BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-057929
Article Type:	Original research
Date Submitted by the Author:	06-Oct-2021
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Keywords:	Public health < INFECTIOUS DISEASES, Infection control < INFECTIOUS DISEASES, Gastrointestinal tumours < ONCOLOGY

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Awareness and attitudes towards Helicobacter pylori screening and health-related behaviors among the general public in China: a cross-sectional study

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Word count 4604

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Abstract

Objective: To evaluate the general population's awareness, attitudes towards Helicobacter pylori screening and health-related behaviors.

Setting: Hengyang, Hunan province of China

Participants: With the method of stratified cluster random sampling method, a pre-tested structured questionnaire was used to interview the general population aged ≥ 18 years old.

Design: A cross-sectional study

Primary and secondary outcome measures: Knowledge, attitude of HP screening and health-related behaviors, socio-demographic factors associated with HP knowledge and screening behavior.

Results: This study involved 1042 participants. The average score of knowledge was 11 (Q_L=4, Q_U=20, range 0-29). About 68.9% of the participants said they had heard of HP, but there were still 703 (67.5%) who had never taken HP test. The most common reasons for not accepting screening include "no symptoms (55.7%)" and "lacking of knowledge about benefits of the test (21.1%)". Independent factors related to knowledge included gender, age, education level, occupation, HP infection, stress status, dining out, use of serving spoons and chopsticks and smoking($p < 0.05$). Factors independently associated with screening behavior included occupation, average monthly income, indigestion, stomach discomfort or pain, stomach disease and knowledge scores($p < 0.05$). Besides,941 (90.3%) participants never used anti-HP toothpaste and 442 (40.5%) never used serving spoons and chopsticks at all. This study found that the risk factors of HP infection included eating out and group eating ($p < 0.05$).

Conclusion: In China, general population have poor knowledge about HP, but most people have a positive attitude towards HP screening. Being asymptomatic and lacking of knowledge about test are the main reasons for their reported reluctance to be screened. These results highlight the urgent need for educational activities to raise awareness and screening rates of HP and encourage people to have a healthy lifestyle.

Keywords: Helicobacter pylori screening, general population, awareness, health-related behaviors, gastric cancer

Strengths and limitations of this study

- In this study, a quantitative method was used to evaluate the general population's knowledge level of HP, and to explore the screening attitude, behavior, and health behaviors related to HP infection.
- The results may be used as a reference for other countries with high HP infection rate and no screening program.
- Since the participants' information were self-reported, there may be recall bias.
- Only quantitative studies were used, other factors related to screening behavior were not explored, such as culture and health beliefs.

Introduction

Helicobacter pylori (H.pylori, HP) is a major risk factor for chronic gastritis, gastric

cancer and peptic ulcer[1]. The main mechanism of transmission is family transmission[2], and HP infection has become a global public health problem[1]. The total global infection rate of HP is 44.3%, which is 50.8% in developing countries and 34.7% in developed countries[3]. About 4.4 billion people were infected with HP worldwide in 2015, among whom about 700 million were in China. The total HP infection rate in China was 55.8%, higher than the mean prevalence of the world[1].

Gastric cancer is the fifth most common malignant tumor and the third most common cause of cancer death worldwide, with a relatively poor prognosis and a serious threat to human health[4]. Particularly, most of the gastric cancer found in China are in advanced stage[5]. The Kyoto global consensus[6] points out that HP infection is closely related to gastric cancer, and eradication of HP at any stage of gastritis is beneficial to reduce the incidence of gastric cancer[7]. A meta-analysis showed that eradication of H.pylori was particularly beneficial for asymptomatic patients and patients following endoscopic resection for early cancer, reducing the risk of gastric cancer by 34% after eradication[8]. Therefore, improving the screening rate of HP and early diagnosis and treatment are essential for the prevention of gastric cancer.

However, there are no national policy or protocols for HP in gastric cancer screening in China[9], although eradication of H.pylori to prevent gastric cancer has a cost-benefit ratio advantage[10]. HP infection is asymptomatic in most people[11]. Moreover, China has a large population and relatively poor medical and health resources, so opportunistic screening of asymptomatic people is the main practice in China[12,13]. Opportunistic screening is done on a voluntary basis, depending on the individual or physician's request[14]. And the screening rate of HP in China, 21.7%, is far away from satisfactory level[15]. However, the general population's lack of awareness of disease risk factors or symptoms and negative screening attitude will lead to delays in diagnosis[9].

Some studies[15-21] showed that people’s awareness of HP was poor. When participants were asked if they had heard of HP, only 22% to 35% of the respondents answered “Yes”[17,21]. Another study[22] showed that only 37% of residents thought they had enough knowledge about HP, and only a small number would consider being tested

for HP when they do not have specific upper gastrointestinal symptoms. Xia et al[21] study showed that only 2% of participants who were diagnosed with HP said they had been tested for HP. Besides, it is reported that 69.8% of the participants had at least one living habit associated with HP infection[15]. Moreover, the level of awareness is not only an important factor affecting the screening rate of HP, but also an important prerequisite for healthy behavior[15,18,23]. Thus, it is critical to improve the knowledge level of HP and health behavior to improve HP screening rate to promote the primary prevention of gastric cancer.

In China, there is little information about the general population's knowledge and screening intention of HP. Hence, this study aimed to evaluate the general population's awareness of HP and their attitudes towards HP screening, and investigate the health-related behaviors and factors related to HP knowledge and screening behavior.

Methods

Setting and sample

This was a cross-sectional study conducted between June and October 2020. The minimum sample size was calculated to be 760 using the formula $N= [\mu_a^2 \times \pi \times (1-\pi)]/\delta 2$[24], in which the prevalence rate of 21.7% (π) was based on the screening rate of HP in the general population, the significance level was 0.05 (α) and the allowable error was 0.03 (δ). Considering the 40% non-response rate and response rate of the questionnaires, the final sample size was determined to be 1016.

Using stratified cluster random sampling method, 12 community health service centers were randomly selected from 22 community health service centers in Hengyang city. According to the proportion, every center involved in 85 participants visiting the community health service center. We sought 12 interviewers with medical background and experience of scene investigation, and they were trained in HP related knowledge and interview skills in detail. Each trained interviewer is accompanied by a medical staff (doctor or nurse) with the support of a community health service center to introduce the purpose. Inclusion criteria were (a) ≥18 years of age, (b) able to

communicate effectively, and (c) voluntary participation. The exclusion criteria was diagnosed with gastric cancer.

Study instrument

The questionnaire included items on awareness, attitudes and health-related behaviors about HP. The survey items were identified through a literature review and expert consultation, including international and domestic consensus[6,10]. The questionnaire comprised four parts: (1) Socio-demographic characteristics, including gender, residence, marital status, education level, occupation, income, family history of gastric cancer, and HP infection, etc. (2) The second part included 23 questions about knowledge of the harm of HP, methods and benefits of the treatment, transmission routes, detection methods, prevention methods and identification of HP treatment. There were 23 items in total, of which 21 items were single choice, and 2 multiple choice questions. The scoring was 1 point for each correct answer and 0 point for the wrong answer or 'don't know' with a total score of 29 points. The respondents' knowledge level was then categorized into the total scores: 21-29 points, high knowledge; 9-20 points, moderate knowledge; and 0–8 points, low knowledge[25]. (3) The third section was about perceptions on the HP detection including 9 questions: (i) 'Do you think HP infection can be prevented?' Options included "yes", "no", and "don't know". (ii) 'Do you think HP infection can be cured?' (yes, no, or don't know). (iii) 'Have you ever been tested for HP ?' (yes or no). (iv) 'Do you think the HP test can accurately detect the presence of HP infection?' (yes, no, or don't know). (v) 'Which HP test do you prefer?' Options include '13C-urea breath test', 'stool tests', 'blood tests', 'endoscopic biopsies', 'none acceptable', 'don't know'. (vi) 'Did the doctor discuss with you about testing for HP?' Options include 'yes', 'no' or 'I don't remember'. (vii) 'Would you like to undertake test of HP?'(yes or no). (viii) 'Why don't you want to undertake test of HP?' Options include lacking of knowledge about the benefits of the test, confirming the disease would induce psychological burden, no symptoms, lacking of time, economic reason, and others. (ix) 'If your test result for HP

is positive, are you willing to receive treatment?'(yes or no). (4) Health-related behaviors: participants were asked to choose the option that best matched to their daily habits including salty diet, pickles, vegetables, fruits and sweets intake, the use of anti-HP toothpaste, brushing teeth, drinking well water and river water, eating regularly, eating out, group meals and use of serving spoons and chopsticks, household tableware disinfection, hand washing, smoking, and drinking alcohol.

The reliability of the questionnaire was assessed by pre-testing in 100 adults. The internal consistency of the questionnaires was accomplished by estimating the Cronbach's alpha based on the recommendation of >0.70. The Cronbach's alpha calculated was 0.84. The validity of the questionnaire was evaluated by structural validity, using the method of exploratory factor analysis. The KMO value calculated was 0.886, and the cumulative variance contribution rate was 70%. Finally, based on the feedback from the pre-test, the questionnaire was revised and re-evaluated to suit the study population.

Data analysis

The data was analyzed by using SPSS V.23. Socio-demographic characteristics and answers of each question were described in terms of frequency and percentage. Associations between socio-demographic characteristics and H.pylori knowledge and screening behavior as well as associations between participants' health-related behaviors and H.pylori infection were analyzed using the chi-square test or Fisher's exact test. The variables of $P \leq 0.15$ in univariate analysis were entered into multivariate logistic regression analysis to investigate the independent factors affecting knowledge, behavior and H.pylori infection. Only the results of the multivariate analysis were presented using odds ratios (OR) and 95% confidence intervals (CI), and $p<0.05$ was regarded as statistically significant.

Patient and public involvement

No patients were involved in the design or development of the study questions and outcome measures. They were also not involved in the recruitment and implementation of the study. The results will be sent to participants interested in this subject via text

message.

Ethics approval

This study was approved by the [details removed for peer review] and participants' informed consent were obtained before participation.

