Prevalence of *Helicobacter pylori* infection among symptomatic children in a tertiary hospital in Southwestern Nigeria: a retrospective study

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Abstract

Objective(s): Acquisition of the bacteria, *H. pylori* mainly occurs in childhood and may be a crucial factor in developing long-term *H. pylori*-related complications. This is especially important in developing countries where relatively high rates of *H. pylori* infection have been reported. Due to limited data concerning the infection in the paediatric population in this locality. This study aimed to investigate the prevalence of *H. pylori* infection among symptomatic children.
Methodology: This was a retrospective study that involved the review of medical microbiology laboratory records to analyse *H. pylori* results of stool samples obtained from children with gastrointestinal symptoms suggestive of *H. pylori* infection between January 2022 and December 2023.
Results: The overall prevalence of *H. pylori* infection among children in this study was 30.7% (116/378) with a peak prevalence of 15.3% among the age group ≥ 16 years. The prevalence of infection was associated with age (p=0.035). The prevalence was also higher among females (23.3%) than males but not statistically significant.
Conclusion: Our study shows a high prevalence of *H. pylori* infection which increased with age and was highest among children ≥16 years.

Prévalence de l'infection *à Helicobacter pylori* chez les enfants symptomatiques dans un hôpital tertiaire du sud-ouest du Nigéria : une étude rétrospective

Résumé

Objectif de l' étude: L'acquisition de la bactérie *H. pylori* survient principalement dans l'enfance et peut être un facteur crucial dans le développement de complications à long terme liées à *H. pylori.* Cela est particulièrement important dans les pays en développement où des taux relativement élevés d'infection *à H. pylori* ont été signalés. En raison du manque de données concernant l'infection dans la population pédiatrique de cette localité, cette étude visait à étudier la prévalence de l'infection *à H. pylori* chez les enfants symptomatiques.
Méthode de l'étude: Il s'agissait d'une étude rétrospective qui impliquait l'examen des dossiers du laboratoire de microbiologie médicale pour analyser les résultats de *H. pylori* dans des échantillons de selles obtenus auprès d'enfants présentant des symptômes gastro-intestinaux suggérant une infection *à H. pylori* entre janvier 2022 et décembre 2023.
Résultats de l'étude: La prévalence globale de l'infection *à H. pylori* chez les enfants de cette étude était de 30,7 % (116/378) avec un pic de prévalence de 15,3 % dans la tranche d'âge ≥ 16 ans. La prévalence de l'infection était associée à l'âge (p = 0,035). La prévalence était également plus élevée chez les femmes (23,3 %) que chez les hommes, mais pas statistiquement significative.
Conclusion: Notre étude montre une prévalence élevée de l'infection *à H. pylori* qui augmente avec l'âge et est la plus élevée chez les enfants de plus de 16 ans.
Mots-clés : *Helicobacter pylori, prévalence, test antigénique dans les selles, enfants, Nigéria*

INTRODUCTION

Helicobacter pylori (*H. pylori)* is a spiral or curved Gram-negative microaerophilic bacterium which selectively colonizes the human gastric epithelium (1,2). It is estimated that more than half of the world's population is infected with *H. pylori* (1,3,4). About 25-50% of the population in developed countries and 70-90% in developing countries are estimated to have this pathogen (5,8). A meta-analysis reported the global prevalence as 44.3% with a low prevalence rate of 8.9% in Yemen and a high prevalence rate of 89.7% in Nigeria (9,10).

Globally, about one-third of all children are infected with *H. pylori* with the prevalence being higher in developing countries than in developed countries (1,2,11,12). The varying prevalence is associated with socio-economic status, level of urbanization and sanitation conditions (2,8,13). Low socio-economic status, poor sanitation and hygiene and lack of potable water are major contributors to its transmission and high prevalence in developing countries (2,12-17).

