from initiatives in different  
10 countries, appropriate and effective educational campaigns should be  
11 conducted, using web-based education tools to broadcast scientific colorectal  
12 cancer prevention information<sup>[47,48]</sup>. Moreover, the government should  
13 establish an organised colorectal cancer screening programme and  
14 incorporate screening into healthcare system in the future<sup>[23]</sup>. Second, health  
15 care professionals should be trained to play an active role in improving  
16 high-risk people's awareness, perceptions and behaviour about colorectal  
17 cancer screening. Less-known risk factors, screening tests and major barriers  
18 discovered in this study need to be emphasized during education interventions.  
19 Further, health promotion campaigns should focus on those who do not see  
20 their physician regularly, without colorectal disease, with low perceived risk  
21 and poor knowledge.

### 22 *Strengths and limitations*

23 To our knowledge, this is the first study in mainland China aiming to assess  
24 awareness, attitude and behaviour about colorectal cancer screening and  
25 explore the reasons underlying low screening rate among high-risk populations.  
26 The study achieved a high response rate and through face-to-face interviews  
27 by trained interviewers strengthened the validity of the study results. Our study  
28 had some limitations. First, as the participants' screening history was  
29 self-reported, recall bias may have occurred. However, respondents were  
30 given a brief description of screening tests before asking if they had ever  
31 undergone screening. Second, we might not cover of all of the barriers  
32 regarding screening uptake as only a quantitative method was used. Further  
33 study is warranted to use qualitative or mixed-method to comprehensively  
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4 explore the related factors. Moreover, We assume that respondents who visit  
5 hospitals tend to have better health awareness. Third, validity of the instrument,  
6 which is an important evaluation factor of the quality of the instrument, was not  
7 explored well.  
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### 11 12 13 **Conclusion**

14  
15 This study indicates that the majority of high-risk people had deficient  
16 knowledge and never undergone colorectal cancer screening. But most of  
17 them held a positive attitude towards the benefits of screening. Being  
18 asymptomatic and never thought of the disease or screening were the main  
19 reasons for not undergoing screening. Our study gives insight into the  
20 development of strategies to improve screening of colorectal cancer in China.  
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**Data availability statement** Data are available by contacting Ying Zeng by E-mail: zengying2003@126.com

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# Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

## Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

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		Reporting Item	Page Number
<b>Title and abstract</b>			
Title	<a href="#">#1a</a>	Indicate the study's design with a commonly used term in the title or the abstract	4
Abstract	<a href="#">#1b</a>	Provide in the abstract an informative and balanced summary of what was done and what was found	4
<b>Introduction</b>			
Background / rationale	<a href="#">#2</a>	Explain the scientific background and rationale for the investigation being reported	6

1	Objectives	<a href="#">#3</a>	State specific objectives, including any prespecified hypotheses	7
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5	<b>Methods</b>			
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9	Study design	<a href="#">#4</a>	Present key elements of study design early in the paper	7
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12	Setting	<a href="#">#5</a>	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7,8
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18	Eligibility criteria	<a href="#">#6a</a>	Give the eligibility criteria, and the sources and methods of selection of participants.	8
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23		<a href="#">#7</a>	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
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29	Data sources / measurement	<a href="#">#8</a>	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	8,9
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38	Bias	<a href="#">#9</a>	Describe any efforts to address potential sources of bias	
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41	Study size	<a href="#">#10</a>	Explain how the study size was arrived at	7,8
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44	Quantitative variables	<a href="#">#11</a>	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	
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50	Statistical methods	<a href="#">#12a</a>	Describe all statistical methods, including those used to control for confounding	9
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55	Statistical methods	<a href="#">#12b</a>	Describe any methods used to examine subgroups and interactions	9
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1	Statistical	<a href="#">#12c</a>	Explain how missing data were addressed	
2	methods			
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5	Statistical	<a href="#">#12d</a>	If applicable, describe analytical methods taking account of	
6	methods		sampling strategy	
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10	Statistical	<a href="#">#12e</a>	Describe any sensitivity analyses	
11	methods			
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15	<b>Results</b>			
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18	Participants	<a href="#">#13a</a>	Report numbers of individuals at each stage of study—eg	10
19			numbers potentially eligible, examined for eligibility,	
20			confirmed eligible, included in the study, completing follow-	
21			up, and analysed. Give information separately for for	
22			exposed and unexposed groups if applicable.	
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27	Participants	<a href="#">#13b</a>	Give reasons for non-participation at each stage	
28				
29				
30	Participants	<a href="#">#13c</a>	Consider use of a flow diagram	
31				
32				
33	Descriptive data	<a href="#">#14a</a>	Give characteristics of study participants (eg demographic,	10,11
34			clinical, social) and information on exposures and potential	
35			confounders. Give information separately for exposed and	
36			unexposed groups if applicable.	
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41	Descriptive data	<a href="#">#14b</a>	Indicate number of participants with missing data for each	
42			variable of interest	
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46	Outcome data	<a href="#">#15</a>	Report numbers of outcome events or summary measures.	
47			Give information separately for exposed and unexposed	
48			groups if applicable.	
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52	Main results	<a href="#">#16a</a>	Give unadjusted estimates and, if applicable, confounder-	12,13,14,15,
53			adjusted estimates and their precision (eg, 95% confidence	
54			interval). Make clear which confounders were adjusted for	16,17,18
55			and why they were included	
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1	Main results	<a href="#">#16b</a>	Report category boundaries when continuous variables were categorized	12,13,14,15, 16,17,18
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6	Main results	<a href="#">#16c</a>	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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11	Other analyses	<a href="#">#17</a>	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	
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16	<b>Discussion</b>			
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19	Key results	<a href="#">#18</a>	Summarise key results with reference to study objectives	19
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22	Limitations	<a href="#">#19</a>	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	24
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28	Interpretation	<a href="#">#20</a>	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	19,20
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34	Generalisability	<a href="#">#21</a>	Discuss the generalisability (external validity) of the study results	21,22,23
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39	<b>Other</b>			
40	<b>Information</b>			
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44	Funding	<a href="#">#22</a>	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	25
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# BMJ Open

## Awareness, Attitude and Barriers of Colorectal Cancer Screening among High-risk Populations in China: A Cross-sectional Study

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4 **Awareness, Attitude and Barriers of Colorectal Cancer Screening among**  
5 **High-risk Populations in China: A Cross-sectional Study**  
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## Awareness, Attitude and Barriers of Colorectal Cancer Screening among High-risk Populations in China: A Cross-sectional Study

### Abstract

**Objective:** To assess the awareness, attitude and barriers of colorectal cancer screening among high-risk populations in China.