Results

Socio-demographic characteristics of the 1042 general population

From June to October 2020, a total of 1100 individuals consented to involve in the study. After removing the questionnaires with incomplete answers, 1042 valid questionnaires were obtained. Thus, the final response rate was 95%.The mean age of the participants was 35.40±13.3 years (range=18-78 years). Of the total sample, more than half (62.6%) were women, 47% had high school education or below, 61.4% lived in rural areas and 48% had low income. Among the participants, 67(6.4%) had a family history of gastric cancer, 501(48.1%) had symptoms of dyspepsia, stomach discomfort or pain, 124(11.9%) had HP infection, and 255(24.5%) had a definite diagnosis of gastric disease. Other variables are listed in (Table 1).

Table 1 Participant characteristics (n=1042)

Characteristics	N (%)
Gender	
Male	390 (37.4)
Female	652 (62.6)
Ages (years)	
18-36	584 (56.0)
36-60	412 (39.5)
≥60	46 (4.5)
Education level	
Primary school and below	86 (8.3)
Secondary school or technical secondary school	403 (38.7)
University or junior college	486 (46.6)
Graduate student or above	67 (6.4)
Occupation	
State functionary	60 (5.8)

Company staff	185 (17.8)
Teacher	73 (7.0)
Medical staff	103 (9.9)
Worker	79 (7.6)
Farmer	117 (11.2)
Self-employed	75 (7.2)
Student	194 (18.6)
Other	156 (15.0)
Marital status	
Single	378 (36.3)
Married	678 (61.2)
Divorced	13 (1.2)
Widowed	13 (1.2)
Residence	
Urban	640 (61.4)
Rural	402 (38.6)
Income (¥)	
< 3000	500 (48.0)
3000-5000	302 (29.0)
5000-10000	187 (17.9)
≥10000	53 (5.1)
Family history of gastric cancer	
Yes	67 (6.4)
No	975 (93.6)
Health status	
Unhealthy	374 (35.9)
Suboptimal	605 (58.1)
Healthy	63 (6.0)
Indigestion, stomach discomfort or pain	
Yes	501 (48.1)
No	541 (51.9)
Helicobacter pylori infection	
Yes	124 (11.9)
No	215 (20.6)
Undetected	703 (67.5)
Related diseases of stomach	
Yes	255 (24.5)
No	600 (57.6)
Don't know	187 (17.9)
Stress	
No stress	161 (15.5)
Low	237 (22.7)
Moderate	545 (52.3)

High	99 (9.5)

Knowledge about helicobacter pylori in the general population

Table 2 presents the participants' knowledge of HP including general knowledge, awareness of HP detection and prevention, and timing of screening and treatment. The average score of knowledge was 11 (Q_L=4, Q_U=20, range 0-29). Of the 1042 respondents, 450 (43.2%), 348 (33.4%) and 244 (23.4%) had low, moderate and high knowledge of HP, respectively. About 718 (68.9%) had heard of HP, however, there were still 703 (67.5%) who had never tested HP. Less than 40% of them thought that H.pylori infection can cause gastritis and other malignancies, treatment of HP infection could prevent gastric cancer. Only 283 (27.2%) knew the treatment of HP. Less than half of the participants knew that H.pylori could be transmitted by fecal-oral or oral transmission. Participants were less aware of the three HP detection methods: blood test (17.2%), stool test (29.5%), and gastroscopy biopsy (33.9%). The most recognized indications for screening and treatment was H.pylori infection (55.9%), followed by chronic gastritis (47.0%-47.4%), and peptic ulcer (47.0%). Less well-recognized indications was long-term use of proton pump inhibitors (24.3%), planned long-term use of non-steroidal anti-inflammatory drugs (22.6%), unknown causes of iron deficiency anemia (19.8%), idiopathic thrombocytopenic purpura (17.6%).

Table 3 shows the results of multivariate analysis of factors related to HP knowledge. Univariate analysis showed that sex, age, educational level, occupation, residence, average monthly income, HP infection, stress status, eating out, use of serving spoons and chopsticks, smoking and other factors were significantly associated with HP knowledge ($p<0.05$). These factors plus variables with p value <0.15 in the univariate analysis were entered into the multivariate logistic regression model. The independent variables related to knowledge included gender, age, education level, occupation, HP infection, stress status, dining out, use of serving spoons and chopsticks and smoking ($p < 0.05$, table 3).

Participants who were found to be less knowledgeable about HP include male sex (OR 0.63;95%CI 0.45 to 0.89), with lower educational level (Primary school and below:

OR 0.004; 95%CI 0.001 to 0.03), having no pressure or low pressure (OR 0.26; 95%CI 0.10 to 0.67), never eating out (OR 0.16; 95%CI 0.06 to 0.47), never using serving spoons and chopsticks (OR 0.53; 95%CI 0.31 to 0.94). Participants more knowledgeable about HP include the man aged 36 to 60 (OR 3.16; 95%CI 1.16 to 8.56), Medical professionals (OR 17.68; 95%CI 2.15 to 145.48), never smoking (OR 3.80; 95%CI 1.83 to 7.89). Participants with (OR 4.37; 95%CI 2.44 to 7.82) or without (OR 1.95; 95%CI 1.30 to 2.93) HP infection had better knowledge about HP than those who had never been tested for HP.

Table 2 Participants' knowledge about helicobacter pylori (n=1042)

Category	N	%
General knowledge		
Have you ever heard of Helicobacter pylori?	718	68.9
Helicobacter pylori infection can cause Helicobacter pylori-related gastritis	400	38.4
Helicobacter pylori infection can cause other malignant tumors	346	33.2
Treatment of Helicobacter pylori infection can prevent gastric cancer	388	37.2
Untreated Helicobacter pylori infection may lead to gastric cancer	473	45.4
Helicobacter pylori infection-related gastritis can cause abdominal pain, abdominal distension, acid reflux, belching and other symptoms	419	40.2
Helicobacter pylori infection can be transmitted through fecal-oral transmission	481	46.2
Helicobacter pylori infection can be transmitted through oral-to-oral	506	48.6
The main treatments for Helicobacter pylori infection are: two antibiotics (such as amoxicillin + clarithromycin) + proton pump inhibitors (such as omeprazole or pantoprazole) + bismuth (such as bismuth potassium citrate).	283	27.2
Awareness of Helicobacter pylori detection and prevention		
Which of the following methods can detect Helicobacter pylori infection? (multiple selections possible)		
13C-urea breath test	529	50.8
Stool tests	307	29.5
Blood tests	179	17.2

Endoscopic biopsies	353	33.9
Don't know	368	35.3
Which of the following measures can prevent Helicobacter pylori infection?		
Wash hands before and after meals	678	65.1
Use chopsticks and separate meals when eating	673	64.6
High temperature disinfection of tableware	669	64.2
Avoid eating dirty water and food	644	61.8
Don't know	296	28.4
Timing of screening and treatment:		
Peptic ulcers	490	47.0
Primary malignant lymphoma of stomach	395	37.9
Chronic gastritis with dyspepsia	490	47.0
Chronic gastritis with atrophy and erosion of gastric mucosa	494	47.4
Early gastric tumors have been resected under endoscope or subtotal gastrectomy.	319	30.6
Long-term use of proton pump inhibitors (omeprazole, pantoprazole, etc.)	253	24.3
Family history of gastric cancer	428	41.1
Plan to take long-term non-steroidal anti-inflammatory drugs (aspirin, celecoxib, indomethacin, etc.)	236	22.6
Iron deficiency anemia of unknown cause	206	19.8
Idiopathic thrombocytopenic purpura	183	17.6
Other Helicobacter pylori related diseases	441	42.3
Helicobacter pylori infection was confirmed by test.	582	55.9
Knowledge level (29 points)		
Low (0-8)	450	43.2
Moderate (9-20)	348	33.4
High (21-29)	244	23.4

Table 3 Logistic multiple regression of factors associated with Helicobacter pylori related knowledge (n=1042)

Variable	β	SE	OR	95%CI	P
Gender					
Male	-0.463	0.177	0.630	**0.445 to 0.891**	**0.009***
Female				1 (ref)	
Ages(years)					
18-36	0.576	0.539	1.780	0.619 to 5.114	0.284
36-60	1.149	0.509	3.156	**1.164 to 8.558**	**0.024***
≥60				1 (ref)	
Education level					

Primary school and below	-5.613	1.008	0.004	**0.001 to 0.026**	**<0.001***
Secondary school or technical secondary school	-3.22	0.604	0.040	**0.012 to 0.131**	**<0.001***
University or junior college	-1.775	0.539	0.170	**0.059 to 0.488**	**0.001***
Graduate student or above				1 (ref)	
Occupation					
State functionary	0.455	0.390	1.576	0.734 to 3.382	0.243
Company staff	0.312	0.276	1.366	0.795 to 2.349	0.259
Teacher	0.562	0.377	1.754	0.838 to 3.669	0.136
Medical staff	2.872	1.075	17.68	**2.149 to 145.48**	**0.008***
Worker	-0.422	0.362	0.656	0.323 to 1.333	0.244
Farmer	0.529	0.324	1.698	0.900 to 3.201	0.102
Self-employed	0.392	0.342	1.480	0.758 to 2.892	0.251
Student	0.831	0.347	2.296	**1.164 to 4.529**	**0.017***
Other				1 (ref)	
Helicobacter pylori infection					
Yes	1.474	0.297	4.369	**2.440 to 7.821**	**<0.001***
No	0.669	0.207	1.953	**1.303 to 2.927**	**0.001***
Undetected				1 (ref)	
Stress					
No stress	-1.363	0.488	0.256	**0.098 to 0.666**	**0.005***
Low	-0.879	0.410	0.415	**0.186 to 0.928**	**0.032***
Moderate	-0.689	0.371	0.502	0.243 to 1.039	0.063
High				1 (ref)	
Eating out					
Never	-1.829	0.546	0.161	**0.055 to 0.468**	**0.001***
Occasionally	-0.892	0.225	0.410	**0.264 to 0.637**	**<0.001***
Usual				1 (ref)	
Use serving spoons and chopsticks					
Never	-0.627	0.286	0.534	**0.305 to 0.935**	**0.028***
Occasionally	0.166	0.268	1.181	0.698 to 1.998	0.535
Usual				1 (ref)	
Smoking					
Never	1.335	0.372	3.801	**1.832 to 7.888**	**<0.001***
Ever	1.027	0.469	2.792	**1.114 to 7.001**	**0.029***
At present				1 (ref)	

Bold figures indicate the statistically significant findings (p<0.05).
CI, confidence interval; SE, standard error; ref, reference.

