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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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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 pretested 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 1042 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 an 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.

Strengths and limitations of this study

- The results may be used as a reference for other countries with high *Helicobacter pylori* 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 low-income and middle-income 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 USA 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 1016.

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) sociodemographic 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 an HP test? ('yes', 'no'); (viii) 'Why do you not want to undertake an 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 pretesting 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 pretest, the questionnaire was revised and re-evaluated.

Data analysis

Data were analysed using SPSS V.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 χ^2 tests or Fisher's exact test. Variables with p≤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 ORs and 95% 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.

RESULTS

Participants' sociodemographic characteristics

From June to October 2020, 1100 individuals consented to participate in this study. After removing incomplete answers, 1042 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.

Knowledge of HP

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 faecal–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

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)
≥10 000	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)

Continued

Table 1 Continued

Characteristics	N (%)
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)

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 sex, 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 tumours	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 faecal–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		

Continued

Table 2 Continued

Category	Yes	%
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 tumours 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

Attitudes towards HP 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 an 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.

Health behaviours

Over half of the participants (553; 53.1%) reported a fruit intake of <200 g/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 to 0.816) and group eating (OR 0.564, 95% CI 0.384 to 0.827).

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 an HP test. However, most had a positive attitude towards HP screening. The main reasons for unwillingness to undertake an HP test included absence of symptoms and insufficient knowledge regarding the test's benefits.

Knowledge of HP

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 UAE, 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

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

Variable	β	SE	OR	95% CI	P value
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).
ref, reference.

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 an 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 socioeconomic 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

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 an HP test?		
Yes	753	72.3
No	289	27.7
Why do you not want to undertake an 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 do not want to undertake test of HP.
HP, *Helicobacter pylori*.

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 behaviour 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 HP screening

Most participants had a positive attitude towards HP detection, but only 27.3% had undertaken an 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 an HP 'detection and treatment' strategy for preventing GC, but only 36.6% had undertaken an 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 an 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 5-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 (ie, 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 an HP test than those with high monthly income. Interestingly, HP-infection risk is closely related to social status.[35 42] This may explain

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

Variable	Screened N (%)	Unscreened N (%)	OR	95% CI	P value
Occupation					
State functionary	21 (35.0)	39 (65.0)	0.925	0.867 to 0.988	0.020*
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)			
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)	0.715	0.589 to 0.867	0.001*
3000–5000	82 (27.2)	200 (72.8)			
5000–10000	66 (35.3)	121 (64.7)			
≥10 000	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)	3.094	2.384 to 4.015	<0.001*
No	115 (19.2)	485 (80.8)			
Don't know	24 (12.8)	163 (87.2)			
Knowledge level					
High	101 (36.5)	176 (63.5)	0.582	0.479 to 0.707	<0.001*
Moderate	96 (35.6)	174 (64.4)			
Low	87 (16.4)	408 (82.4)			

*Statistically significant at p<0.05.

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 *et 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.

HP 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 <200 g, however, daily intake of >400 g 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 two times 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 Monno *et al* showed that eating food from street vendors and eating out were associated with HP infection and may be related

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

Health related behaviours	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)	
>500 g	108 (10.4)
300–500 g	554 (53.2)
<300 g	380 (36.5)
Consumption of fruits (daily)	
>350 g	95 (9.1)
200–350 g	394 (37.8)
<200 g	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)

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

Table 7 Bivariate analysis of factors associated with *Helicobacter pylori* infection (n=339)

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

*Statistically significant at p<0.05.

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: First, 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.

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