The infection is primarily acquired in childhood and the most probable mode of transmission is the oro-oral or faeco-oral route, especially in families within families with mother-to-children transmission being the most frequent route (1,2,4,11,15-17). The infection usually persists throughout the host's life if not treated (1,3,4,18). In general, the symptoms are non-specific and have a varying range of severity but common symptoms include epigastric abdominal pain, dyspepsia, heartburn, nausea, emesis, diarrhoea or constipation (2,14). Paediatric patients may present with recurrent or chronic abdominal pain which may pose a diagnostic challenge for physicians (14). *H. pylori* infection results in the suppression of gastric acid, enhancing access of entero-pathogens in weaning foods into the small intestine; thereby predisposing to childhood diarrhoea, essential nutrient malabsorption (such as iron, vitamins B12 and C) and growth failure (2,4,19,20). Furthermore, the bacteria has been implicated in the pathogenesis of several gastrointestinal disorders such as chronic gastritis, gastroduodenal ulcers, gastric mucosa-associated lymphoid tissue lymphoma and gastric and oesophageal cancers (15,17).

H. pylori has been categorized as a group-I carcinogen as it is the single, greatest risk factor for the development of gastric carcinoma (9,16). In addition, it has been implicated as a cause of colorectal cancer, myocardial infarction and liver cirrhosis (21). It is recommended that all children and adolescents with symptoms suggestive of peptic ulcer disease should be tested and treated in a bid to prevent long-term complications (11). Hence, there is a need to accurately detect this organism to enable effective treatment and prevention of its long-term complications.

Diagnostic techniques for *H. pylori* can be invasive and non-invasive, with each having its advantages and disadvantages depending on the clinical setting (4,21). The invasive techniques require obtaining biopsies of the stomach via fibreoptic endoscopy. Examples of invasive methods include histology of the biopsy, direct Gram stain or culture of the biopsy, rapid urease test and polymerase chain reaction (PCR) (21). The non-invasive methods include serology of whole blood, serum, urine and saliva, stool PCR, stool antigen test, and the ^{13}C urea breath test (20,21). The invasive tests are the best methods to diagnose active *H. pylori* infection although none of the tests have 100% sensitivity (22). In addition, the use of invasive tests in children is more difficult and unpleasant requiring sedation and anaesthesia (22).To avoid these difficulties, a non-invasive test which is convenient, cheaper, faster and reliable for all age groups of children and adolescents is essential. They also provide a more global evaluation of the presence of *H. pylori* compared to the invasive tests which are subject to selection error due to the variable distribution of the bacteria in the gastric mucosa (21). Furthermore, patient compliance is better with the stool antigen test than any of the invasive tests or ^{13}C urea breath test (14).The *H. pylori* stool antigen (HpSA) test is a simple, non-invasive, comparatively inexpensive and reliable assay in diagnosing peptic ulcer or gastritis in children and adults (11,14,22).

There are limited studies among children in developing countries including sub-Saharan Africa despite the high prevalence of *H. pylori* infection and potential for long-term complications. This study sought to evaluate the prevalence of *H. pylori* infection among children and adolescents in Babcock University Teaching Hospital, Ilishan-Remo, South western Nigeria.

MATERIALS AND METHODS

Study Site

The study was conducted in the Babcock University Teaching Hospital, Ilishan-Remo, Ogun State, South western Nigeria. The hospital is a 240-bed tertiary hospital located in a peri-

urban setting of Ogun state. The hospital provides medical and surgical services to Ogun State and the neighbouring states in South western Nigeria.

Study Design

Data from symptomatic children and adolescents (persons less than 18 years of age) who presented at the clinic or Children Emergency Room and had their stool specimens sent to the Medical Microbiology Laboratory of Babcock University Teaching Hospital between January 2022 and December 2023 for the HpSA test were retrospectively analysed.

Inclusion criteria

The inclusion criteria included all patients less than 18 years old who had undergone the *H. pylori* stool antigen test between January 2022 and December 2023.

