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Prevalence and Risk Factors of *Helicobacter pylori* Infection in Elderly Patients With Upper Gastrointestinal Symptoms in Vietnam

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Keywords: elderly patients | *Helicobacter pylori* | prevalence | risk factors | Vietnam

ABSTRACT

Background and Aim: *Helicobacter pylori* infection is a major cause of peptic ulcer disease and gastric cancer. Limited data exist on *H. pylori* prevalence and risk factors of infection among elderly individuals in Vietnam. This study aimed to determine the prevalence and associated risk factors of *H. pylori* infection in elderly Vietnamese patients with upper gastrointestinal symptoms.

Methods: A cross-sectional study was conducted on patients aged ≥60 years with upper gastrointestinal symptoms who underwent endoscopy. The exclusion criteria included recent antibiotic or proton pump inhibitor use, prior *H. pylori* eradication, or upper gastrointestinal surgery. Data on demographics, hygiene, diet, and history were collected through structured questionnaires. *H. pylori* was diagnosed by a rapid urease test. Logistic regression was used to analyze risk factors.

Results: Of 406 participants (mean age 65.4 ± 4.5 years, male-to-female ratio 1:2), *H. pylori* prevalence was 55.6%. The risk factors for *H. pylori* infection included infrequent tooth brushing (OR 18.14, 95% CI 3.94–83.55), overweight/obesity (OR 5.82, 95% CI 3.44–9.88), spicy food consumption (OR 5.18, 95% CI 2.74–9.79), a family history of upper gastrointestinal symptoms (OR 3.15, 95% CI 1.84–5.39), and cat ownership (OR 2.01, 95% CI 1.10–3.68). The vegetarian diet was protective (OR 0.04, 95% CI 0.01–0.18).

Conclusions: *H. pylori* prevalence in elderly Vietnamese is high, with risk factors including poor hygiene, obesity, spicy food, family history, and cat ownership. A vegetarian diet may be protective.

1 | Introduction

Helicobacter pylori infection is a common condition affecting more than 50% of the world's population [1]. To date, the global consensus considers *H. pylori* gastritis an infectious disease [2]. *H. pylori* is also considered the leading cause of peptic ulcer disease and gastric cancer [3]. Elderly people often have multiple comorbidities; thus, the management of *H. pylori* infection in this population requires special attention. Some recent studies have also shown a potential association between *H. pylori* and various cardiovascular diseases, such as hypertension, atherosclerosis, and cerebral infarction, in elderly individuals [4, 5]. And current guidelines recommend screening and eradicating *H. pylori* in patients who are expected to require long-term treatment with aspirin or nonsteroidal anti-inflammatory drugs to prevent gastrointestinal complications [6, 7]. Conversely, certain comorbid conditions may worsen with *H. pylori* eradication therapy in elderly people, including *Clostridioides difficile* colitis

Abbreviations: BMI, body mass index; CI, confidence interval; GERD, gastroesophageal reflux disease; *H. pylori*, *Helicobacter pylori*; IQR, interquartile range; OR, odds ratio; PUD, peptic ulcer disease; SD, standard deviation.

and the relapse or exacerbation of preexisting inflammatory bowel diseases [8]. Therefore, *H. pylori* infection is an important issue that should be considered in elderly individuals.

Vietnam is the country with the highest prevalence of *H. pylori* infection in Southeast Asia [9]. *H. pylori* infection in Vietnam is primarily found in children under 12 years of age [10]. Although many studies have been conducted on *H. pylori* infection in adults in Vietnam, studies specifically focusing on the prevalence of *H. pylori* infection in elderly individuals are scarce. Notably, while recent data show that the reinfection rate after successful eradication of *H. pylori* in adults after 31 months is as high as 27.8% [11], there have been no studies on the risk factors for *H. pylori* infection in elderly Vietnamese individuals. This study was conducted to determine the prevalence and associated factors of *H. pylori* infection in elderly Vietnamese individuals with upper gastrointestinal symptoms who underwent upper gastrointestinal endoscopy.

2 | Patients and Methods

A cross-sectional study was conducted at the outpatient department of the University Medical Center Ho Chi Minh City, Vietnam, from May to July 2022. The inclusion criteria for the study were as follows: (i) aged 60 years and older; (ii) presented with upper gastrointestinal symptoms (heartburn, regurgitation, bloating, early satiety, epigastric pain, or epigastric burning); and (iii) had indications for upper gastrointestinal endoscopy. The exclusion criteria included any of the following: (i) used any antibiotics within 4 weeks or proton pump inhibitors within 2 weeks prior to the visit; (ii) had a history of *H. pylori* eradication or prior history of upper gastrointestinal surgery; and (iii) had contraindications for upper gastrointestinal endoscopy.

