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Asymptomatic *Helicobacter pylori* infection among rural children and adolescents in Bangladesh

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Abstract

Background and objectives: The *Helicobacter pylori* infection rate varies according to the age, location of the residence and socioeconomic status. The aim of the present study was to investigate the status of *H. pylori* infection among the asymptomatic Bangladeshi rural children and adolescents.

Material and methods: This cross-sectional study was carried out in a rural area under Pabna district about 150 km north-west of capital Dhaka. Asymptomatic and apparently healthy rural children and adolescents aged 6 to 18 years were enrolled in the study. A structured questionnaire was used to record the socio-demographic and clinical information. The rate of *H. pylori* infection was determined by the presence of *H. pylori* antigen in faeces and/or anti-*H. pylori* IgG and/or IgA antibodies in blood. *H. pylori* stool antigen was detected by lateral flow chromatographic immunoassay and serum anti-*H. pylori* IgG and IgA antibodies were estimated by ELISA method.

Results: A total number of 185 asymptomatic and apparently healthy children and adolescents were enrolled of which 34, 131 and 20 were in 6-10, 11-15 and 16-18 years age groups respectively. The overall *H. pylori* infection rate was 79.5% (95% CI: 0.729, 0.85) by positive stool antigen or by the presence of serum anti-*H. pylori* IgG/IgA antibodies. The rate of *H. pylori* infection significantly (p=0.05) increased with progress of age. *H. pylori* infection rate was 67.6%, 80.2% and 95% in 6-10, 11-15 and 16-18 years age groups respectively. The concentration of serum anti-*H. pylor*i IgG/IgA antibodies did not differ across the age groups. The infection rate was significantly (p<0.05) higher among the children of illiterate parents compared to the children of literate parents.

Conclusion: The study demonstrated a high prevalence of *H. pylori* infection among children and adolescents in a rural setting. Gender and family history did not affect *H. pylori* prevalence but increasing age and poor educational status of parents were associated with a higher *H. pylori* prevalence.

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Introduction

Helicobacter pylori infection is one of the most chronic infections in humans [1]. It is associated with gastric diseases such as peptic ulcer, chronic gastritis, gastric adenocarcinoma and mucosa associated lymphoid tissue (MALT) lymphomas [2,3]. In addition, the infection has been associated with chronic diarrhea and malnutrition among infants and children [4,5]. In a meta-analysis, the overall global prevalence of *H. pylori* infection has been found as 44.3%, while it is 50.8% in developing countries and 34.7% in developed

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countries [6]. Previously, we reported low prevalence (38.9%, CI: 32.1, 46.2) of *H. pylori* infection in asymptomatic rural adults of Bangladesh [7].

H. pylori is most likely acquired in childhood [8-10]. In developed countries, the prevalence of *H. pylori* infection in children ranges from 10%–16.7% whereas it is 9%–78.6% in school children of developing countries [11-14]. In Bangladesh, the prevalence of *H. pylori* infection in peri-urban children has been reported as 82% [15]. However, the age group at greatest risk of infection is not clear yet [16]. Though the infection is clustered in families, it is not confirmed yet whether it is because of acquisition from person-to-person transmission or from common environmental source(s) [17-19]. Identifying the age group at greatest risk of *H. pylori* infection would be useful in determining the specific risk factors for infection and to plan preventive measure.

No previous study investigated the prevalence in rural children and adolescents in our country. Therefore, the primary aim of the present study was to find out the seroprevalence of *H. pylori* infection among asymptomatic rural children and adolescents in Bangladesh.

Materials and methods

The study was approved by the Institutional Research Review Board of Ibrahim Medical College and written informed consent was obtained from all adult participants and from the guardians of the children after explaining the nature and purpose of the study. Laboratory work was conducted at KA Monsur Research Laboratory at the Department of Microbiology, Ibrahim Medical College.

Study place and population: This cross-sectional study was carried out at Bhulbaria rural area of Santhia Upazilla (sub-district) under Pabna district in 2019. It is located about 150 km north-west of capital Dhaka. Apparently healthy rural school children and adolescents aged 6 to 18 years having no gastrointestinal symptoms, systemic infection, and malnutrition were enrolled in this study. A structured questionnaire (closed ended) was developed and used to record the socio-demographic information and clinical history. It was pretested and checked for applicability before it was finally launched at the field to interview for data collection from the respondents.

