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HELICOBACTER PYLORI INFECTION AND ITS ASSOCIATED RISK FACTORS AMONG SECONDARY SCHOOL STUDENTS IN BENIN CITY, EDO STATE

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ABSTRACT: *Helicobacter pylori infection is a prevalent gastrointestinal condition with significant public health implications, particularly among adolescents. Understanding its prevalence and associated risk factors among secondary school students is crucial for effective prevention and management strategies. This study aimed to determine the prevalence of H. pylori among secondary school students in Benin City and investigate associated risk factors. A cross-sectional study was conducted among 400 secondary school students in Benin City. Participants provided stool samples for H. pylori antigen testing and completed a questionnaire regarding demographic information, housing conditions, hygiene practices, and gastrointestinal symptoms. Data were analysed using SPSS version 22.0. The prevalence of Helicobacter pylori (H. pylori) among secondary school students in Benin City was 32% (128/400). Significant associations were found between H. pylori infection and age, housing conditions (specifically residing in rooming apartments), and handwashing after defecation ($p<0.05$). Gender, number of persons per room, cleanup behaviour after defecation and toilet type were not significantly associated with H. pylori prevalence ($p>0.05$). Symptoms such as epigastric pain and blood in stool were significantly associated with H. pylori positivity ($p<0.05$), while bloating and loss of appetite showed no significant association ($p>0.05$). In conclusion, the prevalence of H pylori among secondary school students is high, emphasising the need for targeted interventions to reduce transmission, promote hygiene practices, address associated symptoms and implement effective prevention strategies within this population.*

KEYWORDS: Peptic ulcer disease, secondary school students, asymptomatic, Edo State, Immunochromatographic.

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INTRODUCTION

Helicobacter pylori is a gram-negative, spiral-shaped bacterium that primarily infects the stomach lining and is strongly associated with chronic gastritis, peptic ulcers, and an increased risk of gastric cancer (Kim & Wang, 2021). This bacterium is adapted to survive in the acidic environment of the stomach by producing the enzyme urease, which hydrolyzes urea into ammonia and carbon dioxide, thereby neutralising stomach acid around the bacterium and creating a more conducive environment (Fagoonee & Pellicano, 2019). Historically, the connection between *H. pylori* and gastrointestinal disease was not recognized until the early 1980s. Australian scientists Dr. Barry Marshall and Dr. Robin Warren discovered the bacterium in 1982 and demonstrated its association with peptic ulcer disease (Sikanda *et al*., 2013). Their pioneering work challenged the prevailing belief that ulcers were primarily caused by stress and lifestyle factors. In a self-experimentation, Dr. Marshall ingested *H. pylori* and subsequently developed gastritis, providing direct evidence of the bacterium's role in the disease. This groundbreaking research earned Marshall and Warren the Nobel Prize in Physiology or Medicine in 2005 (Konturek *et al*., 2006).

H. pylori is now recognized as the most common chronic bacterial infection globally, affecting over half of the world's population (Malfertheiner *et al*., 2023). Epidemiological studies reveal a high prevalence in developing countries, reaching up to 90% more than in developed countries, primarily due to poor sanitation and crowded living conditions (Perez-Perez *et al*., 2004). Infections are typically acquired during childhood, often through oral-oral or faecal-oral routes, and can persist asymptomatically for decades if untreated (Stefano *et al*., 2018). Secondary school students, especially in developing countries like Nigeria, are at increased risk due to environmental and behavioural factors. These students frequently attend overcrowded schools with inadequate sanitation facilities, facilitating the transmission of the bacterium. Communal eating and drinking practices, such as sharing food and utensils, further increase the risk of spreading the infection (Chi *et al*., 2009). Adolescents are also prone to behaviours that increase infection risk, such as poor hand hygiene and consuming potentially contaminated water or food. Socioeconomic factors play an important role, with students from lower-income families facing greater exposure to unsanitary conditions both at school and at home (Mehata *et al*., 2021). *H. pylori* infection in children and adolescents has been associated with various extragastric pathologies such as iron deficiency anaemia, growth retardation, and diabetes (Lupu *et al*., 2022). In addition, *H. pylori* is listed as a group 1 carcinogen in the most recent medical literature and is one of the most significant infectious drivers of cancer worldwide, accounting for 8 of 10 stomach cancer cases in adults (De Martel *et al*., 2020). The significant health burden of *Helicobacter pylori* infection among secondary school students necessitates public health intervention. It is essential to investigate the prevalence of *H. pylori* infection among this population within the community and identify its associated risk factors.

