Risk factors of *Helicobacter pylori* infection among military patients: a hospital-based cross-sectional study

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Background: Military personnel have a potentially increased risk of *Helicobacter pylori* (*H. pylori*) infection, which is a major cause of multiple upper gastrointestinal diseases. However, the risk factors of *H. pylori* infection in this specific population remain unclear.

Methods: Patients who were consecutively admitted to our department between June 2020 and September 2021 and underwent *H. pylori* tests were screened. Demographic data, socioeconomic information, medical history, personal habits, hygienic habits, and family-related information were reviewed. Multivariate logistic regression analysis was performed to identify the independent risk factors of *H. pylori* infection. Odds ratio (OR) with its 95% confidence interval (CI) was calculated.

Results: In this retrospective study, a total of 298 patients were included, of whom 59 were military patients. The overall prevalence of *H. pylori* infection was 30.5% (91/298), and multivariate logistic regression analysis showed that poor personal habit (OR =2.069; 95% CI: 1.142–3.750; P=0.01) and poor hygienic habit (OR =5.767; 95% CI: 2.498–13.312; P<0.001) were independently associated with an increased risk of *H. pylori* infection. The prevalence of *H. pylori* infection in military patients was 35.6% (21/59), and multivariate logistic regression analysis showed that poor hygienic habit (OR =6.542; 95% CI: 1.260–33.959; P=0.02) was independently associated with an increased risk of *H. pylori* infection. But gender, marital status, military service duration, number of people living in the same dormitory, education level, history of drinking coffee, living in the rural area, and family history of *H. pylori* infection were not significantly associated with *H. pylori* infection.

Conclusions: Poor hygienic habit may increase the risk of *H. pylori* infection in military personnel. Improvement of hygienic habits should be recommended in this specific population.

Keywords: *Helicobacter pylori* (*H. pylori*); military personnel; risk factor; hygienic habit; gastrointestinal disease

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Introduction

Helicobacter pylori (*H. pylori*) infection is one of well-known risk factors for gastric cancer (1), which is one of the most common cancer in China (2). It may also be involved in the pathogenesis of some extragastric diseases, including idiopathic thrombocytopenic purpura (3), irritable bowel syndrome (4), and non-alcoholic fatty liver disease (5).

H. pylori infects approximately 4.4 billion individuals worldwide (6). The prevalence of *H. pylori* infection varies among geographic areas in the world. It is the highest in Africa (79.1%), Latin America and the Caribbean (63.4%), and Asia (54.7%), but is the lowest in Northern America (37.1%) and Oceania (24.4%) (6). The estimated prevalence of *H. pylori* infection is 44.2% among the adults living in mainland China from 1990 to 2019, involving 589 million individuals infected with *H. pylori* (7). Furthermore, it is also very different among regions in mainland China, which may be influenced by several factors, such as age, gender, socioeconomic status, environmental conditions, hygienic habits, occupation, and water supply (8-10). Its prevalence is relatively higher in the northwestern (51.8%), eastern (47.7%), and southwestern China (46.6%).

Military personnel should be healthier because they are screened by strict physical examination before enlistment. However, it may be more likely that military personnel are exposed to certain occupational risk factors, such as high-pressure military and survival trainings in harsh environments, which may aggravate the risk and severity of *H. pylori* infection by reducing humoral and cellular immune responses (11). Indeed, our recent study suggests that young military population have a higher prevalence of *H. pylori* infection than civilian population of the same age (12). To the best of our knowledge, only a few studies, which were performed more than 10 years ago, have reported the risk factors associated with *H. pylori* infection in military personnel. With the improvement of people's living conditions, medical level, and health awareness of the disease, the prevalence of *H. pylori* has changed. It may be inappropriate to extrapolate previous findings on risk factors of *H. pylori* infection in military personnel as the current recognition. Herein, a cross-sectional study aims to determine the risk factors of *H. pylori* infection in hospitalized military personnel. We present the following article in accordance with the STROBE reporting checklist (available at https://amj.amegroups.com/article/view/10.21037/amj-22-37/rc).

