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Original Research Article

Risk factors and serological diagnosis of *Helicobacter pylori* infection in children with abdominal pain and vomiting

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ABSTRACT

Background: *Helicobacter pylori* is a Gram-negative bacterium that ranks among the most prevalent chronic infections around the globe. It's closely associated with conditions like gastritis, peptic ulcers, gastric cancer, and mucosa-assisted lymphoid tissue (MALT) lymphoma. Most people get infected during childhood, especially in developing nations, where factors like overcrowding, inadequate sanitation, and unsafe drinking water play a significant role. In Bangladesh, for instance, more than 60% of children are infected by the time they turn two. Getting an accurate diagnosis is essential to minimize complications and enhance the management of gastrointestinal disorders in kids. Objectives of the study were to assess prevalence, risk factors, and diagnostic accuracy of serological testing for *Helicobacter pylori* infection in symptomatic Bangladeshi children.
Methods: This case control study was conducted at the Pediatric Gastroenterology and Nutrition Department, BSMMU, Dhaka from April 2021 to October 2022. A total of 98 children aged 1–18 years with abdominal pain and/or vomiting were enrolled by purposive sampling. Cases were defined by positive anti-*H. pylori* IgG serology, and controls were seronegative. Data collection included demographic, socioeconomic, clinical, and laboratory variables. Statistical analysis employed statistical package for the social sciences (SPSS) v20, with logistic regression for adjusted associations.
Results: Among 96 children, 48 were *H. pylori* IgG positive. Significant risk factors included low socioeconomic status (50% versus 4.2%, p<0.001), low parental education (27.1% versus 0%, p<0.001), and living in a joint family (52.1% versus 14.6%, p<0.001). Key symptoms in positive patients were dyspepsia (78%), loss of appetite (64%), and pallor (66%, p<0.001). Stool antigen was positive in 82% of seropositive cases, and chronic gastritis was the predominant histological finding (92%).
Conclusions: *H. pylori* infection is common in children with abdominal pain strongly linked to poor socioeconomic, environmental, and vomiting children.

Keywords: *Helicobacter pylori*, Abdominal pain, Socioeconomic status, Crowded living conditions, Unsafe drinking water

INTRODUCTION

Helicobacter pylori represents a spiral-shaped, Gram-negative, microaerophilic bacterial organism that demonstrates selective colonization of gastric epithelial tissue and constitutes one of the most prevalent chronic bacterial infections affecting humans.[1] Following its identification in 1983 by Warren and Marshall, who subsequently received the Nobel Prize in Medicine in 2005, comprehensive investigations have confirmed its pathogenic involvement in gastritis, peptic ulcer disease, gastric carcinoma, and mucosa-associated lymphoid tissue (MALT) lymphoma.[2,3] Worldwide, infection affects more than half the global population, though prevalence demonstrates considerable variation based on geographical region, socioeconomic circumstances, and sanitation standards.[4,5] *H. pylori* prevalence exhibits notably elevated rates in developing nations relative to developed countries. Research indicates that in South Asia and sub-Saharan Africa, over 70–80% of children contract the infection prior to reaching adolescence, while infection frequencies in Western Europe, North America, and Australia remain considerably reduced.[6-8] In Bangladesh, infection typically manifests very early, with over 60% of children becoming infected before reaching two years of age.[9] These disparities result from socioeconomic circumstances, overcrowding, inadequate sanitation, and ingestion of contaminated food and water sources.[10] Infection typically develops during early childhood and maintains lifelong persistence without treatment, as spontaneous elimination occurs rarely.[11] While most infected children demonstrate no symptoms, chronic colonization correlates with ongoing gastric inflammation, potentially predisposing individuals to complications in later years.[12] Beyond gastroduodenal pathology, pediatric *H. pylori* infection demonstrates associations with growth impairment, malnutrition, iron-deficiency anemia, and idiopathic thrombocytopenic purpura.[13-15] The World Health Organization has designated *H. pylori* as a group I carcinogen due to its established correlation with gastric malignancy.[16] Transmission mechanisms remain partially elucidated, though person-to-person dissemination through oral–oral, gastro–oral, and fecal–oral routes appears most probable.[17,18] Intrafamilial transmission, especially from maternal to child sources, has been documented as a primary infection pathway.[19] Risk factors include overcrowded living conditions, shared sleeping arrangements, inadequate oral hygiene, and utilization of unsafe drinking water.[20,21] Environmental contamination, particularly through untreated water sources and raw vegetables, may contribute to transmission.[22] Precise diagnosis in pediatric populations holds clinical significance for preventing long-term sequelae. Invasive diagnostic approaches including histological examination, culture methods, and rapid urease testing demonstrate high specificity but necessitate endoscopic procedures and specialized expertise.[23] Non-invasive testing modalities—encompassing urea breath test (UBT), stool antigen test (SAT), and serological evaluations—offer greater practicality in pediatric settings.[24] UBT and SAT provide reliable detection of active infection, while serology, which identifies circulating IgG antibodies, offers cost-effectiveness and screening utility but cannot differentiate between previous and current infection.[25,26] Notwithstanding these constraints, serological evaluation maintains value in resource-constrained nations where alternative methods lack accessibility.[27] Considering the substantial *H. pylori* burden among children in developing regions, investigating risk factors that promote transmission and assessing the utility of serological testing in diagnosis becomes essential. Such knowledge can inform preventive strategy development, guide appropriate treatment timing, and ultimately minimize the burden of chronic gastrointestinal and extra-intestinal complications related to this infection.