Definition of asymptomatic H. pylori infection: Asymptomatic *H. pylori* infection was defined if an apparently healthy individual was found positive for *H. pylori* stool antigen and or anti-*H.pylori* IgG and or IgA antibodies in blood without having any gastrointestinal symptoms.

Sample collection and preparation: Blood sample (about 2.5 ml) was collected aseptically from each participant by peripheral venipuncture. After collection, the serum was separated, aliquoted, refrigerated at 4^0C and then transported to the microbiology laboratory in a cold box and stored at -20^0C until tested. For stool antigen test, participants were asked to bring freshly passed stool (about 3-4 gm) in a sterile container and stored at 4^0C until tested. Stool antigen test was performed within 3/4 hours of collection of stool.

Detection of H. pylori stool antigen: Stool samples were analyzed for *H. pylori*stool antigen using one step rapid lateral flow chromatographic immunoassay (ABON, Inverness Medical Innovation Hong Kong Limited). The test was performed as per manufacturer's instruction. Small portions of stool from different parts of the collected stool were thoroughly mixed with extraction buffer and then vigorously agitated. Two drops of mixture were then put into the round window of the test cassette. Reading was made after 10 minutes of incubation at room temperature. Appearance of control (C) and test (T) lines across the central window of the cassette indicated positive test. Only one C line indicated negative result. The test was considered invalid if no line appeared in C line region.

Detection of serum anti-H. pylori IgG and IgA antibodies by ELISA: Serum samples were tested for the presence of anti-*H. pylori* IgG and IgA antibodies by ELISA method using DRG *H. pylori* IgG and IgA ELISA kit (DRG International Inc., USA). The test was performed according to the manufacturer's instruction. The antibody concentration was expressed in optical density (OD) of the reactants.

Treatment of H. pylori stool antigen positive cases: *H. pylori* stool antigen positive individuals were treated with a proton pump inhibitor (PPI) and two antibiotics namely amoxicillin and metronidazole for 14 days for eradication of *H. pylori* according to the recommended dose schedule [20,21]. Stool samples were collected again and re-tested for *H. pylori* antigen one month after the completion of the treatment.

Results

A total number of 185 apparently healthy asymptomatic children and adolescents were enrolled in the study of which 34, 131 and 20 were in 6-10, 11-15 and 16-18 years age groups respectively. Socio-demographic variables of the participants are shown in Table-1. Almost equal number of male (51.4%) and female (48.6%) participated in the study. All were from middle socio-economic class. Of the enrolled children, 35.1% and 24.3% of their fathers and mothers were illiterate while remaining had access to academic education. Almost all (98.9%) used tube well water for drinking. Most of the participants (87%) used slab latrine. Though 81.6% washed hand with soap after defecation, only 37.3% washed hand with soap before meal. Around 48.1% had family history of gastritis whereas 51.9% had no such history. More than two third of individuals (71.4%) provided history of eating less spicy food. Most of the participants (96.8%) had no history of smoking.

Out of total 185 study population, 147 (79.5%; (95% CI: 0.729, 0.85) participants were positive for *H. pylori* infection either by positive stool antigen or by the presence of serum anti-*H-pylori* IgG/IgA antibodies (Table-2). Stool antigen, anti-*H. pylori* IgG and IgA antibody were positive in 24.9%, 64.9% and 55.1% participants respectively. The rate of *H. pylori* infection significantly (p=0.05) increased with the progress of age. *H. pylori* infection rate was 67.6%, 80.2% and 95% in 6-10, 11-15 and 16-18 years age groups respectively. Concentrations of anti-*H. pylori* IgG and IgA antibodies in different age groups were not significantly different as measured by OD (Table-3).

Table-1: *Socio-demographic characteristics of the study population (N=185)*

Variables	Number (%)
Age groups (years)	
6-10	34 (18.4)
11-15	131 (70.8)
16-18	20 (10.8)
Gender	
Male	95 (51.4)
Female	90 (48.6)
Socioeconomic status	
Middle class	185 (100)
Educational status of mother	
Illiterate	45 (24.3)
Below SSC	101 (54.6)
SSC or above	39 (21.4)
Educational status of father	
Illiterate	65 (35.1)
Below SSC	85 (45.9)
SSC or above	35 (18.9)
Source of drinking water	
Tube well	183 (98.9)
Pipe water	2 (1.1)
Type of toilet used by participant	
Water sealed latrine	16 (8.6)
Slab latrine	161 (87)
Pit/open	8 (4.3)
Hand wash after defecation	
Soap	151 (81.6)
Water	3 (1.6)
Soil/ash	31 (16.8)
Hand wash before meal	
Soap	69 (37.3)
Water	115 (62.2)
Soil/ash	1 (0.5)
Family history of gastritis	
Yes	89 (48.1)
No	96 (51.9)
Food habit of participant	
Spicy food	53 (28.6)
Less spicy food	132 (71.4)
Habit of participant	
Non-smoker	179 (96.8)
Smoker	2 (1.1)
Betel eater	4 (2.2)