Methods

Study design

Since June 2020, we have been prospectively and persistently collecting the data of patients that were admitted to the Department of Gastroenterology and had undergone *H. pylori* tests. In the present study, we retrospectively reviewed the data of patients admitted between June 2020 and September 2021. A diagnosis of *H. pylori* infection is based on the results of ^{13}C-urea breath test, ^{14}C-urea breath test, serological antibody test, and stool antigen test (8). Patients who had undergone *H. pylori* eradication treatment before their admissions and those who were lacking of the data on *H. pylori* infection related risk factors were excluded. Eligible patients were further classified into military and civilian groups based on their identities. An investigator employed the same criteria to record the risk factors that were potentially associated with *H. pylor*i infection. All patients' information was de-identified. The individuals' informed consents for this retrospective analysis were waived. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Medical Ethics Committee of the General Hospital of Northern Theater Command (No. Y [2021] 106).

Data collection

The following data were collected. Demographic data includes age and gender. Military personnel information includes military service duration (<3 or ≥3 years) and number of people living in the same dormitory (<3 or ≥3). Socioeconomic information includes marital status (married or unmarried) and education level (middle school or below, high school or technical school, or university or above). Medical history includes history of hypertension (yes or no), diabetes (yes or no), and coronary heart disease (yes or no). Personal habits include smoking (yes or no), drinking alcohol (yes or no), drinking tea (yes or no), drinking coffee (yes or no), eating spicy food (yes or no), irregular diet (yes or no), eating out frequently (yes or no), and drinking raw water (yes or no). Hygienic habits include hand washing before meals (yes or no), hand washing after visiting toilet (yes or no), halitosis (yes or no), and sharing cups (yes or no). Family-related information includes living area (rural or urban area), annual family income (<50,000 or ≥50,000 RMB), and family history of *H. pylori* infection (yes or no).

Definitions

Poor personal habit would be considered, if any of the following conditions was reported: smoking, drinking alcohol, eating spicy food, irregular diet, eating out frequently, and drinking raw water. Poor hygienic habit would be considered, if any of the following conditions was reported: absence of hand washing before meals, absence of

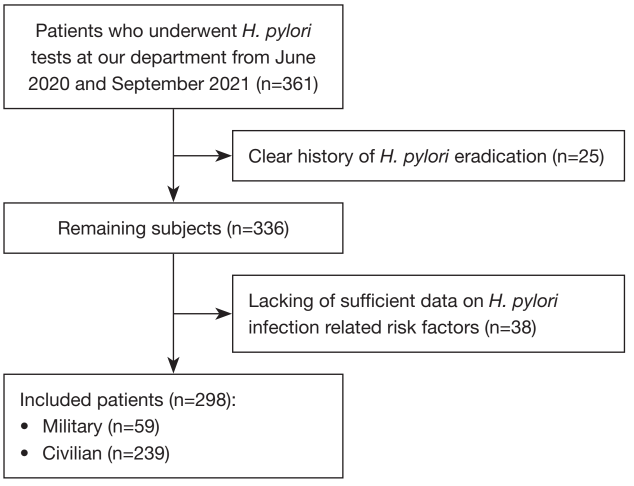

Figure 1 A flowchart of patient inclusion process. *H. pylori*, *Helicobacter pylori*.

hand washing after visiting toilet, halitosis, and sharing cups.

Statistical analyses

All statistical analyses were performed with IBM SPSS 20.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as median (range). Categorical variables were expressed as frequency (percentage). Non-parametric Mann-Whitney U test was used to compare continuous variables and Chi-square and Fisher's exact tests were used to compare categorical variables. Univariate and multivariate analyses were performed after checking the collinearity among the variables. Logistic regression analysis was used to identify the risk factors of *H. pylori* infection. Only variables that are statistically significant in univariate logistic regression analyses were further included in multivariate logistic regression analyses. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. A two-sided P<0.05 was considered statistically significant.

Results

Overall patients

Overall, 361 patients tested for *H. pylori* were screened. Among them, 63 patients were excluded, because 25 patients underwent *H. pylori* eradication treatment before their admissions and 38 were lacking of sufficient data on *H. pylori* infection related risk factors. Finally, 298 patients were included (*Figure 1*). Among them, 206 (69.1%) patients were ≥50 years old, 167 (56.0%) were male, the majority were married (89.3%), and the minority had a medical history of hypertension (18.1%), diabetes (7.0%), and coronary heart disease (6.0%). The prevalence of *H. pylori* infection was 30.5% (91/298) (*Table 1*).