Patients meeting the eligibility criteria for the study were interviewed via a pre-prepared questionnaire. This questionnaire included demographic characteristics (age, sex, body mass index, place of residence, educational level, occupation, and pet ownership), personal hygiene habits (tooth brushing and handwashing before eating), dietary habits (consumption of chili and vegetarian diet), and information related to upper gastrointestinal symptoms (current symptoms and family history of household members with similar symptoms). Patients then underwent upper gastrointestinal endoscopy at the endoscopy department of the University Medical Center in Ho Chi Minh City, Vietnam. All endoscopic procedures were performed via Olympus

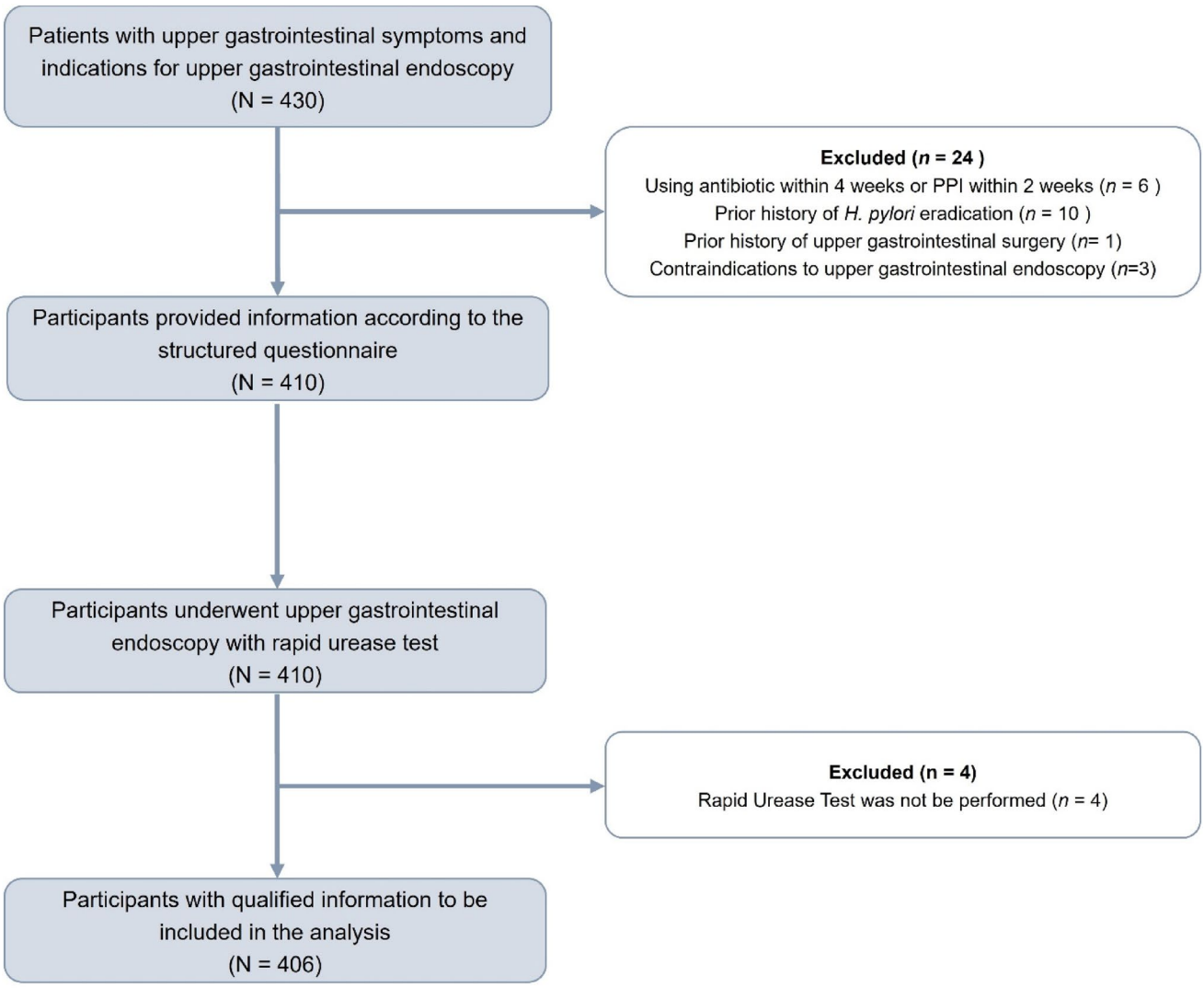

FIGURE 1 | Flow chart of the study participants.

