

# Prevalence of *Helicobacter pylori* Infection in Military Personnel from Northeast China: A Cross-Sectional Study

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**Purpose:** *Helicobacter pylori* infection is an important cause of peptic ulcer disease and gastric cancer. Current knowledge regarding epidemiology of *H. pylori* infection in military personnel has insufficiently been updated. This cross-sectional study aimed to estimate the prevalence of *H. pylori* infection in military personnel and to compare the prevalences in military and civilian groups.

**Patients and Methods:** We retrospectively enrolled the subjects who underwent <sup>14</sup>C-urea breath tests at the Department of Gastroenterology of the General Hospital of Northern Theater Command between January 2017 and July 2020. Subjects were divided into military and civilian groups. *H. pylori* infection and major endoscopic findings were reviewed.

**Results:** Overall, 23,496 subjects were eligible, including 2282 subjects in the military group and 21,214 subjects in the civilian group. In the overall analysis, the prevalence of *H. pylori* infection was not significantly different between military and civilian groups (33.9% versus 34.4%,  $P=0.592$ ). In the population aged 17–25 years, the prevalence of *H. pylori* infection was significantly higher in the military group than in the civilian group (35.6% versus 25.9%,  $P=0.001$ ). Both <sup>14</sup>C-UBT and endoscopy were performed in 547 inpatients, including 83 military inpatients and 464 civilian inpatients. There was a significantly higher prevalence of *H. pylori* in inpatients with peptic ulcer and/or gastric cancer than in those without (65.5% versus 41.4%,  $P=0.001$ ).

**Conclusion:** Among the adolescent population, *H. pylori* infection may be more common in military personnel as compared to the civilians. Well-designed prospective studies should be required to validate such a high prevalence and to explain its potential causes.

**Keywords:** *Helicobacter pylori*, prevalence, military, epidemiology, endoscopy

## Introduction

*Helicobacter pylori* infection is one of the most common bacterial infections in humans.<sup>1</sup> The prevalence of *H. pylori* infection varies around the world. The *H. pylori* infection rate is about 50.8% in developing countries as compared to 34.7% in developed countries.<sup>2</sup> Such a variation is dependent upon society and geographic location, and is affected by environmental factors, socio-demographic characteristics, socio-economic status, health habits and population lifestyles.<sup>3,4</sup> Risk factors of *H. pylori* infection include age, smoking, drinking, socioeconomic status and living environment.<sup>5–8</sup> It has been widely confirmed that *H. pylori* infection is associated with chronic active gastritis, peptic ulcer disease, gastric

adenocarcinoma and mucosa-associated lymphoid tissue lymphoma.<sup>9–11</sup> It has been categorized as a Class I carcinogen according to the World Health Organization.<sup>12</sup>

Military personnel are the most powerful guarantors for safeguarding the territorial integrity of the country and for protecting the people to live and work in the country. Physical and mental health is of particular importance for such a unique population. However, they often suffer from chronic mental and physical health conditions,<sup>13,14</sup> because they have to experience high-pressure military and survival training in extremely harsh environments. This will reduce humoral and cellular immune responses and may aggravate the severity of *H. pylori* infection.<sup>15</sup> In addition, military personnel often endure great pressures from personal development, interpersonal relationships and family and economic situations.<sup>16</sup> As a result, military personnel may have a higher risk of *H. pylori* infection.<sup>17</sup>

Knowledge regarding the epidemiology of *H. pylori* infection in military personnel is of great significance to guide in preventing *H. pylori* infection and decreasing its related diseases, thereby improving the combat effectiveness of the army. However, until now, the evidence on the prevalence of *H. pylori* infection in military personnel is scarce. Herein, the purpose of the present cross-sectional study was to determine the prevalence of *H. pylori* infection in military personnel from Northeast China and to compare the prevalences in the military and civilian groups.