No collinearity was found among the variables. Univariate logistic regression analysis showed that history of drinking tea (OR =1.816; 95% CI: 1.074–3.070; P=0.02), poor personal habit (OR =2.678; 95% CI: 1.518–4.722; P=0.001), and poor hygienic habit (OR =5.767; 95% CI: 3.063–15.826; P<0.001) were associated with an increased risk of *H. pylori* infection. Multivariate logistic regression analysis showed that only poor personal habit (OR =2.069; 95% CI: 1.142–3.750; P=0.01) and poor hygienic habit (OR =5.767; 95% CI: 2.498–13.312; P<0.001) were independently associated with an increased risk of *H. pylori* infection (*Table 2*).

Military patients

Among the 59 military patients, 55 (93.2%) were male, and the minority had a medical history of hypertension (11.9%), diabetes (1.7%), and coronary heart disease (1.7%). The prevalence of *H. pylori* infection in military patients was 35.6% (21/59) (*Table 3*).

No collinearity was found among the variables. Univariate logistic regression analysis showed that history of drinking tea (OR =3.321; 95% CI: 1.009–10.934; P=0.04) and poor hygienic habit (OR =6.196; 95% CI: 1.256–30.553; P=0.02) were associated with an increased risk of *H. pylori* infection. Multivariate logistic regression analysis showed that only poor hygienic habit (OR =6.542; 95% CI: 1.260–33.959; P=0.02) was independently associated with an increased risk of *H. pylori* infection (*Table 4*).

Civilian patients

Among the 239 civilian patients, 112 (46.9%) were male, 236 (98.7%) were married, and the minority reported a medical history of hypertension (19.7%), diabetes (8.4%), and coronary heart disease (7.1%). The prevalence of *H. pylori* infection in civilian patients was 29.3% (70/239) (*Table 5*).

No collinearity was found among the variables. Univariate logistic regression analysis showed that poor personal habit (OR =2.855; 95% CI: 1.543–5.281; P=0.001) and poor hygienic habit (OR =7.343; 95% CI: 2.805–19.220; P<0.001) were associated with an increased risk of *H. pylori* infection. Multivariate logistic regression analysis showed

Table 1 Difference between overall patients with positive and negative *H. pylori* infection

Variables	Overall (N=298)	*H. pylori* positive (N=91)	*H. pylori* negative (N=207)	P value
Gender (male), n (%)	167 (56.0)	55 (60.4)	112 (54.1)	0.31
Age (≥50 years), n (%)	206 (69.1)	69 (75.8)	137 (66.2)	0.09
Marital status (married), n (%)	266 (89.3)	82 (90.1)	184 (88.9)	0.75
Education level, n (%)				
Middle school or below	86 (28.9)	29 (31.9)	57 (27.5)	0.44
High school or technical school	136 (45.6)	37 (40.7)	99 (47.8)	0.25
University or above	76 (25.5)	25 (27.5)	51 (24.6)	0.60
History of hypertension, n (%)	54 (18.1)	16 (17.6)	38 (18.4)	0.87
History of diabetes, n (%)	21 (7.0)	10 (11.0)	11 (5.3)	0.07
History of coronary heart disease, n (%)	18 (6.0)	4 (4.4)	14 (6.8)	0.42
History of drinking tea, n (%)	88 (29.5)	35 (38.5)	53 (25.6)	0.02*
History of drinking coffee, n (%)	22 (7.4)	5 (5.5)	17 (8.2)	0.40
Poor personal habit, n (%)	189 (63.4)	71 (78.0)	118 (57.0)	0.001*
Poor hygienic habit, n (%)	215 (72.1)	84 (92.3)	131 (63.3)	<0.001*
Living in the rural area, n (%)	64 (21.5)	21 (23.1)	43 (20.8)	0.65
Annual family income <50,000 RMB, n (%)	127 (42.6)	40 (44.0)	87 (42.0)	0.75
Family history of *H. pylori* infection, n (%)	13 (4.4)	6 (6.6)	7 (3.4)	0.21

*, statistical significance. *H. pylori*, *Helicobacter pylori*.

