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Survey on Awareness of *Helicobacter pylori* and Gastric Cancer in the Japanese Population Using an Internet Survey

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ABSTRACT

Background: *Helicobacter pylori* (*H. pylori*) infection is a significant risk factor for gastric cancer. The effective implementation of strategies to mitigate gastric cancer requires widespread dissemination of information regarding *H. pylori*, diagnostic methods, and preventive measures. Despite the high incidence of gastric cancer, efforts to disseminate this information are lacking in Japan. Therefore, our survey aimed to evaluate *H. pylori* and gastric cancer awareness in Japan and identify factors associated with *H. pylori* knowledge, focusing on health literacy.

Materials and Methods: This nationwide cross-sectional survey was conducted online. We developed a questionnaire on *H. pylori* awareness and knowledge across four domains: infection risk, *H. pylori*-related diseases, testing and treatment, and gastric cancer-related problems. In addition, we evaluated health literacy using an established health literacy scale. Multivariable regression analysis was conducted using the *H. pylori* knowledge score as the dependent variable.

Results: Over half of the 3095 respondents were aware of *H. pylori* infection (56.4%). The overall correct response rate for the *H. pylori* knowledge questions was 45.7%, with varying performances across the knowledge domains: infection risk (57.3%), *H. pylori*-related diseases (50.9%), testing and treatment (37.5%), and gastric cancer (44.4%). The regression models identified the following factors as associated with a higher *H. pylori* knowledge: older age, higher health literacy scores, previous *H. pylori* testing, and healthcare professional status. Among participants without prior *H. pylori* testing, higher *H. pylori* knowledge scores were associated with a greater willingness to undergo *H. pylori* screening.

Conclusions: To our knowledge, this is the first nationwide assessment of *H. pylori* infection and gastric cancer awareness in Japan. Health literacy and previous *H. pylori* screening were significantly associated with *H. pylori* knowledge. The development of educational strategies for these factors may be desirable for gastric cancer prevention.

1 | Introduction

Helicobacter pylori (*H. pylori*) infection is a major risk factor for gastric cancer, and approximately 90% of non-cardiac gastric

cancer cases worldwide are associated with *H. pylori* infection [1–3]. Gastric cancer is one of the most common cancers worldwide, with 968,784 new cases and 660,175 deaths recorded in 2022 [4]. Although the prevalence of *H. pylori* infection among

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adults has been declining since 1990 and in recent years, more than 40% of the global population remains infected [5]. Long-term observational studies have demonstrated that *H. pylori* eradication treatment reduces the risk of gastric cancer [6]. Although the incidence of gastric cancer and the prevalence of *H. pylori* infection vary considerably across countries and regions [5], the implementation of *H. pylori* screening strategies is gaining attention not only in Asia, including Japan and South Korea, where the incidence of gastric cancer is relatively high, but also in Europe, where the incidence of gastric cancer is relatively lower [7]. Furthermore, although the incidence of gastric cancer in the European Union is generally low, some countries and regions have reported high incidence and mortality rates, prompting the European Council to recommend enhanced gastric cancer screening [7]. In addition, owing to global aging, the incidence and mortality rate of gastric cancer are expected to rise in Europe and worldwide [8]. Therefore, reducing the risk of gastric cancer is an urgent priority in global health.

As of 2019, Japan had the second highest number of gastric cancer cases worldwide, with projections for 129,900 new gastric cancer cases and 41,800 related mortalities by 2023 [4, 9]. Gastric cancer screening is a key strategy for its early detection in Japan. Studies have suggested that undergoing endoscopy at least once every 3 years can reduce gastric cancer-related mortality by approximately 30% compared with not undergoing screening [10]. Although screening is offered in all 47 prefectures in Japan, the current screening rate for gastric cancer has not reached the government's target of 60%, as stipulated in the Fourth Basic Plan for Promotion of Cancer Control [11]. According to the 2022 Basic Survey on National Life, the screening rates for men and women were 53.7% and 43.5%, respectively, in 2022 [12]. Knowledge dissemination is required to improve participation in screening.

In line with these efforts, strategies to stratify and reduce the risk of gastric cancer in Japan include *H. pylori* infection screening and eradication therapy. As more than 99% of gastric cancer cases in Japan are associated with *H. pylori* infection [13, 14], early detection of *H. pylori* and subsequent eradication treatment are considered effective strategies for reducing the incidence of gastric cancer [15]. Although “the ABC method”, which involves measuring serum *H. pylori* antibodies and pepsinogen levels to stratify gastric cancer risk, is not officially recommended as a national screening strategy because of insufficient evidence, many municipalities have increasingly adopted this method as part of their local screening programs [16]. This approach is considered more efficient and cost-effective than conventional radiography screening for gastric cancer detection [16]. Moreover, prioritizing a minimally invasive *H. pylori* test facilitates appropriate referral for endoscopic examination among high-risk individuals, ultimately contributing to an overall increase in endoscopic screening uptake [17]. By integrating local government-based screening with existing gastric cancer screening programs, early detection of at-risk individuals may be further enhanced, suggesting that a wider dissemination of *H. pylori* screening could contribute to a reduction in gastric cancer incidence. Nonetheless, effective implementation of such *H. pylori* screening initiatives requires the dissemination of information regarding *H. pylori*, its various diagnostic methods [18], and individual gastric cancer risks and preventive measures.