Objectives of the study

General objective

General objective of the study was to assess the prevalence, associated risk factors and diagnostic accuracy of serological testing for *H. pylori* infection among children presenting with abdominal pain and/or vomiting.

Specific objectives

Specific objectives include: to determine the prevalence of *H. pylori* infection in children using serological testing, to identify socio-demographic, environmental, and behavioral risk factors associated with *H. pylori* infection, to compare the distribution of risk factors between *H. pylori* positive and *H. pylori* negative groups, and to analyze between identified risk factors and infection status after adjusting for confounding variables.

METHODS

Study design

This case-control study took place in the Department of Pediatric Gastroenterology and Nutrition at Bangladesh Medical University (BMU) in Dhaka, Bangladesh, spanning an 18-month period from April 2021 to October 2022. The aim was to pinpoint risk factors and assess the effectiveness of serological testing in diagnosing Helicobacter pylori infections in children. The study included kids aged 1 to 18 years who came in with abdominal pain and/or vomiting and underwent serological testing for *H. pylori*. Those with positive serology (anti-*H. pylori* IgG) were classified as cases, while the seronegative children acted as controls.

Inclusion criteria

Children <18 years with abdominal pain and/or vomiting, positive anti-*H. pylori* IgG serology, and negative anti-*H. pylori* IgG serology were included.

Exclusion criteria

Patients with previous history of *H. pylori* infection (positive IgG serology or history of eradication therapy), and with co-existing illnesses such as constipation, inflammatory bowel disease, abdominal tuberculosis, or pancreatitis were excluded.

Sample size and sampling

Sample size was calculated for hypothesis testing of two population proportions. Considering α=5% (u=1.28), 80% power (v=0.84), and expected prevalence of *H. pylori* infection (41% among cases versus 21% among controls), the minimum required sample size was 46 children per group. Thus, a total of 100 participants were enrolled (50 cases and 50 controls). Purposive sampling was employed.

Study procedure

We screened eligible children who came to the Pediatric Gastroenterology outpatient department based on specific inclusion and exclusion criteria. After getting written informed consent from their parents or legal guardians, we enrolled the children. We used a structured questionnaire to gather information on demographics, socioeconomic factors, clinical history, and other relevant risk factors. Each child received a thorough physical examination and laboratory tests. We collected five milliliters of venous blood, which was processed within four hours. The Department of Microbiology at BSMMU detected serum anti-*H. pylori* IgG antibodies using a chemiluminescent immunometric assay. We considered titers above 20 U/ml as positive, below 10 U/ml as negative, and those between 10–20 U/ml as indeterminate. For the stool antigen test (SAT), we performed a rapid chromatographic immunoassay using the *H. pylori* antigen rapid test cassette kit.