Table-2: *Rate of H. pylori infection in different age groups of study population as determined by presence of stool antigen and serum anti-H. pylori IgG/IgA antibodies*

Age group (years)	Positive for, n (%)					Negative for, n (%)
	Only Stool Ag	Only IgG	Only IgA	IgG and/or IgA	Ag/IgG/IgA (any one)[a]	Ag/IgA/IgG
6-10 (n=34)	7 (20.6)	17 (50)	17 (50)	21 (61.8)	23 (67.6)	11 (32.4)
11-15 (n=131)	36 (27.5)	84 (64.1)	77 (58.8)	103 (78.6)	105 (80.2)	26 (19.8)
16-18 (n=20)	3 (15)	19 (95)	8 (40)	19 (95)	19 (95)	1 (5)
Total (N=185)	46 (24.9)	120 (64.9)	102 (55.1)	143 (77.3)	147 (79.5)	38 (20.5)

Note: p=0.05 compared among the 6-10, 11-15 and 16-18 years age groups for stool antigen/IgG/IgA antibodies; p>0.05 when compared for stool antigen positivity rate for 3 age groups. p value calculated by chi square test. a: 95% confidence interval of positivity in 6-10 years group 0.494, 0.826, 11-15 years 0.722, 0.866, 16-18 years 0.751, 0.998 and total (6-18 years) 0.729, 0.85. Ag: antigen.

Table-3: *Anti-H. pylori IgG and IgA antibody concentration in different age groups of study population (N=185)*

Age (years)	Anti-*H. pylori* IgG		Anti-*H. pylori* IgA	
	Positive		Positive	
	n	Mean (± SD) OD	n	Mean (± SD) OD
6-10	17	1.7 ± 0.3	17	1.6 ± 1.1
11-15	84	1.9 ± 0.3	77	1.4 ± 0.9
16-18	19	1.9 ± 0.5	8	1.9 ± 1.1
Total	120	1.9 ± 0.4	102	1.5 ± 0.9

*Note: p>0.05, compared among the three age groups for anti-H. pylori IgG and Ig*A. *p value calculated by ANOVA. SD: standard deviation. OD: optical density.*

Significantly higher numbers of individuals were positive for anti-*H. pylori* IgG and IgA antibodies among stool antigen positive individuals compared to those who were stool antigen negative (p<0.001, 0.02 and p<0.009). Out of 46 *H. pylori* stool antigen positive cases, 91.3% were positive for IgG and/or IgA while out of 139 stool antigen negative individuals, 72.7% were also positive for anti-*H. pylori* IgG and/or IgA (Table-4).

No significant (p>0.05) association of *H. pylori* infection was observed with gender and family history of gastritis. The infection rate was significantly (p<0.05) higher among the children of illiterate parents than the children of parents having access to school (Table-5). Out of 46 stool antigen positive individuals, 34 (73.9%) became negative for *H. pylori* stool antigen when tested one month after the completion of scheduled treatment.

Table-4: *Comparison of stool antigen with the presence of serum anti-H. pylori IgG and IgA antibodies*

Stool antigen test	Number	Anti-*H. pylori*		
		IgG +ve n (%)	IgA +ve n (%)	IgG and/or IgA +ve n (%)
Positive	46	41 (89.1)	32 (69.6)	42 (91.3)
Negative	139	79 (56.8)	70 (50.4)	101 (72.7)
Total	185	120 (64.9)	102 (55.1)	143 (77.3)

Note: p=0.0001, p=0.02 and p=0.008 respectively when compared for IgG, IgA and IgG and/or IgA between stool antigen positive and negative cases. p value calculated by chi square test.