However, in Japan, efforts to promote this critical knowledge remain insufficient.

To develop an effective approach for *H. pylori* screening and gastric cancer prevention, it is essential to understand the public awareness of both *H. pylori* infection and gastric cancer. Previous studies in some countries have indicated that the population had insufficient knowledge about *H. pylori* [19–23]; however, studies focusing on the detailed features of individuals with sufficient or insufficient knowledge of *H. pylori* are limited. Despite the high incidence rate of gastric cancer, no nationwide studies have assessed this awareness of gastric cancer and *H. pylori* in Japan, which may impede the effective implementation of screening and eradication initiatives. Therefore, this survey aimed to conduct a nationwide assessment of the baseline knowledge of *H. pylori* infection and gastric cancer-related issues in Japan. In addition, the study sought to identify factors associated with the level of *H. pylori* knowledge.

This study focuses on health literacy, defined as the ability to access, understand, evaluate, and use health information and services [24]. Previous studies on breast cancer have shown that health literacy is highly correlated with disease knowledge and willingness to undergo screening [25, 26]. We developed a comprehensive questionnaire that addressed *H. pylori*-related concerns in greater detail and in a format tailored to the Japanese context. This questionnaire was designed as an established scale to measure *H. pylori* knowledge level. This survey was expected to identify knowledge gaps and contribute to the development of measures to reduce the risk of gastric cancer in Japan.

2 | Materials and Methods

2.1 | Development of Survey Items

We developed the survey items with reference to an existing questionnaire on public attitudes toward *H. pylori* [19]. We created two questions to assess respondents' awareness of *H. pylori* infection. The first question asked the participants about their familiarity with various bacteria and viruses, including *H. pylori*. The second question asked participants about their impressions (positive or negative) of these microorganisms, including *H. pylori*. In addition, we developed questions to assess *H. pylori* knowledge across four domains: infection risk, *H. pylori*-related diseases, testing and treatment, and gastric cancer. Regarding *H. pylori* infection risk, we included seven questions addressing the following: current infection trends in Japan (decreasing trend was the correct answer), infection site, transmission routes, and risk factors (consumption of untreated water, unsanitary habits, parental infection with *H. pylori*, and social contact with infected individuals [not associated; correct]). For *H. pylori*-related diseases, we developed seven questions to examine the relationship between *H. pylori* infection and the following conditions: chronic gastritis, peptic ulcers, gastric mucosa-associated lymphoid tissue (MALT) lymphoma, gastric cancer, pancreatic cancer (not associated; correct), colorectal cancer (not associated; correct), and diabetes mellitus (not associated; correct). The *H. pylori* testing and treatment domain included 13 questions investigating detection methods (blood test, urine test, stool test, breath test, and gastroscopy; with 0.2 points awarded for each

correctly identified method), risk reduction through eradication therapy for various conditions (peptic ulcer, diabetes mellitus [no reduction, correct], MALT lymphoma, gastric cancer, pancreatic cancer [no reduction, correct], colorectal cancer [no reduction, correct]), side effects of eradication therapy, and possible increased risk of other diseases following treatment. Regarding side effects, respondents were asked about the proportion of patients experiencing adverse effects (such as stomach pain, diarrhea, and allergic reactions) following *H. pylori* eradication, with the correct answer being that few patients experienced such side effects. Meanwhile, regarding possible increased risk of other diseases, participants were asked whether *H. pylori* eradication therapy increases the risk of other diseases, with responses indicating “minimal increase” or “no increase” considered correct. The gastric cancer domain comprised 10 questions addressing risk and protective factors. Regarding risk factors, respondents were asked about their family history of gastric cancer and exposure to chronic stress (with the correct answer being that neither significantly increased risk). Regarding protective factors, the questions were whether the following practices reduced gastric cancer risk: regular consumption of leafy greens (not protective, correct), washing fruits and vegetables before eating (protective), avoiding shared dishware (protective), consuming probiotic foods (not protective, correct), reducing processed food intake (not protective, correct), avoiding burnt foods (protective), quitting tobacco and alcohol (protective), and *H. pylori* eradication (protective). A comprehensive list of all the survey items is provided in Appendix S1.

Sociodemographic information included sex (male/female), age, personal annual income (4 million yen or more, or less), educational history (high school graduate or less, vocational school, junior college, university, or higher), and whether the participant was a medical professional. In addition, regarding factors related to *H. pylori* infection, we asked whether the respondents had a history of *H. pylori* screening, had participated in gastric cancer screening within the past 2 years, and had a family member previously diagnosed with *H. pylori* infection.