## Methods

### Study Design

We retrospectively analyzed the data of <sup>14</sup>C-urea breath test (UBT) performed at the Department of Gastroenterology of our hospital from January 2017 to July 2020. Exclusion criteria were as follows: 1) disintegrations per minute (DPM) values for <sup>14</sup>C-UBT tests were lacking; 2) medical records were lacking; 3) subjects had a definite history of *H. pylori* eradication; and 4) repeated <sup>14</sup>C-UBT tests were performed in the same subject. We primarily collected the information regarding demographics (ie, age and gender), subjects' identity (ie, military or civilian) and history of *H. pylori* eradication. Identity of eligible subjects could be clearly classified into military or civilian groups based on their unique ID number obtained from the electronic medical record

system of our hospital. In the current study, military personnel mainly refers to active servicemen in the combat or non-combat army. Besides, some non-active senior officers who are still guaranteed by the army were also included in the military personnel group. Otherwise, civilians are defined.

### <sup>14</sup>C-UBT

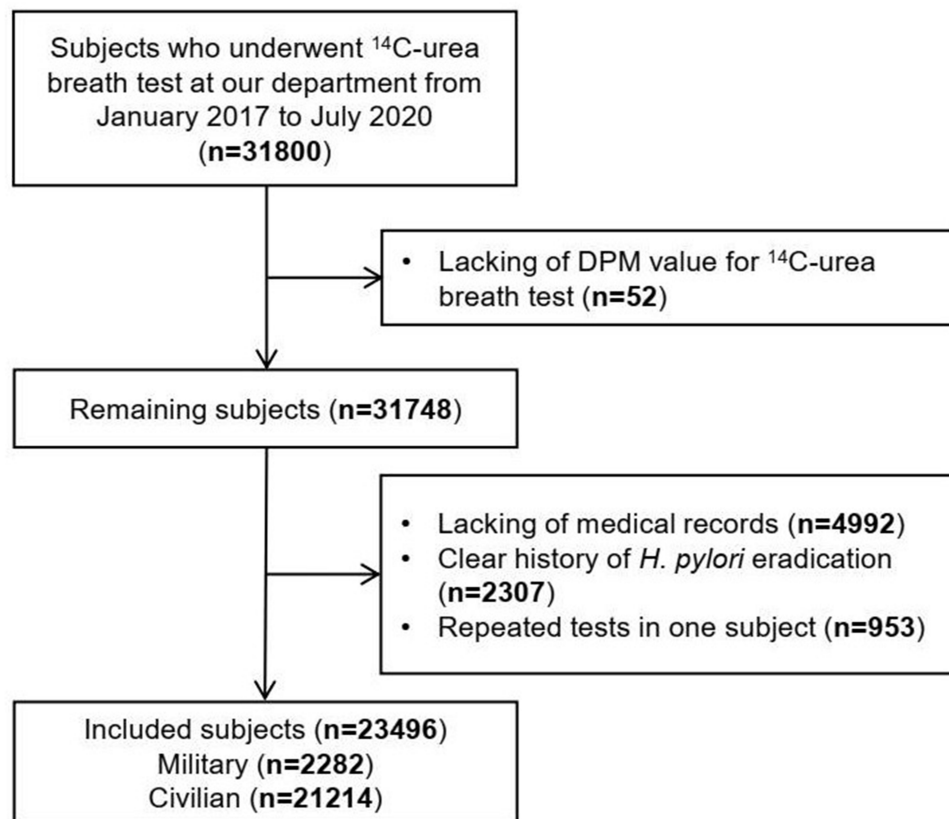
Subjects undergo <sup>14</sup>C-UBT tests fasting or 2 hours after eating. Before the <sup>14</sup>C-UBT test, subjects take one urea [<sup>14</sup>C] capsule (27.8 kBq) with cold drinking water and remain relatively calm for 5 minutes. A bottle of CO<sub>2</sub> gas collector is opened, and a clean gas duct with backflow prevention device is inserted. The lower end of the duct penetrates into the gas collector liquid, and the subjects blow air through the tube with moderate force. When the CO<sub>2</sub> gas collector turns from purple to colorless, the subjects stop blowing (about 1–3 minutes). After the gas sample is collected, 4.5 mL diluted scintillation solution is added into the sample bottle with a clean pipette, and the bottle is sealed with a cap. The sample is dissolved and shaken well into the tester [HUBT-01P (Shen Zhen Shi Zhong He Hai De Wei Sheng Wu Ke Ji You Xian Gong Si)] for *H. pylori* detection. A diagnosis of *H. pylori* infection is based on the <sup>14</sup>C-UBT result  $\geq 100$  DPM/mmolCO<sub>2</sub>.