**Design:** A cross-sectional study was employed.

**Setting:** This study was conducted in nine hospitals in Hunan province, China.

**Participants:** Individuals with a high-risk for colorectal cancer were interviewed using a pretested structured questionnaire.

**Primary and secondary outcome measures:** Knowledge, attitude of colorectal cancer screening, sociodemographic factors associated with colorectal cancer screening knowledge and behaviour, and barriers of colorectal cancer screening.

**Results:** This study included 684 participants. The mean knowledge score was 11.86/24 (SD 4.84). But over 70% of them held a positive attitude towards screening. Only 13.3% had undergone colorectal cancer screening. Independent factors related to knowledge were education level of college or above, working as a white collar, higher income, having health insurance, having seen a doctor in the past year and with a high perceived risk ( $p < 0.05$ ). Factors independently associated with screening behaviour included personal history of colorectal disease, having seen a doctor in the past year, previous discussion of colorectal cancer screening, high perceived risk and better knowledge ( $p < 0.05$ ). Main reasons for not undergoing screening were no symptoms or discomfort (71.1%), never having thought of the disease or screening (67.4%) and no doctor advised me (29.8%).

**Conclusion:** In China, the majority of high-risk people had deficient knowledge and had never undergone colorectal cancer screening. But most of them held a positive attitude towards the benefits of colorectal cancer screening. This has promising implications to design targeted educational

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4 campaigns and establish screening programmes to improve colorectal cancer  
5 awareness and screening participation. Health care professionals should  
6 advise high-risk individuals to participate in screening and inform them about  
7 cancer risk.  
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11 **Keywords:** colorectal cancer screening, awareness, barriers, prevention  
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### 15 **Strengths and limitations of this study**

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- 17 ▪ These findings may be used as a reference for other countries with no  
18 screening programmes.  
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- 20 ▪ The study achieved a high response rate through face-to-face interviews by  
21 trained data collectors.  
22
- 23 ▪ The participants' screening history was self-reported, therefore, recall bias  
24 may have occurred.  
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- 26 ▪ We may not have covered all of the barriers regarding screening uptake as  
27 only a quantitative method was used.  
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## Introduction

Colorectal cancer is the third most common cancer and the second leading cause of cancer death worldwide.<sup>[1]</sup> The World Health Organization (WHO) showed that nearly half of the new cases were found in Asia and mostly in China.<sup>[2]</sup> Colorectal cancer is the second most common malignancy in China, with 521,400 new cases and 248,000 deaths occurring in 2018.<sup>[2]</sup> The incidence rates and mortality rates of colorectal cancer in China continue to rise due to an aging and growing population.<sup>[3]</sup>

Early colorectal cancer has a better prognosis than advanced and metastatic colorectal cancer.<sup>[4]</sup> However, most patients are diagnosed during the advanced stage of the disease with a poor prognosis.<sup>[5,6]</sup> In China, the 5-year survival rate of colorectal cancer is lower than that of many developed countries such as Korea with a rising cancer burden.<sup>[7-10]</sup> A study showed that the incidence of prehospital delay among Chinese patients with colorectal cancer was 47%, suggesting delays in diagnosis and treatment.<sup>[11]</sup> These studies indicate that there are problems regarding screening and prevention of this disease. High-risk populations are the key target populations of cancer screening.<sup>[12]</sup> To strengthen efforts to promote colorectal cancer prevention and control, it is particularly important to improve screening for prevention and early detection of colorectal cancer for high-risk populations in China. High-risk populations for developing colorectal cancer are individuals with colorectal diseases such as colorectal adenomas, inflammatory bowel disease and hereditary syndromes and those with a family history of colorectal cancer.<sup>[13,14]</sup>

Colorectal cancer screening via colonoscopy is known as an effective method to prevent and detect early-stage colorectal cancer and improve survival and prognosis.<sup>[15]</sup> Despite the heavy burden of colorectal cancer in China, unlike in other East Asian countries such as Korea, there are no nationwide screening guidelines or programmes.<sup>[16]</sup> As a result of the large populations but with an uneven distribution of health, medical and financial resources, opportunistic screening with colonoscopy in asymptomatic people

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4 is widely used in China.<sup>[17]</sup> Opportunistic screening is performed on a voluntary  
5 basis and is dependent on a request from a physician or individual.<sup>[18]</sup>  
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8 Unfortunately, the screening rate of colorectal cancer in China is far away  
9 from satisfactory level. The majority (about 85%) of high-risk populations still  
10 never have done colorectal cancer screening according to the report by Chen  
11 et al<sup>[19]</sup> in 2018. Key factors contributing to non-participation in colorectal  
12 cancer screening could be a poor awareness of colorectal cancer screening, a  
13 negative attitude towards screening and multiple barriers related to  
14 screening.<sup>[20]</sup> Previous studies suggested that the general population had  
15 deficient knowledge of colorectal cancer and screening.<sup>[21,22]</sup> Moreover, few  
16 studies also indicated that screening knowledge and practice were suboptimal  
17 among high-risk populations.<sup>[23,24]</sup> In China, fewer studies reported inadequate  
18 public knowledge and screening of colorectal cancer.<sup>[25,26]</sup>  
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30 Currently, there are few studies exploring awareness, attitude and identify  
31 barriers for colorectal cancer screening among high-risk populations in China.  
32 Therefore, it is crucial to assess awareness, attitude and possible barriers that  
33 hinder screening so that more effective approaches can be implemented to  
34 promote screening uptake. The objectives of this study were to (1) assess  
35 awareness, attitude and behaviour of colorectal cancer screening among  
36 high-risk populations in China, (2) examine sociodemographic factors  
37 associated with colorectal cancer screening knowledge and behaviour, and (3)  
38 identify the barriers to colorectal cancer screening.  
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## 48 **Methods**