We used the Health Literacy Scale (HLS-14) developed by Suka et al. to assess health literacy [27]. The HLS-14 consists of 14 questions, each scored on a 5-point scale, yielding a maximum total score of 70 points. Higher points indicate better health literacy. The scale measures three dimensions of health literacy: functional health literacy (basic literacy), communicative health literacy (the ability to obtain, communicate, and apply information), and critical health literacy (the ability to critically examine information).

The contents of the questionnaire were validated in advance by two gastroenterologists (H.S. and Y.N.), one gastroenterological surgeon (Y.M.), and one public health scientist (M.T.). Among the questions that tested *H. pylori* knowledge, the internal reliability of the ordinal scale questions was confirmed using the Cronbach's α coefficient.

2.2 | Distribution of Surveys

This cross-sectional survey was conducted nationwide in Japan via an online platform managed by Macromill Inc., a market

research company with approximately 36 million registered panel members across Japan. The survey targeted adults aged 20–69 years and was conducted between March 14 and 16, 2024. A quota sampling approach was employed through an online survey company to recruit participants until the target sample size of 3000 was reached. The age and sex distribution of the participants reflected that of the general Japanese population. To ensure geographic representativeness, participants were recruited from all 47 prefectures, according to their respective population sizes. Data collection was performed after the predetermined sampling quotas were met. The research company implemented quality control measures to exclude invalid responses, including those completed in unreasonably short timeframes, thereby enhancing data integrity. Although the exact screening thresholds are proprietary (protected by the company's patent) and not publicly disclosed, 3% of short-duration responses were excluded. The participants received reward points.

2.3 | Scoring

Questions on *H. pylori* knowledge were scored based on the answers. For scoring, 1 point was added for the correct answer, and 0 points were added for the wrong answer or answers of “do not know.” The questions are shown in Appendix S1, and the scoring details are provided in Appendix S2.

2.4 | Data Analysis

For data analysis, sociodemographic variables were categorized as follows: sex (male/female), age (under 40 years/40 years and older), personal annual income (<4 million yen/4 million yen or more), educational background (high school graduate or less/vocational school or junior college/university degree or higher), history of *H. pylori* screening (no prior screening/previous screening), and professional status (medical professional/non-medical professional). The age categorization of 40 years reflects the threshold at which various cancer screenings, including gastric cancer screening, have traditionally been recommended in Japan, although current guidelines now recommend gastric cancer screening from the age of 50 years. Respondents were stratified into quartiles (Q1–Q4) based on their health literacy scores to facilitate the analysis of knowledge patterns across different health literacy levels. To identify the factors associated with *H. pylori* knowledge, we conducted multivariable regression analysis with the *H. pylori* knowledge score as the dependent variable. Based on previous studies, we included age, sex, annual household income, educational background, and occupation as potential explanatory variables. All items, except household income, were mandatory to answer. Respondents who did not answer household income were excluded from regression analysis. In addition, we hypothesized that both *H. pylori* screening history and health literacy may affect knowledge levels but recognized that these variables may be interrelated. Therefore, we constructed three regression models. Model 1 was a comprehensive model including all sociodemographic variables, *H. pylori* screening history, and health literacy score as explanatory variables. Model 2 was a restricted model including all sociodemographic variables and *H. pylori* screening history but

excluding health literacy scores. Model 3 was an alternative model including all sociodemographic variables and health literacy scores, excluding *H. pylori* screening history. To investigate potential effect modifications, we extended Model 1 by incorporating the interaction terms between health literacy scores and each explanatory variable. Furthermore, we conducted stratified analyses by dividing the sample into two subgroups based on *H. pylori* screening history (those with and without previous screening) and applying Model 1 separately to each subgroup to identify potential differences in knowledge determinants.

Regarding participants without prior *H. pylori* screening, we assessed their willingness to undergo screening and the reasons for their perspectives. Thereafter, we performed an additional regression analysis, with willingness to undergo *H. pylori* screening as the dependent variable and the *H. pylori* knowledge score as the primary explanatory variable, while adjusting for sociodemographic factors. All statistical analyses were performed using Stata version 18.0 (StataCorp, College Station, Texas, USA). Statistical significance was defined as $p < 0.05$ for all analyses.

2.5 | Ethical Considerations

Informed consent was obtained from all participants prior to the survey. This study was approved by the Ethical Review Committee of Disaster Comprehensive Health Management Institute (No. SG2023-02) prior to the questionnaire survey.

