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Investigation of *Helicobacter pylori* Infection and Its Related Factors in the Tianjin Binhai Area, China

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Abstract

Background: *Helicobacter pylori* is one of the most widely distributed and most common bacteria in the world. There is a discrepancy in the *H. pylori* infection rate among different regions and countries that may be due to many factors.
Objectives: The study aimed to determine the current status of *H. pylori* infection in the Tianjin Binhai area, China, and evaluate the factors related to *H. pylori* infection.
Methods: We recruited a sample of 2235 cases and conducted the ^{14}C or ^{13}C breath tests and questionnaire surveys. The factors affecting *H. pylori* infection were analyzed using the chi-square test and multiple logistic regression.
Results: The overall *H. pylori* infection rate was 45.6%, with the highest rate among male and married population and the lowest rate in the 11 - 20-year-old group. Moreover, populations with a high degree of culture or income had lower infection rates ($P < 0.05$). Populations who were smoking, drinking, eating seafood, or had more salt intake had higher infection rates ($P < 0.05$). Furthermore, the infection rate was higher in the population who had hypertension ($P = 0.001$) or dyspeptic symptoms ($P < 0.05$) in the last year. It was revealed that taking a previous *H. pylori* examination and education level were negatively correlated with *H. pylori* infection, and marital status was an important influential factor for *H. pylori* infection.
Conclusions: The rate of *H. pylori* infection was lower in the Tianjin Binhai area than in the whole country, which may be related to socioeconomic status and marital status. Furthermore, it is also probably related to gender and hypertension.

Keywords: *Helicobacter pylori*, Risk Factors, Epidemiological Study, Tianjin Binhai Area

1. Background

Helicobacter pylori is one of the most widely distributed and most common bacteria in the world (1). China is a country with a high incidence of *H. pylori* infection. The infection rate is 40 - 90% among the general population of China with an average rate of 58.07% (2). According to statistics, approximately 700 million people are infected with *H. pylori* in China (3). *Helicobacter pylori* infection is an important cause of digestive tract diseases such as chronic gastritis, digestive ulcer, gastric cancer, and gastric mucosa-associated lymphoid tissue (MALT) lymphoma. It is also related to parenteral diseases such as blood diseases, cardiovascular diseases, autoimmune diseases, and skin diseases (4). *Helicobacter pylori* infection is associated with several common gastrointestinal diseases such as peptic ulcer, gastric precancerous lesions, and others. This infection is also related to a variety of other systemic diseases such as cardiovascular disease and diabetes. In 1994, Mendall (5) first proposed that *H. pylori* infection had a certain correlation with the occurrence of coronary atherosclerotic heart disease.

Helicobacter pylori infection is in the association with geographic area and socioeconomic level. The *H. pylori* infection rate is lower in developed countries than in developing countries (6) so that the *H. pylori* infection rate is generally lower than 30% in developed countries, while its infection rate might be as high as 50 - 70% in developing countries. In a randomly selected sample of 930 adults aged 35 - 74 years from four areas of Italy, the *H. pylori* infection rate was 45% (7). In the UK, the *H. pylori* infection rate was 37% in male employees. In the United States, the *H. pylori* infection rate in the general population is approximately 30 - 40%.

Some studies have pointed out that the poorer economic status and a lower degree of culture may induce higher *H. pylori* infection rates (8). *Helicobacter pylori* infection has become a public health problem that seriously endangers the health of residents in China. There may be

large differences in the rate of *H. pylori* infection among various sectors of an area (8).

2. Objectives

We aimed to investigate and analyze the epidemic trend of *H. pylori* infection and its related factors in the Tianjin Binhai area to provide a scientific basis for the prevention of *H. pylori* infection in this area.

