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Retrospective Study

Epidemiological investigation of *Helicobacter pylori* infection in elderly people in Beijing

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Author contributions: Zhang M and Zhu HM designed the research; She J, Liang XY, and Dong LK performed the research; Tang Z performed data and statistical analyses; Li BY analyzed data; Zhu HM wrote the paper.

Institutional review board

statement: This survey is a retrospective study, only collecting the clinical data of patients. Since it will not bring risks to patients' physiology and do not interfere with patients' treatment plan, and researchers will protect patients' information from disclosure, Xuanwu Hospital of Capital Medical University agreed to exempt this study from ethical review.

Informed consent statement: The research subjects of this survey have fully understood and agreed to the research content.

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Abstract

BACKGROUND

The *Helicobacter pylori* (*H. pylori*) infection rate in China is approximately 50%. *H. pylori* is a pathogenic factor of peptic ulcer and chronic gastritis. In addition, *H. pylori* infection may also be associated with a variety of cardiovascular diseases in elderly people, such as arteriosclerosis, coronary heart disease, and cerebral infarction, having deleterious effect on their health. With the aging of the population, the disease characteristics of the elderly population have been increasingly valued by the whole society. We conducted an epidemiological survey of *H. pylori* infection among elderly people in Beijing to provide a basis for health management of *H. pylori* infection.

AIM

To understand the epidemiological characteristics of *H. pylori* infection in elderly people in Beijing.

METHODS

A total of 1090 elderly people aged more than 60 years from different parts of Beijing (urban and rural areas) were selected using the random cluster sampling method. Structured questionnaires were completed during home visits and the ¹³C-urea breath test was conducted for *H. pylori* detection.

RESULTS

The prevalence of *H. pylori* infection was 46.5% (507/1090). The infection rate in men was 51.8%, which was significantly higher than that in women (42.5%; $P < 0.05$). The *H. pylori* infection rate in illiterate people was significantly higher than that in literate persons (53.5% vs 44.8%, $P < 0.05$). The total infection rate of *H. pylori* gradually increased with age and the difference was statistically significant ($P < 0.01$). The *H. pylori* infection rate in smokers was significantly higher than that in non-smokers and those who had quit smoking ($P < 0.05$).

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CONCLUSION

The prevalence of *H. pylori* infection among elderly people is 46.5% and the infection rate gradually increases with age. Sex, education level, age, and smoking were determined to be *H. pylori* infection risk factors. The relationship of *H. pylori* infection with region, occupation, drinking, and diet structure needs to be further studied.

Key words: *Helicobacter pylori*; Epidemiologic; Elderly persons; 13C-urea breath test; Prevalence; Characteristics

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Core tip: *Helicobacter pylori* (*H. pylori*) infection is globally distributed and elderly people are a high-risk population. With the ageing of society, the elderly population suffering from digestive diseases combined with *H. pylori* infection has accounted for a considerable proportion. We conducted an epidemiological survey of *H. pylori* infection among elderly people in Beijing to provide a basis for health management of *H. pylori* infection. This is a large elderly population and interesting associations between *H. pylori* and subjects' habits have been found. This article is the latest epidemiological study on the *H. pylori* infection in elderly people in Beijing, China.

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INTRODUCTION

Helicobacter pylori (*H. pylori*) infection is globally distributed^[1] and elderly people are a high-risk population. An Italian study reported that the infection rate among asymptomatic elderly people reaches 40%-60%, while the infection rate in the elderly with gastrointestinal diseases is > 70%^[2]. *H. pylori* can be infected in early childhood, although most infected people have no symptoms in their lifetime, and approximately 1%^[3] develop gastric cancer or gastric mucosa-associated lymphoid tissue lymphoma. Due to its ability to trigger gastric mucosal carcinogenesis, the International Agency for Research on Cancer has defined *H. pylori* as a class I carcinogen as early as 1994^[4]. *H. pylori* is a pathogenic factor of peptic ulcer and chronic gastritis. In addition, *H. pylori* infection may also be associated with a variety of cardiovascular diseases in elderly people, such as arteriosclerosis, coronary heart disease, and cerebral infarction^[5,6], having deleterious effect on their health. *H. pylori* infection is related to age, socioeconomic status, education level, and other factors. The infection rate in China is approximately 50%^[7]. With the aging of the population, the disease characteristics of the elderly population have been increasingly valued by the whole society. We conducted an epidemiological survey of *H. pylori* infection among elderly people in Beijing to provide a basis for health management of *H. pylori* infection.