3 | Results

Our survey included 3095 respondents, whose characteristics are summarized in Table 1. Of these, 13.5% reported a family history of *H. pylori* infection and 27.9% had previously undergone *H. pylori* testing. The overall mean health literacy score was 48.5 points, with component scores of 17.7 for functional health literacy, 17.0 for communicative health literacy, and 13.7 for critical health literacy. Regarding *H. pylori* awareness (Figure 1a), 56.4% of respondents reported “Understand the characteristics well” or being “Somewhat aware,” 32.7% had “heard of it but don’t understand well,” and 10.9% had “Never heard of it/Don’t know.” Most respondents (79.5%) recognized *H. pylori* as “harmful” (Figure 1b).

3.1 | *H. pylori* Knowledge Score

H. pylori knowledge assessment demonstrated excellent internal consistency reliability (Cronbach’s $\alpha = 0.9535$). The overall correct response rate was 45.7% (SD: 19.0), with varying performances across the four knowledge domains: *H. pylori* infection risk (57.3%, standard deviation [SD]: 22.0), related diseases (50.9%, SD: 32.3), testing and treatment (37.5%, SD: 21.6), and gastric cancer (44.4%, SD: 18.5). Figure S1 shows the distribution of the *H. pylori* knowledge scores. The knowledge scores varied considerably, with quartiles of 8 (25th percentile), 18 (median), and 22 (75th percentile) points. As illustrated in Figure 2, *H. pylori* knowledge scores were positively associated with health

literacy levels, with higher health literacy quartiles corresponding to greater *H. pylori* knowledge.

3.2 | Factors Associated With *H. pylori* Knowledge Score

Model 3 identified factors significantly associated with higher *H. pylori* knowledge: older age, higher health literacy scores, previous *H. pylori* testing, and healthcare professional status (Table 2). In model 2, female sex was a significant factor. Table 3 presents the estimated *H. pylori* knowledge scores across the levels of each explanatory variable and shows the potential interaction effects. A significant negative interaction was observed between health literacy and *H. pylori* screening history (Figure S2), suggesting that the effect of health literacy on knowledge was more pronounced among those without a previous screening.

Stratified analyses based on screening history (Table 4) revealed different patterns of knowledge determinants between those with and those without prior *H. pylori* testing. Among respondents without prior *H. pylori* testing, the following factors were significantly associated with higher knowledge scores: older age, female sex, greater health literacy, and healthcare professional status. In contrast, among those with previous *H. pylori* testing, only older age and higher health literacy scores showed significant associations.

3.3 | Factors Associated With Willingness to Undergo *H. pylori* Screening

Among participants without prior *H. pylori* screening, the regression analysis revealed that higher *H. pylori* knowledge scores were significantly associated with greater willingness to undergo screening after adjusting for sociodemographic factors (Table S1). When asked about screening attitudes, 46% of the respondents expressed willingness to undergo *H. pylori* testing, 16.4% were opposed to screening, and 37.7% were neutral to screening. The respondents willing to be tested cited the main motivations as wanting to check for the presence of *H. pylori* (63.6%), openness to screening if routinely offered (46.6%), and a desire to prevent gastric ulcers and cancer (41.0%). The primary barriers among those who were unwilling to undergo testing included a perceived lack of necessity (35.1%), cost concerns (33.2%), and perceived test difficulty (27.9%).

4 | Discussion

This study is the first nationwide assessment of knowledge regarding *H. pylori* infection in the general Japanese population. Although the level of *H. pylori* awareness was high (89.1% had heard of it), comprehensive understanding was limited, with only 56.4% of respondents reporting that they understood its characteristics. Our findings showed that health literacy was associated with *H. pylori* knowledge. In addition, the level of *H. pylori* knowledge was significantly related to willingness to undergo *H. pylori* screening. These results indicate that disseminating detailed knowledge regarding *H. pylori* may lead to

TABLE 1 | Characteristics of respondents.

	Total	Health literacy 1Q ^a	Health literacy 2Q	Health literacy 3Q	Health literacy 4Q
	N = 3095	N = 708	N = 711	N = 870	N = 806
Age					
20–39 years	1059 (34.2)	276 (39.0)	243 (34.2)	288 (33.1)	252 (31.3)
40–69 years	2036 (65.8)	432 (61.0)	468 (65.8)	582 (66.9)	554 (68.7)
Sex					
Male	1550 (50.1)	423 (59.7)	359 (50.5)	411 (47.2)	357 (44.3)
Female	1545 (49.9)	285 (40.3)	352 (49.5)	459 (52.8)	449 (55.7)
Income ^b					
< 4,000,000 yen/year	773 (33.4)	188 (35.7)	187 (35.6)	237 (37.0)	161 (25.8)
≥ 4,000,000 yen/year	1541 (66.6)	338 (64.3)	338 (64.4)	403 (63.0)	462 (74.2)
Education					
High school diploma or lower	1014 (32.8)	299 (42.2)	246 (34.6)	282 (32.4)	187 (23.2)
College degree	772 (24.9)	167 (23.6)	182 (25.6)	218 (25.1)	205 (25.4)
University degree or higher	1309 (42.3)	242 (34.2)	283 (39.8)	370 (42.5)	414 (51.4)
Family history of <i>H. pylori</i> infection					
Absent	2678 (86.5)	631 (89.1)	621 (87.3)	754 (86.7)	672 (83.4)
Present	417 (13.5)	77 (10.9)	90 (12.7)	116 (13.3)	134 (16.6)
<i>H. pylori</i> screening history					
Absent	2230 (72.1)	573 (80.9)	532 (74.8)	613 (70.5)	512 (63.5)
Present	865 (27.9)	135 (19.1)	179 (25.2)	257 (29.5)	294 (36.5)
Gastric cancer screening history in 2 years					
Absent	1978 (63.9)	502 (70.9)	476 (66.9)	552 (63.4)	448 (55.6)
Present	1117 (36.1)	206 (29.1)	235 (33.1)	318 (36.6)	358 (44.4)
Field of work					
Non-medical	2759 (89.1)	617 (87.1)	628 (88.3)	799 (91.8)	715 (88.7)
Medical	336 (10.9)	91 (12.9)	83 (11.7)	71 (8.2)	91 (11.3)