3. Methods

3.1. Patients and Criteria

To understand the current status of *H. pylori* infection in the Tianjin Binhai area and to evaluate the factors related to *H. pylori* infection, we conducted a study from January 2013 to July 2013. A total of 10 cluster sampling surveys were performed in the development zone, the urban zone and suburban zone of Tianjin Binhai area. In total, 2235 cases (835 males and 1400 females) were invited to participate in the study; however, 2128 cases were enrolled in the survey, with a response rate of 95.2%. The age range was 4 to 90-years-old, comprising 1985 adults ($\geq$ 18 years) and 143 children ($\leq$ 18 years). We excluded people with antibiotics or acid inhibitors use in the last three weeks, the previous diagnosis of cancer, a history of gastrectomy, and the age of $\leq$ 18 years. People from the same household were also excluded.

3.2. Survey Method

A questionnaire was developed by medical specialists according to the "National *Helicobacter pylori* bacterial epidemiological survey program". The questionnaire included general data such as gender, age, marital status, education level, occupation, income, residence areas, living habits, or habits and ways of life, formerly medical history, and family history.

3.3. Helicobacter pylori Detection Method

The ^{14}C urea breath test (^{14}C-UBT) was generally adopted and the ^{13}C urea breath test (^{13}C-UBT) was used in children and pregnant groups. We employed HUBT-20 and SN3357 types of *H. pylori* detection instruments (Shenzhen Zhonghe Haidewei Biotechnology Co., Ltd.) and ^{14}C and ^{13}C urea breath test kits. The ^{14}C-UBT was performed as described previously (9). For the present study, a ^{14}C-UBT value of > 100 dpm/mmol CO_2 was defined as positive and < 100 dpm/mmol CO_2 as negative. In the morning following an overnight fast, subjects rinsed their mouths prior to the test. Each subject swallowed one C14 urea capsule with lukewarm water. After 25 minutes, subjects were asked to exhale through a straw into a CO_2 collector. We recorded the time required for the colored fluid in the CO_2 collector to change to colorless. Samples were sealed with caps after adding diluted scintillation fluid using pure methanol-rinsed transfer pipettes. Samples were shaken and mixed well and C14 radiation was measured. For C13-UBT, the subject with overnight fast was asked to exhale into a CO_2 collector sample. Then, the subject swallowed one C13 urea capsule, and exhaled into another CO_2 collector sample. The two samples were attached to SN3357 types of *H. pylori* instruments for the detection. The values of dpm were then calculated and data were analyzed as mean $\pm$ SD of dpm values.

3.4. Criteria for Diagnosis of Helicobacter pylori Infection

Cases with positive ^{14}C-UBT or ^{13}C-UBT detection results were assessed as current *H. pylori* infection.

3.5. Statistical Methods

The rate of *H. pylori* infection was expressed in percentages and analyzed with SPSS V. 19.0 software. Categorical data are presented as proportions. Groups were compared with the chi-square test. Unadjusted and stepwise multivariate Cox regression models were used to assess the effects of qualitative variables on the risk of *H. pylori* infection. This analysis implies a possible bias or lack of generalization of these tertiles to other patient groups. $P < 0.05$ was considered statistically significant.

4. Results

4.1. Helicobacter pylori Infection Status

Overall, 1860 adult cases were ultimately enrolled in the study, excluding those with antibiotics or acid inhibitors use in the last three weeks, the previous diagnosis of cancer, and history of gastrectomy. These cases were involved in the data analysis of *H. pylori* infection rates and risk factors. They comprised 560 (30.1%) male cases and 1300 (69.9%) female cases. The age range was 18 to 90-years-old. There were 858 *H. pylori*-positive cases in the sample, giving an overall *H. pylori* infection rate of 46.1%. The infection rate was slightly higher in males than in females (49.2% vs. 44.8%, P = 0.01). Furthermore, the *H. pylori* infection rate was different in different age groups. The under 20-year-old group had the lowest *H. pylori* infection rate (19.6%), while it was the highest in the 31 - 40-year-old group and 71 - 80-year-old group (52.4% and 52.5%, respectively). This was followed by the 41 - 50-year-old group, 51 - 60-year-old group, and 61 - 70-year-old group (46.9%, 46.3%, and 47.3%, respectively) (Table 1).