Table-5: *Status of H. pylori infection according to the socio-demographic characteristics of the study population (N=185)*

Characteristics	Positive for *H. pylori* stool Ag/IgG/IgA n (%)	p value
Gender		
Male (n=95)	74 (77.9)	0.34
Female (n=90)	76 (84.4)	
Educational status of mother		
Group 1: Illiterate (n=45)	42 (93.3)	0.02 (Gr. 1 vs 2)
Group 2: <SSC (n=101)	76 (75.2)	0.53 (Gr. 2 vs 3)
Group 3: ≥SSC (n=39)	32 (82.1)	0.21 (Gr. 3 vs 1)
Educational status of father		
Group 1: Illiterate (n=65)	58 (89.2)	0.02 (Gr. 1 vs 2)
Group 2: <SSC (n=85)	62 (72.9)	0.21 (Gr. 2 vs 3)
Group 3: ≥SSC and (n=35)	30 (85.7)	0.85 (Gr. 3 vs 1)
Family history of gastritis		
Yes (n=89)	76 (85.4)	0.21
No (n=96)	74 (77.1)	

Note: p value calculated by chi square test. Ag: antigen. Gr.: group.

Discussion

This is the first study describing the *H. pylori* infection rate in rural children and adolescents in Bangladesh. In this study, *H. pylori* infection in an individual was defined as positive stool antigen and/or positive serum anti-*H. pylori* IgG and/or IgA antibodies. In the present study, we found the overall positivity rate as 79.5%; 67.6%, 80.2% and 95% in 6-10, 11-15 and 16-18 years age groups respectively. We found an increasing prevalence with age. This finding is comparable with other studies [22-24]. A plausible explanation might be increasing chance of exposure to *H. pylori* with advance of age due to consumption of *H. pylori* contaminated food/drinks from street vendors with poor hygienic condition. Children of lower age groups frequently consume antibiotics for other infections which might indirectly prevent infection by *H. pylori* infection [25].

Our study showed *H. pylori* IgG positivity rate of 64.9% in children and adolescents. In another developing country Benin, the rate was 68.3% in rural children [26]. In addition, in Vietnam, it was 41.4% in rural children [27]. On the other hand, the prevalence of *H. pylori* IgG antibodies in urban children of Benin was 78.3%. The lower rate of *H. pylori* infection in rural thanurban population might be due to crowded accommodation, poor sanitation and exposure to unhygienic foods [26].

In the current study, the prevalence of *H. pylori* stool antigen in asymptomatic rural children and adolescents was 24.9%. It was 14.2% in African rural children [28]. Positive *H. pylori* stool antigen means active infection or individual is harboring the organism whereas positive *H. pylori* IgG antibodies represent current or previous *H. pylori* infection [29]. In our study, the *H. pylori* infection rate by serum anti-*H. pylori* IgG antibodies was 64.9% while the *H. pylori* stool antigen positivity rate was 24.9%. This difference suggests spontaneous resolution of infection in children. Auto-curability among black children aged 7-21 years in USA was 0.3% yearly and 5.5% per year in white children in the same cohort study [30]. Among Peruvian children, a spontaneous eradication of 7% monthly was reported [31]. The natural history of *H. pylori* infection in children continues to evolve. Further studies are needed to investigate whether re-infection or persistent infection occurs in antibody positives cases by detecting stool antigen or urea breath test or endoscopy.

We found no significant gender difference in the prevalence of *H. pylori* infection. It could be due to both boys and girls were equally exposed to same environment or sources in school as well as residence. Similar finding was observed in a meta-analysis of 10 studies conducted over the last 20 years in different countries [32]. However, few other studies reported significantly higher infection rates in boys than that of girls [33,34]. Our findings showed a significant association between higher rates of *H. pylori* infection in children of illiterate parents. It indicates that children of illiterate parents might have less knowledge regarding personal hygiene and good life style and that ultimately poses greater risk to be infected with *H. pylori*.

Our study revealed *H. pylori* infection was acquired in early childhood in rural Bangladeshi children. However, further study is necessary to understand the long term consequences of childhood *H. pylori* infection on the overall health of the population with the progress of age.

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Authors' contributions

SM: sample/data collection, laboratory work, data entry and analysis and manuscript writing; FR: sample/data collection, laboratory work, data entry and analysis; FA: sample/data collection and data entry; RK and SA: sample/data collection; SPS: data entry; MSAJ: sample/data collection and data analysis; MAS and JAH: Idea generation, study design, data analysis and editing of manuscript.

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