### Upper Gastrointestinal Endoscopy

We also collected the information regarding endoscopic and pathological findings for inpatients, mainly peptic ulcer and gastric cancer. Among the inpatients, the criteria for upper gastrointestinal endoscopy are mainly based on the patient's digestive symptoms, as well as the attending physicians' decisions and the patient's willingness.

### Statistical Analyses

All statistical analyses were performed with IBM SPSS 20.0 (IBM Corp, Armonk, NY, USA) and Microsoft Office Excel 2010 software (Microsoft Corp, Redmond Washington, USA). Continuous variables were expressed as median (range). Categorical variables were expressed as frequency (percentage). Non-parametric Mann–Whitney *U*-test was used for continuous variables, and chi-square test was used for categorical variables to compare the prevalences in military and civilian groups. Subgroup analyses were performed according to the age, gender and endoscopic diagnosis. A two-sided  $P < 0.05$  was considered statistically significant.



**Figure 1** A flowchart of subject inclusion.

## Results

### Subject Characteristics

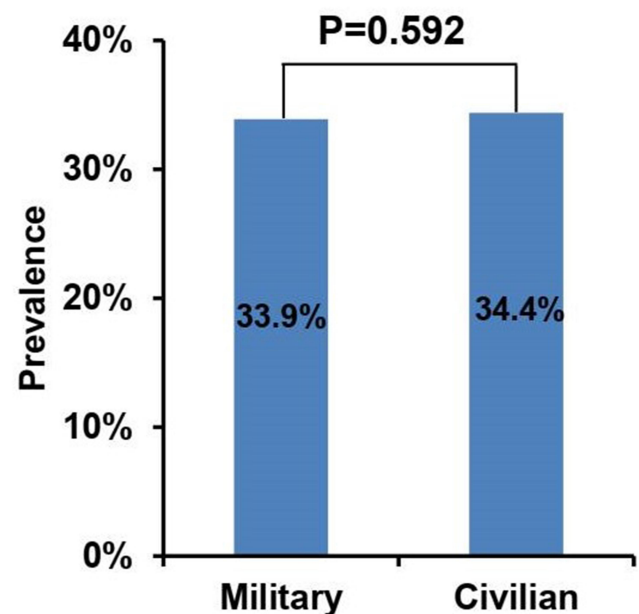
During the study period, there were a total of 31,800 <sup>14</sup>C-UBT records. Among them, 8304 records were excluded, because 52 subjects were lacking the DPM values for <sup>14</sup>C-UBT; 4992 subjects were lacking medical records; 2307 subjects had a definite history of *H. pylori* eradication; and 953 subjects had repeated <sup>14</sup>C-UBT tests. Finally, 23,496 subjects were eligible, including 2282 military subjects and 21,214 civilian subjects (Figure 1). The median age of the military group was 36.00 years (range: 17.00–96.00); and 87.29% (1992/2282) were male. The median age of civilian group was 51.00 years (range: 8.00–94.00); and 44.25% (9387/21,214) were male.