Table 1. *Helicobacter pylori* Infection Test Results in Different Gender and Age Groups

Item	Cases	Cases of Positive Hp	Rate of Positive Hp (%)	χ^2	P Value
Gender				5.897	0.01
Male	560	276	49.2		
Female	1300	582	44.8		
Total	1860	858	46.1		
Age, y				39.238	0.000
< 20	58	11	19.6		
21 - 30	168	63	37.6		
31 - 40	270	141	52.4		
41 - 50	380	178	46.9		
51 - 60	460	213	46.3		
61 - 70	362	171	47.3		
71 - 80	136	71	52.5		
> 80	26	10	31.2		
Total	1860	858			

4.2. The Effect of Socioeconomic Status on Helicobacter pylori Infection

We evaluated *H. pylori* infection in populations with different socioeconomic statuses in terms of marriage, education, occupation, family income, and residence area were evaluated in the questionnaire survey. The results showed that socioeconomic status had a significant effect on *H. pylori* infection. Married people had a slightly higher infection rate of *H. pylori* than unmarried people (47.1% vs. 27.3%, P < 0.01). *Helicobacter pylori* infection rates were 52.9%, 64.8%, 55%, and 43.5% migrant workers, fishermen, cases without a job, and general staff, respectively, which were higher than the rates in cases with other occupations. Furthermore, students and retirees had lower infection rates (22.0% and 37.6%, respectively). The differences were statistically significant compared to other groups. *Helicobacter pylori* infection rate was lower in the population with a monthly income of over 3000 Yuan than in people with under 3000 Yuan income level, and the difference was statistically significant (38.3% vs. 48.9%, P = 0.042). Among the study areas, the *H. pylori* infection rate was the highest in Hangu (57.1%). Furthermore, the population in the Kangcui area had the lowest *H. pylori* infection rate (38.3%) (Table 2).

4.3. The Effect of Personal Lifestyle or Habit on Helicobacter pylori Infection

In this survey, we evaluated the relationship between the individual lifestyle or habits and *H. pylori* infection. The results showed that the *H. pylori* infection rate was higher in the smoking population than in a normal population (54.8% vs. 45.0%, P < 0.01). The *H. pylori* infection rate was higher in the drinking population than in a normal population (46.7% vs. 37.6%, P < 0.01) (Figure 1). Furthermore, the *H. pylori* infection rate was higher in the population with the habit of outside dining (54.7% vs. 48.2%, P = 0.038). This rate was also higher in populations that often ate seafood, drink tea, and ate pickled food. In addition, this rate was higher in populations with a large amount of salt intake (52.4% vs. 45.3%, P = 0.001). *Helicobacter pylori* infection had no correlation with the consumption of soy products and fresh garlic, vinegar and spicy food. In addition, the rate of *H. pylori* infection was higher in populations who reared animals at home (52.6% vs. 45.6 %, P = 0.032) (Table 3).

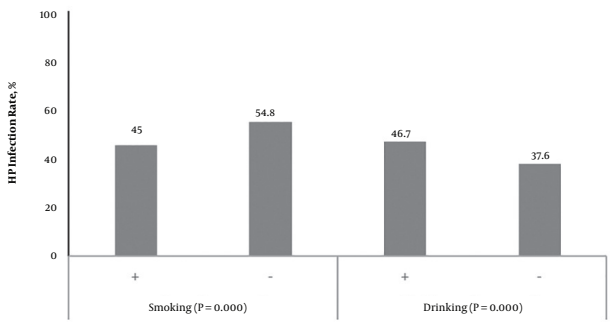

Figure 1. Analysis of correlation between *Helicobacter pylori* infection and smoking and drinking

Table 2. Analysis of Correlation Between *Helicobacter pylori* Infection and General Socioeconomic Status