TABLE 1 | Characteristics of the study participants ($N = 406$).

Characteristics	*n* (%)
Age	
60–69	334 (82.3%)
70–79	69 (17.0%)
≥80	3 (0.7%)
Gender	
Female	272 (67.0%)
Male	134 (33.0%)
Body mass index (kg/m^2)	
Normal	169 (41.6%)
Underweight	12 (3.0%)
Overweight and obese	225 (55.4%)
Residence	
Urban	199 (49.0%)
Rural	207 (51.0%)
Education level, *n* (%)	
Primary	176 (43.3%)
Secondary	177 (43.6%)
College	42 (10.4%)
Postgraduate	11 (2.7%)
Occupation	
Farmers	168 (41.4%)
Housewives	98 (24.1%)
Workers	51 (12.6%)
Public servants	47 (11.6%)
Merchants	42 (10.3%)

gastroscopes (model GIF-H180, Olympus Corp., Tokyo, Japan). The endoscopists were blinded to the patient information collected via the above questionnaire but were informed of the patient's upper gastrointestinal symptoms and clinical diagnosis. After the endoscopic findings were evaluated, a biopsy sample was taken from the greater curvature of the lower corpus for *H. pylori* diagnosis via a local rapid urease test. This biopsy site has been demonstrated to provide the highest sensitivity for diagnosing *H. pylori* in Vietnamese individuals, surpassing biopsies from the mid-antrum and mid-corpus locations [12]. The local rapid urease test used in this study has been validated and shown to have an accuracy comparable to that of PyloriTek (Serim Research Corp., Elkhart, IN, USA) [13]. This study was conducted with the approval of the Ethics Committee in Biomedical Research at the University of Medicine and Pharmacy at Ho Chi Minh City under document number 107/HDDD-DHYD.

The main variables in this study are defined as follows: *H. pylori* infection was defined by a positive rapid urease test. Body mass index (BMI) was categorized as normal (18.5–22.9), underweight (<18.5), or overweight/obese (≥23) on the basis of the BMI criteria for Asian populations [14]. The family history was defined as having a household member with upper gastrointestinal symptoms or who was diagnosed with gastric-duodenal disease. Pet ownership was categorized as no pets, dog ownership, cat ownership, or other animal ownership. Handwashing habits before meals were categorized as "always washing" or "not regularly washing." Tooth brushing habits were defined as regular (≥1 time/day) or irregular. Chili consumption habits were measured by daily consumption of "ớt chỉ thiên" chili and were categorized as yes (≥0.5 peppers per main meal) or no (<0.5 peppers or none). A vegetarian diet was defined as following a plant-based diet for more than 1 year without consuming meat or fish. In terms of residence, the definition of "urban area" in this study follows the guidelines of Vietnam's Urban Planning Law and is defined as a densely populated area where the majority of activities are in nonagricultural economic sectors. It serves as a political, administrative, economic, cultural, or specialized center that plays a role in promoting the socioeconomic development of the nation, a region, or a locality. This includes inner-city and suburban areas of a city; inner-town and suburban areas of a town; and townships. Patients residing in areas not included in the above definition are considered to be in rural areas.

All the statistical analyses in this study were conducted via R (version 4.3.1). Continuous variables are presented as the means and standard deviations (SDs) if normally distributed and as medians with interquartile ranges (IQRs) if nonnormally distributed. Categorical variables are expressed as frequencies and percentages. The chi-square test or Fisher's exact test was used to compare categorical variables. Univariable and multivariable logistic regression analyses were performed to identify factors associated with *H. pylori* infection. Variables with a p value < 0.05 were included in the univariable logistic regression model, and those with a p value < 0.1 were included in the multivariable logistic regression analysis. To ensure that the results are not affected by the zero-event values, Firth's correction was applied to handle infinite odds ratios (ORs). ORs with 95% confidence intervals (CIs) were reported to quantify the strength of the associations between each independent variable and the outcome. All the statistical tests were two-sided and conducted with a significance level set at 5%.