### 49 *Setting and sample*

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51 This was a cross-sectional study conducted between April and August 2019.  
52 The sample size was calculated based on 15% ( $\pi$ ) of the prevalence rate of  
53 colorectal cancer screening using a formula  $N=[Z^2_{\alpha/2} \times \pi \times (1-\pi)]/\delta^2$ ,<sup>[27]</sup> with 0.03  
54 allowable error ( $\delta$ ) and  $Z_{\alpha/2}=1.96$  at 95% confidence interval. Considering the  
55 40% non-response rate, the final sample size was 760.  
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Nine hospitals were selected from a total of 42 in Hunan province using a cluster random sampling method. The source population were individuals from gastrointestinal department of hospitals with a high risk of developing colorectal cancer according to medical records by convenience sampling. With the support of hospitals, each trained interviewer was accompanied by a medical staff to introduce the study aim. The inclusion criteria<sup>[13,14]</sup> included: (1) age 18 to 75 years, (2) a family history of colorectal cancer or adenomas, (3) a personal history of colorectal cancer or adenomas, (4) a personal history of inflammatory bowel disease and (5) a personal history of hereditary syndromes. The exclusion criteria<sup>[13,14]</sup> included: (1) age less than 18 years, (2) being diagnosed with colorectal cancer, (3) unable to communicate with the investigator and (4) severe cognitive impairment. Individuals who consented to participate in the study completed a standardised face-to-face questionnaire, which lasted for approximately 15 to 20 minutes. Each participant received ¥30 (about \$4.2) for completing the survey. This study was approved by the Ethic Committee of the University of South China (No. 4304081009636) and informed consent was obtained from all participants prior to participation.

### *Instrument*

The questionnaire included items about awareness, attitudes and screening for colorectal cancer. Survey items were identified from the research literature,<sup>[28,29]</sup> the American Cancer Society and China Anti-Cancer Association.<sup>[30]</sup> The questionnaire consisted of 4 sections. The first section comprised socio-demographic characteristics, such as gender, age, education level, occupation, marital status, residence, income, health insurance, and perceived health status. The second part included 24 questions about knowledge of colorectal cancer: risk factors, warning signs and screening tests. Two items had multiple answers, so the scoring was 1 point for each correct answer and 0 points for the wrong answer or 'don't know' with a total score of 24 points. The third section was related to attitudes toward the colorectal cancer screening, such as colorectal cancer is preventable, early colorectal

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4 cancer is curable, colonoscopy can help to find colorectal cancer early,  
5 colonoscopy can help to prevent colorectal cancer, colonoscopy is beneficial,  
6 colonoscopy is important. The possible responses were 'yes', or 'no'. In the  
7 fourth section, participants were questioned whether they had ever undergone  
8 colorectal cancer screening with 'yes' or 'no' answer. Participants who  
9 answered 'no' were asked to choose the reasons for not undergoing screening,  
10 and more than 1 choice was allowed. Mean knowledge scores were calculated  
11 based on the number of correct responses and total scores ranged from 0 to  
12 24 points.  
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21 The reliability was evaluated by pretesting 80 people. The internal  
22 consistency of the questionnaires was accomplished by estimating the  
23 Cronbach's alpha based on the recommendation of >0.70. The Cronbach's  
24 alpha calculated was 0.88. Face validity was performed to assess the  
25 comprehension towards understanding of the questionnaire and to assess how  
26 important it was to target study participants. Finally, the questionnaire was  
27 modified and re-evaluated to fit the study population based on the feedback  
28 from the pilot study.  
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### 36 *Statistical analysis*

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38 Data were analysed using IBM SPSS V.23.0. Descriptive statistics were used  
39 to describe the participants' socio-demographics and responses to each  
40 question. The t test and analysis of variance test were used to investigate the  
41 association of demographic factors with knowledge. The  $\chi^2$  or Fisher's exact  
42 test were used to find the association between demographic factors and  
43 behaviour of colorectal cancer screening. Variables with a p value  $\leq 0.15$  in the  
44 univariate analysis were included in the multiple linear regression analysis to  
45 investigate the independent factors for screening knowledge, while variables  
46 with a p value  $\leq 0.15$  in the univariate analysis were included in the binary  
47 logistic regression analysis to identify the independent factors for screening  
48 behaviour. Only the results of the bivariate and multivariate analyses were  
49 presented using odds ratios (OR) and 95% confidence intervals (CI). A p value  
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of <0.05 was regarded as statistically significant.

#### *Patient and public involvement*

No participants were involved in our work. The study results will be made available to participants interested in this subject.

## **Results**

### *Sample characteristics*

Of the 760 high-risk individuals, 712 consented to involve in the study, of whom 28 completed less than 50% of the questionnaire. Thus, the final response rate was 90.0% (n=684). The mean age of the participants was 47.01±7.39 years (range=27-74 years). Of the total sample, more than half (54.5%) were men, 75.6% had high school education or below and 58.0% lived in urban areas. Almost all (94.4%) were married and 86.7% were insured. About 37.9% had low income. The majority (88.7%) had no personal history of colorectal disease and 93.1% had a family history of colorectal cancer or adenomas. Only 14.2% reported previous discussion of screening with the doctor, and 13.7% perceived their risk of developing colorectal cancer was high. Other variables are listed in Table 1.