Attitudes towards helicobacter pylori screening

Table 4 shows the participants' attitudes towards HP screening. A majority of participants held a positive attitude towards HP screening. More than 60% of them thought that HP infection could be prevented or cured and HP test could accurately detect the presence of HP infection. The most commonly acceptable (56.9%) test was 13C-urea breath test, while a small number of people (16%) knew nothing about HP test. When participants were asked if their doctor have discussed H.pylori test with them, almost 70% gave a negative answer. However, 72.3% participants indicated that they would like to undertake test of HP. And 96.3% of participants said they were willing to receive treatment if they were tested positive for H.pylori. Only 289 (27.7%) participants were reluctant to undertake test of HP because there were no symptoms (55.7%) and lack of knowledge about benefits of the test (21.1%).

Table 5 shows the results of a multivariate analysis of factors associated with HP detection behavior. Univariate analysis showed that age, occupation, marital status, residence, average monthly income, family history of gastric cancer, health status, indigestion, stomach discomfort or pain, stomach disease and knowledge scores were related to HP detection behavior. These factors plus variables with p value <0.15 in the univariate analysis were entered into the multivariate logistic regression model. The independent variables related to HP detection behavior included occupation, average monthly income, indigestion, stomach discomfort or pain, stomach disease and knowledge scores.

Participants who were found less likely to undertake test for HP include workers, students and farmers (OR 0.925,95%CI 0.867 to 0.988), with low monthly income (OR 0.712,95%CI 0.607 to 0.835) and low knowledge scores (OR 0.602,95%CI 0.507 to 0.716), while those with symptoms of stomach discomfort (OR 1.744,95%CI 1.279 to 2.379) and stomach-related diseases (OR 3.326,95%CI 2.578 to 4.292) were more likely to undertake HP test .

Table 4 Helicobacter pylori screening attitudes among participants (n=1042)

Question	Number	%
Do you think HP infection can be prevented?		
Yes	782	75.0
No	40	3.8
Don't know	220	21.1
Do you think HP infection can be cured?		
Yes	770	73.9
No	49	4.7
Don't know	223	21.4
Have you ever been tested for HP?		
Yes	284	27.3
No	758	72.7
Do you think the HP test can accurately detect the presence of HP infection?		
Yes	698	67.0
No	62	6.0
Don't know	282	27.1
Which HP test do you prefer?		
13C-urea breath test	593	56.9
Stool tests	93	8.90
Blood tests	133	12.8
Endoscopic biopsies	35	3.4
none acceptable	21	2.0
don't know	167	16.0
Did the doctor discuss with you about testing for HP?		
Yes	215	20.6
No	725	69.6
I don't remember	102	9.8
Would you like to undertake test of HP?		
Yes	753	72.3
No	289	27.7
Why don't you want to undertake test of HP (n=289)*		
Lacking of knowledge about benefits of the test	61	21.1
Confirming the disease would induce psychological burden	22	7.6
No symptoms	161	55.7
Lacking of time	22	7.6
Economic reason	14	4.8
Other	9	3.1

If your test result for HP is positive, are you willing to receive treatment?		
Yes	1003	96.3
No	39	3.7

*Participants who don't want to undertake test of HP.
HP, helicobacter pylori

Table 5 Bivariate analysis of factors associated with Helicobacter pylori detection behavior (n=1042)

Variable	Screened N (%)	Unscreened N (%)	OR	95%CI	P
Occupation					
State functionary	21 (35.0)	39 (65.0)			
Company staff	51 (27.6)	134 (72.4)			
Teacher	21 (28.8)	52 (71.2)			
Medical staff	29 (28.2)	74 (71.8)			
Worker	14 (17.7)	65 (82.3)	0.925	0.867 to 0.988	0.020
Farmer	26 (22.2)	91 (77.8)			
Self-employed	30 (40.0)	45 (60.0)			
Student	39 (20.1)	155 (79.9)			
Other	53 (34.0)	103 (66.0)			
Income (¥)					
＜3000	114 (22.8)	386 (77.2）			
3000-5000	82 (27.2)	220 (72.8)	0.712	0.607 to 0.835	＜0.001*
5000-10000	66 (35.3)	121 (64.7)			
≥10000	22 (41.5)	31 (68.5)			
Indigestion, stomach discomfort or pain					
Yes	181 (36.1)	320 (63.9)	1.744	1.279 to 2.379	＜0.001*
No	103 (19.0)	438 (81.0)			
Relatesd diseases of stomach					
Yes	145 (56.9)	110 (43.1)			
No	115 (19.2)	485 (80.8)	3.326	2.578 to 4.292	＜0.001*
Don't know	24 (12.8)	163 (87.2)			
Knowledge level					
High	84 (34.4）	160 (65.6)			
Moderate	126 (36.2)	222 (63.8)	0.602	0.507 to 0.716	＜0.001*
Low	74 (16.4)	376 (83.6)			

*Statistically significant at P<0.05.
CI, confidence interval; OR, odds ratio.

Health related behaviors of general population

More than half of the participants' (553,53.1%) fruit intake was less than 200g/day, the ideal intake recommended by the Dietary guidelines for Chinese residents. About 941 (90.3%) participants never used anti-HP toothpaste and 253 (24.3%) participants brushed their teeth once a day. A total of 203 (19.5%) of the participants often eat out and 418 (40.1%) of the participants often eat in groups. About 442 (40.5%) have never used serving spoons and chopsticks. Among the 1042 participants, 460 (44.1%) of the participants have never sterilized their home tableware (Table 6).

Table 7 shows the results of multivariate analysis of factors related to HP infection. The risk factors of HP infection in this study were eating out (OR 0.512, 95% CI 0.322-0.816) and group eating (OR 0.564, 95% CI 0.384-0.827).

Table 6 Health related behaviors of general population (n=1042)

Health related behaviors	N(%)
Salty diet	
Light	502 (48.2)
More salty	513 (49.2)
Very salty	27 (2.6)
Consumption of pickled foods	
Never	97 (9.3)
Occasionally	848 (81.4)
Usual	97 (9.3)
Consumption of vegetables(daily)	
＞500g	108 (10.4）
300-500g	554 (53.2)
＜300g	380 (36.5)
Consumption of fruits(daily)	
＞350g	95 (9.1)
200-350g	394 (37.8)
＜200g	553 (53.1)
Dessert intake (daily)	
Never	298 (28.6)
Occasionally	686 (65.8)
Usual	58 (5.6)
Use of anti-HP toothpaste	
Never	941 (90.3)

Occasionally	97 (9.3)
Usual	4 (0.4)
Times of brushing teeth	
＞3 times/day	3 (0.3)
3 times/day	50 (4.8)
2 times/day	735 (70.5)
1 time/day	253 (24.3)
Drinking unboiled water	
Never	772 (74.1)
Occasionally	219 (21.0)
Usual	51 (4.9)
Regular diet	
Regular	549 (52.7)
Suboptimal	407 (39.1）
Irregular	86 (8.3)
Eating out	
Never	55 (5.3)
Occasionally	784 (75.2)
Usual	203 (19.5)
Group dining	
Never	74 (7.1)
Occasionally	550 (52.8)
Usual	418 (40.1)
Use of serving spoons and chopsticks	
Never	422 (40.5)
Occasionally	478 (45.9)
Usual	142 (13.6)
Tableware disinfection	
1 time/day	198 (19.0)
3-5 times/week	114 (10.9)
1-2 times/week	270 (25.9)
Never	460 (44.1)
Habit of washing hands before meals and after going to the toilet	
Every time	736 (70.6)
Usual	225 (21.6)
Sometiomes	81 (7.8)
Smoking	
Never	821 (78.8)
Ever	81 (7.8)
At present	140 (13.4)
Drinking	
Never	674 (64.7)
Ever	276 (26.5)
At present	92 (8.8)

Table 7 Bivariate analysis of factors associated with Helicobacter pylori infection (n=1042)

Variable	Helicobacter pylori infection		95%CI	P
	Yes N (%)	No N (%)		
Eating out				
Never	2 (12.5)	14 (87.5)		
Occasionally	84 (34.1)	162 (65.9)	0.322 to 0.816	0.005*
Usual	38 (49.4)	39 (50.6)		
Group dining				
Never	7 (24.1)	22 (75.9)		
Occasionally	55 (30.7)	124 (69.3)	0.384 to 0.827	0.003*
Usual	62 (47.3)	69 (52.7)		

*Statistically significant at P<0.05.
CI, confidence interval; OR, odds ratio.

Discussion

Understanding the general population's awareness and attitude towards HP screening can help to develop appropriate HP prevention and screening strategies. Overall, the study found that most of the participants had insufficient awareness of HP, and only a small number of them had HP test. However, most of the participants had a positive attitude towards HP screening and its benefits. The main reasons for unwillingness to undertake HP test include no symptoms and lack of knowledge about benefits of the test.

Helicobacter pylori knowledge

The results of this study showed that the knowledge level of HP in the general population was poor, which was similar to the previous studies[15,16,18,19,21]. Wu et al[15] showed that 35% of the participants correctly answered the harmfulness of the HP infection. Shin et al[19] reported that 37.2% of the participants believed that HP would not cause symptoms of dyspepsia and most people did not know the treatment of HP. Another study[16] reported that only 27% of participants correctly answered that HP was associated with peptic ulcer. And stress was considered to be the biggest risk factor for

gastric cancer rather than HP[18]. In general, the participants had a good awareness of the mode of transmission and prevention of HP, but they had a poor understanding of the harm, therapeutic benefits, treatment, testing, and the timing of screening and treatment of HP infection. This result indicates that health education should focus on these aspects. The results of this study also showed that 68.9% of participants reported hearing of H.pylori, which is higher than previous studies[17,21]. The reason may lies in that the effect of eradicating HP has been explored in some areas with high incidence of gastric cancer in China and the publicity of information related to gastric cancer and HP has increased. With the exposure to the media and use of mobile phones, the general population may have some understanding of HP[15,26].