Sample size and sampling method

A convenience sampling method was used to select patients who met the inclusion criteria of the study. The laboratory records were carefully reviewed to identify all patients that met the inclusion criteria. A total of 378 fulfilled the criteria and were included in the study.

Ethical considerations

Ethical approval for the study was obtained from the Babcock University Health Research and Ethics Committee (BUHREC No 693/22). As this was a retrospective study which did not involve patient contact or recruitment of patients hence informed consent was not deemed necessary. However, confidentiality and anonymity of patients' data were ensured in accordance with the Declaration of Helsinki.

Laboratory procedure

Fresh stool samples sent to the Medical Microbiology Laboratory for HpSA test are routinely collected in plain universal bottles and tested using a rapid strip *H. pylori* stool antigen kit (Lotus NL B.V, The Hague, Netherlands) according to the manufacturer's instructions. This is a qualitative, rapid, sandwich, solid-phase immunochromatographic assay based on the lateral flow chromatography technique and detects *H. pylori* antigen in human stool. It has a sensitivity of 99.0%, a specificity of 97.9% and positive and negative predictive values of 99.0% and 97.9% respectively.

Data collection and analysis

Data were collected using a proforma designed specifically for this study. Data collected included age, gender, symptoms and results of *H. pylori* stool antigen test. Data were anonymised and patients were given identification numbers. Data were analysed using IBM_SPSS Statistics for Windows software version 20 (IBM, Armonk, New York, USA). Data were presented as means, standard deviation for continuous variables and percentages for categorical variables. Chi-square statistic was used to determine the associations between demographic characteristics and HpSA test positivity and statistical significance level was considered at a p-value (p) of < 0.05.

RESULTS

A total of 378 children with symptoms were included in the study and there were 281 females (74.3%) and 97 (25.7%) males (Table 1). The age range was 3 – 17 years with a mean age of 13.9 ± 3.7. The mean age for females was 14.2 ± 3.4 years while that of males was 13.1 ± 4.2 years. All the children were divided into 4 age groups, including ≤5, 6-10, 11-15 and ≥16year age group. The majority (202, 53.4%) of the participants were between the age of 16 and 17 years. The symptoms reported among the patients were dyspepsia, chest pain, recurrent abdominal pain, nausea and vomiting.

***H. pylori* infection rate**

Overall, 30.7% (116/378) of the participants tested positive for HpSA. The overall rates of HpSA-positivity varied among the age groups with the age group ≥16 years having the highest prevalence (58, 15.3%) while the age group ≤5 years had the lowest prevalence (8, 2.1%) and this finding was statistically significant ($x^2 = 8.582$, $p = 0.035$) (Table 2).

Further analysis within the age sub-group shows that in the age group of ≤5 years, 8 patients (66.7% of this age group) tested positive for *H. pylori*, representing 6.9% of all *H. pylori*-positive patients, while 4 patients (33.3% of this age group) tested negative, making up 1.5% of all *H. pylori*-negative patients (Table 3). In the ≥16 years age group, 58 patients (28.7%) tested positive, (Figure 1) representing half of all positive cases, while 144 patients (71.3%) tested negative, comprising 55.0% of all negative cases. The chi-square statistic for age is 8.582, with a p-value of 0.035, indicating a statistically significant association between age and *H. pylori* status, suggesting that the likelihood of being *H. pylori*-positive varies with age.

Furthermore, the HpSA-positivity rate

was higher among females (23.3%) than males (7.4%) but it was not statistically significant (x^2=0.204, p = 0.652). Females were the major proportion (76%) of *H. pylori*-positive participants while males comprised 24% of the *H. pylori*-positive participants (Figure 2). Concerning gender distribution and *H. pylori* infection among the participants, 88 (31.3%) females were *H. pylori*-positive, which represents 75.9% of all positive cases while 193 (68.7%) females were negative, making up 73.7% of all negative cases (Table 4). Among the male participants, 28 (28.9%) *were H. pylori*-positive, constituting 24.1% of all positive cases, while 69 (71.1%) males were negative, accounting for 26.3% of all negative cases. The chi-square statistic for gender is 0.204, with a p-value of 0.652, indicating no statistically significant association between gender and *H. pylori* status suggesting that gender does not significantly impact the likelihood of being *H. pylori*-positive.

