

Seroprevalence and risk factors associated with *Helicobacter pylori* infection among children aged less than 18 years old in Duhok Province, Iraq

Azad Mohammed Taher Al-Brefkani¹, Ibrahim A. Naqid^{2,*}, Nizar Bakir Yahya³, Nawfal R. Hussein²

¹Department of Medical Lab Technology, Shekhan Technical College of Health, Duhok Polytechnic University, Duhok, Kurdistan Region, Iraq

²Department of Biomedical Sciences, College of Medicine, University of Zakho, Kurdistan Region, Iraq

³Department of Paediatric, College of Medicine, University of Duhok, Kurdistan Region, Iraq

*Correspondence to: Ibrahim A. Naqid (Email: ibrahim.naqid@uoz.edu.krd)

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Abstract

Objectives This study aimed to detect the prevalence of *H. pylori* infection and identify potential factors associated with infection in Duhok province, Iraq.

Methods This cross-sectional study was conducted in Duhok Province, Kurdistan Region, Iraq. Over a four-year period from 2016 to 2020, a total of 381 children aged four to 18 years who attended the hospitals and were evaluated for specific IgG antibodies against *H. pylori* using serological tests were included. A questionnaire was completed at the start of the study. *H. pylori* serology data were analyzed using the chi-square test.

Results The seroprevalence of *H. pylori* IgG-specific antibodies among the study participants was 31%. The infection rate significantly increased with increasing age of the participants ($P < 0.001$), from 19.8% among four to five-year-olds to 42.9% among 16 and 18-year-olds. The infection rate was significantly higher in girls (35.9%) than that in boys (26.5%) ($P < 0.047$). Infections were also higher among university students (41%; $P < 0.001$), children from the country-side population (41%; $P < 0.001$), children from crowded households (67.3%; $P < 0.001$), and children with a history of gastrointestinal pain (44.4%; $P > 0.001$).

Conclusion The prevalence rate of *H. pylori* infection among children in Duhok province is quite similar to that reported in previous studies in the Kurdistan region, Iraq, and increases with age. University attendance, history of gastrointestinal pain, countryside population, and overcrowding were risk factors associated with *H. pylori* infection. Valuable approaches to improve sanitary purposes and educational and socioeconomic status should be emphasized and promoted to reduce the risk of *H. pylori* infection among children.

Keywords *H. pylori*, seroprevalence, risk factors, children, Duhok, Iraq

Introduction

Helicobacter pylori (*H. pylori*) is a spiral, gram-negative bacterium that is recognized as a worldwide problem. It colonizes the human stomach in approximately half of the world's population and can cause gastritis and peptic ulceration.^{1,2} Infection with this microorganism plays an essential role in the pathogenesis of gastric adenocarcinoma (GA) and primary gastric lymphoma in adulthood.³ GA is the second most common cause of cancer-related deaths worldwide.⁴

In a previous study conducted in Iraq, the prevalence of *H. pylori* infection varied according to age group, ranging from 27% in children to 58% in teenagers.⁵ In the same study, the infection rate was 78%, which was significantly higher than the prevalence in children.⁵ Several studies have described a significant variation in the seroprevalence of *H. pylori* infection between and within countries due to differences in ethnicity and geographical settings of each population.⁶ It was previously proposed that the acquisition of infection with *H. pylori* occurs during early childhood; adults may carry the same bacterial strain for consecutive decades.^{7,8} It has been previously shown that the prevalence of *H. pylori* infection increases significantly with age, which is largely due to a birth cohort effect rather than a late acquisition of infection.⁵ Additionally, previous report linked *H. pylori* infection with low socioeconomic status, crowded or poor living conditions, low education level or quality of drinking water, and inadequate sanitation practices.⁹

Studies of seroprevalence and the determination of potential risk factors associated with *H. pylori* infection are essential in establishing appropriate health strategies for preventing *H. pylori*-related diseases in the community. Therefore, the present study aimed to evaluate the potential risk factors associated with the seroprevalence rate of *H. pylori* infection among individuals aged 18 years and younger in Duhok province, Kurdistan region, Iraq.