3 | Results

A total of 430 patients agreed to participate in the study. After excluding patients who did not meet the research criteria, 406 patients were included in the analysis (Figure 1). The average age of the study participants was 65.4 ± 4.5 years, with a male-to-female ratio of 1:2. The demographic characteristics of the patients are presented in Table 1. The prevalence of *H. pylori* infection was 55.6%. The main gastrointestinal symptoms are presented in Figure 2. The most common symptom was epigastric pain, which occurred in 64.8% of the patients. The upper gastrointestinal lesions detected via endoscopy included erosive esophageal reflux disease, peptic ulcer disease, and gastric cancer, with rates of 13.1%, 10.1%, and 1.2%, respectively. In the univariate analysis, factors positively associated with *H. pylori* infection included being female, being overweight or obese,

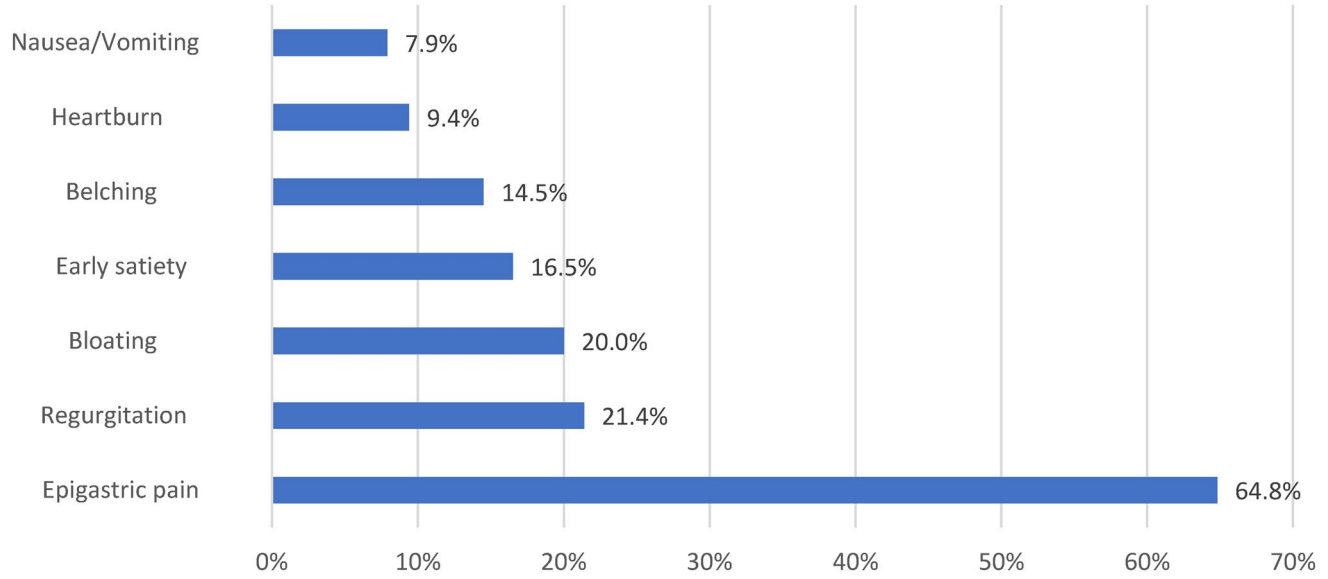

FIGURE 2 | Gastrointestinal symptoms of the study participants.

having a family history of upper gastrointestinal symptoms, not regularly washing their hands before meals, not brushing their teeth regularly, and consuming spicy foods (Table 2). Pet ownership was also a related factor, but the prevalence of *H. pylori* infection was significantly greater only in those who owned cats, with no clear association in dog or rodent owners. Moreover, being a vegetarian was negatively associated with *H. pylori* infection. The results of the multivariate analysis of factors associated with *H. pylori* infection are presented in Table 3. The associated factors included infrequent tooth brushing (OR 18.14, 95% CI 3.94–83.55), being overweight or obese (OR 5.82, 95% CI 3.44–9.88), consuming spicy foods (OR 5.18, 95% CI 2.74–9.79), having a family history of upper gastrointestinal symptoms (OR 3.15, 95% CI 1.84–5.39), and owning cats (OR 2.01, 95% CI 1.10–3.68). Conversely, being a vegetarian was negatively associated with *H. pylori* infection (OR 0.04, 95% CI 0.01–0.18). However, not regularly washing hands before meals had a borderline association with *H. pylori* infection ($p = 0.057$).

4 | Discussion

Our study revealed that the prevalence of *H. pylori* infection in elderly individuals was 55.7%. The factors associated with the risk of *H. pylori* infection include being overweight or obese, infrequent tooth brushing, having a family history of upper gastrointestinal symptoms, and owning cats, whereas a vegetarian diet is a protective factor.