The general population's awareness of HP was related to their socio-demographic characteristics. Our study found that men, the elderly, under-educated participants and those who had never undertaken HP test had lower awareness. In addition, participants who used to eat out and use serving spoons and chopsticks, and medical staff and students, showed better awareness. In daily life, women are more likely to assume the role of family caregivers than men, participate in nursing services, pay attention to health knowledge, and gain more knowledge about HP in this process[27,28]. The reason for the higher awareness level of medical staff, students and people with higher education level may be that they have more access to all kinds of health education knowledge[29], and medical staff have more professional knowledge. In fact, HP infection rate is closely related to socio-economic status[30], so health education intervention should pay more attention to socially disadvantaged individuals. Besides, after the HP test or treatment, people with or without HP inflection would gain more understanding of HP compared with those who have never undertake HP test[15,31]. The results of this study show that people who often eat out and use serving spoons and chopsticks have a higher level of knowledge, but the proportion of these people is less than 20%. The possible reason for this result is that the media has a certain exposure to HP and promoting the use of serving spoons and chopsticks, but it has not widely aroused people's attention to the prevention of HP infection[15,32,33]. Therefore, educational education also needs to increase the radiation of media publicity, so that

the general population can acquire more relevant health knowledge in their daily life.

Helicobacter pylori screening attitude

In this study, most of the participants had a positive attitude towards HP detection, but only 27.3% of the participants had undertaken HP test, which was consistent with the results of previous studies[15,19]. WU et al[15] reported that 87% of participants supported HP screening, but the screening rate was only 21.7%. Shin et al[19] reported that most participants were willing to accept the HP "detection and treatment" strategy to prevent gastric cancer, but only 36.6% of them said they had undertaken HP test. In an early study in China[21], 81% of the participants thought they would not be infected with HP, but the actual infection rate of HP was 41%. This attitude may be affected by the fact that HP's turning to the gastric cancer involves a multi-step process from chronic gastritis to atrophic gastritis, intestinal metaplasia, atypical hyperplasia and gastric cancer, which may take decades[34]. During this process, HP infection is asymptomatic or take many years to appear symptoms[15].

In this study, the primary reason for participants' reluctance to undertook HP test was no symptoms, which was not mentioned in previous study about HP testing. This was similar to the results of gastroscopic screening for gastric cancer in South Korea[18]. This may be related to engraved Chinese cultural beliefs that it is unnecessary to seek medical care when no obvious symptoms are observed[32,35]. The results showed that most of the participants said that doctors had not discussed HP test with them. The reason may due to the poor health resources and heavy workload of doctors who had an average 5-hour workload of 34.3 patients[12,36]. When seeing a doctor, the doctor prescribe a test or treatment because he may not have time to carefully discuss with patients about the potential benefits or dangers of eradicating HP. And the general population has a poor knowledge of HP, so even if the participants have a positive attitude towards screening, HP test is still in a state of passive acceptance, that is, opportunistic screening, rather than active requirements. Therefore, it should be advocated to reduce the workload of doctors and train new doctors, give full play to the role of medical workers in health education, influence people's views on diseases, and

advocate regular screening.

The results of multivariate analysis showed that occupation, monthly income, stomach discomfort symptoms, stomach-related diseases and knowledge scores will affect HP detection behaviors. People with low monthly income were less likely undertook HP test than those with high monthly income. Interestingly, HP infection is closely related to social economy[30], while lack of money and high cost are common barriers to preventive screening[32]. It also may be the reason why the detection rate of students, workers and farmers is lower than that of other occupations in this study. And farmers and workers may have insufficient access to social resources about HP screening information[37]. In contrast to no symptoms, people will seek medical care when they have symptoms of stomach discomfort or stomach-related diseases[38]. Participants with low knowledge scores were less likely to undertake test of HP because of a lack of awareness of the risk of the disease, and Wu's study pointed out that the level of awareness of HP affected the rate of HP screening[15]. To improve HP screening rate, the HP knowledge level of the general population should be improved and targeted intervention should be carried out. Furthermore, health education should pay more attention to those who are under-served and socially disadvantaged.

Helicobacter pylori infection and health-related behaviors

Some known risk factors and transmission routes of HP infection are associated with health-related behaviors[2]. More than half of the participants in this study had a daily fruit intake of less than 200g. A study from Latvia[39] reported that HP infection was associated with lifestyle, especially dietary factors. Participants' vegetables or fruits daily intake of more than 400g was negatively correlated with HP infection. Wang et al [40] also reported that eating fruits and vegetables can reduce the risk of stomach cancer caused by HP. This suggests that medical professional should encourage people to adjust their diet and eat more fruits and vegetables. The results of this study also showed that 24.3% of the participants only brushed their teeth once a day, and 90.3% of the participants had never used anti-HP toothpaste. A study from Brazil has shown that the oral cavity is likely to be the parasitic environment of HP[41]. An intervention study from

China[42] showed that the oral HP negative transformation rate was 31.03% (27/87) when special toothpaste was used to brush teeth twice a day in the morning and evening. Therefore, medical workers should emphasize the importance of eradicating HP from oral microenvironment and maintaining oral hygiene in public.

The multivariate results of this study showed the risk factors of HP infection are dining out and group meals, which was similar to the results of previous studies[42,43]. Studies by Rosa Monno et.al showed that eating food from street vendors and eating out were associated with HP infection and may be related to poor hygiene[43]. Xu et al[42] reported that poor hygiene habits such as not using serving spoons and chopsticks and eating together increase the risk of HP infection. In China, the habit of not using serving spoons and chopsticks and eating together may play a very important role in HP infection and reinfection. In fact, a retrospective study[44] in Hong Kong reported that the prevalence of HP in children declined between 2005 and 2017, which may be due to the habit of using serving spoons and chopsticks and a decline in adult infection rates, leading to a decrease in HP transmission among family members. Thus, medical workers should further strengthen the publicity and education of health knowledge, and advocate the individual serving and serving spoons and chopsticks.

Taking one step forward

In Japan, gastric cancer screening was incorporated into the national plan long time ago. In 2000, health insurance supported HP eradication in patients with peptic ulcer. In 2013, HP eradication treatment in patients with HP positive chronic gastritis diagnosed by endoscopy was included in the national health insurance[45,46]. The organic combination of primary prevention of HP screening and eradication therapy with secondary prevention of gastric cancer screening became a mature policy for gastric cancer prevention and control in recent years, and the implementation of these medical insurance policies has also achieved good results[47,48]. In China, the government has paid attention to public awareness of cancer, implemented the Three-year Action Plan for Cancer Prevention and Control in China (2015-2017), and explored HP eradication treatment in some areas with high incidence of gastric cancer, which is highly cost-

effective[26]. However, there is a lack of evidence to assess the effectiveness of these measures. Therefore, this study can be used as a basis for measuring the effectiveness of further health interventions.

This study shows that there is a lack of awareness of HP among the general population, and there are some misunderstandings and obstacles in HP screening and prevention.Therefore, some suggestions are offered to improve the general population's awareness of HP. Firstly, in the prevention and control of gastric cancer, the government can consider combining primary prevention with secondary prevention and adding it into health insurance[47]. Secondly, media should be properly leveraged to publicize the information related to popular science HP[32]. Thirdly, community hospitals should strengthen health education for community people, give full play to the role of community medical workers, and improve people's awareness of HP. In health education, the little-known risk factors and screening obstacles found in this study should be emphasized. In addition, health education activities should pay more attention to those with low income and poor knowledge. Fourthly, medical workers should strengthen the education of HP prevention knowledge and encourage people to develop good health-related habits, such as adjusting eating habits, using serving spoons and chopsticks.

Strengths and limitations

This study investigated the awareness and screening attitude of HP, and health-related behaviors among the general population. In the course of the survey, a high response rate was achieved through face-to-face interviews. Moreover, there are some limitations. First, as the participants' information was self-reported, there may be recall bias. Secondly, the answers to some questions may be subjective. For example, the demarcation of "light", "salty" and "very salty" was not clear, but it could be evaluated by daily salt intake. Thirdly, regarding the screening of behavioral barriers, only quantitative research method is adopted, so the research findings require further confirmation and support. Hence, further study could be carried out using qualitative or

mixed methods.

Conclusions

This study shows that general population's knowledge about Helicobacter pylori is poor, and only a small number of people have undertaken HP test. However, a majority of people have a positive attitude towards HP screening. The main reasons for reluctance to take a test are that being asymptomatic and lack of knowledge about benefits of the test. Relevant health education and intervention measures should be carried out to improve the awareness and screening rate of Helicobacter pylori and to advocate a healthy lifestyle in the general population in China.

Conflict of interest

The authors declare that they have no competing interests.

Acknowledgement

The authors thank all the participants in this study. We are grateful to Professor Shui-dong Feng on statistical consultation. We also gratefully acknowledge Professor De-liang Cao and Professor Qian Tao (The Chinese University of Hong Kong) for their advice with manuscript writing.

Contributions

Conceptualization, Ying Zeng, Xi Zeng, Ying-xin Wang and Jin-yu Zou; Data curation, Ying Zeng, Xi Zeng, Ying-xin Wang, Jin-yu Zou, Li-feng Hu; Investigation, Ying-xin Wang, Jin-yu Zou, Li-feng Hu, Qi Liu, Ruo-lin Huang, Tian Tang, Qian-qian Yue, Ying-xue Sun, Qiao Xiao; Methodology, Ying Zeng, Xi Zeng; Software, Qi Liu; Writing original draft, Ying Zeng, Ying-xin Wang, Jin-yu Zou; Writing review & editing, Ying Zeng, Xi Zeng.