Materials and Methods

Study design and population

This cross-sectional study was conducted at the Heevi and Azadi Teaching Hospital and Shekhan Hospital, Kurdistan Region, Iraq. Over a four-year period (2016–2020), a total of 381 blood samples were collected randomly from children aged four to 18 years and evaluated for specific IgG antibodies against *H. pylori*. Information about sociodemographic characteristics including age, gender, hygienic practices, sources of drinking water, education level of parents, accommodation, smoking status, number of family members, family income history of gastrointestinal diseases, and frequency of eating fast food and French fries obtained from each subject after obtaining consent using the questionnaire. All subjects were invited to answer the questionnaire through a face-to-face interview, which was the same as in a previous study.¹⁰

Inclusion and exclusion criteria

All patients who attended the Heevi and Azadi Teaching Hospital and whose guardians agreed were included in this study. Patients who did not agree to participate were excluded. Other exclusion criteria included a self-reported history of *H. pylori*-positivity and other gastric disorders.

Serological detection of anti-*H. pylori* IgG

A 5-mL syringe and needle were used to bleed about 5 mL of blood from each subject under aseptic conditions. The blood samples were then centrifuged at 1500 rpm for 5 min to obtain the serum and kept frozen at -20°C until required. Anti-*H. pylori* IgG positivity was determined using a commercial kit (Bioactiva Diagnostica, Germany) following the manufacturer's instructions. The cut-off was determined by an index value obtained from the ratio of sample absorbance to the absorbance of a cut-off calibrator. The result was considered negative if the *H. pylori* IgG index was <0.90 , and positive if the *H. pylori* IgG index was >1.00 .

Ethics approval

The study was approved by the ethics committee of the College of Medicine, University of Zakho, Kurdistan Region of Iraq, based on the ethical principles of human research and experimentation. Informed consent was obtained from the children's parents or legal guardians before enrollment in the study.

Statistical analysis

Statistical analysis was performed using SPSS (SPSS, Inc., Cary, NC, USA). To investigate the risk factors for *H. pylori*

seropositivity and influential factors, the Chi-square test was used. A significance level of $P < 0.05$ was used for all analyses.

Results

The sociodemographic variables associated with the seroprevalence of *H. pylori* infection in children aged less than 18 years are presented in Table 1. During the study period, 381 (200 girls, 181 boys) were tested for *H. pylori*-specific IgG. The ages of the participants ranged from four to 18 years. The seroprevalence of *H. pylori* IgG-specific antibodies was 118 (31.0%). The seroprevalence rate of *H. pylori* according to age varied from 19.8% in the age group of four to six years to 42.9% in the age group of 16 to 18 years. There was a positive association between age and seroprevalence; older age had a higher prevalence rate of *H. pylori* IgG antibodies ($P < 0.001$). The seropositivity of *H. pylori* was significantly associated between male (26.5%) and female (35.9%) participants ($P < 0.047$). According to the students' education level, the highest seropositivity was found among university students (44.4%) and the lowest at the pre-school level (20%), with statistically significant differences ($P < 0.001$). In addition, infection prevalence was significantly higher in the country-side population (41.0%) than that in the city population (25.2%) ($P < 0.001$). There was also a significant association between the fathers' education levels and *H. pylori* positivity ($P < 0.039$), while no association was found between the mothers' education levels and *H. pylori* positivity ($P > 0.31$). No significant relationships were found between sources of drinking water ($P > 0.52$), frequency of

Table 1. Relationship between *H. pylori* seroprevalence and associated risk factors

Demographic data	<i>H. pylori</i> infection (No. [%])		Total	χ^2	P value
	Positive <i>n</i> = 118 (31.0%)	Negative <i>n</i> = 263 (69.0%)			
Age (Year)					
4-6	26 (19.8%)	105 (80.2%)	131	16.61	0.002
7-9	9 (29.0%)	22 (71.0%)	31		
10-12	14 (26.9%)	38 (73.1%)	52		
13-15	30 (39.5%)	46 (60.5%)	76		
16-18	39 (42.9%)	52 (57.1%)	91		
Gender					
Boys	53 (26.5%)	147 (73.5%)	200	3.93	0.047
Girls	65 (35.9%)	116 (64.1%)	181		
Education qualification of students					
Pre-School	20 (20.0%)	80 (80.0%)	100	21.63	0.001
Primary School	21 (21.0%)	79 (79.0%)	100		
Secondary School	38 (42.2%)	52 (57.8%)	90		
High School	35 (42.7%)	47 (57.3%)	82		
University	4 (44.4%)	5 (55.6%)	9		
Accommodation					
City	61 (25.2%)	181 (74.8%)	242	10.31	0.001