Items	Cases	Cases of Positive Hp	Rate of Positive Hp (%)	χ^2	P Value
Education levels				19.436	0.000
Primary school or below	586	314	53.5		
Junior high school, high school or technical secondary school	720	335	46.5		
Junior college or above	554	209	37.7		
Marital status				30.156	0.000
Unmarried	95	26	27.3		
Married	1765	832	47.1		
Occupation				47.325	0.000
None	20	11	55.0		
Farmer	567	259	45.7		
Farmworker	70	37	52.9		
Worker	458	225	49.1		
Clerk[a]	152	80	52.6		
Medical staff	46	20	43.5		
Teacher	160	65	40.6		
Student	50	11	22.0		
Fisherman	88	57	64.8		
Retiree	170	64	37.6		
Others[b]	79	29	36.7		
Location				112.438	0.000
Dagang	400	201	50.3		
Hangu	254	145	57.1		
Hujiayuan	265	101	38.1		
Jixiao	87	30	34.5		
Kangcui	235	90	38.3		
Longsheng Park	150	82	54.7		
Ningchegu	201	98	48.7		
Shanghaiyuan	118	47	39.8		
Tanggu Experiment school	123	54	43.9		
Others[c]	27	10	37.0		
Monthly Income				4.235	0.042
< 3000	1370	670	48.9		
> 3000	490	188	38.3		

[a] Mainly means corporate clerk.
[b] Includes seamen, civil servant, driver, self-employed entrepreneur, and so on.
[c] Means outpatient visits or volunteers of Hp examination to hospital.

4.4. The Effect of Personal Health Status on Helicobacter pylori Infection

It was found in the survey that 574 cases had one or several kinds of dyspeptic symptoms such as abdominal distension, heartburn, acid regurgitation, nausea, belching, hiccup, and early satiety for nearly a year. The *H. pylori* infection rate was higher in this population than in the asymptomatic population (53.2% vs. 44.9%, P = 0.001). However, there was no difference in the infection rate between a population who underwent previous *H. pylori* erad-

Table 3. Analysis of *Helicobacter pylori* Infection and Risk Factors of Living Habits

Items	Cases	Cases of Positive Hp	Rate of Positive Hp (%)	χ^2	P Value
Drinking tea				4.357	0.018
Occasionally	1721	802	46.6		
Frequently	139	56	40.3		
Eating vinegar				0.638	0.210
Occasionally	1698	796	46.9		
Frequently	162	62	38.3		
Eating uncooked garlic				1.453	0.214
Occasionally	1711	786	45.9		
Frequently	149	72	48.3		
Eating seafood				19.231	0.000
Occasionally	1452	615	42.3		
Frequently	408	243	59.6		
Eating beans				0.985	0.125
Occasionally	1645	749	45.5		
Frequently	215	109	50.7		
Eating spicy food				0.894	0.389
Occasionally	1523	691	45.3		
Frequently	337	167	49.6		
Eating out				5.123	0.038
Occasionally	1621	782	48.2		
Frequently	139	76	54.7		
Eating Pickled food				11.125	0.001
Occasionally	1548	735	47.5		
Frequently	212	123	58.0		
Eating salt				11.543	0.001
Lightly	1635	740	45.3		
Heavily	225	118	52.4		
Keeping animals				4.453	0.032
No	1708	778	45.6		
Yes	152	80	52.6		

ication treatment and the general population. Furthermore, there was no difference in the infection rate between a population with a history of medication in the past three months (including antihypertensive drugs, diabetes drugs, and heart disease drugs) and the general population (Figure 2).

In the survey, there were 422 cases, 155 cases, 208 cases, and 171 cases infected with *H. pylori* who had a history of hypertension, diabetes, coronary atherosclerosis, and fatty liver, respectively. The *H. pylori* infection rate was higher in the hypertension population than in the general population (51.9% vs. 44.4%, P = 0.001). There was no significant difference in the infection rate between a population with other underlying diseases and the general population. The family history of cancer was not related to *H. pylori* infection (51.3% vs. 45.9%, P = 0.76) (Table 3, Figure 3).