**Table 1 Participant characteristics (n=684)**

<b>Characteristics</b>	<b>N (%)</b>
Gender	
Male	373 (54.5)
Female	311 (45.5)
Age (years)	
<40	79 (11.5)
40-49	399 (58.3)
50-59	163 (23.8)
>60	43 (6.3)

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Mean±SD	47.01±7.39
Education level	
High school or below	517 (75.6)
College or above	167 (24.4)
Occupation	
Farmer	63 (9.2)
Worker	304 (44.4)
Unemployed	105 (15.4)
White collar	212 (31.0)
Marital status	
Single	38 (5.6)
Married	646 (94.4)
Residence	
Urban	397 (58.0)
Rural	287 (42.0)
Income (¥)	
<3000	259 (37.9)
3000-5000	207 (30.3)
>5000	218 (31.9)
Health insurance	
Yes	593 (86.7)
No	91 (13.3)
Self-reported health status	
Good	274 (40.1)
Fair	363 (53.1)
Poor	47 (6.9)
Personal history of colorectal disease	
Yes	77 (11.3)
No	607 (88.7)

Seen a doctor in the past year		
None		356 (52.0)
1-2 times		230 (33.6)
≥3 times		98 (14.3)
Previous discussion of colorectal cancer screening		
Yes		97 (14.2)
No		587 (85.8)
Family history of colorectal cancer or adenomas		
Yes		637 (93.1)
No		47 (6.9)
Perceived risk		
Low		248 (36.3)
Medium		342 (50.0)
High		94 (13.7)

### *Knowledge of colorectal cancer and screening*

Table 2 presents the participants' knowledge about colorectal cancer and screening including risk factors, warning signs and screening tests. The mean total knowledge score was 11.86 (SD 4.84, range 0-24). The mean knowledge scores for risk factors, warning signs and screening tests were 5.38 (SD 2.70, range from 0-11), 4.60 (SD 2.03, range 0-8) and 1.88 (SD 1.19, range 0-5), respectively. The most well recognised risk factors were inflammatory bowel disease (63.2%), followed by colon polyps (62.1%) and excess alcohol consumption (60.4%). Less well-recognised risk factors included family history of colorectal cancer (49.6%), smoking (48.1%), older age (45.3%), being overweight or obese (44.0%), having an inherited syndrome (40.8%) and diabetes (11.5%). The most highly recognised warning signs were blood in the stool (76.0%), rectal bleeding (74.0%) and change in bowel habits (66.4%).

The least recognised symptoms included unexplained weight loss (57.3%), bowel does not empty (55.3%) and tiredness/anaemia (29.5%). Importantly, only 40.9% were aware that colorectal cancer could be asymptomatic. The most commonly heard of screening test was colonoscopy but only 46.6% knew that colonoscopy was the gold standard method of colorectal cancer screening. Less than a third were aware of stool DNA test (21.5%) and IFOBT and high-risk factor questionnaire (8.6%).

Table 3 presents the results of the multiple linear regression for factors associated with colorectal cancer screening knowledge. In the univariate analysis, education level, occupation, residence, income, health insurance, having seen a doctor in the past year, previous discussion of colorectal cancer screening and perceived risk were significantly associated with colorectal cancer knowledge ( $p < 0.05$ ). These factors plus variables with  $p$  value  $< 0.15$  (personal history of colorectal disease) in the univariate analysis were included in the multiple linear regression model. Factors independently associated with knowledge were education level, occupation, income, health insurance, having seen a doctor in the past year and perceived risk ( $p < 0.05$ ).

Participants who were found to be more knowledgeable about colorectal cancer and screening included with a college education or above ( $\beta = 2.41$ , 95%CI 1.54 to 3.28,  $p < 0.001$ ), working as a white collar ( $\beta = 1.89$ , 95%CI 0.42 to 3.36,  $p = 0.012$ ), with higher income ( $\beta = 1.65$ , 95%CI 0.70 to 2.59,  $p = 0.001$ ;  $\beta = 1.47$ , 95%CI 0.43 to 2.51,  $p = 0.006$ ), having health insurance ( $\beta = 1.39$ , 95%CI 0.43 to 2.36,  $p = 0.005$ ), having seen a doctor in the past year ( $\beta = 1.93$ , 95%CI 0.93 to 2.92,  $p < 0.001$ ) and perceiving greater risk ( $\beta = 1.82$ , 95%CI 0.76 to 2.88,  $p = 0.001$ ).

**Table 2 Knowledge of colorectal cancer and screening (n=684)**

Category	N	%
<b>Risk factors</b>		

Older age	310	45.3
Low physical activity	384	56.1
High intake of red and processed meat	388	56.7
Smoking	329	48.1
Excess alcohol consumption	413	60.4
Being overweight or obese	301	44.0
Colon polyps	425	62.1
Inflammatory bowel disease	432	63.2
Family history of colorectal cancer	339	49.6
Having an inherited syndrome	279	40.8
Diabetes	79	11.5
<b>Warning symptoms</b>		
Blood in the stool	520	76.0
Rectal bleeding	506	74.0
Change in bowel habits	454	66.4
Tiredness/anaemia	202	29.5
Unexplained weight loss	392	57.3
Abdominal pain	417	61.0
Bowel does not empty	378	55.3
Colorectal cancer can be present without any symptoms	280	40.9
<b>Screening tests</b>		
FOBT	294	43.0
Colonoscopy/sigmoidoscopy	465	68.0
Stool DNA test	147	21.5
IFOBT and high-risk factor questionnaire	59	8.6
Which of the four choices is the gold standard method of colorectal cancer screening? (Colonoscopy)	319	46.6