MATERIALS AND METHODS

Research subjects

The cluster sampling was based on a random sample of the elderly population in both urban (Xuanwu) and rural (Daxing and Huairou) areas in Beijing, stratified by living conditions, education, and age in 2017. Informed consent was obtained from all the examinees. This study was reviewed and approved by the Xuanwu Hospital Institution Review Board.

Sample size estimation: According to the literature, the infection rate of *H. pylori* in the elderly is 40%^[2]. In order to understand the infection rate of *H. pylori* in the target population, the error is required to be no more than 2% ($\alpha = 0.05$), and the sample size is 1180. A total of 1180 questionnaires were distributed and 1090 were recovered, with

a response rate of 92.3%.

Eligibility criteria: The inclusion criteria were: (1) Age over 60 years old (gender unlimited); and (2) No antibiotics, bismuth, or proton pump inhibitors have been taken within 1 mo. The exclusion criteria were: (1) Those who did not have an empty stomach for more than 4 h on the test day; (2) Those who could not cooperate with the examination; (3) Those who underwent partial gastrectomy; and (4) Those who were allergic to urea-¹³C.

Survey

A questionnaire survey was carried out by the uniformly trained professionals. The survived data included history of *H. pylori* infection, dietary and hygiene habits, and smoking and drinking history. In addition, physical examination was performed, including blood pressure, height, weight, and waist and hip circumference measurement. Samples for blood biochemistry were also collected.

H. pylori detection method

The ¹³C urea breath test (¹³C-UBT) was used for detection of *H. pylori* infection. The test was performed on an empty stomach in the morning using a commercial kit (Beijing Haide Run Pharmaceutical Group Co., Ltd.). First, baseline samples were collected. Subjects were instructed to exhale as much air as possible in the blue bottom air bag. Next, they took urea ¹³C tablets with 100 mL of warm water. After 30 min, testing samples were collected. Subjects were instructed to exhale as much air as possible in the red bottom air bag. The 0-min and 30-min sample air bags were analyzed using external ¹³C infrared spectrometer for ¹³CO₂ detection (IRIS-Lab ¹³C infrared spectrometer; Wagner, Germany). The detection value (DOB) was determined as follows: $DOB = \delta\%_{(30\text{ min})} - \delta\%_{(0\text{ min})}$. The test was considered positive when $DOB \geq 4.0$.

Statistical analysis

The survey data were analyzed using EpiData software. After comparing and correcting the errors, the EpiData data were exported and converted into SPSS files. Measurement data are expressed as the mean \pm SD ($\bar{x} \pm s$) and were analyzed using the *t* test. Count data are expressed as rates (%) and were analyzed using the χ^2 test. *P* < 0.05 was considered statistically significant. All calculations were performed using SPSS ver. 17.0 statistical software.

RESULTS

A total of 1180 elderly people aged > 60 years were randomly selected. Among them, 1090 were tested for *H. pylori*. Their average age was 70.77 years. There were 469 (43.0%) men and 621 (56.9%) women, with 665 (61.0%) and 425 (39.0%) subjects from rural and urban areas, respectively. According to the age group, there were 279 (25.5%) subjects aged 60-64 years; 263 (24.1%) aged 65-69 years; 209 (19.2%) aged 70-74 years; 171 (15.6%) aged 75-80 years; and 168 (15.4%) aged 80 years or older.

Characteristics of *H. pylori* infection according to sex, education level, and region

Of the 1090 elderly persons, 507 were found to have *H. pylori* infection, with an infection rate of 46.5%. According to the sex, the infection rate was significantly higher in men (51.8%) than in women (42.5%) ($\chi^2 = 9.290$, *P* < 0.05). According to the education level, the *H. pylori* infection rate was significantly higher in illiterate (53.5%) than in literate (44.8%) subjects ($\chi^2 = 5.124$, *P* < 0.05). According to the region of residence, the urban infection rate (48.9%) was slightly higher than that of rural areas (44.9%), but there was no significant difference between the two groups ($\chi^2 = 1.650$, *P* > 0.05, Table 1).