With respect to the prevalence of *H. pylori* infection, a study conducted in Vietnam 20 years ago reported that the rate of infection among elderly individuals was as high as 80% [15]. A recent meta-analysis revealed that the global prevalence of *H. pylori* infection has declined over the last three decades in adults but not in children or adolescents [16]. Therefore, the changing trend in Vietnam is consistent with the global situation. Although our study revealed a significant reduction in the prevalence of *H. pylori* infection, the rate is still relatively high and warrants attention. Degenerative joint diseases and neurological or cardiovascular conditions are common in elderly individuals, and current guidelines for managing *H. pylori* infection emphasize the strong need to screen for and eradicate *H. pylori* to prevent gastrointestinal complications in patients who are expected to undergo long-term treatment with nonsteroidal anti-inflammatory drugs and aspirin [7].

Obesity has been identified as a factor related to *H. pylori* infection in studies on other populations. A systematic review and meta-analysis of case–control studies comprising 25 519 subjects revealed that obese subjects had a greater risk of *H. pylori* infection than lean subjects did (OR: 1.46; 95% CI: 1.26–1.68) [17]. Additionally, *H. pylori*-infected subjects had a greater risk of obesity than noninfected subjects did (OR: 1.01; 95% CI: 1.01–1.02). This bidirectional relationship underscores the complex interplay between *H. pylori* infection and metabolic health. Previous studies have shown that infected individuals tend to exhibit increased insulin resistance, a contributing factor to the development of obesity [18]. Additionally, obese individuals may have impaired immune function, including reduced maturation of monocytes into macrophages and decreased cytotoxic activity of natural killer cells. These impairments reduce bactericidal activity, increasing the susceptibility of obese individuals to *H. pylori* infection [19].

In our study, infrequent tooth brushing habits were also a risk factor for *H. pylori* infection. The oral cavity can serve as a significant reservoir for *H. pylori*. Poor oral hygiene leads to dental plaque, and periodontal pockets provide an environment conducive to *H. pylori* colonization. A recent meta-analysis of observational studies revealed that the odds of *H. pylori* infection in patients with periodontal disease were significantly greater (OR: 2.47; 95% CI: 2.01–3.03) [20]. The relationship between infrequent handwashing before meals and *H. pylori* infection in our study was borderline. However, we believe that this could still be a potential risk factor. A study in adults in Indonesia revealed that infrequent handwashing practices before meals were significantly associated with an increased risk of *H. pylori* infection (OR: 4.10; 95% CI: 1.15–14.6) [21]. A recent study

TABLE 2 | Prevalence of *H. pylori* infection according to sociodemographic characteristics and lifestyle habits.

Characteristics	*H. pylori* (+) $n = 226$	*H. pylori* (−) $n = 180$	Total $n = 406$	p
Age group, *n* (%)				
60–69	188 (56.3)	146 (43.7)	334 (100)	0.763
70–79	36 (52.2)	33 (47.8)	69 (100)	
≥80	2 (66.7)	1 (33.3)	3 (100)	
Gender, *n* (%)				
Female	161 (59.2)	111 (40.8)	272 (100)	0.042
Male	65 (48.5)	69 (51.5)	134 (100)	
Body mass index				
Normal	49 (29.0)	120 (71.0)	169 (100)	<0.001
Underweight	3 (25.0)	9 (75.0)	12 (100)	
Overweight and obesity	174 (77.3)	51 (22.7)	225 (100)	
Family history of upper gastrointestinal symptoms				
No	71 (28.3)	180 (71.7)	251 (100)	<0.001
Yes	155 (100.0)	0 (0.0)	155 (100)	
Living area				
Urban	117 (58.8)	82 (41.2)	199 (100)	0.213
Rural	109 (52.7)	98 (47.3)	207 (100)	
Education level				
Primary school	109 (61.9)	67 (38.1)	176 (100)	0.072
High school	87 (48.9)	91 (51.2)	178 (100)	
College	26 (60.5)	17 (39.5)	43 (100)	
Postgraduate	4 (44.4)	5 (55.6)	9 (100)	
Occupation, *n* (%)				
Housewife	65 (66.3)	33 (33.7)	98 (100)	0.015
Others	161 (52.3)	147 (47.7)	308 (100)	
Pets				
None	71 (49.0)	74 (51.0)	145 (100)	0.042
Cat	80 (64.5)	44 (35.5)	124 (100)	0.017
Dog	59 (49.2)	61 (50.8)	120 (100)	0.087
Rodent[a]	13 (100)	0 (0)	17 (100)	0.001
Handwashing before eating				
No or not regularly	100 (64.9)	54 (35.1)	154 (100)	0.003
Yes	126 (50.0)	126 (50.0)	252 (100)	
Brushing teeth habit				
At least once a day	188 (51.5)	177 (48.5)	365 (100)	<0.001
Not regularly	38 (92.7)	3 (7.3)	41 (100)	