(Continued)

Table 1. Relationship between *H. pylori* seroprevalence and associated risk factors—Continued

Demographic data	<i>H. pylori</i> infection (No. [%])		Total	χ^2	P value
	Positive n = 118 (31.0%)	Negative n = 263 (69.0%)			
Country side	57 (41.0%)	82 (95.0%)	139		
Students father education qualification					
Non-literate	31 (34.8%)	58 (65.2%)	89	10.1	0.039
Primary School	28 (34.6%)	53 (65.4%)	81		
Secondary School	27 (41.5%)	38 (58.5%)	65		
High School	11 (21.6%)	40 (78.4%)	51		
University	21 (22.1%)	74 (77.9%)	95		
Students mother education qualification					
Non-literate	33 (34.4%)	63 (65.6%)	96	4.73	0.31
Primary School	33 (31.1%)	73 (68.9%)	106		
Secondary School	30 (36.1%)	53 (63.9%)	83		
High School	11 (25.6%)	32 (74.4%)	43		
University	11 (20.8%)	42 (79.2%)	53		
Source of drinking water					
Tape water	82 (32.0%)	174 (68.0%)	256	0.41	0.52
Mineral water	36 (28.8%)	89 (71.2%)	125		
Fast food					
Daily	16 (34.8%)	30 (65.2%)	46	1.75	0.62
Weekly	39 (28.1%)	100 (71.9%)	139		
Monthly	34 (35.1%)	63 (64.9%)	97		
Occasionally	29 (29.3%)	70 (70.7%)	99		
Chips and cakes					
Daily	87 (32.3%)	182 (67.7%)	269	3.2	0.36
Weekly	22 (26.8%)	60 (73.2%)	82		
Monthly	7 (41.2%)	10 (58.8%)	17		
Occasionally	2 (15.4%)	11 (84.6%)	13		
History of gastrointestinal pain in last 3 weeks					
Yes	52 (44.4%)	65 (55.6%)	117	14.33	0.001
No	66 (25.0%)	198 (75.0%)	264		
Habit of hand washing before eating					
Yes	68 (28.5%)	171 (71.5%)	239	1.9	0.16
No	50 (35.2%)	92 (64.8%)	142		
Washing raw vegetables					
Yes	114 (30.4%)	261 (69.6%)	375	3.63	0.57
No	4 (66.7%)	2 (33.3%)	6		
Smoking Status					
Yes	4 (30.8%)	9 (69.2%)	13	3.86	0.145
No	28 (41.2%)	40 (58.8%)	68		
Not regularly	7 (70.0%)	3 (30.0%)	10		
Teeth decay					
Yes	48 (31.4%)	105 (68.6%)	153	0.019	0.89

(Continued)

Table 1. Relationship between *H. pylori* seroprevalence and associated risk factors—Continued

Demographic data	<i>H. pylori</i> infection (No. [%])		Total	χ^2	P value
	Positive n = 118 (31.0%)	Negative n = 263 (69.0%)			
No	70 (30.7%)	158 (69.3%)	228		
Family income					
Very bad	6 (35.3%)	11 (64.7%)	17	1.72	0.78
Bad	12 (29.3%)	29 (70.7%)	41		
Middle	73 (32.4%)	152 (67.6%)	225		
Good	25 (29.1%)	61 (70.9%)	86		
Very good	2 (16.7%)	10 (83.3%)	12		
Number of family members					
2-4	14 (23.0%)	47 (77.0%)	61		
5-7	36 (20.3%)	141 (79.7%)	177	45.84	0.001
8-10	31 (35.2%)	57 (64.8%)	88		
>10	37 (67.3%)	18 (32.7%)	55		

P values were determined using Chi-Square test (χ^2). P value <0.05 were considered statistically significant.

fast food consumption ($P > 0.62$), frequency of eating chips and cakes ($P > 0.36$), and *H. pylori* positivity. The prevalence of *H. pylori* infection was also significantly higher in patients with a history of gastrointestinal pain than that in patients without ($P < 0.001$).