DISCUSSION

In developing countries like Nigeria, *H. pylori* infection usually occurs in childhood and can lead to chronic health problems such as chronic gastritis, gastroduodenal ulcers and gastric cancer later in life (23). Despite this, there is limited data about *H. pylori* in children in southwestern Nigeria. Hence, this study sought to add to the available data on *H. pylori* among children in Nigeria as determination of the burden of the infection may aid early diagnosis and enable early therapy for children who meet the treatment criteria.

This study documents the prevalence of *H. pylori* infection among children who presented with symptoms at clinics in Babcock University Teaching Hospital, located in a semi-urban setting in Southwestern Nigeria, with a prevalence of 30.7%. The prevalence rate of 30.7% observed in this study is high and indicates that *H. pylori* infection is significant among children in the study locality. This finding is comparable with the prevalence rates previously reported among children in Nigeria, and other developing countries and the overall global prevalence among children (4,8,12,23-27). However, it is lower than the prevalence rate reported by Mynepall *et al* among secondary school children in Lagos (59.0%) (18) and Olufemi *et al* with a prevalence rate of 72.4% among asymptomatic children in Lagos (28). The lower prevalence rate observed in this study may also be attributable to the diagnostic modality employed as the HpSA test detects only current infections. In contrast, Mynepall *et al* employed a serological test which detects *H. pylori* antibody (Immunoglobulin G) and does not differentiate current from past *H. pylori* infections (30).

The prevalence rate reported in this study is also lower than that reported by Olokoba *et al* (56.7%) among dyspeptic Nigerians in Northeastern Nigeria (31). This might also be due to the diagnostic technique used — an endoscopic biopsy with histology, an invasive test which is the gold standard due to its very high sensitivity and specificity particularly when combined with special stains and immunohistochemistry (32). Endoscopy also has the advantage of providing information about the state of the gastric mucosa (32,33). However, it is not without its' drawbacks as it is more expensive with a longer turnaround time, requires patient's compliance and possibly sedation in children and depends on the observer's skill. Furthermore, due to the patchy distribution of *H. pylori* in the gastric mucosa, a false negative report may be obtained when an adequate number, site and sizes of biopsies are not collected (33). The non-invasive HpSA test employed in this study is cheaper, more convenient and rapid but prone to false negatives when the bacterial load is low, recent use of proton pump inhibitors, bismuth preparations or antibiotics (33,34). In addition, the performance of the test may also be limited by degradation of *H. pylori* antigen while passing through the intestine resulting in a false negative result (33). All these might contribute to the lower prevalence observed in this study as the drug use history could not be obtained due to the retrospective nature of the study and the inability to access the clinical notes of the participants.

Another possible reason for the variation the prevalence rates observed in both studies may be due to the difference in the age of the study population, as our study was among children while the participants in Olokoba *et al* were predominantly adults (age range 14 – 103 years). Literature has reported increasing prevalence of *H. pylori* infection with age probably as a result of continuous risk of acquiring the infection (34,35). As Velhuyzen van Zanten *el al* has reported a 1%/year continuous risk of being infected (35).

The prevalence rate observed in this study is higher than the prevalence rate, of 6% reported by Adedoyin *et al* among children in selected hospitals in Keffi, Nigeria (36) and 14.2% reported by Awuku *et al* among children in a rural setting in Ghana (31). However, this

agrees with reports that the prevalence of *H. pylori* infections varies within and between regions and countries due to differing socio-economic status, sanitation and hygiene and source of water supply (1,2,12,13).