Characteristics of *H. pylori* infection according to age

The *H. pylori* infection rates in different age groups are presented in Table 2. The total infection rate gradually increased with age and the difference was statistically significant ($\chi^2 = 13.518$, *P* = 0.009).

Occupational distribution characteristics of *H. pylori* infection

Among the 1090 elderly subjects surveyed, 1081 had clearly defined occupational categories. The positive rate of *H. pylori* infection was highest among those who had performed light physical work. However, there was no significant difference among different groups ($\chi^2 = 1.576$, *P* > 0.05; Table 3).

Table 1 Characteristics of *Helicobacter pylori* infection according to sex, education level, and region

	Subjects (n)	<i>H. pylori</i> positive (n)	<i>H. pylori</i> infection rate (%)	P value
Sex				0.002
Male	469	243	51.8 ^a	
Female	621	264	42.5	
Education level				0.024
Illiterate	209	112	53.5 ^a	
Literate	871	391	44.8	
Region				0.199
Rural (Daxing and Huairou)	665	299	44.9	
Urban (Xuanwu)	425	208	48.9	
Total	1090			

^a $P < 0.05$. *H. pylori*: *Helicobacter pylori*.

Relationship between *H. pylori* infection and dietary structure

Among the 1090 elderly subjects, we could clearly define the diet structure for 1077. According to the questionnaire, in the non-staple food, meatarians were defined as eating meat more than 3 days a week, and mainly vegetarians were defined as eating vegetables every day and meat occasionally. And the above situation needs to last for 1-5 years.

The *H. pylori* infection rate was the highest (47.5%) among the elderly subjects with a balanced diet. However, there was no significant difference among the three groups ($\chi^2 = 0.393$, $P > 0.05$; Table 4).

Relationship between *H. pylori* infection and smoking and drinking

According to the World Health Organization's relevant standards for defining drinkers and smokers, people who smoke continuously or cumulatively for half a year or more are defined as smokers; people who drink at least twice in seven days or for more than one year are defined as drinkers. Among the 1090 elderly subjects surveyed, the alcohol consumption status was clearly defined for 1076. The positive rate of *H. pylori* infection was the highest among those consuming alcohol (51.0%); however, the difference among the groups was not statistically significant ($\chi^2 = 3.832$, $P > 0.05$).

The smoking status was defined for 1081 of the 1090 elderly subjects surveyed. The positive rate of *H. pylori* infection in smokers was significantly higher than that in non-smokers and those who had quit smoking ($\chi^2 = 6.821$, $P < 0.05$; Table 5).

DISCUSSION

The results of this study showed that the current infection rate of *H. pylori* in this population in Beijing was 46.5%. According to epidemiological surveys, the infection rate of *H. pylori* was 39.9%-84.2% worldwide^[8-11]. The infection rate varies greatly in different countries and regions. Older people over 60 years of age are still the group with a higher infection rate^[2]. In 2005, the infection rates of *H. pylori* among elderly people in Shanghai and Beijing reached 72.4% and 83.4%, respectively^[12,13]. The reasons for the decrease in this rate in Beijing are thought to be as follows: (1) The data is the latest statistical data from the past three years, allowing for greater differences when compared with older data; and (2) In previous epidemiological studies, *H. pylori* serum antibody test was used. The disadvantage of serological test is that it cannot distinguish the present or previous infection of *H. pylori*. Compared with previous serological tests, the ¹³C-UBT used in this study has the advantage of high sensitivity and specificity for detecting a current *H. pylori* infection^[14,15]. The results of the ¹³C-UBT are related to the amount of bacteria in the stomach, the site of colonization in the stomach, and gastrointestinal motility, and may be affected by other diseases, although it can better reflect the status of *H. pylori* infection. According to the data, *H. pylori* infection rates in most countries have been declining since the beginning of the 21st century^[16-18]. A multicenter longitudinal study in South Korea showed that the positive rate of serological detection of *H. pylori* infection in 2011 was 54.4% (5873/10796), which was significantly lower than 59.6% in 2005 and 66.9% in 1998. The declining trend of serological positive rate of *H. pylori* infection may be due

Table 2 Characteristics of *Helicobacter pylori* infection according to age

Age (yr)	Subjects (n)	<i>H. pylori</i> infection	
		<i>H. pylori</i> positive (n)	<i>H. pylori</i> infection rate (%)
60-64	279	112	40.1 ^a
65-69	263	120	45.6
70-74	209	95	45.5
75-79	171	83	48.5
80 +	168	97	57.7
Total	1090	507	46.5

^a $P < 0.01$. *H. pylori*: *Helicobacter pylori*.

to the birth cohort effect. This suggests that we need to further study the human host factors and socio-economic and health factors associated with *H. pylori* infection^[19].