Funding

This study was funded by the National Natural Science Foundation of China (NSFC), Grant/Award number: 81641112; Hunan Provincial Natural Science Foundation of China, Grant/Award number: 2019JJ50521, 2019JJ40254; Key Project of Hunan Provincial Education Department, Grant/Award number: 18A229; Hunan Excellent

Young Teachers Fund, Grant/Award number: 2018191RQG010; Excellent Youth Project of Hunan Provincial Department of Education, Grant/Award number: 19B495; University of South China Innovation Foundation for Postgraduate, Grant/Award: 2021101; The University of South China Innovation & Entrepreneurship Foundation for Undergraduate, Grant/Award: 20212544 . This work was also supported by the construction program of the key discipline in Hunan Province, Center for Gastric Cancer Research of Hunan Province and Key Laboratory of Tumour Cellular & Molecular Pathology (Hengyang Medical School, University of South China): N/A.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	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	6-7
Bias	9	Describe any efforts to address potential sources of bias	6-7
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-10
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	10-19

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	24
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19-23
Generalisability	21	Discuss the generalisability (external validity) of the study results	23-24
Other information			
Funding	22	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	25-26

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

What is the general Chinese public's awareness of and attitudes towards Helicobacter pylori screening and associated health behaviours? A cross-sectional study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-057929.R1
Article Type:	Original research
Date Submitted by the Author:	29-Dec-2021
Complete List of Authors:	Wang, Ying-xin ; University of South China, Hengyang Medical School, School of Nursing Zou, Jin-yu; University of South China, Hengyang Medical School, School of Nursing Hu, Li-feng; University of South China, Hengyang Medical School, School of Nursing Liu, Qi; University of South China, Hengyang Medical School, School of Nursing; The Hong Kong Polytechnic University, School of Nursing Huang, Ruo-lin ; University of South China, Hengyang Medical School, School of Nursing Tang, Tian; University of South China, Hengyang Medical School, School of Nursing Yue, Qian-qian; University of South China, Hengyang Medical School, School of Nursing Sun, Ying-xue; University of South China, Hengyang Medical School, School of Nursing Xiao, Qiao; University of South China, Hengyang Medical School, School of Nursing Zeng, Xi ; University of South China, Hengyang Medical School, Hunan Province Key Laboratory of Tumor Cellular & Molecular Pathology, Cancer Research Institute; University of South China, Hengyang Medical School, Hunan Province Cooperative innovation Center for Molecular Target New Drug Study Zeng, Ying ; University of South China, Hengyang Medical School, School of Nursing; University of South China, Hengyang Medical School, Hunan Province Key Laboratory of Tumor Cellular & Molecular Pathology, Cancer Research Institute
Primary Subject Heading:	Public health
Secondary Subject Heading:	Public health, Infectious diseases
Keywords:	Public health < INFECTIOUS DISEASES, Infection control < INFECTIOUS DISEASES, Gastrointestinal tumours < ONCOLOGY

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What is the general Chinese public's awareness of and attitudes towards *Helicobacter pylori* screening and associated health behaviours? A cross-sectional study

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Word count: 4315

Abstract

Objective: To evaluate the general population's awareness of and attitudes toward *Helicobacter pylori* (HP) screening and health behaviours.

Design: Cross-sectional study

Setting: Hengyang, Hunan Province, China

Participants: Using stratified cluster random sampling, a pre-tested structured questionnaire was used to interview members of the general population aged ≥18 years.

Primary and secondary outcome measures: Knowledge of and attitudes toward HP screening and associated health behaviours, sociodemographic factors associated with HP knowledge, and screening behaviours.

Results: This study featured 1,042 participants. The average knowledge score was 11 (Q_L=4, Q_U=20, range 0–29). Approximately 68.9% of the participants said they had heard of HP, but 67.5% had never had a HP test. The most common reasons for not undergoing screening were 'no symptoms' (55.7%) and 'lack of knowledge regarding the benefits of the test' (21.1%). Independent factors related to knowledge included age, education level, occupation, HP infection, frequency of drinking unboiled water ($p<0.05$). Factors independently associated with screening behaviour included occupation, average monthly income, presence/absence of indigestion, stomach discomfort or pain, and/or stomach disease and knowledge score ($p<0.05$). Overall, 941 (90.3%) participants never used anti-HP toothpaste, and 442 (40.5%) never used serving spoons or chopsticks. The risk factors for HP infection included eating out and eating in groups ($p<0.05$).

Conclusion: In China, the general population has poor knowledge of HP, but most people have a positive attitude towards HP screening. Being asymptomatic and lacking knowledge about testing were the main reasons for reluctance to be screened. These results highlight the urgent need for educational activities to raise awareness, enhance screening rates for HP, and encourage people to adopt a healthy lifestyle.

Keywords: *Helicobacter pylori* screening, general population, awareness, health behaviours, gastric cancer

Strengths and limitations of this study

- The results may be used as a reference for other countries with high HP infection rates and no screening programmes.
- As the participants' information was self-reported, recall bias may have been present.
- Only quantitative measurements were conducted.
- Other factors related to screening behaviour, such as culture and health beliefs, were not explored.

INTRODUCTION

Helicobacter pylori (HP) infection is a major risk factor for chronic gastritis, gastric cancer (GC) and peptic ulcer,[1] and HP infection has become a global public health problem.[2] The main mechanism of HP transmission is direct person-to-person.[3] Globally, the average HP infection rate is 44.3%; 50.8% in developing countries and 34.7% in developed countries.[4] In 2015, approximately 4.4 billion people worldwide had HP infections, among whom approximately 700 million were in China; the total HP infection rate in China was 55.8%, higher than the mean global prevalence.[2]

GC is the sixth-most-common malignant tumour and the fourth-most-common cause of cancer-related deaths worldwide, and has a relatively poor prognosis.[5] Most patients with GC in China are diagnosed at an advanced stage.[6] The Kyoto Global consensus[7] reported that HP infection is closely related to GC, and that eradication of HP is beneficial for reducing GC incidence.[8] Further, a meta-analysis showed that eradication of HP can reduce GC incidence in healthy individuals and patients with gastric neoplasia, and can also reduce GC mortality.[9] Therefore, improving HP-screening rates and providing early diagnosis and treatment are essential for GC prevention.

However, although eradication of HP to prevent GC has a cost - benefit advantage,[10] China lacks national policies or protocols for HP in GC screening.[11] HP infection is usually asymptomatic,[12] and China has a large population and relatively poor medical and health resources; therefore, opportunistic screening of asymptomatic people is currently the main approach.[13,14] Such opportunistic screening is performed on a voluntary basis, based on an individual or physician's request.[14] The screening rate for HP in China (21.7%) is far from satisfactory,[15] and the general population's lack of awareness of HP risk factors or symptoms and negative attitude towards screening contribute to delays in diagnosis.[11]

Studies[15-20] have shown that the general population has poor awareness of HP. surveys of Chinese people have reported that only 22–35% have ever heard of HP. [16,20]. Further, only 37% of medical residents in the US feel they have sufficient knowledge

regarding HP, and just 22% would consider being tested for HP if they had no specific upper gastrointestinal symptoms. [21] In a survey of migrant workers in China, in which participants were tested for HP, only 2% of those who returned positive HP results reported being previously tested for HP. [20] Meanwhile, a survey of Chinese physicians and the general public found that 69.8% of the participants had at least one lifestyle habit associated with a risk of HP infection.[15] Level of awareness not only affects the HP-screening rate, but also engagement in associated health behaviours.[15,17,22] Thus, to promote the primary prevention of GC, it is critical to improve knowledge levels regarding HP and associated health behaviours, thereby improving the HP-screening rate.

There is little information regarding the general Chinese population's knowledge and screening intentions concerning HP. Hence, this study aimed to evaluate the general population's awareness of HP, their attitudes toward HP screening, and investigate health behaviours and factors related to HP knowledge and screening behaviours.

METHODS

Setting and sample

This was a cross-sectional study was conducted between June and October 2020. The minimum sample size was calculated to be 726. This was determined using the formula $N=[\mu_a^2\times\pi\times(1-\pi)]/\delta^2$,[23] in which the prevalence rate of 21.7% (π) was based on the HP-screening rate for the general population, the significance level was 0.05 (α), and the allowable error was 0.03 (δ). Considering a non-response rate of 40%, the final sample size was determined to be 1,016.

Using stratified cluster random sampling, 12 community health-service centres were randomly selected from the 22 such centres in Hengyang city, China. Eighty-five patients from each centre were approached for participation. We recruited 12 interviewers with a medical background and experience of investigation, and trained them in HP-related knowledge and interview skills. With the consent of the community health-service centres, each trained interviewer was accompanied by medical staff (a

doctor or nurse) and approached patients for participation. The inclusion criteria were: ≥18 years of age, able to communicate effectively, and willing to voluntarily participate. The exclusion criterion was having a GC diagnosis.

Study instrument

The questionnaire included items on awareness, attitudes, and health behaviours related to HP. The survey items were identified through a literature review and expert consultation.[7,24] The questionnaire comprised four parts: (1) Socio-demographic characteristics, including gender, residence, marital status, education level, occupation, income, family history of GC, and HP-infection status, etc. (2) 23 questions concerning knowledge of the harmfulness of HP, methods and benefits of HP treatment, HP transmission routes, and the methods of detecting and preventing HP methods. Twenty-one items were single-choice questions; two were multiple-choice questions. One point was awarded for each correct answer, and zero points were awarded for incorrect or 'do not know' answers. The maximum total score was 29 points. The respondents' knowledge level was categorised as follows: 0–10=low knowledge, 11–19=moderate knowledge, 20–29=high knowledge.[25] (3) perceptions of HP detection, featuring nine questions: (i) 'Do you think HP infection can be prevented?' (possible responses: 'yes', 'no', 'do not know'); (ii) 'Do you think HP infections can be cured?' ('yes', 'no', 'do not know'); (iii) 'Have you ever been tested for HP? ('yes', 'no'); (iv) 'Do you think the HP test can accurately detect HP infection?' ('yes', 'no', 'do not know'); (v) 'Which HP test do you prefer?' ('13C-urea breath test', 'stool test', 'blood test', 'endoscopic biopsy', 'none', 'do not know'); (vi) 'Has your doctor discussed HP testing with you?' ('yes', 'no', 'do not remember); (vii) 'Would you like to undertake a HP test? ('yes', 'no'); (viii) 'Why do you not want to undertake a HP test?' ('lack of knowledge regarding the benefits of the test', 'a positive test would cause psychological burden', 'I have no symptoms', 'lack of time', 'economic reasons', 'other'); and (ix) 'If you tested positive for HP, would you be willing to receive treatment?' ('yes', 'no'). (4) Health behaviours: including whether the participants had a salty diet; ate pickles, vegetables, fruits, or sweets; used anti-HP toothpaste, brushed their teeth, drank unboiled water (well or river water); ate frequently; ate out; had group meals; used serving spoons and chopsticks; disinfected household tableware; regularly washed their

hands; smoked; and drank alcohol.

The questionnaire's reliability was assessed by pre-testing it on 100 adults. The internal consistency was determined by estimating the Cronbach's alpha, which was found to be 0.84. The validity of the questionnaire was evaluated using structural and content validity. The calculated Kaiser-Meyer-Olkin value was 0.886, and the cumulative variance contribution rate was 70%. The item-content-validity-index was 0.81–1; the scale-content-validity-index was 0.914. Based on feedback from the pre-test, the questionnaire was revised and re-evaluated.