4.5. The Effect of Single Testing Factor on Helicobacter pylori Infection

Multivariate logistic regression analysis was performed on possible risk factors for *H. pylori* infection in the univariate analysis. The results revealed (Table 4) that

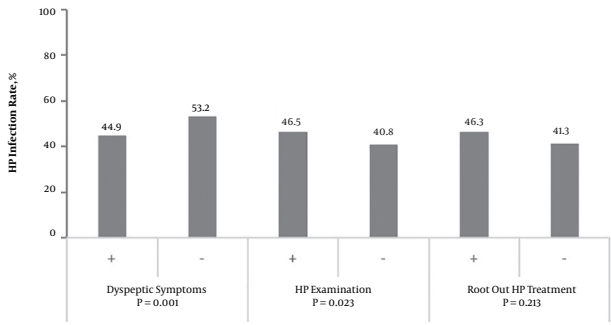

Figure 2. Analysis of correlation between *Helicobacter pylori* Infection, digestive tract symptom, history of *H. pylori* infection, history of *H. pylori* treatment, and drug history in recent three months

marriage and education level were important factors affecting *H. pylori* infection. Furthermore, gender and hypertension may be associated with *H. pylori* infection. *Helicobacter pylori* infection was negatively correlated with a previous examination for *H. pylori* infection.

5. Discussion

5.1. Helicobacter pylori Infection Status

There are significant differences in the *H. pylori* infection rate among different regions and countries. China is a country with a vast territory and there are significant differences in topographic and geographic conditions. Furthermore, there is a significant difference in the *H. pylori* infection rate across the country. The region with the lowest infection rate was Guangdong province (42%), and the region with the highest infection rate was Tibetan Lama (90%) (8). The infection rate was 45.39% in Hebei province. In this study, the positive rate of *H. pylori* infection was 48.6% in 1860 adults in the Tianjin Binhai area, which was lower than the domestic average level and a little higher than the average infection rate in Hebei province. Since *H. pylori* infection is associated with socioeconomic, health, family, and environmental factors, the incidence rate varies in different areas, even at different times (10, 11) in the same area. Therefore, we can speculate that local, social, economic, and development factors, population density, and lifestyle have important influences on the detection rate of *H. pylori*.

5.2. The Relationship Between Helicobacter pylori Infection and Gender or Age

In this study, the *H. pylori* infection rates were 49.2% and 44.8% in men and women, respectively. The rate of male cases was slightly higher than that of female cases, which was not consistent with some reports (12, 13) and consistent with other reports (14, 15). These might be related to the differences in races, living habits, and living conditions of the subjects. In addition, the reason that the positive rate of male cases was higher than that of female cases may be related to the high intensity of work, more opportunities of outdoor dining, smoking, drinking, and ignoring the dietetic hygiene.

Many studies (16, 17) have shown that the *H. pylori* infection rate exhibited a gradually increasing trend with the increase in age. In this study, it was shown that the *H. pylori* infection rate in the 31 - 80-year-old group was higher than the average level, which may be due to the relatively frequent social activities, interpersonal communications, and greatly increased opportunities of interpersonal contact transmission. Furthermore, there was an obvious upward trend in the 31 - 40-year-old group than in the 21 - 30-year-old group. These might be due to greater working pressure, lack of regularity of life, and more dinner for social intercourse, which resulted in a higher chance of infection. Thus, prevention should be made early. Good personal hygiene habits should be developed and diet should be monitored to reduce the *H. pylori* infection. With the further increase in age, the infection rate of people over 80 years decreased (31.2%), which may be due to medications, decreased social activities, and more attention given to the health and diet by the elderly people. In addition, due to the small sample size in this group, there might be deviations in the statistical results. Thus, further studies with larger sample sizes should be conducted.