**Table 3 Multiple linear regression of factors associated with colorectal cancer knowledge (n=684)**

	Knowledge Score			
	$\beta$	SE	95%CI	P
<b>Education level</b>				
High school or below	1 (ref)			
College or above	2.410	0.442	1.542, 3.279	<0.001*
<b>Occupation</b>				
Farmer	1 (ref)			
Worker	1.002	0.645	-0.264, 2.268	0.121
Unemployed	0.786	0.693	-0.573, 2.146	0.257
White collar	1.891	0.750	0.420, 3.363	0.012*
<b>Income (¥)</b>				
<3000	1 (ref)			
3000-5000	1.646	0.480	0.703, 2.589	0.001*
>5000	1.470	0.530	0.429, 2.512	0.006*
<b>Health insurance</b>				
No	1 (ref)			
Yes	1.386	0.493	0.429, 2.364	0.005*
<b>Seen a doctor in the past year</b>				
None	1 (ref)			
1-2 times	0.586	0.368	-0.137, 1.309	0.112
$\geq 3$ times	1.925	0.506	0.932, 2.918	<0.001*
<b>Perceived risk</b>				
Low	1 (ref)			
Medium	-0.292	0.364	-1.007, 0.423	0.423
High	1.820	0.540	0.760, 2.879	0.001*
<b>Constant</b>	7.365	0.704	5.983, 8.747	0.000*

$R^2=0.210$ ,  $F=17.510$ ,  $P=0.000$ .



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3 \*Statistically significant at  $P < 0.05$ .

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5 CI, confidence interval; SE, standard error; ref, reference.  
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10 *Attitudes towards colorectal cancer screening*

11 Table 4 shows the attitudes towards colorectal cancer screening. A majority of  
12 participants held a positive attitude towards screening. More than 70% of them  
13 thought that colorectal cancer was preventable, early colorectal cancer was  
14 curable, colonoscopy could help to find colorectal cancer early, colonoscopy  
15 could help to prevent early colorectal cancer, colonoscopy was beneficial and  
16 colonoscopy was important. But only 58.7% thought they needed colonoscopy  
17 if they felt well. Of all the participants, only 91 (13.3%) had undergone  
18 colorectal cancer screening. There was a significant portion of participants  
19 (86.7%) who had not participated in colorectal cancer screening.  
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29 Table 5 shows the results of the bivariate analysis for factors associated  
30 with colorectal cancer screening behaviour. In the univariate analysis, factors  
31 significantly associated with colorectal cancer screening behaviour were  
32 personal history of colorectal disease, having seen a doctor in the past year,  
33 previous discussion of colorectal cancer screening and perceived risk ( $p < 0.05$ ).  
34 These factors plus variables with  $p$  value  $< 0.15$  (education level) in the  
35 univariate analysis were included in the binary logistic regression model. The  
36 independent variables associated with colorectal cancer screening behaviour  
37 included personal history of colorectal disease, having seen a doctor in the  
38 past year, previous discussion of colorectal cancer screening, perceived risk  
39 and knowledge ( $p < 0.05$ ). Participants with a personal history of colorectal  
40 disease were more likely to have attended colorectal cancer screening  
41 compared with those without colorectal disease (OR 2.33, 95%CI 1.12 to 4.87,  
42  $p = 0.024$ ). Participants who had seen a doctor in the past year were more likely  
43 to have undergone colorectal cancer screening than those who had never  
44 seen a doctor in the past year (OR 3.20, 95%CI 1.80 to 5.68,  $p < 0.001$ ; OR  
45 2.41, 95%CI 1.17 to 4.96,  $p = 0.017$ ). Moreover, participants who had previous  
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discussion of colorectal cancer screening were more likely to have been screened for colorectal cancer (OR 2.42, 95%CI 1.25 to 4.66, p=0.008). Further, those with a higher perceived risk of developing colorectal cancer tended to have undergone screening than the other groups (OR 4.03, 95%CI 1.95 to 8.32, p<0.001). Additionally, those who had more knowledge were more likely to have done colorectal cancer screening (OR 1.06, 95%CI 1.00 to 1.12, p=0.044).

**Table 4 Colorectal cancer screening perceptions (n=684)**

Question	N	%
Colorectal cancer is preventable	524	76.6
Early colorectal cancer is curable	595	87.0
Colonoscopy can help to find colorectal cancer early	615	89.9
Colonoscopy can help to prevent colorectal cancer	521	76.2
Colonoscopy is beneficial	567	82.9
Colonoscopy is important	496	72.5
You need colonoscopy even if you feel healthy	402	58.8

**Table 5 Bivariate analysis of factors associated with colorectal cancer screening behaviour (n=684)**

Variable	Screened N (%)	Unscreened N (%)	OR	95%CI	P
<b>Personal history of colorectal disease</b>					
No	60 (9.9)	547 (90.1)	1 (ref)		
Yes	31 (40.3)	46 (59.7)	2.337	1.121,	0.024*

4.874

**Seen a doctor in the past year**

None	23 (6.5)	333 (93.5)	1 (ref)		
1-2 times	43 (18.7)	187 (81.3)	3.195	1.799, 5.676	<0.001*
≥3 times	25 (25.5)	73 (74.5)	2.409	1.170, 4.958	0.017*

**Previous discussion of colorectal cancer screening**

No	57 (9.7)	530 (90.3)	1 (ref)		
Yes	34 (35.1)	63 (64.9)	2.416	1.254, 4.655	0.008*

**Perceived risk**

Low	17 (6.9)	231 (93.1)	1 (ref)		
Medium	38 (11.1)	304 (88.9)	1.246	0.666, 2.333	0.491
High	36 (38.3)	58 (61.7)	4.029	1.951, 8.320	<0.001*
<b>Knowledge score, mean (SD)</b>	<b>13.9 (4.6)</b>	<b>11.6 (4.8)</b>	<b>1.060</b>	<b>1.001, 1.121</b>	<b>0.044*</b>

\*Statistically significant at  $P < 0.05$ .