(Continues)

TABLE 2 | (Continued)

Characteristics	*H. pylori* (+) $n=226$	*H. pylori* (−) $n=180$	Total $n=406$	p
Spicy food consumption				
No	136 (46.9)	154 (54.1)	290 (100)	<0.001
Yes	90 (71.4)	26 (28.6)	126 (100)	
Vegetarian				
No	223 (58.4)	159 (41.6)	382 (100)	<0.001
Yes	3 (12.5)	21 (87.5)	24 (100)	

[a]Including nine hamsters, three squirrels, and one hedgehog.

TABLE 3 | Factors related to *H. pylori* infection: Multivariate logistic regression analysis results.

Characteristics	OR (95% CI)	p
Gender		
Female	1	0.393
Male	0.39 (0.39–1.41)	
BMI		
Normal	1	
Underweight	0.42 (0.10–1.80)	0.254
Overweight or obesity	5.82 (3.44–9.88)	<0.001
Occupation		
Housewife	1	0.146
Others	0.60 (0.30–1.19)	
Pet		
None	1	
Cat	2.01 (1.10–3.68)	0.023
Dog	—	
Rodent	—	
Handwashing		
Yes	1	0.057
No or not regularly	1.73 (0.98–3.06)	
Brushing teeth habit		
At least once a day	1	<0.001
Not regularly	18.14 (3.94–83.55)	
Spicy food consumption		
No	1	<0.001
Yes	5.18 (2.74–9.79)	
Vegetarian		
No	1	<0.001
Yes	0.04 (0.01–0.18)	
Family history of upper gastrointestinal symptoms		
No	1	<0.001
Yes	3.15 (1.84–5.39)	

in Vietnamese children revealed that infrequent handwashing with soap after using the toilet was a significant risk factor for *H. pylori* infection (OR: 1.71; 95% CI: 1.13–2.59). In addition, this study revealed that the use of only water to clean after toilet use, as opposed to the use of paper or a combination of water and paper, significantly increased the risk of *H. pylori* infection (OR: 3.13; 95% CI: 1.28–7.64) [22]. These study results highlight the importance of hand hygiene in reducing the risk of *H. pylori* infection.

The relationship between vegetarian and spicy diets and the risk of *H. pylori* infection has also been addressed in previous studies but with mixed results. An age- and sex-matched case–control study revealed that there was no difference in *H. pylori* seropositivity between Asian vegans and meat eaters [23]. A study conducted 10 years ago in Beijing, China, reported an increased prevalence of *H. pylori* infection in vegetarians [24]. A vegetarian diet can help prevent gut infections by promoting diverse and beneficial gut microbiota, enhancing antipathogenic and anti-inflammatory bacterial populations, and increasing the production of health-promoting metabolites such as short-chain fatty acids [25]. Capsaicin, the active ingredient in chili, inhibited the growth of *H. pylori* in a dose-dependent manner in vitro, and bactericidal activity was observed within 4 h [26]. However, our study revealed that consuming spicy food was positively associated with the risk of *H. pylori* infection. The habit of eating raw chili peppers, especially in rural areas of Vietnam, and the potential presence of *H. pylori* in vegetables, as reported in previous studies, may contribute to the differences in study results regarding the relationship between diet and *H. pylori* infection risk [27].

The transmission of *H. pylori* between pets and humans has long been studied. The prevalence rates of *H. pylori* infection in dogs and cats are 28% and 24%, respectively [28]. Studies have shown that individuals who own a cat as a child are slightly more likely to be *H. pylori* seropositive than those who do not [29]. However, there was no difference between subjects who owned a cat and those with other pets. There have also been case reports of *H. pylori* transmission between humans and dogs [30]. Our study revealed a high prevalence of *H. pylori* infection in people who owned cats but not dogs. We believe that the differences in the study results may be due to the contribution of other risk behaviors not clarified in this study, and further research, such as habits of contact, bathing, and pet hygiene, is needed, as the main transmission route is fecal-oral.