In this study, the prevalence rate of *H. pylori* infection was significantly associated with increasing age as the highest prevalence was observed among participants ≥16 years (15.3%) and lowest among those between 1-5 years (2.1%). Several studies have reported a positive correlation between age and prevalence (2,12,31). However, some studies reported decreasing prevalence with increasing age and suggested that this may be due to spontaneous elimination of the infection or indirect benefit from antibiotics used for another purpose. Within the age group ≤5 years, 66.7% had *H. pylori* infection. This is similar to the findings of some studies in Nigeria (19,25) indicating that *H. pylori* colonization occurs in the early years of life with possible sources of infection being the caregivers, family members and nursery attendants (31). Other factors that may also contribute to the infection in this age group include loss of maternal acquired immunity, and the more adventurous nature of children in this age group with less regard for hygienic practices which may facilitate acquisition of the organism (19,23).

This study had a female preponderance of 74.3% with a higher prevalence among females (23.3%) than males (7.4%). Among many populations, the effect of gender on the prevalence of *H. pylori* is different as some studies reported higher prevalence in males than females while other studies reported no difference (2). The higher prevalence in females observed in this study is similar to the findings in some other studies (18,31). The reason for this is yet to be understood. However, the female preponderance was not statistically significant implying that gender might not play a role in the acquisition of *H. pylori* infection in children.

CONCLUSION

This study demonstrated a high prevalence of *H. pylori* among symptomatic children in a peri-urban setting with a significant association with age. Efforts should be made to exclude *H. pylori* infection in symptomatic children due to the high disease burden in our setting. Further research to determine the risk factors and impact of *H. pylori* infection in children in this locality should be conducted to guide preventive measures.

Limitations: Due to the retrospective nature of the study and inability to access the clinical records of the patients, cessation of the use of proton pump inhibitors, H_2 receptor blockers, N-acetylcysteine, bismuth preparations for 2 weeks, antibiotics for 4 weeks or antacids for 2 days before the test could not be ascertained and excluded from the study.

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Authors' Contribution: TOO conceptualized the study and study design TOO and OHN were involved in data collection, TOO and OHN analysed/interpreted the data, TOO prepared the first draft of the manuscript, OHN, OII, AA, OAO, SO and ECJ reviewed and edited the first draft of the manuscript. All authors contributed to the development of the final manuscript and approved its submission for publication.

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Table 1: Characteristics of the participants

Variables		Frequency	Percentage
Age group (years)	≤ 5	12	3.2
	6-10	60	15.9
	11-15	104	27.5
	≥16	202	53.4
Gender	Female	281	74.3
	Male	97	25.7
	Total	378	100.0

Table 2: Comparing the prevalence of *H. pylori* infection in the sub-groups to the total number participants

Variables		*H. pylori*-positive (N=116) n (%)	*H. pylori*-negative (%) (N=262) n (%)	Total (N=378) n (%)	X^2	p-value
Age (years)	=5	8 (2.1)	4 (1.0)	12 (3.2)	8.582	**0.035**
	6-10	21 (5.6)	39 (10.3)	60 (15.9)		
	11-15	29 (7.7)	75 (19.8)	104 (27.5)		
	=16	58 (15.3)	144 (38.1)	202 (53.4)		
Gender	Female	88 (23.3)	193 (51.0)	281 (74.3)	0.204	0.652
	Male	28 (7.4)	69 (18.2)	97 (25.7)		
	Total	116 (30.7)	262 (69.3)	378 (100.0)		

Table 3: Prevalence of *H. pylori* infection within and across the age groups of the participants

Variables	*H. pylori*-positive (N= 116), (Row%, Column %)	*H. pylori*-negative (%) (N=262), (Row%, Column %)	Total (N=378), (Row%, Column %)	X^2	p-value
Age (years)					
=5	8 (66.7, 6.9)	4 (33.3, 1.5)	12 (100, 3.2)	8.582	**0.035**
6-10	21 (35.0, 18.1	39 (65.0, 14.9)	60 (100, 15.9)		
11-15	29 (27.9, 25.0)	75 (72.1, 28.6)	104 (100, 27.5)		
=16	58 (28.7, 50.0)	144 (71.3, 55.0)	202 (100, 53.4)		