### Prevalence of *H. pylori* Infection

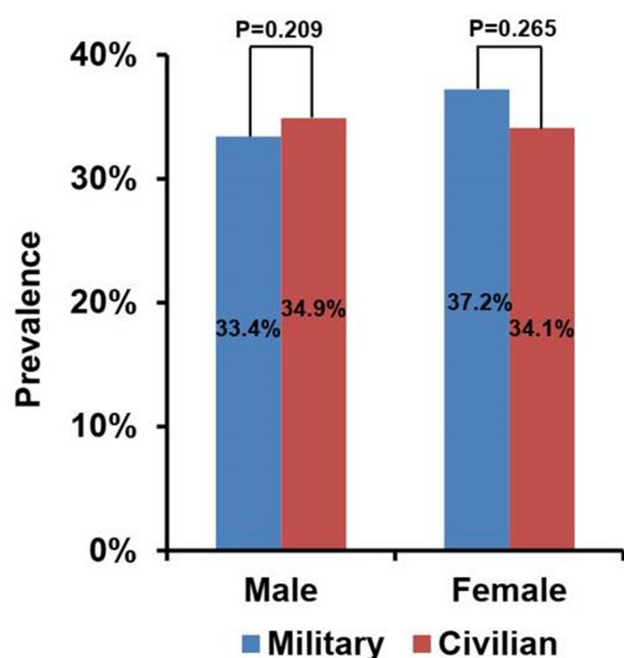
In the overall analysis, the prevalence of *H. pylori* infection was not significantly different between military and civilian groups (33.9% [773/2282] versus 34.4% [7305/21,214],  $P=0.592$ ) (Figure 2).

In the male population, the prevalence of *H. pylori* infection was not significantly different between military and civilian groups (33.4% [665/1992] versus 34.9% [3272/9387],  $P=0.209$ ). In the female population, the prevalence

of *H. pylori* infection was not significantly different between military and civilian groups (37.2% [108/290] versus 34.1% [4033/11,827],  $P=0.265$ ) (Figure 3).



**Figure 2** Overall analysis of the prevalence of *Helicobacter pylori* infection between military and civilian groups.



**Figure 3** Gender analysis of the prevalence of *Helicobacter pylori* infection between military and civilian groups.

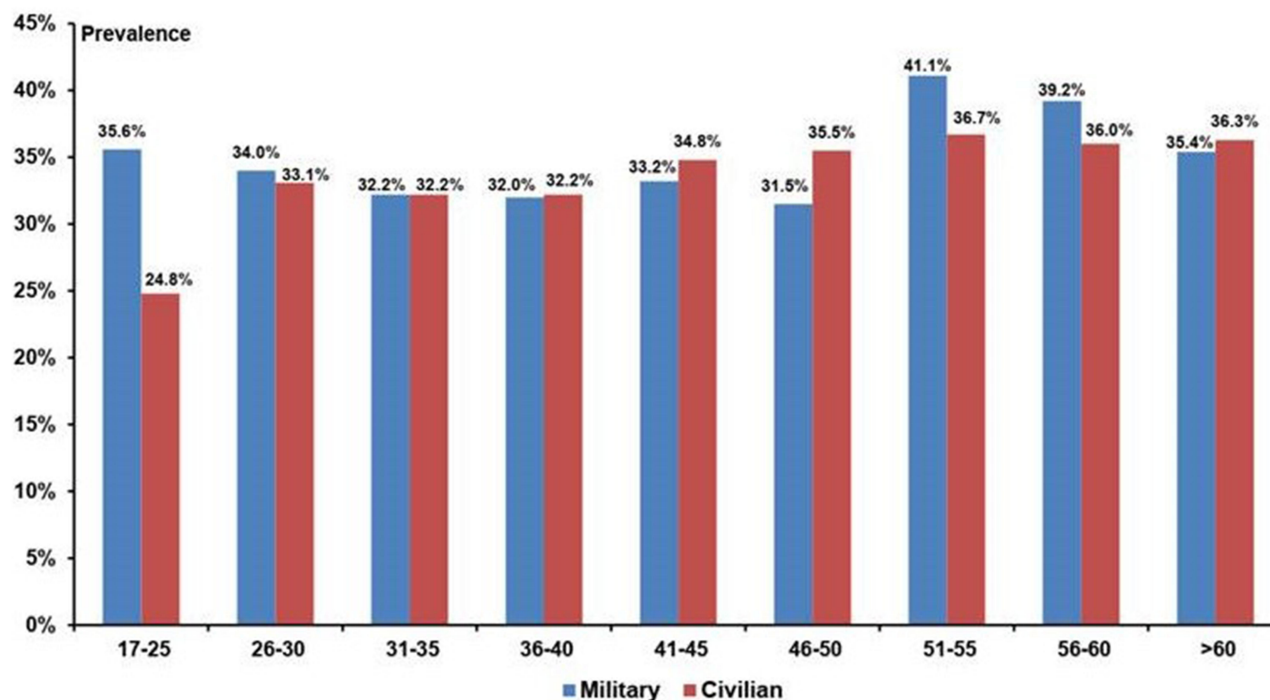
In the population aged 17–25 years, the prevalence of *H. pylori* infection was significantly higher in the military group than in the civilian group (35.6% [94/264] versus 25.9% [281/1132],  $P=0.001$ ) (Figure 4). However, in other age populations, the prevalence of *H. pylori* infection was