Table 2 Logistic regression analyses of risk factors for *H. pylori* infection in overall patients

Variables	Univariate analysis			Multivariate analysis		
	OR	95% CI	P value	OR	95% CI	P value
Gender (male *vs.* female)	1.296	0.785–2.139	0.31	–	–	–
Age (≥50 years)	1.603	0.916–2.804	0.09	–	–	–
Marital status (married *vs.* unmarried)	1.139	0.505–2.569	0.75	–	–	–
Education level (High school or below *vs.* University or above)	0.863	0.494–1.509	0.60	–	–	–
History of drinking tea (yes *vs.* no)	1.816	1.074–3.070	0.02*	1.290	0.741–2.246	0.36
History of drinking coffee (yes *vs.* no)	0.650	0.232–1.819	0.41	–	–	–
Poor personal habit (yes *vs.* no)	2.678	1.518–4.722	0.001*	2.069	1.142–3.750	0.01*
Poor hygienic habit (yes *vs.* no)	6.962	3.063–15.826	<0.001*	5.767	2.498–13.312	<0.001*
Living in the rural area (yes *vs.* no)	1.144	0.633–2.068	0.65	–	–	–
Annual family income <50,000 RMB (yes *vs.* no)	1.082	0.658–1.779	0.75	–	–	–
Family history of *H. pylori* infection (yes *vs.* no)	2.017	0.658–6.179	0.21	–	–	–

*, statistical significance. *H. pylori*, *Helicobacter pylori*; OR, odds ratio; CI, confidence interval.

Table 3 Difference between military patients with positive and negative *H. pylori* infection

Variables	Overall (N=59)	*H. pylori* positive (N=21)	*H. pylori* negative (N=38)	P value
Gender (male), n (%)	55 (93.2)	19 (90.5)	36 (94.7)	0.93
Marital status (married), n (%)	30 (50.8)	12 (57.1)	18 (47.4)	0.47
Military service duration (≥3 years), n (%)	51 (86.4)	20 (95.2)	31 (81.6)	0.28
Number of people living in the same dormitory (≥3), n (%)	45 (76.3)	19 (90.5)	26 (68.4)	0.05
Education level, n (%)				
Middle school or below	2 (3.4)	2 (9.5)	0 (0.0)	0.23
High school or technical school	33 (55.9)	11 (52.4)	22 (57.9)	0.78
University or above	24 (40.7)	8 (38.1)	16 (42.1)	0.79
History of hypertension, n (%)	7 (11.9)	3 (14.3)	4 (10.5)	>0.99
History of diabetes, n (%)	1 (1.7)	0 (0.0)	1 (2.6)	>0.99
History of coronary heart disease, n (%)	1 (1.7)	1 (4.8)	0 (0.0)	0.76
History of drinking tea, n (%)	16 (27.1)	9 (42.9)	7 (18.4)	0.04*
History of drinking coffee, n (%)	6 (10.2)	1 (4.8)	5 (13.2)	0.56
Poor personal habit, n (%)	52 (88.1)	19 (90.5)	33 (86.8)	>0.99
Poor hygienic habit, n (%)	42 (71.2)	19 (90.5)	23 (60.5)	0.01*
Living in the rural area, n (%)	11 (18.6)	4 (19.0)	7 (18.4)	>0.99
Annual family income <50,000 RMB, n (%)	5 (8.5)	1 (4.8)	4 (10.5)	0.78
Family history of *H. pylori* infection, n (%)	3 (5.1)	2 (9.5)	1 (2.6)	0.59

*, statistical significance. *H. pylori*, *Helicobacter pylori*.

Table 4 Logistic regression analyses of risk factors for *H. pylori* infection in military patients

Variables	Univariate analysis			Multivariate analysis		
	OR	95% CI	P value	OR	95% CI	P value
Gender (male *vs.* female)	0.528	0.069–4.048	0.53	–	–	–
Marital status (married *vs.* unmarried)	1.481	0.506–4.334	0.47	–	–	–
Military service duration (≥3 *vs.*<3 years)	4.516	0.516–39.529	0.17	–	–	–
Number of people living in the same dormitory (≥3 *vs.*<3)	4.385	0.877–21.926	0.07	–	–	–
Education level (High school or below *vs.* University or above)	1.182	0.397–3.519	0.76	–	–	–
History of drinking tea (yes *vs.* no)	3.321	1.009–10.934	0.04*	3.545	0.982–12.794	0.05
History of drinking coffee (yes *vs.* no)	0.330	0.036–3.031	0.32	–	–	–
Poor personal habit (yes *vs.* no)	1.439	0.254–8.154	0.68	–	–	–
Poor hygienic habit (yes *vs.* no)	6.196	1.256–30.553	0.02*	6.542	1.260–33.959	0.02*
Living in the rural area (yes *vs.* no)	1.042	0.267–4.074	0.95	–	–	–
Annual family income <50,000 RMB (yes *vs.* no)	0.425	0.044–4.072	0.45	–	–	–
Family history of *H. pylori* infection (yes *vs.* no)	3.895	0.332–45.741	0.27	–	–	–

*, statistical significance. *H. pylori*, *Helicobacter pylori*; OR, odds ratio; CI, confidence interval.