Table 4: Prevalence of *H. pylori* infection within and across the gender of the participants

	H. pylori-positive (N= 116), (Row%, Column %)	*H. pylori*-negative (%) (N=262), (Row%, Column %)	Total (N=378), (Row%, Column %)	X^2	p-value
Gender					
Female	88 (31.3, 75.9)	193 (68.7, 73.7)	281 (100, 74.3)	0.204	0.652
Male	28 (28.9, 24.1)	69 (71.1, 26.3)	97 (100, 25.7)		
Total	116 (30.7, 100)	262 (69.3, 100)	378 (100.0, 100)		

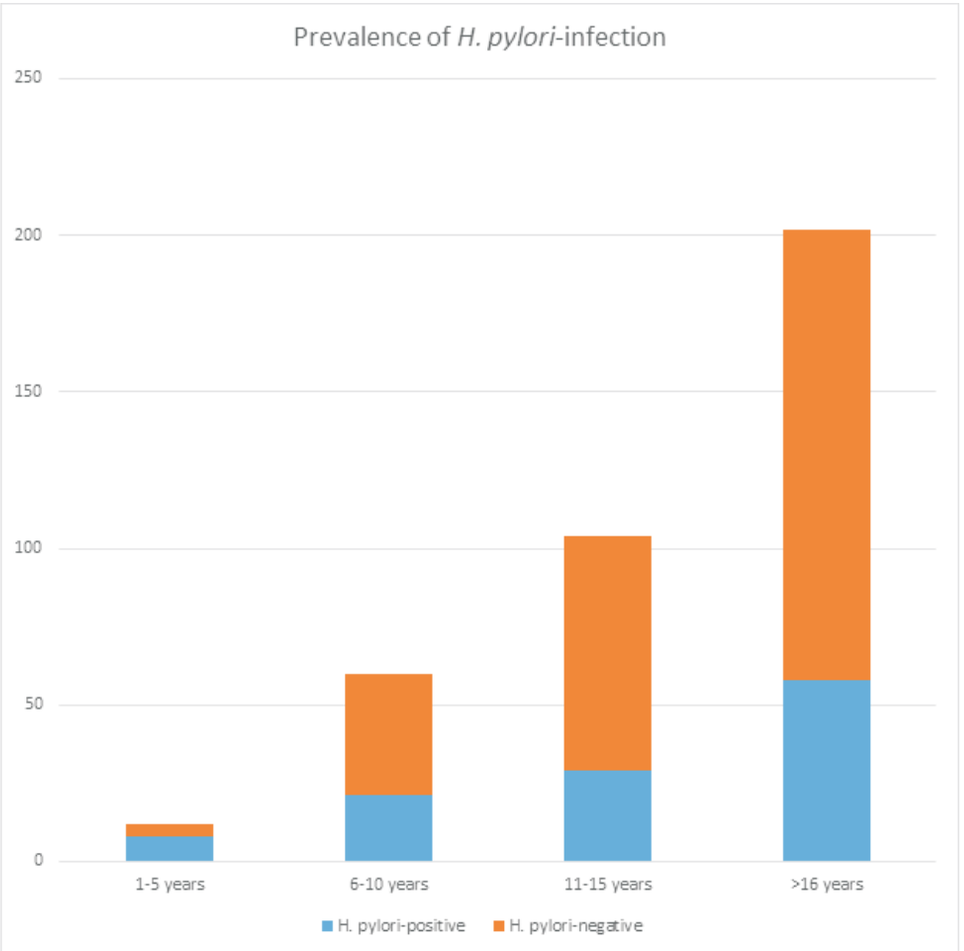

Figure 1: Prevelence of *H. pylori* infection among the age groups of the participants