Data analysis

Data were analysed using SPSS version 23. Sociodemographic characteristics and item responses were described in terms of frequencies and percentages. Associations among sociodemographic characteristics and HP knowledge and screening behaviour, and between participants' health behaviours and HP infection, were analysed using chi-square tests or Fisher's exact test. Variables with $P \leq 0.15$ in univariate analysis were entered into multivariate logistic regression analysis to investigate the independent factors affecting knowledge, behaviour, and HP infection. The multivariate-analysis results were presented using odds ratios (ORs) and 95% confidence intervals (CIs), and statistical significance was set at $p<0.05$.

Patient and public involvement

None of the participants were involved in the design or development of the study questions or outcome measures, or in the recruitment or implementation of the study. The results will be sent to interested participants via text message.

Ethics approval

This study was approved by the Ethics Committee of the University of South China (number 4304082008946) and informed consent was obtained from participants before participation.

RESULTS

Participants' sociodemographic characteristics

From June to October 2020, 1,100 individuals consented to participate in this study. After removing incomplete answers, 1,042 valid questionnaires remained. The final response rate was 95%. The participants' mean age was 35.40±13.3 years (range=18-78 years). Over half (62.6%) were women, 47% had high-school education or below, 61.4% lived in rural areas and 48% had low income[26,27]. Sixty-seven (6.4%) had a family history of GC, 501 (48.1%) had symptoms of dyspepsia, stomach discomfort, or pain; 124 (11.9%) had HP infection, and 255 (24.5%) had a definite diagnosis of gastric disease. The remaining variables are listed in (Table 1).

Table 1 Participant characteristics (n=1042)

Characteristics	N (%)
Sex	
Male	390 (37.4)
Female	652 (62.6)
Ages(years)	
18-36	584 (56.0)
36-60	412 (39.5)
≥60	46 (4.5)
Education level	
Primary school and below	86 (8.3)
Secondary school or technical secondary school	403 (38.7)
University or junior college	486 (46.6)
Graduate student or above	67 (6.4)
Occupation	
State functionary	60 (5.8)
Company staff	185 (17.8)
Teacher	73 (7.0)
Medical staff	103 (9.9)
Worker	79 (7.6)
Farmer	117 (11.2)
Self-employed	75 (7.2)
Student	194 (18.6)
Other	156 (15.0)
Marital status	

Single	378 (36.3)
Married	638 (61.3)
Divorced	13 (1.2)
Widowed	13 (1.2)
Residence	
Urban	640 (61.4)
Rural	402 (38.6)
Income (¥)	
<3000	500 (48.0)
3000-5000	302 (29.0)
5000-10000	187 (17.9)
≥10000	53 (5.1)
Family history of gastric cancer	
Yes	67 (6.4)
No	975 (93.6)
Health status	
Unhealthy	374 (35.9)
Suboptimal	605 (58.1)
Healthy	63 (6.0)
Indigestion, stomach discomfort or pain	
Yes	501 (48.1)
No	541 (51.9)
Helicobacter pylori infection	
Yes	124 (11.9)
No	215 (20.6)
Undetected	703 (67.5)
Related diseases of stomach	
Yes	255 (24.5)
No	600 (57.6)
Do not know	187 (17.9)
Stress	
No stress	161 (15.5)
Low	237 (22.7)
Moderate	545 (52.3)
High	99 (9.5)

Knowledge of *Helicobacter pylori*

Table 2 presents the participants' knowledge of HP, including general knowledge, awareness of HP detection and prevention methods, and indications for screening and treatment. The average knowledge score was 11 (Q_L=4, Q_U=20, range: 0–29). Of the 1042 respondents, 495 (47.5%), 370 (25.9%) and 277 (26.6%) had low, moderate and

high knowledge of HP, respectively. Overall, 718 (68.9%) had heard of HP; however, 703 (67.5%) had never been tested HP. Less than 40% thought that HP infection could cause gastritis and other malignancies, or that treatment of HP prevents GC. Only 283 (27.2%) knew about HP treatment methods. Less than 50% knew that HP could be transmitted via fecal-oral or oral transmission. Participants were also relatively unaware of the three HP-detection methods: blood test (17.2%), stool test (29.5%), and gastroscopic biopsy (33.9%). The most recognised indications for screening and treatment were HP infection (55.9%), followed by chronic gastritis (47.0%-47.4%), and peptic ulcer (47.0%). Less well-recognised indications were long-term use of proton-pump inhibitors (24.3%), planned long-term use of non-steroidal anti-inflammatory drugs (22.6%), unknown causes of iron deficiency anaemia (19.8%), and idiopathic thrombocytopenic purpura (17.6%).

Table 3 shows the results of the multivariate analysis of factors related to HP knowledge. Univariate analysis showed that sex, age, education level, occupation, residence, average monthly income, HP-infection status, stress status, frequency of eating out, use of serving spoons and chopsticks, smoking and other factors were significantly associated with HP knowledge ($p<0.05$). These factors plus variables with $p<0.15$ in the univariate analysis were entered into the multivariate logistic regression model. The independent variables related to knowledge included age, education level, occupation, HP infection, frequency of drinking unboiled water ($p<0.05$, table 3).

Participants who were found to be less knowledgeable about HP include male sex (OR 0.63, 95%CI 0.45 to 0.89), and those who had a lower educational level (primary school and below: OR 0.004, 95%CI 0.001 to 0.03). Participants who were more knowledgeable about HP included medical professionals (OR 17.68, 95%CI 2.15 to 145.48), students (OR 2.849, 95%CI 1.318 to 6.518), and those who drinking unboiled water usually (never /occasionally drinking unboiled water: OR 0.427, 95%CI 0.200 to 0.912; OR 0.279, 95%CI 0.123 to 0.633). Participants with (OR 4.37, 95%CI 2.44 to 7.82) and without (OR 1.95, 95%CI 1.30 to 2.93) HP infections had better knowledge about HP than those who had never been tested for HP.

Table 2 Participants' knowledge about *Helicobacter pylori* (n=1042)

Category	Yes	%
General knowledge		
Have you ever heard of *Helicobacter pylori*?	718	68.9
Helicobacter pylori infection can cause *Helicobacter pylori*-related gastritis	400	38.4
Helicobacter pylori infection can cause other malignant tumors	346	33.2
Treatment of *Helicobacter pylori* infection can prevent gastric cancer	388	37.2
Untreated *Helicobacter pylori* infection may lead to gastric cancer	473	45.4
Helicobacter pylori infection-related gastritis can cause abdominal pain, abdominal distension, acid reflux, belching and other symptoms	419	40.2
Helicobacter pylori infection can be transmitted through fecal-oral transmission	481	46.2
Helicobacter pylori infection can be transmitted through oral-to-oral	506	48.6
The main treatments for *Helicobacter pylori* infection are: two antibiotics (such as amoxicillin + clarithromycin) + proton pump inhibitors (such as omeprazole or pantoprazole) + bismuth (such as bismuth potassium citrate).	283	27.2
Awareness of *Helicobacter pylori* detection and prevention		
Which of the following methods can detect *Helicobacter pylori* infection? (multiple-choice possible)		
13C-urea breath test	529	50.8
Stool tests	307	29.5
Blood tests	179	17.2
Gastroscopic biopsies	353	33.9
Do not know	368	35.3
Which of the following measures can prevent *Helicobacter pylori* infection?		
Wash hands before and after meals	678	65.1
Use chopsticks and separate meals when eating	673	64.6
High temperature disinfection of tableware	669	64.2
Avoid eating/drinking dirty food and water	644	61.8
Do not know	296	28.4
Indications for screening and treatment:		
Peptic ulcers	490	47.0
Primary malignant lymphoma of stomach	395	37.9

Chronic gastritis with dyspepsia	490	47.0
Chronic gastritis with atrophy and erosion of gastric mucosa	494	47.4
Early gastric tumors have been resected under endoscope or subtotal gastrectomy.	319	30.6
Long-term use of proton-pump inhibitors (omeprazole, pantoprazole, etc.)	253	24.3
Family history of gastric cancer	428	41.1
Plan to take long-term non-steroidal anti-inflammatory drugs (aspirin, celecoxib, indomethacin, etc.)	236	22.6
Iron deficiency anaemia of unknown cause	206	19.8
Idiopathic thrombocytopenic purpura	183	17.6
Other Helicobacter pylori related diseases	441	42.3
Helicobacter pylori infection was confirmed by test.	582	55.9
Knowledge level (29 points)		
Low (0-10)	495	47.5
Moderate (11-19)	270	25.9
High (20-29)	277	26.6

Table 3 Logistic multiple regression of factors associated with *Helicobacter pylori* related knowledge (n=1042)

Variable	β	SE	OR	95%CI	P
Sex					
Male	-0.774	0.242	0.461	0.287 to 0.741	**0.001**
Female				1 (ref)	
Education level					
Primary school and below	-5.241	0.931	0.005	0.001 to 0.034	**<0.001**
Secondary school or technical secondary school	-3.022	0.579	0.049	0.016 to 0.152	**<0.001**
University or junior college	-1.715	0.515	0.180	0.066 to 0.494	**0.001**
Graduate student or above				1 (ref)	
Occupation					
State functionary	0.362	0.442	1.436	0.603 to 3.416	0.414
Company staff	0.364	0.317	1.439	0.773 to 2.680	0.252
Teacher	0.684	0.407	1.982	0.893 to 4.398	0.093
Medical staff	3.310	1.092	27.391	3.222 to 232.840	**0.002**
Worker	-0.158	0.401	0.854	0.389 to 1.872	0.693
Farmer	0.570	0.373	1.769	0.852 to 3.670	0.126
Self-employed	0.242	0.385	1.273	0.599 to 2.709	0.530
Student	1.047	0.393	2.849	1.318 to 6.518	**0.008**
Other				1 (ref)	

Helicobacter pylori infection					
Yes	1.474	0.297	4.369	2.440 to 7.821	**<0.001**
No	0.669	0.207	1.953	1.303 to 2.927	**0.001**
Undetected				1 (ref)	
Drinking unboiled water					
Never	-0.851	0.387	0.427	0.200 to 0.912	**0.028**
Occasionally	-1.278	0.419	0.279	0.123 to 0.633	**0.002**
Usual				1 (ref)	

Bold figures indicate the statistically significant findings ($p<0.05$).
CI, confidence interval; SE, standard error; ref, reference.