CI, confidence interval; OR, odds ratio; ref, reference.

*Barriers to participate in colorectal cancer screening*

Table 6 reports the reasons why participants have not undergone colorectal cancer screening. There were 71.1% of the participants pointed out that screening was not needful due to no symptoms or discomfort, 67.4% said that they had never thought of the disease or screening, and 29.8% mentioned that lack of recommendation by physicians. There was a significant number of participants who thought screening was too painful, unpleasant or

embarrassing (20.0%) and some answered that they were not at risk for colorectal cancer (19.0%). Other reasons were lack of time (15.3%), difficult to assess medical facilities (12.4%), fear of bowel preparation (12.3%), unawareness of the benefits of screening (11.2%) and financial problem (9.6%).

**Table 6 Reasons for not undergoing colonoscopy (n=593)**

Reasons	N	%
Never thought of it	400	67.4
Doctor did not advise me	177	29.8
No symptoms or discomfort	422	71.1
Afraid of detecting colorectal cancer	39	6.5
Lack of time	91	15.3
Fear regarding bowel preparation	73	12.3
Too painful, unpleasant or embarrassing	119	20.0
Financial problem	57	9.6
Unawareness of the benefits of screening	67	11.2
Difficult to access medical facilities	74	12.4
Believe risks outweigh benefits	17	2.8
Lack of support from others	4	0.6
Not at risk for colorectal cancer	113	19.0

## Discussion

Understanding and recognising awareness and attitude regarding colorectal cancer screening and reasons towards low screening uptake among high-risk populations could help in developing appropriate policies for prevention and control of colorectal cancer. The study found that most of the participants had deficient knowledge and had never done colorectal cancer screening, but held a positive attitude towards screening and its benefits. Main reasons for not

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4 seeking screening included no symptoms and never having thought of the  
5 disease or screening.  
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### 7 *Colorectal cancer and screening awareness*

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9 Participants' knowledge of colorectal cancer and screening was insufficient,  
10 which was similar to studies conducted in Hong Kong and Saudi Arabia<sup>[31,32]</sup>  
11 but lower than that found in the Australian and Iranian studies.<sup>[33,34]</sup> Moreover,  
12 while participants had a relatively good awareness of warning symptoms, they  
13 had a poorer awareness of risk factors and screening tests. Less than half of  
14 participants identified risk factors such as smoking, older age, being  
15 overweight or obese, having an inherited syndrome and diabetes. This result  
16 indicates that people are unfamiliar with cancer-related risk factors.  
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20 Two of thirds of participants identified the main warning signs, whilst  
21 nonspecific symptoms such as tiredness/anaemia, bowel does not empty and  
22 unexplained weight loss were less likely to be identified. This would delay in  
23 seeking medical help.<sup>[35]</sup> Importantly, less than half of participants knew  
24 colorectal cancer can be asymptomatic, implying a gap in educational  
25 interventions. Furthermore, approximately a quarter of the participants  
26 indicated that they had never heard of even one screening test. This result  
27 shows that poor awareness of screening tests is a factor contributing to low  
28 participation rate of colorectal cancer screening, and indicates that screening  
29 tests could be a good target for cancer awareness-raising initiatives.<sup>[36]</sup>  
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33 Our finding found that respondents with lower education level and income,  
34 and who worked as farmers had worse awareness. Further, those who had no  
35 health insurance, had never seen a physician within the past year and with a  
36 lower perceived risk of colorectal cancer showed lower knowledge. There is a  
37 possibility that they had insufficient access to social resources and were less  
38 aware of information about colorectal cancer screening.<sup>[37]</sup> Studies have  
39 reported similar findings that socially disadvantaged groups were less  
40 knowledgeable.<sup>[38,39]</sup> Evidence also suggests that socially disadvantaged  
41 groups were less likely to have undergone screening.<sup>[22][37]</sup> Thus, educational  
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4 interventions should target these underserved and socially disadvantaged  
5 individuals.

#### 6 *Colorectal cancer screening attitude*

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9 Participants held positive attitudes towards screening and early diagnosis of  
10 colorectal cancer, implying that they were aware of the value of early diagnosis  
11 and the benefits of screening, while only less than 60% of the participants  
12 agreed that they needed colonoscopy even if they felt healthy. Therefore, it is  
13 necessary to educate the public about the importance and necessity of  
14 screening. Only a small percentage of participants (13.3%) had undergone  
15 colorectal cancer screening at least once, which was similar to that reported in  
16 the Hong Kong studies (14%)<sup>[26]</sup> but lower than that of the Korean and Iranian  
17 studies (>45%).<sup>[23][40]</sup> This difference may be because, in China, colonoscopy  
18 is conducted via opportunistic screening, and thus it relies on individuals  
19 voluntarily requesting it and shouldering the expenses.<sup>[16,17]</sup> It is noteworthy  
20 that the majority of participants had never done colonoscopy screening  
21 possibly due to low-risk perception, poor awareness towards screening or  
22 other reasons that may have limited their access to screening.<sup>[23]</sup> Therefore, it  
23 is crucial to explore the important barriers of colonoscopy screening among  
24 Chinese high-risk populations.<sup>[19]</sup>

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Bivariate analysis showed that personal history of colorectal disease,  
having seen a doctor in the past year, previous discussion of colorectal cancer  
screening, perceived risk and knowledge were significantly associated with  
better screening behaviour. We found that only a minority (14%) of participants  
reported previous discussion about screening with physicians and thought that  
they had a high risk of developing colorectal cancer, which was below the  
estimates (28%–55%) from studies in Iran and USA.<sup>[23,24]</sup> This finding indicated  
that the participants were underestimating their risk of colorectal cancer and  
were not aware of the importance of screening. It is therefore urgent to plan  
health education interventions to correct public misperceptions of self-risk of  
developing colorectal cancer, and to emphasise the significance of screening.