Other potential risk factors such as the habit of hand-washing before eating, washing raw vegetables, smoking status, tooth decay, and family income were not statistically associated with *H. pylori* infection. Additionally, a significant association was found between the number of family members with *H. pylori* positivity ($P < 0.001$); larger families had a higher prevalence rate (67.3%).

Discussion

H. pylori infection is one of the most common chronic infections worldwide; it is estimated that approximately half of the world's population is infected with this pathogen.^{1,11} *H. pylori* infection is a risk factor for gastric ulcer disease and plays a significant role in gastric cancer and gastric lymphoma.⁴ The seroprevalence study and detection of common risk factors for *H. pylori* infection have the potential to underpin appropriate health strategies for preventing *H. pylori*-associated diseases in the community. *H. pylori* infection has been studied extensively in Iraq; it has been found to be one of the most common infectious agents causing gastric diseases.^{2,12-15} In addition, the prevalence of *H. pylori* infection has been studied in different age groups.⁵ However, no study has determined the other potential risk factors associated with this infection. Therefore, this study examined the seroprevalence of *H. pylori* infection and its associated risk factors.

In this study, the prevalence of *H. pylori* infection was 31.0% among children aged four to 18 years who attended the Heevi and Azadi Teaching Hospital. Our findings are comparable to those reported in other community-based studies conducted in Sulaimani province, Iraq, where the

prevalence of infection was 32.3%.¹⁶ In another study conducted in Iraq, the overall seropositivity of *H. pylori* was 36% in children and 78% in adults.⁵ Another study also found that 28% of recruited samples were seropositive for *H. pylori* infection in Duhok Province, Iraq, which is slightly lower than the prevalence reported in our study.¹⁷ The prevalence of *H. pylori* infection ranges from more than 70% in developing countries, such as India and Bangladesh, to around 20% in developed countries, such as Australia and the Netherlands.¹⁸ However, the prevalence of infection in our study was much lower than that reported in several studies in Iran, where *H. pylori* infection rates were found to be at 47% to 64%¹⁹ and at 72.8%.²⁰ Nguyen et al. conducted another study in Langson province, Vietnam, and found an overall seropositivity rate of 41.4% to 46.8% in children.²¹ The results of our study were also inconsistent with those of a study conducted in Egypt, Saudi Arabia, and Turkey, where the prevalence rates of *H. pylori* infection were at 60%, 75%, and 77.5%, respectively.^{22,23}

This study noted possible reasons for this discrepancy in the infection rate between our study and previous reports, which could be due to variations in the studied regions and groups and as well as the laboratory techniques used in the studies. The observed low prevalence in our study could also be the result of frequent usage of antibiotics and proton pump inhibitors or the gradual improvement of socioeconomic status and sanitation during the last decades.²⁴ This practice could have led to the increased clearance of *H. pylori*, thereby resulting in lowered prevalence.

Different risk factors are associated with *H. pylori* infection during childhood. Our results showed a significant relationship between *H. pylori* seropositivity and several variables related to socio-demographic characteristics such as age, gender, student and parents' education, accommodation, history of gastrointestinal pain, and number of family members. According to age group, the rate of *H. pylori* infection varied

from 19.8% to 42.9%. There was a significant difference between age seroprevalence; older age and those between 16 to 18 years had a higher prevalence rate of *H. pylori* IgG antibodies ($P < 0.001$). Our results are similar to those of a previous study conducted in Iraq, which reported that the prevalence of infection varied according to age, ranging from 27% in children to 58% in teenagers.⁵ Another study conducted in Vietnam reported an increase in the seroprevalence of *H. pylori*, from 30.9% in children under three years to 53.1% in those 15 to 18 years of age in a study population of 476 children.²¹ Additionally, the highest infection rate was found in girls (35.9%), with a statistically significant difference ($P < 0.05$). In contrast to our study, studies from developed countries indicated a higher *H. pylori* infection rate in boys than that in girls.²⁵ Other studies conducted in developing countries found that seropositivity rates in men and women seem to be similar.²⁶ Gender-specific *H. pylori* seropositivity rates often vary according to the developmental index of the country and its geographic location.