Attitudes towards *Helicobacter pylori* screening

Table 4 shows the participants' attitudes toward HP screening. Most held a positive attitude towards HP screening. Over 60% believed that HP infection could be prevented or cured, and that testing could accurately detect HP infection. The most commonly accepted test (56.9%) was 13C-urea breath test; 16% knew nothing about HP tests. When participants were asked if their doctor had discussed HP testing with them, almost 70% said no. However, 72.3% indicated that they would like to have a HP test. Furthermore, 96.3% said they were willing to receive treatment if they tested positive for HP. Only 289 (27.7%) were reluctant to undergo HP testing (because they had no symptoms [55.7%] and lacked knowledge regarding the test's benefits [21.1%]).

Table 5 shows the results of the multivariate analysis of the factors associated with HP detection. Univariate analysis showed that age, occupation, marital status, residence, average monthly income, family history of GC, health status, indigestion, stomach discomfort or pain, and stomach disease, and knowledge scores were related to HP detection. These factors plus variables with $p<0.15$ in the univariate analysis were entered into the multivariate logistic regression model. The independent variables related to HP-detection behaviour included occupation, average monthly income, indigestion, stomach discomfort or pain, and stomach disease, and knowledge scores.

Participants who were less likely to undertake HP tests included workers, students, and farmers (OR 0.925, 95%CI 0.867 to 0.988), and those with low monthly income (OR 0.712, 95%CI 0.607 to 0.835) and low knowledge scores (OR 0.602, 95%CI 0.507

to 0.716); those with symptoms of stomach discomfort (OR 1.744, 95%CI 1.279 to 2.379) and stomach-related diseases (OR 3.326, 95%CI 2.578 to 4.292) were more likely to undertake the HP test.

Table 4 *Helicobacter pylori* screening attitudes among participants (n=1042)

Question	Number	%
Do you think HP infections can be prevented?		
Yes	782	75.0
No	40	3.8
Do not know	220	21.1
Do you think HP infections can be cured?		
Yes	770	73.9
No	49	4.7
Do not know	223	21.4
Have you ever been tested for HP?		
Yes	284	27.3
No	758	72.7
Do you think the HP test can accurately detect HP infection?		
Yes	698	67.0
No	62	6.0
Do not know	282	27.1
Which HP test do you prefer?		
13C-urea breath test	593	56.9
Stool tests	93	8.90
Blood tests	133	12.8
Endoscopic biopsy	35	3.4
None acceptable	21	2.0
Do not know	167	16.0
Has your doctor discussed HP testing with you?		
Yes	215	20.6
No	725	69.6
Do not remember	102	9.8
Would you like to undertake a HP test?		
Yes	753	72.3
No	289	27.7
Why do you not want to undertake a HP test (n=289)*		
Lacking of knowledge regarding benefits of the test	61	21.1
Confirming the disease would induce psychological burden	22	7.6
No symptoms	161	55.7
Lacking of time	22	7.6
Economic reason	14	4.8

Other	9	3.1
If your tested positive for HP, would you be willing to receive treatment?		
Yes	1003	96.3
No	39	3.7

*Participants who don't want to undertake test of HP.

HP, helicobacter pylori

Table 5 Bivariate analysis of factors associated with *Helicobacter pylori* detection behavior (n=1042)

Variable	Screened N (%)	Unscreened N (%)	OR	95%CI	P
Occupation					
State functionary	21 (35.0)	39 (65.0)			
Company staff	51 (27.6)	134 (72.4)			
Teacher	21 (28.8)	52 (71.2)			
Medical staff	29 (28.2)	74 (71.8)			
Worker	14 (17.7)	65 (82.3)	0.925	0.867 to 0.988	0.020*
Farmer	26 (22.2)	91 (77.8)			
Self-employed	30 (40.0)	45 (60.0)			
Student	39 (20.1)	155 (79.9)			
Other	53 (34.0)	103 (66.0)			
Income (¥)					
<3000	114 (22.8)	386 (77.2)			
3000-5000	82 (27.2)	200 (72.8)			
5000-10000	66 (35.3)	121 (64.7)	0.715	0.589 to 0.867	0.001*
≥10000	22 (41.5)	31 (68.5)			
Indigestion,stomach discomfort or pain					
Yes	181 (36.1)	320 (61.9)	1.523	1.093 to 2.122	0.013*
No	103 (19.0)	438 (81.8)			
Related diseases of stomach					
Yes	145 (56.9)	110 (43.1)			
No	115 (19.2)	485 (80.8)	3.094	2.384 to 4.015	< 0.001*
Don't know	24 (12.8)	163 (87.2)			
Knowledge level					
High	101 (36.5)	176 (63.5)			
Moderate	96 (35.6)	174 (64.4)	0.582	0.479 to 0.707	< 0.001*
Low	87 (16.4)	408 (82.4)			

*Statistically significant at P<0.05.

CI, confidence interval; OR, odds ratio.

Health behaviours

Over half of the participants (553; 53.1%) reported a fruit intake of <200g/day (recommended intake for Chinese residents[28]). Meanwhile, 941 (90.3%) never used anti-HP toothpaste, and 253 (24.3%) brushed their teeth once a day. Further, 203 (19.5%) participants often eat out and 418 (40.1%) often ate in groups, 442 (40.5%) never used serving spoons or chopsticks, and 460 (44.1%) never sterilised their home tableware (Table 6).

Table 7 shows the results of the multivariate analysis of factors related to HP infection. The risk factors for HP infection were eating out (OR 0.512, 95%CI 0.322-0.816) and group eating (OR 0.564, 95%CI 0.384-0.827).

Table 6 Health related behaviors of general population (n=1042)

Health related behaviors	N (%)
Salty diet	
Light	502 (48.2)
More salty	513 (49.2)
Very salty	27 (2.6)
Consumption of pickled foods	
Never	97 (9.3)
Occasionally	848 (81.4)
Usual	97 (9.3)
Consumption of vegetables (daily)	
>500g	108 (10.4)
300-500g	554 (53.2)
<300g	380 (36.5)
Consumption of fruits (daily)	
>350g	95 (9.1)
200-350g	394 (37.8)
<200g	553 (53.1)
Dessert intake (daily)	
Never	298 (28.6)
Occasionally	686 (65.8)
Usual	58 (5.6)
Using anti-HP toothpaste	
Never	941 (90.3)
Occasionally	97 (9.3)
Usual	4 (0.4)
Times of brushing teeth	

>3 times/day	3 (0.3)
3 times/day	51 (4.9)
2 times/day	735 (70.5)
1 time/day	253 (24.3)
Drinking unboiled water (well or river water)	
Never	772 (74.1)
Occasionally	219 (21.0)
Usual	51 (4.9)
Regular diet	
Regular	549 (52.7)
Suboptimal	407 (39.1)
irregular	86 (8.3)
Eating out	
Never	55 (5.3)
Occasionally	784 (75.2)
Usual	203 (19.5)
Group dining	
Never	74 (7.1)
Occasionally	550 (52.8)
Usual	418 (40.1)
Use of serving spoons and chopsticks	
Never	422 (40.5)
Occasionally	478 (45.9)
Usual	142 (13.6)
Tableware disinfection	
1 time/day	198 (19.0)
3-5 times/week	114 (10.9)
1-2 times/week	270 (25.9)
Never	460 (44.1)
Habit of washing hands before meals and after going to the toilet	
Every time	736 (70.6)
Usual	225 (21.6)
Sometimes	81 (7.8)
Smoking	
Never	821 (78.8)
Ever	81 (7.8)
At present	140 (13.4)
Drinking	
Never	674 (64.7)
Ever	276 (26.5)
At present	92 (8.8)

Table 7 Bivariate analysis of factors associated with Helicobacter pylori infection

(n=1042)

Variable	Helicobacter pylori infection		95%CI	P
	Yes N (%)	No N (%)		
Eating out				
Never	2 (12.5)	14 (87.5)		
Occasionally	84 (34.1)	162 (65.9)	0.322 to 0.816	0.005*
Usual	38 (49.4)	39 (50.6)		
Group dining				
Never	7 (24.1)	22 (75.9)		
Occasionally	55 (30.7)	124 (69.3)	0.384 to 0.827	0.003*
Usual	62 (47.3)	69 (52.7)		

*Statistically significant at P<0.05.
CI, confidence interval; OR, odds ratio.

DISCUSSION

Understanding the general population's awareness and attitude towards HP screening can help to develop appropriate HP prevention and screening strategies. Most of the study participants had low awareness of HP, and few had received a HP test. However, most had a positive attitude towards HP screening. The main reasons for unwillingness to undertake a HP test included absence of symptoms and insufficient knowledge regarding the test's benefits.

Knowledge of *Helicobacter pylori*

This study found that the general population has poor knowledge of HP; this is similar to findings for areas with high infection rates[15,17,18,20,25]. In a survey conducted in the United Arab Emirates, only 24.6% had heard of HP.[25] Wu et al., surveying Chinese physicians and members of the general population, reported that 35% were aware of the harmfulness of HP infection.[15] In surveys conducted in South Korea, 37.2% believed that HP does not cause symptoms of dyspepsia, most did not know about HP treatment methods,[18] and stress, rather than HP, was considered the biggest risk factor for GC.[17] In contrast, in a Singapore-based survey, where HP prevalence is low, 60% believed that gastropathy is associated with HP and 82.9% believed that the stomach is the site of HP infection.[29] In general, the present participants had good awareness of

HP transmission and prevention methods, but a poor understanding of the harmfulness, therapeutic benefits, treatment, testing, and the indications for screening and treatment of HP infection. These results indicate that health education should focus on these aspects. Further, 68.9% of the present participants reported having heard of HP. This is higher than that reported in previous studies[16,20], possibly because, in some areas in China with a high GC incidence, efforts have been made to eradicate HP, and publicity concerning GC and HP has increased public awareness.[15,30] A Ethiopia-based meta-analysis[31] suggested that Ethiopia's decreasing trend in HP infections from 1990 to 2017 was related to relative improvements in public lifestyle and behavioural changes, as well as increased awareness of the transmission, diagnosis, eradication, prevention, and control of HP infection.