A wealth of epidemiological data^[20,21] indicates that the prevalence of *H. pylori* infection in men is higher than that in women. This study showed that the prevalence of *H. pylori* in elderly men in Beijing was higher than that in women ($P < 0.05$), which was consistent with the results of foreign surveys. The reason may be that the difference in hormone secretion between men and women affects gastric emptying and bacterial load, which requires further study. More social activities for men increase the chance of *H. pylori* infection. The living habits and eating habits of men and women are different, which can also increase the chance of *H. pylori* infection^[22].

Many epidemiological studies have shown that the prevalence of *H. pylori* increases with age^[23,24]. Our survey showed that the total infection rate of *H. pylori* in the elderly population is gradually increasing with age, and the difference was statistically significant ($P < 0.05$). It has also been recognized that *H. pylori* infection is closely related to the educational level. Studies have shown that individuals with lower educational level and socioeconomic status were 5.5 and 6.6 times more likely to be infected with *H. pylori*, respectively^[25]. This survey showed that the infection rate of *H. pylori* among illiterate elderly people was significantly higher than that in literate people ($P < 0.05$), which was consistent with the survey results at home and abroad.

H. pylori infection is usually closely related to people's living habits. This study showed that the infection rates in the elderly people had no significant correlation with different occupations and different dietary structures. Previous surveys^[13] of elderly persons in different urban and rural areas of Beijing (Huairou, Daxing, and Xuanwu) showed that the total infection rate of *H. pylori* in mountainous areas was higher than that in urban and suburban areas, with significantly statistical differences. However, in our survey, there was no significant difference in the *H. pylori* infection rate between urban and rural areas in Beijing ($P > 0.05$), which may be related to the acceleration of urbanization in Beijing, the large population mobility, the urban and rural environmental health, and the reduction of differences in socio-economic conditions.

The positive rate of *H. pylori* infection was the highest among those consuming alcohol. The *H. pylori* infection rate in smokers was significantly higher than that in non-smokers. It is suggested that tobacco and alcohol could damage the defense barrier of the gastric mucosa, affect prostaglandin synthesis in the gastric mucosa, and reduce mucus secretion and mucosal blood flow, resulting in weakening of the defense function of the gastric mucosa and making it vulnerable to *H. pylori* invasion^[26-28]. A meta-analysis also showed that the infection rate of *H. pylori* in drinkers has decreased and that moderate drinking may help to eliminate *H. pylori*^[29].

The inadequacy of this study is that the selected elderly population has certain particularity. Chronic atrophic gastritis has a high incidence in the elderly and increases with age^[26]. The accuracy of *H. pylori* diagnosis in atrophic gastritis is low. Because of low acid in the stomach, other urease positive bacteria may be colonized in patients with chronic atrophic gastritis, thus leading to false positive results^[30].

In conclusion, *H. pylori* infection among the elderly people in Beijing is closely related to sex, age, smoking, and education level, while the relationship of *H. pylori* infection with region, diet structure, occupation, and drinking needs further study.

Table 3 Occupational distribution characteristics of *Helicobacter pylori* infection

Occupational	Subjects (n)	<i>H. pylori</i> positive (n)	<i>H. pylori</i> infection rate (%)	P value
Mainly brain work	169	75	44.3	0.455
Light physical work	259	129	49.8	
Heavy physical work	653	299	45.7	
Total	1081	503		

H. pylori: *Helicobacter pylori*.

Table 4 Relationship between *Helicobacter pylori* infection and dietary structure

Dietary structure	Subjects (n)	<i>H. pylori</i> positive(n)	<i>H. pylori</i> infection rate (%)	P value
Mainly vegetarian	488	223	45.6	0.821
Mainly meat	84	38	45.2	
Balanced diet	505	240	47.5	
Total	1077	501		