not significantly different between military and civilian groups.

### Upper Gastrointestinal Endoscopy

Five hundred and forty-seven inpatients, including 83 military inpatients and 464 civilian inpatients, underwent both  $^{14}\text{C}$ -UBT and upper gastrointestinal endoscopy. The median age of the military group was 48.00 years (range: 19.00–92.00); and 96.40% (80/83) were male. The median age of the civilian group was 58.00 years (range: 17.00–86.00); and 61.60% (286/464) were male. Among them, the prevalence of *H. pylori* infection was 49.91% (273/547); the prevalence of peptic ulcer and/or gastric cancer was 35.47% (194/547), including 186 peptic ulcer and 8 gastric cancer. There was a significantly higher prevalence of *H. pylori* infection in inpatients with peptic ulcer and/or gastric cancer than in those without (65.5% [127/194] versus 41.4% [146/353],  $P=0.001$ ).

The prevalence of peptic ulcer and/or gastric cancer was higher in the military group than in the civilian group, but the difference was not statistically significant (44.6% [37/83] versus 33.8% [157/464],  $P=0.060$ ). By contrast, the prevalence of peptic ulcer and/or gastric cancer was statistically similar between *H. pylori* positive military and civilian groups (43.5% [20/46] versus 47.1% [107/227],  $P=0.650$ ) (Table 1).



**Figure 4** Age analysis of the prevalence of *Helicobacter pylori* infection between military and civilian groups.

**Table I** Comparison of Prevalence of Peptic Ulcer and/or Gastric Cancer Between Military and Civilian Groups

Variables	Military Group		Civilian Group		P value
	No. Pts.	Frequency (Percentage)	No. Pts.	Frequency (Percentage)	
Peptic ulcer and/or gastric cancer	83	37 (44.6%)	464	157 (33.8%)	0.060
Peptic ulcer and/or gastric cancer and <i>H. pylori</i> positive	46	20 (43.5%)	227	107 (47.1%)	0.650

**Abbreviations:** Pts., patients; *H. pylori*, *Helicobacter pylori*.

## Discussion

By using a relatively large population-based sample, we observed that the prevalence of *H. pylori* in the military personnel was 33.9%, which was similar to that in our civilian participants (34.4%). However, the prevalence was lower than that reported in previous Chinese studies. Among them, 510 air force personnel from the Chinese Southern Theater underwent serology antibody assessment and <sup>14</sup>C-UBT, and the prevalence of *H. pylori* was 59.2%;<sup>18</sup> 1649 Chinese army and navy recruits underwent <sup>13</sup>C-UBT, and the prevalence of *H. pylori* was 46.5%;<sup>19</sup> 1293 Chinese army personnel underwent <sup>13</sup>C-UBT, and the prevalence of *H. pylori* was 45.63%.<sup>20</sup>