Operational definitions

Case of H. pylori

Child with abdominal pain and/or vomiting with positive anti-*H. pylori* IgG serology.

Socioeconomic class

Lower: <8,250 BDT/month, middle: 8,250–78,000 BDT/month, upper: >78,000 BDT/month.

Overcrowding

It was defined as >8 persons in the household.

Unsafe drinking water

It was defined as stored in uncovered container, tap water, or unboiled.

Poor sanitation

It was defined as absence of sanitary latrine or flush system.

Statistical analysis

The analytical procedures were conducted utilizing statistical package for the social sciences (SPSS) (version 20.0, SPSS). Quantitative variables were reported as mean±standard deviation (SD), whereas qualitative variables were displayed as counts and proportions. Inter-group comparisons employed independent samples t-tests for quantitative data and Chi-square analyses for qualitative data. Multivariate logistic regression analysis was utilized to determine odds ratios (ORs) alongside 95% confidence intervals (CIs) following adjustment for potential confounders. Statistical significance was established at p value <0.05.

RESULTS

Table 1 shows among the 96 patients (48 positive and 48 negative), the mean age was similar between groups 11.30±3.08 versus 10.94±3.58 years, p=0.591. Most patients were 6–12 years old 50% in both groups. Females were more common in the positive group 60.4%, while males were slightly higher in the negative group 54.2% statistically significant p=0.161. Striking difference was observed in family provider education where 27.1% of positives had less than primary education compared to none in the negative group p<0.001. Socioeconomic disparities were also notable, with 50% of positives from lower class families versus only 4.2% in negatives, while middle/upper class families dominated the negative group 95.8% and p<0.001. Family structure showed significant variation, as joint families were more common among positives 52.1% whereas nuclear families were predominant among negatives 85.4% and p<0.001.

Figure 1 shows age-wise distribution of anti *H. pylori* IgG among 48 positives also 48 negative patients. In the <6 years group, the prevalence was low, with 10.0% positive and 12.0% negative cases. The majority of patients in both groups were in the 6 to <12 years range, accounting for 50.0% each. In the 10 to <18 years group, 40.0% were positive and 38.0% were negative. This indicates that the highest proportion *H. pylori* IgG positivity was observed in children age 6 to <12 years, with a gradual decline in the older age group.

Table 2 compares clinical history between 48 anti-*H. pylori* IgG positive also 48 negative patients. Mean duration of abdominal pain was longer in the positive group 4.01±4.18 months compared to the negative group 2.80±2.93 months, though not statistically significant. Dull and epigastric pain were more frequent among positives, while diffuse and umbilical pain were more common in negatives. Dyspepsia 78% versus 50%, p=0.004, loss of appetite 64% versus 26%, p<0.001, heartburn/

hyperacidity 56% versus 32%, p=0.016 and history of poor growth 20% compare with 6%, p=0.037 associated with the positive group. Other features like recurrent vomiting and past history of *H. pylori* infection showed no significant differences.

Table 1: Sociodemographic characteristics of the study patients (n=100).

Variables	Positive (n=50) (%)	Negative (n=50) (%)	P value
Age (years)			
<6	5 (10.4)	6 (12.5)	
6 to <12	24 (50.0)	24 (50.0)	
12 to <18	19 (39.6)	18 (37.5)	
Mean±SD	11.30± 3.08	10.94± 3.58	0.591 ns
Sex			
Male	19 (39.6)	26 (54.2)	
Female	29 (60.4)	22 (45.8)	0.161 ns
Male: female	1:1.5	1.2:1	
Education attainment of family provider			
Less than primary	13 (27.1)	0 (0.0)	<0.001*
Upto secondary	18 (37.5)	20 (41.7)	
More than secondary	17 (35.4)	28 (58.3)	
Socioeconomic status			
Lower class	24 (50.0)	2 (4.2)	
Middle class	24 (50.0)	42 (87.5)	<0.001*
Upper class	0 (0.0)	4 (8.3)	
Size of family			
Nuclear family	23 (47.9)	41 (85.4)	<0.001*
Joint family	25 (52.1)	7 (14.6)	