Sociodemographic characteristics influence awareness of HP. Our study found that men, undereducated participants and those who had never undertaken a HP test had lower awareness. Women are more likely to assume the role of family caregivers than men, participate in nursing services, pay attention to health knowledge, and, thus, gain more knowledge about HP in this process[32,33]. Meanwhile, medical staff, students, and people with higher education levels may have higher awareness because they have more access to health education,[34] HP infection rate is closely related to socio-economic status,[35] thus, health education interventions should focus on socially disadvantaged individuals. Besides, after the HP test or treatment, people with or without HP inflection would gain more understanding of HP compared with those who have never undertake HP test[15,36]. Studies[15,25] have mentioned that it is necessary to strengthen the general population's knowledge of HP infection. In a qualitative study on the relationship between GC and HP infection, participants voiced a strong desire for more, holistic, health education.[37] Such education can be provided by hanging posters in popular places, through social media, and through medical workers.[15,37]

In the results of univariate analysis in this study, some health behaviours, such as the using of serving spoons and chopsticks, eating out and group dining, were significant with knowledge scores. Only drinking unboiled water was the influencing

factor of knowledge score in the results of multivariate analysis (P<0.05), but it was contrary to what we expected. We speculated that the reason might be that these participants were more confident that they were in good health,[38] and even though they know that drunk unboiled water was a risk factor for HP infection, they are not willing to change it. According to the Information-Motivation-Behavioral Skills model,[39] the change of behavior is affected not only by knowledge but also by motivation. This suggests that health interventions should not only improve people's knowledge of HP through health education, but also promote the formation of motivation for health behavioural change.

Attitudes towards *Helicobacter pylori* screening

Most participants had a positive attitude towards HP detection, but only 27.3% had undertaken a HP test. Similarly, in WU et al.[15] 87% of participants supported HP screening, but only 21.7% had been screened and in Shin et al.[18] most participants were willing to accept a HP 'detection and treatment' strategy for preventing GC, but only 36.6% had undertaken a HP test. In a China-based study,[20] 81% of participants thought that they were not infected with HP, but, after testing, 41% were found to be infected. This relaxed attitude towards testing may be influenced by the manner by which HP causes GC: a multi-step process that may take decades, from chronic gastritis through atrophic gastritis, intestinal metaplasia, and atypical hyperplasia to GC.[40] During this process, HP infection can be asymptomatic, and may take many years for symptoms to appear.[15]

In this study, the primary reason for participants' reluctance to undertake a HP test was a lack of symptoms; this was not mentioned in previous studies. This is, however, similar to results from South Korea concerning gastroscopic screening for GC.[17] This attitude may be related to Chinese cultural beliefs that it is unnecessary to seek medical care when there are no obvious symptoms.[41,42] Most of the present participants said that their doctors had not discussed HP tests with them. This may be due to the poor health resources and heavy workloads of doctors, who have on average five-hour workloads

and 34.3 patients each;[43,44] doctors, due to excess patient workload, may prescribe a test or treatment rather than discuss the benefits of eradicating HP. Furthermore, the general population has poor knowledge of HP; thus, even if an individual has a positive attitude toward screening, the HP test remains in a state of passive acceptance (i.e. opportunistic screening, rather than active requirements).

The results of the multivariate analysis showed that occupation, monthly income, stomach discomfort symptoms status, diseases of the stomach and knowledge scores affect HP-detection behaviours. People with low monthly income were less likely to undertake a HP test than those with high monthly income. Interestingly, HP-infection risk is closely related to social status[35,42]. This may explain why, in this study, the detection rate among students, workers, and farmers was lower than that for other occupations; farmers and workers also have poor access to HP-screening information.[45] In contrast to individuals with no symptoms, people will seek medical care when they have symptoms of stomach discomfort or stomach-related diseases[46]. Participants with low knowledge scores were less likely to undertake HP testing because of inadequate awareness of HP risks; similarly, Wu's at al.[15] found that HP awareness affects the HP-screening rate. To improve the HP-screening rate, the general population' knowledge of HP should be improved, and targeted interventions should be conducted. Furthermore, health education should focus on those who are underserved and socially disadvantaged.

Helicobacter pylori infection and health behaviours

Some known risk factors and transmission routes of HP infection are associated with health behaviours.[47] Over half of the present participants had a daily fruit intake <200g, however, daily intake of >400g of vegetables or fruits is negatively correlated with HP infection.[48] Consuming fruits and vegetables can also reduce the risk of HP-associated stomach cancer.[49] Thus, medical professionals should encourage people to eat more fruits and vegetables. In this study, 24.3% of participants brushed their teeth only once a day, and 90.3% never used anti-HP toothpaste. The oral cavity can be a parasitic

environment for HP[50]. In a China-based intervention study of individuals with oral HP,[51] using special toothpaste twice a day removed all oral HP from 31.03% (27/87) of the participants. Therefore, medical workers should emphasised the importance of eradicating HP from the oral microenvironment and maintaining oral hygiene.

The multivariate analysis results showed that the risk factors for HP infection are eating out and group dining; this is similar to previous findings.[51,52] Studies by Rosa Monno et.al showed that eating food from street vendors and eating out were associated with HP infection and may be related to poor hygiene.[52] Xu et al.[51] reported that poor hygiene habits, such as not using serving spoons and chopsticks and eating in groups increase the risk of HP infection. In China, the habit of not using serving spoons and chopsticks and eating in groups may play a very important role in HP infection and reinfection. A retrospective study[53] conducted in Hong Kong reported that the prevalence of HP among children declined in 2005–2017, which may have been due to increased use of serving spoons and chopsticks and a decline in adult infection rates. Thus, medical workers should strengthen the publicity and provision of health knowledge, and advocate the use of serving spoons and chopsticks for group dining.

Taking one step forward

In Japan, GC screening is incorporated into the national plan. In 2000, Japan's national health insurance began supporting HP eradication in patients with peptic ulcers, and in 2013, HP-eradication treatment in patients with HP-positive chronic gastritis diagnosed by endoscopy was included in the national health insurance.[54,55] In recent years, the combination of primary prevention (through HP screening and eradication therapy) and secondary prevention (GC screening) has become a strong policy for GC prevention and control, and these medical-insurance policies have also achieved good results[56,57]. In China, the government has concerned public awareness of cancer, implemented the Three-year Action Plan for Cancer Prevention and Control in China (2015–2017), and explored HP-eradication treatment in areas with a high incidence of GC, which is a highly cost-effective approach.[30] However, there is little data regarding the

effectiveness of these measures. Therefore, this study's findings can represent a basis for measuring the effectiveness of further health interventions.

This study shows that the general population lacks awareness of HP, and that there are some misunderstandings and obstacles concerning HP screening and prevention. Therefore, we make the following suggestions: Firstly, for the prevention and control of GC, the government should consider combining primary prevention approaches with secondary prevention approaches and adding them to health insurance.[56] Second, a variety of methods such as the media should publicise scientific information regarding HP.[42] Third, community hospitals should strengthen health education for local people and provide community medical workers with full support for improving people's awareness of HP. Such health education should target the little-known risk factors and screening obstacles identified in this study. Additionally, health-education activities should focus on those with low incomes and poor knowledge. Fourthly, medical workers should strengthen the people's HP-prevention knowledge and promote their motivation to develop good health behaviours.

Strengths and limitations

This study investigated the general population's awareness and attitude toward HP, screening, as well as their engagement in associated health behaviours. The survey had a high response rate. However, this study had some limitations. First, as the participants' information was self-reported, recall bias may have been present. Second, some questions may have been subjective: for example, the demarcation of 'light', 'salty' and 'very salty' was not clear, this could have been evaluated by considering daily salt intake. Third, regarding the screening of behavioural barriers, only quantitative research methods were adopted; thus, the research findings require further confirmation and support. Further studies should be conducted using qualitative or mixed methods.

CONCLUSIONS

This study shows that the general population has poor knowledge of HP, and that few

people have undertaken HP test. However, most people have a positive attitude toward HP screening. The main reasons for reluctance to take a test are being asymptomatic and having inadequate knowledge about the benefits of the test. Relevant health education and intervention measures should be implemented to improve, among the general population in China, awareness and screening rates of HP and recognition of the importance of a healthy lifestyle. Concurrently, reductions in doctors' workloads, training new doctors, and giving medical workers full support to provide health education, influence people's views on diseases, and advocate regular screening should be pursued.

Conflict of interest

The authors declare that they have no competing interests.

Acknowledgement

The authors thank all the participants in this study. We are grateful to Professor Shui-dong Feng on statistical consultation. We also gratefully acknowledge Professor De-liang Cao and Professor Qian Tao (The Chinese University of Hong Kong) for their advice with manuscript writing.

Contributions

Conceptualization, Ying Zeng, Xi Zeng, Ying-xin Wang and Jin-yu Zou; Data curation, Ying Zeng, Xi Zeng, Ying-xin Wang, Jin-yu Zou, Li-feng Hu; Investigation, Ying-xin Wang, Jin-yu Zou, Li-feng Hu, Qi Liu, Ruo-lin Huang, Tian Tang, Qian-qian Yue, Ying-xue Sun, Qiao Xiao; Methodology, Ying Zeng, Xi Zeng; Software, Qi Liu; Writing original draft, Ying Zeng, Ying-xin Wang, Jin-yu Zou; Writing review & editing, Ying Zeng, Xi Zeng.

Date availability statement

Date are available upon reasonable request. Date are available by contacting Ying Zeng by E-mail: zengying2003@126.com

Funding

This study was funded by the National Natural Science Foundation of China (NSFC),

Grant/Award number: 81641112; Hunan Provincial Natural Science Foundation of China, Grant/Award number: 2019JJ50521, 2019JJ40254; Hunan Excellent Young Teachers Fund, Grant/Award number: 2018191RQG010; Excellent Youth Project of Hunan Provincial Department of Education, Grant/Award number: 19B495; University of South China Innovation Foundation for Postgraduate, Grant/Award: 213YXC013; The University of South China Innovation & Entrepreneurship Foundation for Undergraduate, Grant/Award: 210XCX193; 210XCX195 . This work was also supported by the construction program of the key discipline in Hunan Province, Center for Gastric Cancer Research of Hunan Province and Key Laboratory of Tumour Cellular & Molecular Pathology (Hengyang Medical School, University of South China).

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	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	6-7
Bias	9	Describe any efforts to address potential sources of bias	6-7
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-10
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	10-19

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11, 14, 17
		(*b*) Report category boundaries when continuous variables were categorized	5, 15
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11, 14, 17
Discussion			
Key results	18	Summarise key results with reference to study objectives	19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	24
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19-23
Generalisability	21	Discuss the generalisability (external validity) of the study results	23-24
Other information			
Funding	22	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	25-26

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.