^a1, 2, 3, 4Q means first, second, third, fourth quartile of health literacy.

^b781 respondents who selected no answers or selected “unclear” were excluded.

widespread screening. In addition, to disseminate knowledge regarding *H. pylori*, educational initiatives should be tailored to different health literacy levels and screening histories.

H. pylori screening rate among our respondents (27.9% overall; 36.8% among those aged 40 years or older) was relatively high compared with the rate in previous studies assessing awareness in other countries. Previous studies have reported screening rates of 15.4% in the United States [19] and 21.7% in China [20]. Similarly, our observed gastric cancer screening rate (36.1% overall; 46.8% among those aged 40 or older) was substantial. The higher screening rates in Japan likely reflect its comprehensive national gastric cancer screening program and insurance

coverage for *H. pylori* infection testing when diagnosed alongside related conditions such as chronic gastritis. This infrastructure creates multiple opportunities for *H. pylori* detection and facilitates higher awareness compared with regions without systematic screening programs.

In the present study, 89.1% of the Japanese respondents had heard of *H. pylori*, with 56.4% claiming to understand its characteristics. These awareness levels exceeded those reported in previous studies in other countries: 52.3% in the United States [19], 49.8% in China [20], 52.6% in a multi-country Asian population [22], and 24.6% in the United Arab Emirates [23]. Furthermore, the higher awareness level in