Table 5 Difference between civilian patients with positive and negative *H. pylori* infection

Variables	Overall (N=239)	*H. pylori* positive (N=70)	*H. pylori* negative (N=169)	P value
Gender (male), n (%)	112 (46.9)	36 (51.4)	76 (45.0)	0.36
Marital status (married), n (%)	236 (98.7)	70 (100.0)	166 (98.2)	0.62
Education level, n (%)				
Middle school or below	84 (35.1)	27 (38.6)	57 (33.7)	0.47
High school or technical school	103 (43.1)	26 (37.1)	77 (45.6)	0.23
University or above	52 (21.8)	17 (24.3)	35 (20.7)	0.54
History of hypertension, n (%)	47 (19.7)	13 (18.6)	34 (20.1)	0.78
History of diabetes, n (%)	20 (8.4)	10 (14.3)	10 (5.9)	0.03*
History of coronary heart disease, n (%)	17 (7.1)	3 (4.3)	14 (8.3)	0.27
History of drinking tea, n (%)	72 (30.1)	26 (37.1)	46 (27.2)	0.12
History of drinking coffee, n (%)	16 (6.7)	4 (5.7)	12 (7.1)	0.91
Poor personal habit, n (%)	137 (57.3)	52 (74.3)	85 (50.3)	0.001*
Poor hygienic habit, n (%)	173 (72.4)	65 (92.9)	108 (63.9)	<0.001*
Living in the rural area, n (%)	53 (22.2)	17 (24.3)	36 (21.3)	0.61
Annual family income <50,000 RMB, n (%)	122 (51.0)	39 (55.7)	83 (49.1)	0.35
Family history of *H. pylori* infection, n (%)	10 (4.2)	4 (5.7)	6 (3.6)	0.68

*, statistical significance. *H. pylori*, *Helicobacter pylori*.

Table 6 Logistic regression analyses of risk factors for *H. pylori* infection in civilian patients

Variables	Univariate analysis			Multivariate analysis		
	OR	95% CI	P value	OR	95% CI	P value
Gender (male *vs.* female)	1.296	0.741–2.264	0.36	–	–	–
Education level (High school or below *vs.* University or above)	0.814	0.420–1.577	0.54	–	–	–
History of drinking tea (yes *vs.* no)	1.580	0.875–2.854	0.13	–	–	–
History of drinking coffee (yes *vs.* no)	0.793	0.247–2.549	0.69	–	–	–
Poor personal habit (yes *vs.* no)	2.855	1.543–5.281	0.001*	2.296	1.211–4.353	0.01*
Poor hygienic habit (yes *vs.* no)	7.343	2.805–19.220	<0.001*	6.279	2.373–16.612	<0.001*
Living in the rural area (yes *vs.* no)	1.185	0.613–2.290	0.61	–	–	–
Annual family income <50,000 RMB (yes *vs.* no)	1.304	0.745–2.282	0.35	–	–	–
Family history of *H. pylori* infection (yes *vs.* no)	1.646	0.450–6.024	0.45	–	–	–

*, statistical significance. *H. pylori*, *Helicobacter pylori*; OR, odds ratio; CI, confidence interval.

that poor personal habit (OR =2.296; 95% CI: 1.211–4.353; P=0.01) and poor hygienic habit (OR =6.279; 95% CI: 2.373–16.612; P<0.001) remain independently associated with an increased risk of *H. pylori* infection (*Table 6*).

Discussion

Our study found that the prevalence of *H. pylori* infection in inpatients was 30.5%, which was lower than that reported in previous studies from China (13). This finding may support a declining trend in the prevalence of *H. pylori* infection (14), probably due to the development of China's economy, the improvement of public health conditions and living standards, and the increased awareness and willingness to screen *H. pylori*.

An important finding of our study is that *H. pylori* infection was significantly associated with poor personal habit. First, active smokers and drinkers were more likely to have *H. pylori* infection. This could be attributed to destructive effects of smoking and drinking alcohol on the immunity of the gastric mucosa and lining layers, hence increasing their susceptibility to infection by *H. pylori* (15). Second, the gastric mucosa integrity is maintained by its defensive mechanisms against damaging factors (16). Spicy food and irregular diet may damage the gastric mucosa, which in turn decreases its ability to prevent from *H. pylori* infection. Third, eating out frequently can lead to *H. pylori* infection due to poor cleaning of tableware or contaminated food. Forth, contaminated water supply may serve as an environmental source of *H. pylori* infection. Currently, the US Environmental Protection Agency includes *H. pylori* in its Contaminant Candidate List, which comprises chemical and microbiological contaminants that are known to be present in drinking water systems and are suspected to pose public health risks (17). Multiple studies have confirmed the occurrence of *H. pylori* in drinking water around the world (18,19).