5.3. The Relationship Between Helicobacter pylori Infection and Personal Lifestyle or Habits

Studies have reported that drinking unboiled water and eating raw vegetables and fruits may increase the *H. pylori* infection rate (18-20). The results of the present study revealed that the *H. pylori*-positive rate increased in populations who often consumed seafood, which may be associated with eating raw seafood and increased exposure to contaminated seafood. In this investigation, dogs are the main home-reared animals, and it was found that the positive rate of *H. pylori* infection was higher in populations rearing dogs. Epidemiological data revealed that rearing dogs is a risk factor for *H. pylori* infection (21) and it was inferred that dogs may be the potential storage source of bacteria.

In this study, the *H. pylori* infection rate was higher in smoking and drinking populations. This is consistent with some reports that *H. pylori* was positively related to smoking and drinking (22), while it contradicts some other re-

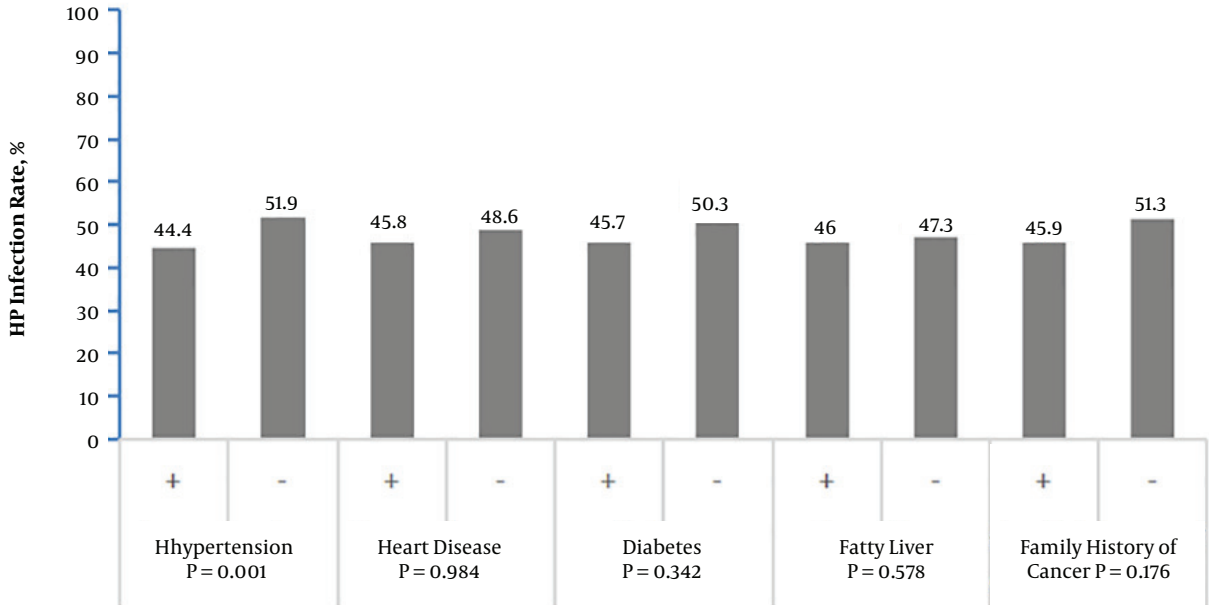

Figure 3. Analysis of correlation between *Helicobacter pylori* infection, medical history and family history of cancer

Table 4. Multivariate Logistic Regression Analysis Performed on Possible Risk Factors Related to *Helicobacter pylori* Infection in the Univariate Factor Analysis