Additionally, the prevalence of *H. pylori* infection varies among countries, which may be related to regional, ethnic and national socioeconomic conditions,<sup>21</sup> and among armies which may be related to military environment, logistic equipment and sanitary conditions. Our prevalence was higher than that reported in other countries, where the *H. pylori* seropositive rate was 26.3% in US army recruits,<sup>22</sup> 23% in Hungarian male recruits<sup>23</sup> and 27.23% in Greek navy recruits.<sup>24</sup>

In the adolescent population, the prevalence of *H. pylori* infection was significantly higher in the military group than in the civilian group. This may be explained by the following. First, the recruits need to go through high-intensity military training, which is a psychologically and physically demanding process, for the purpose of achieving physical standards established by the army.<sup>25</sup> Extensive military training can cause mental stress,<sup>26</sup> which suppresses the body's humoral and cellular immunity and increases the risk of *H. pylori* infection.<sup>15</sup> Second, lots of young soldiers live collectively in a barrack and share the same dormitory.<sup>27</sup> Overcrowding, which is common in military communities, has been shown to be an important risk factor for *H. pylori* infection.<sup>28</sup>

We also found the prevalence of peptic ulcer and/or gastric cancer was higher in the military group than in the civilian group, which was consistent with previous findings,<sup>29</sup> however, the prevalence of peptic ulcer and/or gastric cancer in the *H. pylori* positive military groups was lower than in the *H. pylori* positive civilian groups. This finding suggests that other causes, except for *H. pylori* infection, make more contributions to the development of peptic ulcer and/or gastric cancer in military personnel. Notably, our recent systematic review indicated that the 6 most important risk factors for peptic ulcer in military personnel were history of smoking, followed by high-intensity training, mental stress, family history of peptic ulcer, history of alcohol drinking and use of non-steroidal anti-inflammatory drugs.<sup>30</sup>

In this study, the <sup>14</sup>C-UBT was used to detect the presence of *H. pylori*. It is noninvasive and has become increasingly more popular than invasive tests for the diagnosis of *H. pylori* infection. <sup>14</sup>C-UBT has a high diagnostic accuracy for detecting *H. pylori* infections.<sup>31</sup> It is able to detect current *H. pylori* infection,<sup>32</sup> and is used to evaluate the efficacy of *H. pylori* eradication therapy. However, there are some limitations regarding the use of <sup>14</sup>C-UBT. For example, a history of antibiotics use, proton pump inhibitors or bismuth may produce false negative results.<sup>33</sup> In addition, the <sup>14</sup>C-UBT is not recommended for use in children or pregnant women due to its radioactivity.<sup>31</sup>

There are some other limitations in our study. First, some subjects' information cannot be accurately traced by the electronic medical records, and then they have been excluded. Second, the history of *H. pylori* eradication has not been sufficiently reviewed. Third, there is a difference in the sample size between military and civilian groups. Fourth, we cannot distinguish the difference in the prevalence of *H. pylori* infection between combat and non-combat military personnel.

In conclusion, *H. pylori* infection is common in the military personnel from Northeast China, especially in the adolescent population. Therefore, we should strengthen

the screening of *H. pylori* in such populations in the future. Additionally, considering the negative impact of *H. pylori* infection, the risk factors for *H. pylori* infection should be further identified, and its effective prevention and treatment strategy should be established.

## Abbreviations

*H. pylori*, *Helicobacter pylori*; UBT, urea breath test; DPM, disintegrations per minute.

## Ethics Approval and Informed Consent

The study protocol has been approved by the Medical Ethical Committee of the General Hospital of Northern Theater Command with an approval number [Y (2021) 018] and performed according to the Declaration of Helsinki. Due to the nature of this retrospective observational study without any additional interventions, patients' informed consents were exempted. All personally identifiable records are kept confidential.

## Disclosure

The authors report no conflicts of interest in this work.

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