H. pylori: *Helicobacter pylori*.

Table 5 Relationship between *Helicobacter pylori* infection and smoking and drinking

	Subjects (n)	<i>H. pylori</i> positive(n)	<i>H. pylori</i> infection rate (%)	P value
Consuming alcohol				0.147
Not drinking	738	330	44.7	
Drinking	292	149	51.0	
Quitting drinking	46	19	41.3	
Total	1076	498		
Smoking				0.033
Not smoking	767	346	45.1 ^a	
Smoking	210	114	54.2	
Quitting smoking	104	43	41.3	
Total	1081	503		

^a*P* < 0.05. *H. pylori*: *Helicobacter pylori*.

ARTICLE HIGHLIGHTS

Research background

Helicobacter pylori (*H. pylori*) infection is globally distributed. The *H. pylori* infection rate in China is approximately 50%. A large number of studies show that *H. pylori* infection rate increases with age. The infection rate among asymptomatic elderly people is 40%-60%, while the rate among elderly people with gastrointestinal diseases is more than 70%. This may be due to the low immunity of the elderly, poor living and health conditions, and low socio-economic status. *H. pylori* is a pathogenic factor of peptic ulcer and chronic gastritis. Compared with young people, the detection and treatment of *H. pylori* in the elderly should be regarded as an important goal in clinical practice, because it plays an important role in gastrointestinal diseases in the elderly. With the aging of the population, the disease characteristics of the elderly population have been increasingly valued by the whole society. We conducted an epidemiological survey of *H. pylori* infection among elderly people in Beijing to provide a basis for health management of *H. pylori* infection.

Research motivation

With the increase of age, the infection rate of *H. pylori* also increases. Compared with young people, the elderly have more non-steroidal anti-inflammatory drug-related gastrointestinal damage and higher incidence of functional dyspepsia, chronic atrophic gastritis, and gastric cancer. *H. pylori* infection will not only aggravate the non-steroidal anti-inflammatory drug-related gastrointestinal damage, but is also the known cause of chronic atrophic gastritis and

gastric cancer. *H. pylori* infection may also be associated with a variety of cardiovascular diseases in elderly people, such as arteriosclerosis, coronary heart disease, and cerebral infarction, having deleterious effect on their health. Therefore, *H. pylori* infection is more harmful to the elderly. We conducted an epidemiological survey of *H. pylori* infection among elderly people in Beijing to further improve the knowledge, prevention, diagnosis, and treatment of *H. pylori* infection and related diseases in the elderly.

Research objectives

The main objective of this study was to investigate the status of *H. pylori* infection in the elderly in different areas of Beijing. At the same time, we investigated the influencing factors of *H. pylori* infection in the elderly, including gender, region, occupation, history of *H. pylori* infection, and dietary and hygiene habits, to provide a basis for health management of *H. pylori* infection.

Research methods

The ^{13}C urea breath test (^{13}C -UBT) was used for detection of *H. pylori* infection. The test was performed on an empty stomach in the morning using a commercial kit. First, baseline samples were collected. Subjects were instructed to exhale as much air as possible in the blue bottom air bag. Next, they took urea ^{13}C tablets with 100 mL of warm water. After 30 min, testing samples were collected. Subjects were instructed to exhale as much air as possible in the red bottom air bag. The 0-min and 30-min sample air bags were analyzed using external ^{13}C infrared spectrometer for $^{13}\text{CO}_2$ detection. Compared with serological tests, the ^{13}C -UBT used in this study has the advantage of high sensitivity and specificity for detecting a current *H. pylori* infection.

Research results

The prevalence of *H. pylori* in elderly men in Beijing was higher than that in women ($P < 0.05$). Moreover, the infection rate of *H. pylori* among illiterate elderly people was significantly higher than that in literate people ($P < 0.05$). However, the infection rates in the elderly people had no significant correlation with occupation or dietary structure. In addition, the positive rate of *H. pylori* infection was the highest among those consuming alcohol and the *H. pylori* infection rate in smokers was significantly higher than that in non-smokers.

Research conclusions

H. pylori infection among the elderly people in Beijing is closely related to sex, age, smoking, and education level.

Research perspectives

The relationship of *H. pylori* infection with region, diet structure, occupation, and drinking needs further study.

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