Risk Factors	Regression Coefficient	S.E	χ^2	P Value	Exp (B)
Gender	0.211	0.114	3.437	0.064	1.235
Marriage	0.937	0.226	17.130	0.000	2.552
Digestive tract symptoms or not	0.184	0.104	3.142	0.076	1.202
Smoking	0.126	0.117	1.165	0.280	1.135
Drinking wine	0.063	0.152	0.173	0.678	1.065
Drinking tea	0.104	0.158	0.436	0.509	1.110
Eating seafood	0.124	0.110	1.263	0.261	1.132
Eating out	0.200	0.155	1.665	0.197	1.222
Eating pickled food	0.208	0.139	2.249	0.134	1.231
Eating salt	0.041	0.101	0.164	0.686	1.042
Hypertension	0.194	0.112	2.965	0.085	1.214
Economic status	0.119	0.127	0.867	0.352	1.126
Keeping animals	0.140	0.146	0.927	0.336	1.151
Hp test	-0.484	0.187	6.732	0.009	0.616
Age bracket	-0.052	0.040	1.698	0.193	0.950
Culture	-0.194	0.082	5.638	0.018	0.823
District	0.034	0.018	3.712	0.054	1.035
Occupation	-0.005	0.019	0.057	0.811	0.995

search that smoking and drinking were negatively correlated with the *H. pylori* infection rate (23, 24).

We found that the regular consumption of raw garlic and soy products did not reduce the infection rate of *H. pylori*. This was different from a previous report that garlic could prevent *H. pylori* infection (25). However, occa-

sional tea-drinking may reduce the incidence of *H. pylori* infection that might be induced by catechins found in the tea (26-28). However, frequent tea-drinking would increase the *H. pylori* infection rate. A study reported that the irregular washing of cups would enable *H. pylori* infection to increase (29), which may be a reason why the infection rate increased in the case of frequent tea drinking. Pickled foods contain high levels of carcinogens. Hence, the consumption of pickled foods has been listed among the main pathogenic factors of cancer, especially digestive tract cancers. *Helicobacter pylori* has been listed as a class I etiological factor of gastric cancer. It was found in this study that pickled food is also a risk factor of *H. pylori* infection, illustrating that cancer-inducing material in pickled food not only acts on the biochemistry mechanism of tissues and cells, but also indirectly affects the occurrence and development of gastric cancer, which is a risk factor of *H. pylori* infection.

5.4. The Relationship Between Helicobacter pylori Infection and General Social and Economic Conditions

It was found in the present study that the *H. pylori* infection rate was higher in a population with the education level of primary school or lower than in populations with the education level of junior middle school to special secondary school, as well as junior college or above. The *H. pylori* infection rate was lower in the population with a monthly income of more than 3000 Yuan than in a population with a monthly income of less than 3000 Yuan. In addition, the *H. pylori* infection rate was higher in migrant workers, fishermen, people without occupations, and general staff than in people with other occupations. These may be possibly associated with the lower income of these people, as well as the relatively poor living and health conditions. Furthermore, studies have shown that fatigue and non-regular rest are factors related to *H. pylori* infection (30). Among them, the *H. pylori* infection rate was significantly higher among fishermen than among other occupational groups, and this may be correlated with their residence in suburbs, as well as the relatively poor living conditions. Moreover, it may also be related to their frequent consumption of seafood, eating pickled foods, and more salt intake. In addition, it was also found in the present study that the *H. pylori* infection rate was higher in the married population than in the unmarried population, which may be related to the increase in household populations.

Helicobacter pylori infection has been reported to be related to the geographic area and socioeconomic status. It was found to be lower in developed countries than in developing countries (6). Furthermore, the *H. pylori* infection rate was generally lower than 30% in developed countries, while its positive infection rate might be as high as 50 - 70% in developing countries. For example, in the randomly selected 930 adults aged 35 - 74-years-old in four areas of Italy, the *H. pylori* infection rate was 45% (7). In the UK, the *H. pylori* infection rates were 37% in male employees and blood donors. In the United States, the *H. pylori* infection rate was approximately 30 - 40% in the general population. Some studies have pointed out that the poorer the economic status and the lower the degree of culture, the higher the *H. pylori* infection rate (8). The China *H. pylori* cooperative research group reported in a research of the epidemiology of *H. pylori* infection that the longer the years of education, the lower the *H. pylori* infection rate; the more the household populations, the higher the *H. pylori* infection rate; and the higher the income level, the lower the *H. pylori* infection rate.