Another important finding of our study is that *H. pylori* infection was also significantly associated with poor hygienic habit. The frequency distribution of *H. pylori* infection among different populations and among different socioeconomic groups within a given population is clearly correlated with the standards of public hygiene (20). First, previous studies have shown that poor hand hygiene may have a higher risk of gastrointestinal infection; by comparison, good hand hygienic habits can effectively prevent from diseases (21). Such an association between hand hygiene and *H. pylori* infection may be in favor of *H. pylori* transmission by the fecal-oral route. Second, sharing cups may lead to cross-infection and oral transmission of *H. pylori*, because *H. pylori* DNA has been found in saliva (22). Third, halitosis symptoms can be observed in people with dental calculus and plaque, which can provide an environment for oral *H. pylori* colonization. Then, oral *H. pylori* invades the stomach with saliva, which can lead to gastric *H. pylori* infection (23). Therefore, oral health conditions may directly or indirectly affect the process of *H. pylori* infection or reinfection (24). On the other hand, halitosis is caused by volatile sulfur compounds (VSCs), which are generated through the decomposition of protein contained in food residue by oral bacteria (25). An increased level of VSCs may lead to erosive changes in upper gastrointestinal tract mucosa, which in turn leads to *H. pylori* colonization at the injured site (26,27).

We further confirmed that poor hygienic habit was independently associated with an increased risk of *H. pylori* infection in military patients. Notably, military personnel often live in poor hygienic conditions during military training and missions (28), which increases the risk of *H. pylori* infection. Our recent systematic review also indicated that the prevalence of *H. pylori* infection was higher in military personnel presenting with halitosis (29). Thus, the improvement of hygienic conditions and habits in this unique occupational group significantly diminishes the risk of developing contagious diseases of the digestive system.

Our univariate analyses also demonstrated that the risk of *H. pylori* infection was associated with drinking tea in the overall patients, especially among military groups. By contrast, previous studies found that drinking tea can prevent from *H. pylori* infection through antibacterial activity of catechins (30). This difference may be closely related to the discrepancy in drinking tea habits among regions. Most Chinese people are used to drinking tea on an empty stomach, drinking strong tea, and leaving tea residue in the cup after drinking tea. Tea residue contains cadmium, lead, mercury, arsenic, and other harmful metals and even some carcinogens, such as nitrite. These substances will adhere to the surface of the tea cup and enter the digestive system with drinking tea, and then combine with proteins, fatty acids, and vitamins in food to form insoluble precipitates. It not only hinders the absorption and digestion of these nutrients, but also damages the gastrointestinal mucosa, facilitating *H. pylori* colonization (31).

The length of service of military personnel, a special occupational group, may affect *H. pylori* infection. A previous study showed that the *H. pylori* infection rate in military personnel serving for 3 years or more (63.2%) was significantly higher than those serving for less than 3 years (53.4%), and the difference was statistically significant between the two groups (P=0.028) (32). Accordingly, the military service duration was defined in the present study. However, we did not find any significant difference.

There are some limitations in our study. First, a relatively small number of inpatients may underestimate the impact of some risk factors on the development of *H. pylori* infection. Second, our study population is only symptomatic patients admitted to the hospital, which cannot sufficiently reflect the real number of patients infected by *H. pylori*.

Third, some questions evaluated in our patients may be more subjective. For example, halitosis is not evaluated by objective methods, such as the organoleptic method or volatile sulfur monitoring. Thus, our statistical results are potentially biased.

Conclusions

In conclusion, poor personal and hygienic habits may predispose to *H. pylori* infection. In future, it is necessary to design more rigorous large-scale studies to further verify these risk factors and establish a simple prediction model to more accurately evaluate the risk of *H. pylori* infection among military personnel.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://amj.amegroups.com/article/view/10.21037/amj-22-37/rc

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Medical Ethics Committee of the General Hospital of Northern Theater Command (No. Y [2021] 106) and the individuals' informed consents for this retrospective analysis were waived.

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