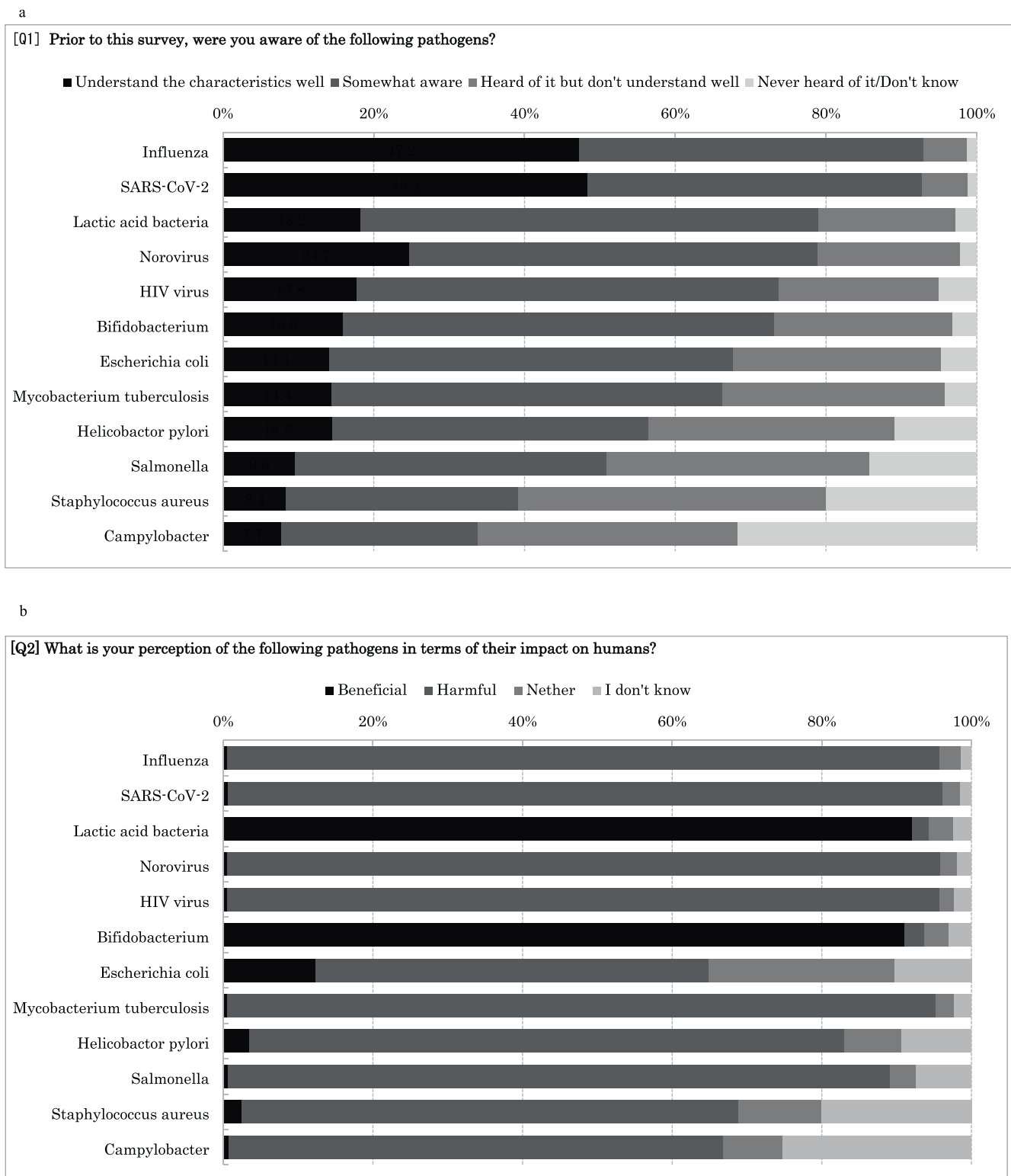


FIGURE 1 | (a) Respondents' awareness of *H. pylori* infection. (b) Respondents' impression regarding *H. pylori*.

Japan likely stems from its high incidence of gastric cancer, established nationwide gastric cancer screening programs, and insurance coverage for *H. pylori* testing when diagnosed with related conditions such as chronic gastritis and ulcers, all of which create multiple exposures to *H. pylori* information. Nevertheless, 43.6% of respondents lacked a substantive understanding of *H. pylori* infection despite having heard of

it, highlighting a critical knowledge gap that requires targeted educational interventions.

The knowledge levels varied considerably across the four *H. pylori* domains assessed in this study. The respondents demonstrated relatively higher knowledge of *H. pylori* infection risk (57.3%) and related diseases (50.9%) but showed a notable lack

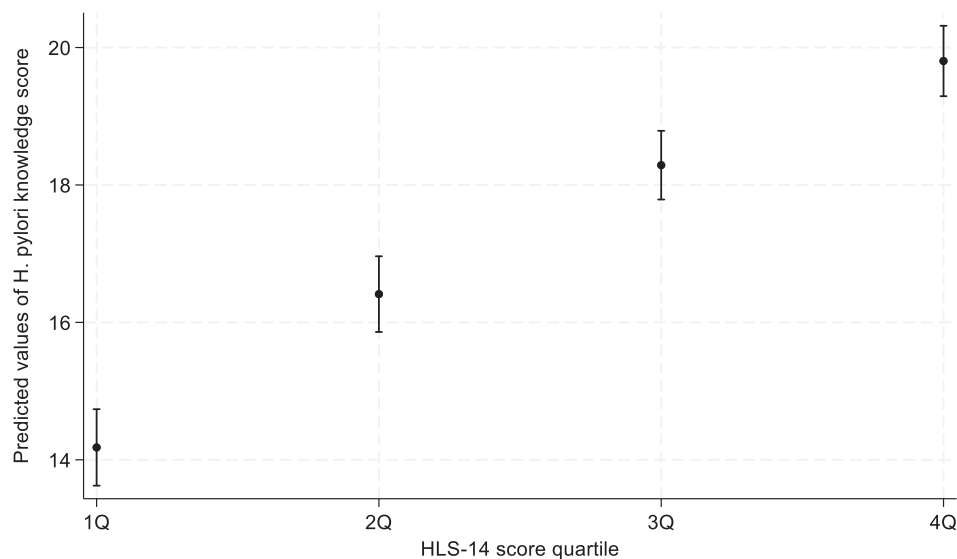


FIGURE 2 | Relationship between *H. pylori* knowledge score and health literacy score. [†]The dots are point estimates, and the bars are 95% confidence intervals.

of understanding of testing and treatment methods (37.5%) and gastric cancer relationships (44.4%). Particularly, low levels of knowledge regarding testing and treatment may help explain screening reluctance, as nearly 30% of the respondents mentioned perceived test difficulty as a barrier to screening. This is similar to the findings of a US study [19], which revealed that the concerns regarding treatment being worse than the disease symptoms affected the decision to seek medical care. Although methodological factors, such as question difficulty, may have affected domain-specific scores, these findings suggest a critical need for targeted education regarding *H. pylori* testing procedures and treatment efficacy. In this study, we did not ask respondents about the sources of their *H. pylori* knowledge, and future research should investigate the information sources that shape public knowledge regarding *H. pylori* to develop more effective educational interventions.