*P value significant, ns: p value non-significant

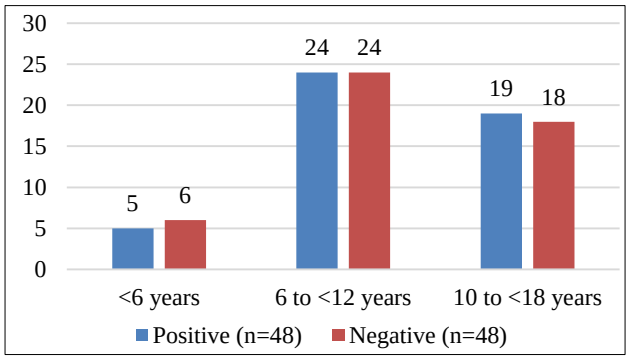

Figure 1: Age distribution of the children in *H. pylori* positive and negative group.

Table 3 shows the physical findings among 48 anti-*H. pylori* IgG positive also 48 negative patients. The mean weight, height and BMI were slightly higher in the positive group but the differences were not statistically significant. A striking difference was observed in pallor, present in 66% of positive cases compared to only 22% in negatives p<0.001, indicating a strong association with *H. pylori* positivity. Abdominal tenderness was found in 24% of positives and 20% of negatives, with no significant difference.

Table 3: Physical findings of study patients (n=100).

Physical findings	Positive (n=48)	Negative (n=48)	P value
Weight (kg)	33.59±13 .49	30.98±12 .62	0.319 ns
Height (cm)	136.34±1 8.74	133.73±2 0.07	0.417 ns
BMI (kg/m²)	17.21±3. 53	16.54±3. 16	0.320 ns
Pallor (%)	32 (66.0)	11 (22.0)	<0.001*
Abdominal tenderness (%)	12 (24.0)	10 (20.0)	0.629 ns

*P value significant, ns: p value non-significant

Following covariate adjustment through logistic regression analysis, the factors that maintained independent associations with Hp seropositivity included: reduced socioeconomic standing [adjusted OR: 1.47, 95% CI (0.78-2.93)]; household overcrowding conditions [adjusted OR: 2.36, 95% CI (1.24-4.36)]; contaminated domestic water supply [adjusted OR: 2.68, 95% CI (1.68-5.14)]; inadequate waste management systems [adjusted OR: 1.14, 95% CI (1.03-2.56)] (Table 4).

Table 4: Multivariate logistic regression model for predictors of *H. pylori* infection among the study children (n=98).

Risk factors	B	P value	Adjusted OR	95% CI
Low socio-economic class	-3.055	0.001*	1.47	0.78-2.93
Overcrowding in the family	2.298	0.029*	2.36	1.24-4.36
Unsafe home drinking water	1.369	0.037*	2.68	1.66-5.14
Poor garbage disposal service	-1.956	0.007*	1.14	1.03-2.56

*P value significant

Table 5 shows among 48 anti-*H. pylori* IgG positive patients, stool antigen was positive in the majority 82% and negative in 18%. Endoscopic evaluation revealed that most patients had normal findings 74%, while small proportions showed duodenal nodularity 12%, antral nodularity 8%, gastric erythema 2%, gastric erosion 2%, or active bleeding 2%.

Histopathological examination demonstrated chronic gastritis as the most common lesion 46%, followed by chronic gastritis with *H. pylori* infection 36%, chronic active gastritis 10%, chronic duodenitis 6%, and a single case 2% of chronic gastritis with intestinal metaplasia.

Table 5: Stool antigen, endoscopy and histopathological findings of anti *H. pylori* IgG positive group (n=50).

Variables	Frequency	Percentage (%)
Stool antigen		
Positive	39	82.0
Negative	9	18.0
Endoscopy findings		
Antral nodularity	4	8.0
Gastric erythema	1	2.0
Duodenal nodularity	6	12.0
Active bleeding	1	2.0
Gastric erosion	1	2.0
Normal	35	74.0
Histopathological findings		
Chronic duodenitis	3	6.0
Chronic gastritis	22	46.0
Chronic gastritis with *H. pylori*	17	36.0
Chronic gastritis with intestinal metaplasia	1	2.0
Chronic active gastritis	5	10.0