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4 Similar to our findings, a study found that individuals with gastrointestinal  
5 tract diseases were more likely to undergo gastrointestinal cancer screening  
6 than individuals without diseases, which may be because the onset of  
7 uncomfortable symptoms motivates them to seek medical help and participate  
8 in screening.<sup>[41]</sup> A study that assessed beliefs, knowledge and screening  
9 among Asian Americans in California, found that participants who had seen  
10 their physician within the past year were more likely to attend colorectal cancer  
11 screening.<sup>[22]</sup> Furthermore, participants who received a physician's advice for  
12 screening were associated with higher adherence to cancer screening.<sup>[42]</sup> Choi  
13 et al found that those with a greater perceived risk of colorectal cancer were  
14 also significantly more likely to be screened than those with a lower perceived  
15 risk.<sup>[43]</sup> Wong et al found that participants with better knowledge concerning  
16 colorectal cancer screening were associated with performing screening.<sup>[26]</sup>  
17 Therefore, physicians should emphasise screening and risk education for  
18 high-risk individuals.  
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### 33 *Colorectal cancer screening barriers*

34 'No symptoms or discomfort' was the most common reason for not undergoing  
35 screening. This was consistent with previous studies.<sup>[41][44]</sup> This implies that  
36 participants mistakenly become convinced that screening is only required upon  
37 symptoms or feeling ill. They then go to health facilities to seek medical help,  
38 which can be worrying because the disease only becomes symptomatic at an  
39 advanced stage.<sup>[45]</sup> Therefore, there is a strong need to address such  
40 misconceptions and to educate people about the indications of cancer  
41 screening.  
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50 Moreover, 'never thought about the disease or screening' was another  
51 major barrier for participation in screening, which further reflects the lack of  
52 knowledge about colorectal cancer and its screening. This may be partly  
53 because colonoscopy for colorectal cancer screening is not covered by  
54 Chinese routine medical check-up.<sup>[16]</sup> In addition, it may also be because  
55 cancer is a taboo topic in Chinese culture and traditional beliefs, and Chinese  
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4 people are reluctant to think or speak about it. The notion of detecting a hidden  
5 or asymptomatic disease by screening does not exist in traditional Chinese  
6 beliefs.<sup>[12]</sup> This result emphasises the need to increase awareness of the  
7 importance of colorectal cancer screening for this preventable disease. It is  
8 also necessary to design culturally tailored education to reduce adverse beliefs  
9 or attitudes towards cancer.  
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15 'Lack of recommendation from physician' was found to be a key reason for  
16 not participating in screening. This suggests that clinicians need to pay more  
17 attention to educating patients about screening and to improving  
18 patient-physician communication. Physicians should also play an active role in  
19 delivering early screening information to high-risk populations. Other barriers  
20 observed included 'too painful, unpleasant or embarrassing' and 'I am not at  
21 risk for colorectal cancer'. As reported, the majority of the barriers are related  
22 to a lack of understanding and awareness of colorectal cancer screening.  
23 Some were health system and health professional related. Therefore, it is  
24 imperative to conduct awareness campaigns to attract public attention, correct  
25 these misconceptions and overcome psychological barriers. Better  
26 communication with participants regarding the screening procedure could  
27 potentially remove the perception of embarrassment and fear. Health care  
28 professionals should encourage high-risk individuals to participate in screening  
29 and inform them about cancer risk.  
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#### 44 *Implications*

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46 Korea, a country with high incidence rates of colorectal cancer, has  
47 implemented a nationwide screening programme and set up institutions  
48 responsible for providing comprehensive cancer information to promote public  
49 awareness and screening uptake.<sup>[9]</sup> In China, the government has begun to  
50 pay attention to awareness and screening about cancer. Health China Action:  
51 Cancer Prevention and Control Implementation Plan and Healthy China 2030  
52 Strategy set a series of goals of attaining more than a 70% awareness rate of  
53 cancer prevention knowledge, making public aware of their cancer risk and  
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4 promoting cancer screening for high-risk groups.<sup>[46,47]</sup> However, data to  
5 evaluate the effectiveness of such initiatives are lacking, therefore, this study  
6 could be used as a basis to measure the effectiveness of further health  
7 promoting campaigns.  
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11 Our results have indicated that Chinese high-risk people have deficient  
12 awareness, some misconceptions and barriers regarding colorectal cancer  
13 screening. Moreover, they are still not aware of their cancer risk and the need  
14 for undergoing screening. Our findings suggest that strategies to improve  
15 awareness and screening uptake in high-risk populations should include three  
16 components. First, the government should learn from initiatives in different  
17 countries. Appropriate and effective educational campaigns should be  
18 conducted, using web-based education tools to broadcast scientific colorectal  
19 cancer prevention information.<sup>[48,49]</sup> Moreover, the government should  
20 establish an organised colorectal cancer screening programme and  
21 incorporate screening into healthcare system in the future.<sup>[23]</sup> Second, health  
22 care professionals should be trained to play an active role in improving  
23 high-risk people's awareness, perceptions and behaviour about colorectal  
24 cancer screening. Less-known risk factors, screening tests and major barriers  
25 discovered in this study need to be emphasised during education interventions.  
26 Further, health promotion campaigns should focus on those who do not see  
27 their physician regularly, those without colorectal disease, those with a low  
28 perceived risk, and those with poor knowledge.  
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#### 46 *Strengths and limitations*