The association between health literacy and *H. pylori* knowledge is a significant finding in this study, with a notably negative interaction observed between health literacy and screening history. Health literacy contributed significantly to the *H. pylori* knowledge level of the respondents who had not undergone *H. pylori* screening compared with those who had undergone screening. The stratified analysis revealed different knowledge determinants between the *H. pylori* screening-experienced and screening-naïve groups: while older age and health literacy were significant factors in both groups, female sex, higher annual income, and healthcare worker status were only significant among those without prior *H. pylori* screening. These findings align with those of previous international studies that identified several factors that contribute to the knowledge of *H. pylori* infection and gastric cancer. A Chinese study [20] showed that age, education, residential location (urban or rural), attitudes toward *H. pylori* screening, and screening experience affected knowledge levels. Similarly, another Asian study [22] highlighted a higher education level (university or college) as a significant factor. In addition, a US study emphasized the importance of personal or family screening and treatment experiences [19]. The main commonality in these previous studies and the present

survey was that a history of *H. pylori* screening affects the level of *H. pylori* knowledge. In addition, a study examining the relationship between health literacy and knowledge and attitudes toward breast cancer screening [26] showed that higher health literacy was associated with more positive knowledge and attitudes toward breast cancer screening (breast cancer screening beliefs), which may support the results of this study. To improve *H. pylori* knowledge, different approaches may be effective, depending on whether the individual has experience with *H. pylori* screening, health literacy, or social background.

In the present survey, 46% of the respondents without a history of *H. pylori* screening were willing to undergo screening. As it is unclear why people had not been screened despite their willingness to undergo *H. pylori* screening, it is necessary to investigate the factors that prevent the screening. In addition, respondents who had never been screened for *H. pylori* were more likely to have higher *H. pylori* knowledge scores, health literacy scores, and income level (4 million yen/year), which significantly increased their motivation to undergo *H. pylori* screening. The main reasons cited by respondents with negative concerns about the examination were “I don’t think I need to be tested for *Helicobacter pylori*” (35.1%), “It’s expensive” (33.2%), and “The test seems to be difficult” (27.9%). These findings agree with those of previous studies; a UK street survey [21] identified “lack of symptoms” as a common reason for reluctance toward *H. pylori* screening, whereas a questionnaire survey in the United Arab Emirates [23] reported that experiencing warning symptoms significantly increased preventive behavior to *H. pylori* infection. This consistency suggests that asymptomatic *H. pylori* infection presents a universal challenge for promoting screening. Educational interventions should emphasize that *H. pylori* infection often remains asymptomatic until a significant pathology develops, underscoring the importance of proactive screening, regardless of symptom status.

In the present study, the health literacy scores (overall score: 48.5; functional: 17.7; communicative: 17.0; critical: 13.7) were similar to those reported by Suka et al. [27] in their national

TABLE 2 | Regression models for *H. pylori* knowledge scores.

	Model 1			Model 2			Model 3		
	Coefficient	95% CI	p	Coefficient	95% CI	p	Coefficient	95% CI	p
Age (ref. 20–39 years)									
40–60 years	2.33	1.75 to 2.90	<0.001	1.43	0.83 to 2.03	<0.001	1.36	0.79 to 1.94	<0.001
Sex (ref. Male)									
Female	0.49	−0.06 to 1.05	0.082	0.99	0.44 to 1.54	<0.001	0.46	−0.08 to 0.99	0.098
Education (ref. high school diploma or lower)									
College degree	0.12	−0.60 to 0.84	0.744	0.30	−0.42 to 1.03	0.410	0.09	−0.61 to 0.78	0.803
University degree or higher	0.04	−0.60 to 0.68	0.904	0.51	−0.13 to 1.15	0.115	−0.16	−0.78 to 0.47	0.621
Income (ref. <4,000,000 yen/year)									
≥4,000,000 yen/year	0.36	−0.21 to 0.94	0.212	0.40	−0.18 to 0.97	0.174	0.19	−0.36 to 0.75	0.491
Health literacy score	0.26	0.23 to 0.30	<0.001				0.24	0.20 to 0.27	<0.001
<i>H. pylori</i> screening test history (ref. absent)									
Present				4.18	3.58 to 4.78	<0.001	3.76	3.18 to 4.34	<0.001
Field of work (ref. non-medical)									
Medical	1.61	0.74 to 2.48	<0.001	1.09	0.22 to 1.96	0.014	1.32	0.48 to 2.16	0.002

Abbreviation: CI, confidence interval.

TABLE 3 | *H. pylori* knowledge score estimates and *p* values for interaction.