DISCUSSION

This study provides an analysis of risk factors, clinical profile and serological diagnosis of *H. pylori* infection in children presenting the abdominal pain and vomiting. Our findings highlight that socio-demographic factors are more strongly associated with *H. pylori* infection than clinical symptoms alone, and confirm the utility of serological testing alongside other diagnostic methods in a pediatric population. A striking finding of our study was the profound impact of socio-economic and educational determinants on *H. pylori* seropositivity. We observed that a low socioeconomic status, lower education level of the family provider (less than primary education), and living in a joint family system were prevalent in the *H. pylori* positive group ($p<0.001$). Further identified low socioeconomic status, family overcrowding, unsafe drinking water, and poor garbage disposal as independent risk factors for infection. This strongly suggests that *H. pylori* transmission is facilitated by conditions of poor hygiene and crowded living, which are often intertwined with lower socioeconomic conditions.[28] This aligns with a large cohort study which found that household crowding and lack of access to clean water were paramount risk factors for early acquisition of *H. pylori* in children underscoring the fecal oral route as a primary mode of transmission.[29] The clinical presentation in our cohort revealed several symptoms significantly associated with *H. pylori* positivity. Dyspepsia, loss of appetite, heartburn/hyperacidity, and a history of poor growth were all markedly more common in seropositive children. Notably, the character of abdominal pain differed, with dull and epigastric pain being more frequent in the positive group. This is consistent with known manifestations of *H. pylori* associated gastritis and peptic ulcer disease in children, where epigastric discomfort and dyspeptic symptoms are hallmark features.[30] Furthermore, the significant association with poor growth reinforces the potential long-term nutritional consequences of chronic *H. pylori* infection, possibly due to chronic inflammation, loss of appetite, and malabsorption.[31] On physical examination, the most significant finding was the high prevalence of pallor among H. pylori positive children (66% versus 22%, $p<0.001$). This is a critical observation, as it points toward a possible link between infection and iron deficiency anemia. *H. pylori* can contribute to anemia through several mechanisms including chronic blood loss from gastric erosions impaired iron absorption due to hypochlorhydria and bacterial consumption of dietary iron.[32]

An analysis confirmed that *H. pylori* eradication therapy improved iron deficiency anemia in children, establishing a causal relationship in a subset of patients.[33] Regarding diagnosis, our study utilized anti *H. pylori* IgG serology and found the highest prevalence of positivity in children aged 6 to <12 years. While serology is a non-invasive and useful screening tool, it has limitations, including an inability to distinguish between active and past infection. This is reflected in our results, where 18% of seropositive patients had a negative stool antigen test, which is a more reliable marker of active infection. The gold standard remains endoscopy with histology. Our endoscopic findings showed that a majority (74%) of infected children had a normal-appearing mucosa, emphasizing that a normal endoscopy does not rule out infection.

However, histopathology revealed that chronic gastritis was nearly universal, with 46% showing chronic gastritis and 36% showing chronic gastritis with confirmed *H. pylori* organisms. This discrepancy between endoscopic and histological findings is well-documented in pediatrics; histological changes often precede visible mucosal damage.[34] The discovery of a single case of intestinal metaplasia, a pre-malignant condition, though rare in children, underscores the importance of eradication therapy to prevent long-term sequelae.[35] The age distribution of infection in our study, peaking in the 6-12 year age group, is consistent with the typical acquisition pattern in developing countries, where the infection is often acquired in early childhood.[36]

Limitations

Not with standing its contributions, this study presents multiple constraints: the hospital-based methodology and purposive sampling approach restrict the external validity of results to the broader population, given that study participants may lack representativeness of the general pediatric cohort; the reliance on serological testing (anti-*H. pylori* IgG) as the principal approach for categorizing cases and controls fails to differentiate between current and previous infections.

CONCLUSION

In a recent ethics study, researchers discovered that the rate of *H. pylori* infections among children experiencing abdominal pain was notably high. Several key risk factors linked to the onset of *H. pylori* infection included low socioeconomic status, living in joint families, overcrowded living conditions, reliance on unsafe drinking water, inadequate sanitation facilities, poor garbage disposal services, and a family history of peptic ulcer disease (PUD).

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