This study has several limitations. First, it is a cross-sectional study conducted at a single center, so causal relationships cannot be determined, and the results cannot be generalized accurately to the entire Vietnamese population. Second, the logistic regression results in our study show an extremely wide 95% CI for the odds ratio for tooth brushing habits, suggesting potential undersampling issues for this factor. In addition, the majority of patients were from the primary employment sector. Therefore, further studies with larger sample sizes and representations from higher socioeconomic classes should be conducted. Third, information on dietary habits, lifestyle, and disease status is subjective and may be subject to recall bias. Fourth, we identified *H. pylori* infection status via only one diagnostic method in this study. Therefore, the likelihood of false-negative and false-positive *H. pylori* infection is also challenging to control ideally.

5 | Conclusions

In conclusion, our study revealed that the prevalence of *H. pylori* infection in elderly individuals in Vietnam has significantly decreased compared with the results of previous studies two decades ago but remains relatively high. This study also identified factors associated with *H. pylori* infection, laying the groundwork for follow-up studies to evaluate causal relationships and the potential for preventing *H. pylori* infection in elderly individuals in Vietnam.

Acknowledgments

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Ethics Statement

This study was conducted with the approval of the Ethics Committee in Biomedical Research at the University of Medicine and Pharmacy at Ho Chi Minh City under document number 107/HDDD-DHYD.

Consent

Written informed consent was obtained from all participants.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

References

1. J. K. Y. Hooi, W. Y. Lai, W. K. Ng, et al., "Global Prevalence of *Helicobacter pylori* Infection: Systematic Review and Meta-Analysis," *Gastroenterology* 153, no. 2 (2017): 420–429.

2. K. Sugano, J. Tack, E. J. Kuipers, et al., "Kyoto Global Consensus Report On *Helicobacter pylori* gastritis," *Gut* 64, no. 9 (2015): 1353–1367.

3. P. Malfertheiner, M. C. Camargo, E. el-Omar, et al., "*Helicobacter pylori* Infection," *Nature Reviews Disease Primers* 9, no. 1 (2023): 19.

4. J. M. Choi, S. H. Lim, Y. M. Han, et al., "Association Between *Helicobacter pylori* Infection and Arterial Stiffness: Results From a Large Cross-Sectional Study," *PLoS One* 14, no. 8 (2019): e0221643.

5. F. Khademi, H. Vaez, A. A. Momtazi-Borojeni, A. Majnooni, M. Banach, and A. Sahebkar, "Bacterial Infections Are Associated With Cardiovascular Disease in Iran: A Meta-Analysis," *Archives of Medical Science* 15, no. 4 (2019): 902–911.

6. P. Katelaris, R. Hunt, F. Bazzoli, et al., "*Helicobacter pylori* World Gastroenterology Organization Global Guideline," *Journal of Clinical Gastroenterology* 57, no. 2 (2023): 111–126.

7. P. Malfertheiner, F. Megraud, T. Rokkas, et al., "Management of *Helicobacter pylori* Infection: The Maastricht VI/Florence Consensus Report," *Gut* 71, no. 9 (2022): 1724–1762.

8. A. G. Gravina, R. Pellegrino, V. Iascone, G. Palladino, A. Federico, and R. M. Zagari, "Impact of *Helicobacter pylori* Eradication on Inflammatory Bowel Disease Onset and Disease Activity: To Eradicate or Not to Eradicate?," *Diseases* 12, no. 8 (2024): 179.

9. D. T. Quach, R. K. Vilaichone, K. V. Vu, Y. Yamaoka, K. Sugano, and V. Mahachai, "*Helicobacter pylori* Infection and Related Gastrointestinal Diseases in Southeast Asian Countries: An Expert Opinion Survey," *Asian Pacific Journal of Cancer Prevention* 19, no. 12 (2018): 3565–3569.

10. V. B. Nguyen, G. K. Nguyen, D. C. Phung, et al., "Intra-Familial Transmission of *Helicobacter pylori* Infection in Children of Households With Multiple Generations in Vietnam," *European Journal of Epidemiology* 21, no. 6 (2006): 459–463.

11. N. A. Do, T. H. H. Nguyen, and T. T. D. T. Nguyen, "Recrudescence or Reinfection of *H. pylori* of Duodenal Ulcer Patients After Eradication in E Hospital," *Journal of 108-Clinical Medicine* 14, no. 7 (2019): 24–29.

12. T. D. Quach, T. O. Nguyen, and S. T. Nguyen, "The Role of Biopsy Sites Recommended by the Revised Sydney System in Detecting Precancerous Gastric Lesions," *Vietnamese Journal of Gastroenterology* 2008, no. 4 (2008): 736–741.