In this study, the highest infection rate of *H. pylori* was found among university students (44.4%) and the lowest rate at the pre-school level (20%), with significant differences ($P < 0.001$). This could be due to university students living in dormitories with other students, which could increase the chance of acquiring the infection among themselves. There is also crowding at the universities that increases the chance of person-to-person transmission. Our results are inconsistent with those of a previous study conducted in Duhok province, Iraq, which showed that there were no significant differences between different levels of education.¹⁷ In a study conducted in Taiwan, lower education levels of mothers were associated with higher *H. pylori* infection rates.²⁷ In another study conducted in Russia, a strong positive association between the mothers' education level and *H. pylori* infection rate was observed.²⁸ In contrast, in the present study, there was a positive association between the fathers' education level, rather than the mothers', and *H. pylori* infection rate ($P < 0.039$). This could be partly due to the number of samples used in the present study. Further studies are required to recruit a larger number of samples to explore this area.

Additionally, the prevalence rate of *H. pylori* infection was significantly higher in rural areas than in urban areas ($P < 0.001$). This could be due to poor personal, environmental, and residential hygiene conditions, differences in socioeconomic conditions, sources of drinking water, low levels of education, crowded families, and poor residential facilities in rural areas. Public health education on preventable risk factors associated with *H. pylori* infection, such as personal hygiene and sanitation, should be emphasized and promoted in such areas. In this study, *H. pylori* seropositivity was 44.4% among those with a history of gastrointestinal disease, with a significant difference ($P < 0.001$). Our finding of a positive association between *H. pylori* infection and gastrointestinal disease could be, at least, partly explained by the confounding effects of nutritional habits and several lifestyles accompanying such diseases.

The number of children is the main reason for the increase in household size. Household size, in turn, increases the possibility of *H. pylori* infection. Our study found a lower infection rate of *H. pylori* (20.3%) among children from

households with one to seven members, compared to 67.3% among children from households with more than 10 members ($P < 0.001$). This could mean that overcrowding increases the chances of acquiring *H. pylori* infection among children.²⁹ In large families, children often share their bedrooms or beds with their siblings. Sharing beds can significantly increase the risk of *H. pylori* infection exposure.²⁵ The seropositivity rates of *H. pylori* infection are also high in adults living in large households.^{6,30}

On the other hand, in the present study, no positive associations were found between the mothers' education levels, habit of hand washing before eating, washing raw vegetables, smoking status, tooth decay, family income, and *H. pylori* infection. A study conducted in Vietnam found a significant relationship between *H. pylori* seropositivity and several variables related to the socioeconomic status of their household, such as monthly income, mother's education, and father's occupation.³¹ Another study showed that the prevalence of infection was lower in children from families of higher socioeconomic status ($P < 0.005$).³² The poor socioeconomic status of children in Iran was associated with a higher prevalence of infection ($P < 0.005$).³³ Furthermore, a study found that the prevalence of *H. pylori* infection in children without regular hand washing after defecation was significantly higher than in those doing regular hand washing ($P = 0.021$).³¹ Therefore, our findings disagree with those of previous studies.^{32,33} These differences could be partially due to the number of samples, geographical locations, and techniques used for the detection of infection. Further studies are needed to explore the potential risk factors associated with *H. pylori* infection.

In conclusion, the infection rate of *H. pylori* was found to be 31% in children aged less than 18 years. This rate is quite similar to other previous studies reported in the Kurdistan region, Iraq, and in neighboring countries. Our data found a low prevalence of *H. pylori* infection among children at an early age; prevalence increases along with increasing age. The highest infection rate was also observed in girls than in boys. Student and parents' education, accommodation, history of gastrointestinal pain, and overcrowding were the risk factors associated with *H. pylori* infection in children. No significant association was found between the habit of handwashing before eating, washing raw vegetables, smoking status, tooth decay, family income, and the rate of *H. pylori* infection. Therefore, effective approaches to improve sanitation and as well as educational and socioeconomic status should be emphasized and promoted to reduce and control *H. pylori* infection.

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Conflicts of Interest

The authors declare that there is no conflict of interests. ■

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