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48 To our knowledge, this is the first study in mainland China aiming to assess  
49 awareness, attitude and behaviour about colorectal cancer screening and to  
50 explore the reasons underlying low screening rate among high-risk populations.  
51 The study achieved a high response rate through face-to-face interviews by  
52 trained interviewers, which strengthened the validity of the study results. Our  
53 study had some limitations. First, as the participants' screening history was  
54 self-reported, recall bias may have occurred. However, respondents were  
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4 given a brief description of screening tests before asking if they had ever  
5 undergone screening. Second, we may not have covered all of the barriers  
6 regarding screening uptake as only a quantitative method was used. Further  
7 study is warranted to use qualitative or mixed-method to comprehensively  
8 explore the related factors. Moreover, we assume that respondents who visit  
9 hospitals tend to have better health awareness. Third, validity of the instrument,  
10 which is an important factor in evaluating the quality of the instrument, was not  
11 explored well.  
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## 21 **Conclusion**

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23 This study indicates that the majority of high-risk people had deficient  
24 knowledge and had never undergone colorectal cancer screening. But most of  
25 them held a positive attitude towards the benefits of screening. Being  
26 asymptomatic and never having thought of the disease or screening were the  
27 main reasons for not undergoing screening. Our study gives insight into the  
28 development of strategies to improve screening of colorectal cancer in China.  
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51 interests.  
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22 designed the study. Ruo-lin Huang, Qi Liu, Ying-xin Wang, Jin-yu Zou, Li-feng  
23 Hu, Wen Wang, Ying-hui Huang, Yi-zhuo Wang and Bo Zeng carried out the  
24 data collection. Ying-xin Wang and Wen Wang analysed the data. Ying Zeng,  
25 Ruo-lin Huang and Qi Liu drafted the manuscript. Ying Zeng and Xi Zeng  
26 reviewed and edited the manuscript.  
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35 **Data availability statement** Data are available by contacting Ying Zeng by  
36 E-mail: zengying2003@126.com  
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41 **Ethics approval** This study was approved by the Ethic Committee of the  
42 University of South China (No. 4304081009636) and informed consent was  
43 obtained from all participants prior to participation.  
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# Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

## Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Reporting Item	Page Number
<b>Title and abstract</b>			
Title	<a href="#">#1a</a>	Indicate the study's design with a commonly used term in the title or the abstract	4
Abstract	<a href="#">#1b</a>	Provide in the abstract an informative and balanced summary of what was done and what was found	4
<b>Introduction</b>			
Background / rationale	<a href="#">#2</a>	Explain the scientific background and rationale for the investigation being reported	6

1	Objectives	<a href="#">#3</a>	State specific objectives, including any prespecified hypotheses	7
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5	<b>Methods</b>			
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9	Study design	<a href="#">#4</a>	Present key elements of study design early in the paper	7
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12	Setting	<a href="#">#5</a>	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7,8
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18	Eligibility criteria	<a href="#">#6a</a>	Give the eligibility criteria, and the sources and methods of selection of participants.	8
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23		<a href="#">#7</a>	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
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29	Data sources / measurement	<a href="#">#8</a>	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	8,9
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38	Bias	<a href="#">#9</a>	Describe any efforts to address potential sources of bias	
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41	Study size	<a href="#">#10</a>	Explain how the study size was arrived at	7,8
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44	Quantitative variables	<a href="#">#11</a>	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	
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50	Statistical methods	<a href="#">#12a</a>	Describe all statistical methods, including those used to control for confounding	9
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55	Statistical methods	<a href="#">#12b</a>	Describe any methods used to examine subgroups and interactions	9
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1	Statistical	<a href="#">#12c</a>	Explain how missing data were addressed	
2	methods			
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5	Statistical	<a href="#">#12d</a>	If applicable, describe analytical methods taking account of	
6	methods		sampling strategy	
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10	Statistical	<a href="#">#12e</a>	Describe any sensitivity analyses	
11	methods			
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15	<b>Results</b>			
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18	Participants	<a href="#">#13a</a>	Report numbers of individuals at each stage of study—eg	10
19			numbers potentially eligible, examined for eligibility,	
20			confirmed eligible, included in the study, completing follow-	
21			up, and analysed. Give information separately for for	
22			exposed and unexposed groups if applicable.	
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27	Participants	<a href="#">#13b</a>	Give reasons for non-participation at each stage	
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30	Participants	<a href="#">#13c</a>	Consider use of a flow diagram	
31				
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33	Descriptive data	<a href="#">#14a</a>	Give characteristics of study participants (eg demographic,	10,11
34			clinical, social) and information on exposures and potential	
35			confounders. Give information separately for exposed and	
36			unexposed groups if applicable.	
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41	Descriptive data	<a href="#">#14b</a>	Indicate number of participants with missing data for each	
42			variable of interest	
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46	Outcome data	<a href="#">#15</a>	Report numbers of outcome events or summary measures.	
47			Give information separately for exposed and unexposed	
48			groups if applicable.	
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52	Main results	<a href="#">#16a</a>	Give unadjusted estimates and, if applicable, confounder-	12,13,14,15,
53			adjusted estimates and their precision (eg, 95% confidence	16,17,18
54			interval). Make clear which confounders were adjusted for	
55			and why they were included	
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1	Main results	<a href="#">#16b</a>	Report category boundaries when continuous variables were categorized	12,13,14,15, 16,17,18
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6	Main results	<a href="#">#16c</a>	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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11	Other analyses	<a href="#">#17</a>	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	
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16	<b>Discussion</b>			
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19	Key results	<a href="#">#18</a>	Summarise key results with reference to study objectives	19
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22	Limitations	<a href="#">#19</a>	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	24
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28	Interpretation	<a href="#">#20</a>	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	19,20
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34	Generalisability	<a href="#">#21</a>	Discuss the generalisability (external validity) of the study results	21,22,23
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39	<b>Other</b>			
40	<b>Information</b>			
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44	Funding	<a href="#">#22</a>	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	25
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