13. D. T. Quach, "Evaluation of a Local Rapid Urease Test for *Helicobacter pylori* Diagnosis in Comparison With PyloriTek," *Journal of Gastroenterology and Hepatology* 21 (2006): A391.

14. WHO, *The Asia-Pacific Perspective: Redefining Obesity and Its Treatment* (Sydney: Health Communications Australia, 2000).

15. T. T. Hoang, C. Bengtsson, D. C. Phung, M. Sörberg, and M. Granström, "Seroprevalence of *Helicobacter pylori* Infection in Urban and Rural Vietnam," *Clinical and Diagnostic Laboratory Immunology* 12, no. 1 (2005): 81–85.

16. Y.-C. Chen, P. Malfertheiner, H. T. Yu, et al., "Global Prevalence of *Helicobacter pylori* Infection and Incidence of Gastric Cancer Between 1980 and 2022," *Gastroenterology* 166, no. 4 (2024): 605–619.

17. A. Baradaran, H. Dehghanbanadaki, S. Naderpour, et al., "The Association Between Helicobacter Pylori and Obesity: A Systematic Review and Meta-Analysis of Case–Control Studies," *Clinical Diabetes and Endocrinology* 7 (2021): 15.

18. T. Gunji, N. Matsuhashi, H. Sato, et al., "*Helicobacter pylori* Infection Significantly Increases Insulin Resistance in the Asymptomatic Japanese Population," *Helicobacter* 14, no. 5 (2009): 496–502.

19. A. Martí, A. Marcos, and J. A. Martínez, "Obesity and Immune Function Relationships," *Obesity Reviews* 2, no. 2 (2008): 131–140.

20. Y. Moradi, L. Majidi, S. Khateri, et al., "The Association Between Periodontal Diseases and *Helicobacter pylori*: An Updated Meta-Analysis of Observational Studies," *BMC Oral Health* 23, no. 1 (2023): 523.

21. Y. Goto, A. F. Syam, N. Darnindro, and F. C. Hapsari, "Prevalence and Risk Factors for *Helicobacter pylori* Infection Among Healthy Inhabitants in Northern Jakarta, Indonesia," *Asian Pacific Journal of Cancer Prevention* 17, no. 10 (2016): 4747–4753.

22. T. H. Che, T. C. Nguyen, V. N. T. Vu, et al., "Factors Associated With *Helicobacter pylori* Infection Among School-Aged Children From a High Prevalence Area in Vietnam," *International Journal of Public Health* 68 (2023): 1605908.

23. M. J. Webberley, J. M. Webberley, D. G. Newell, P. Lowe, and V. Melikian, "Seroepidemiology of *Helicobacter pylori* Infection in Vegans and Meat-Eaters," *Epidemiology and Infection* 108, no. 3 (2009): 457–462.

24. M. Zhang, "Seroepidemiology of *Helicobacter pylori* infection in Elderly People in the Beijing Region, China," *World Journal of Gastroenterology* 20, no. 13 (2014): 3635.

25. A. Tomova, I. Bukovsky, E. Rembert, et al., "The Effects of Vegetarian and Vegan Diets on Gut Microbiota," *Frontiers in Nutrition* 6 (2019): 47.

26. N. L. Jones, S. Shabib, and P. M. Sherman, "Capsaicin as an Inhibitor of the Growth of the Gastric Pathogen *Helicobacter pylori*," *FEMS Microbiology Letters* 146, no. 2 (2006): 223–227.

27. E. Yahaghi, F. Khamesipour, F. Mashayekhi, et al., "*Helicobacter pylori* in Vegetables and Salads: Genotyping and Antimicrobial Resistance Properties," *BioMed Research International* 2014 (2014): 1–11.

28. S. I. Shaaban, D. Talat, S. A. Khatab, et al., "An Investigative Study on the Zoonotic Potential of *Helicobacter pylori*," *BMC Veterinary Research* 19, no. 1 (2023): 16.

29. P. M. Webb, T. Knight, J. B. Elder, D. G. Newell, and D. Forman, "Is *Helicobacter pylori* Transmitted From Cats to Humans?," *Helicobacter* 1, no. 2 (2007): 79–81.

30. S. Kubota-Aizawa, Y. Matsubara, H. Kanemoto, et al., "Transmission of *Helicobacter pylori* Between a Human and Two Dogs: A Case Report," *Helicobacter* 26, no. 3 (2021): e12798.