5.5. Relationship Between Helicobacter pylori Infection and Personal Health Status

However, this study found that the *H. pylori* infection rate was higher in populations experiencing dyspeptic symptoms in recent years than in the normal population, which is consistent with the findings of many studies (31, 32). However, it remains controversial whether the eradication of *H. pylori* infection could improve the symptoms of functional dyspepsia (33, 34). In the future, the correlation between different digestive symptoms and *H. pylori* infection, as well as the improvement of digestive symptoms post-*H. pylori* eradication, may be further studied to clarify the correlation between *H. pylori* infection and gastrointestinal symptoms.

The results of this study revealed that the rate of infection was low among people who previously took an *H. pylori* test, as they have higher cognition of *H. pylori*, so that they have good dietary habits, reducing the chance of *H. pylori* infection. The present study found no significant differences in *H. pylori* infection rates between patients with diabetes and coronary heart disease and the general population, that is not consistent with previous reports (5, 35, 36). In the future, larger sample-sized, randomized, double-blinded, and more in-depth studies are required to explore the relationship between *H. pylori* infection and cardiovascular disease in the Binhai area. In addition, *H. pylori* strains should be isolated to perform a virulence analysis.

Research has shown that there is a correlation between *H. pylori* infection and the incidence of hypertension (37). The present study also found that the *H. pylori* infection rate was higher in hypertensive patients than in the general population, suggesting *H. pylori* infection is associated

with hypertension. It was speculated that *H. pylori* infection may be involved in the pathophysiology of hypertension through some mechanisms; for example, *H. pylori* may affect endothelial function by regulating vascular active substances such as NO and endothelin-1. *Helicobacter pylori* infection is involved in oxidative stress, which leads to cellular apoptosis and the activation of tumor necrosis factor; these biological effects may lead to the occurrence of hypertension.

The results of the multivariate logistic regression analysis revealed that marital status and education level were important predictors of *H. pylori* infection. Gender and hypertension may be associated with *H. pylori* infection. *H. pylori* infection was negatively correlated with taking a previous *Helicobacter pylori* test. Since risk factors were more in the multivariate analysis and the number of *H. pylori*-positive cases and total sample size were relatively insufficient, the difference might be statistically insignificant.

5.6. Conclusions

In summary, the present study showed that the positive risk factors for *H. pylori* infection included male gender, smoking, drinking wine, eating out, eating seafood, eating pickled food, eating salt, drinking tea, keeping animals, poorer economic situation, lower income, marriage, and lower degree of culture while the negative risk factors were eating beans, eating uncooked garlic, eating vinegar, and eating spicy food. The prevalence of *H. pylori* infection and its related factors in the population of the Tianjin Binhai area were investigated for the first time in this survey. Our results revealed that *H. pylori* infection was related to education level and marital status. Furthermore, the relationships between health habits, diet, high blood pressure, gastrointestinal symptoms, and *H. pylori* infection needs to be further studied. By increasing the awareness of healthy diet among people, the promotion of personal hygiene habits, and the development of the people's awareness of *H. pylori* infection, along with the development of the economy, we believe that the infection rate of *H. pylori* would show a downward trend year by year.

Footnotes

Authors' Contribution: Substantial contributions to the conception and design of the work and drafting of the work: Jing Zou; revising the manuscript critically for important intellectual content: Yun-Qing Xiao, Yun-Feng Cheng, Xiu-Yan Ren, Shu-Wu Li, and Gang Ding; acquisition, analysis, and interpretation of data, and final approval of the version to be published: Jing Zou, Yun-Qing Xiao, Yun-Feng Cheng, Xiu-Yan Ren, Shu-Wu Li, and Gang Ding. Agreement to be 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 by all authors.

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