	Estimates	<i>p</i> for interaction
Age		
20–39 years	16.4 (15.9–16.9)	
40–69 years	17.8 (17.5–18.1)	0.868
Sex		
Male	17.1 (16.8–17.5)	
Female	17.6 (17.2–18)	0.187
Education		
High school	17.4 (16.9–17.8)	
College degree	17.5 (16.9–18)	0.384
University degree or higher	17.2 (16.8–17.6)	0.737
Income		
< 4,000,000 yen/year	17.2 (16.8–17.7)	
≥ 4,000,000 yen/year	17.4 (17.1–17.7)	0.167
<i>H. pylori</i> screening test history		
Absent	16.2 (15.9–16.5)	
Present	20.0 (19.5–20.5)	0.002

assessment of Japanese adults using the same HLS-14 instrument, with 50.3 ± 6.8 points of overall, 19.1 ± 3.6 points of functional, 17.8 ± 3.6 points of communicative, and 13.4 ± 2.7 points of critical health literacy scores. This consistency in the results suggests that our sample is representative of the general Japanese adult population in health literacy levels, thus strengthening the generalizability of our findings.

4.1 | Limitations

First, as the title of the questionnaire was “Questionnaire on Health,” it is possible that it was biased toward those with an interest in health. In addition, analyses were restricted to complete cases: only participants who answered all items were included, and those who discontinued the survey were excluded. Second, other typical health literacy scales include the REALM [28] and TOFHLA [29]; however, these were not used in this study because they are difficult to apply in Japan. Third, some respondents had a very low score of 0 points for *H. pylori* knowledge. It is possible that they lacked knowledge regarding *H. pylori*, and some respondents had difficulty understanding the questions as the questions contain specific and complex items about cancer or *H. pylori*. Fourth, because it was an online survey providing reward points as incentives, the respondents might be skewed toward some specific subgroups, which may be unrepresentative. To avoid such bias as much as possible, we recruited participants to ensure the sex and age demographics of the study sample mirrored those of the Japanese population. It is necessary to verify whether the findings of this study are applicable to the general public

TABLE 4 | Regression analysis of *H. pylori* knowledge scores among respondents with and without *H. pylori* screening history.

	Respondents without <i>H. pylori</i> screening experience			Respondents with <i>H. pylori</i> screening experience		
	Coefficient	95% CI	<i>p</i>	Coefficient	95% CI	<i>p</i>
Age (ref. 20–39 years)						
40–60 years	1.19	0.51 to 1.86	0.001	2.16	1.00 to 3.32	<0.001
Sex (ref. male)						
Female	0.73	0.05 to 1.42	0.036	−0.19	−1.00 to 0.63	0.653
Education (ref. high school diploma or lower)						
College degree	0.08	−0.8 to 0.95	0.859	0.12	−0.96 to 1.20	0.832
University degree or higher	−0.14	−0.92 to 0.65	0.736	−0.30	−1.25 to 0.66	0.540
Income (ref. < 4,000,000 yen/year)						
≥ 4,000,000 yen/year	0.15	−0.54 to 0.85	0.670	0.37	−0.50 to 1.23	0.407
Health literacy score	0.27	0.23 to 0.31	<0.001	0.16	0.11 to 0.21	<0.001
Field of work (ref. non-medical)						
Medical	1.76	0.68 to 2.84	0.001	0.57	−0.67 to 1.80	0.370

Abbreviation: CI, confidence interval.

through research employing different recruitment methods and targeting different populations. Finally, because 781 respondents who did not answer household income were excluded from regression analysis, some bias might exist.

5 | Conclusion

To the best of our knowledge, this is the first nationwide assessment of *H. pylori* infection and gastric cancer awareness in Japan. Our findings demonstrate that health literacy and previous *H. pylori* screening experience were significantly associated with better *H. pylori* knowledge. Future public health initiatives should develop targeted educational strategies that account for differences in health literacy, screening history, and sociodemographic characteristics to enhance *H. pylori* screening uptake and contribute to gastric cancer prevention efforts.

Author Contributions

Study conception: C.M., H.S., M.T., and Y.M. Data collection: H.S. Investigation: C.M. and H.S. Data analysis and interpretation: C.M., H.S., M.T., Y.M., Y.N., Y.S., T.U., T.K., and Y.E. Drafting of the article: C.M. and H.S. Critical revisions of the article: M.T. and Y.N. Final approval of the version to be published: All authors.

Ethics Statement

This study was approved by the Ethical Review Committee of the Disaster Comprehensive Health Management Institute (No. SG2023-02).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Appendix S1:** hel70089-sup-0001-AppendixS1.docx. *Helicobacter pylori* Survey. **Appendix S2:** hel70089-sup-0002-AppendixS2.docx. *Helicobacter pylori* survey scoring rules. **Appendix S3:** hel70089-sup-0003-AppendixS3.docx. **Figure S1:** Frequency of the *H. pylori* knowledge total score. **Figure S2:** Relationships between health literacy score and *H. pylori* screening test history with *H. pylori* knowledge score. **Table S1:** Regression analysis of motivation toward *H. pylori* screening tests among respondents without *H. pylori* screening history.