Based on the data generated, targeted healthcare interventions can be implemented to promote good health. In Benin City, there is a scarcity of research on the prevalence of *H. pylori* infection and its associated risk factors among secondary school students. Therefore, the objective of this study is to investigate the prevalence and associated risk factors of *H. pylori* infection among secondary school students in Benin City, Nigeria.

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METHODS

Study Area

This cross-sectional study was conducted among secondary school students attending public schools in Benin City, Nigeria. Benin City comprises three Local Government Areas: *Egor*, *Oredo* and *Ikpoba-Okha* Local Government Areas respectively, with a population of 1,086,882 people with 542,545 and 544,337 being male and females respectively. Benin City is bounded to the west by Ovia North East Local Government Area and the North-East by *Uhunmwuode* Local Government Area and South by *Ethiope*-West Local Government Area of Delta State. Public schools for both boys and girls are available in this city which was sampled.

Inclusion and Exclusion Criteria

The study included secondary school students aged between 14 and 19 years, excluding those younger or older than this range. Individuals who declined to participate were also excluded. Both apparently healthy participants and those exhibiting symptoms were included in this study.

Data Collection

After the participants and their guardians signed an informed consent form, the selected students were approached. A questionnaire was employed to gather data on various sociodemographic characteristics, such as age, gender, parental educational level, religion, and class, as well as information on housing conditions, hygiene practices, and any symptoms reported by the participants.

Sample Size Calculation

A total of 400 secondary school students were enrolled in the study. An assumed prevalence of *H. pylori* infection which was 64% was used in calculating the sample size in this study. This assumption was based on a previous study in Ibadan, Nigeria (Jemilohun *et al*., 2010). The sample size of 400 secondary school students was calculated to detect a difference of 5% at α=0.05, with a power of 80%. We assumed that 10% of the participants would not respond or would have incomplete data.

Ethical Approval

Ethical approval for this study was obtained from the research and ethics committee of Edo State Ministry of Health.

Sample Collection

Each participant was asked to provide a stool sample. They were provided with a sterile, leak-proof, single-use universal container with a screw-capped lid, along with instructions on how to collect their stool specimen in private. The stool specimens were then transported to the Microbiology Laboratory Unit at the University of Benin Teaching Hospital in Benin City and processed within two hours.

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Laboratory Analysis

The presence of *Helicobacter pylori* antigen in the stool was detected using a one-step *H. pylori* antigen test cassette, supplied by Blue Cross BioMedical Co., Ltd., Beijing, China, following the manufacturer's instructions. A positive *H. pylori* test was defined as a positive antigen test performed on the stool specimen.

Statistical Analysis

The data collected were entered into a computer using the IBM Statistical Package for the Social Sciences (SPSS) for Windows (version 22.0; SPSS Inc., New York, NY). Results were presented using tables and charts and Chi square test was used to determine if there was association between variables. $P<0.05$ was considered significant.

RESULTS

Demographic Characteristics of Participants

Table 1 presents the sociodemographic characteristics of 400 respondents. Age-wise, 48 respondents were under 15 years old (12.0%), while 352 were over 15 years old (88.0%). The gender distribution included 172 males (43.0%) and 228 females (57.0%). Class-wise, 32 respondents were in SS1 (8.0%), 160 in SS2 (40.0%), and 208 in SS3 (52.0%). Regarding religion, 314 respondents were Christians (78.5%), 77 were Muslims (19.3%), and 9 belonged to other religions (2.2%). For fathers' educational status, 12 had no formal education (3.0%), 39 had primary education (9.8%), 221 had secondary education (55.3%), and 128 had tertiary education (32.0%). As for mothers' educational status, 12 had no formal education (3.0%), 80 had primary education (20.0%), 185 had secondary education (46.3%), and 123 had tertiary education (30.7%).

Table 1: Sociodemographic Characteristics of Participants

Variable	Number (n=400)	Percentage (%)
Age		
<15 years	48	12.0
>15 years	352	88.0
Sex		
Male	172	43.0
Female	228	57.0
Class		
SS1	32	8.0
SS2	160	40.0
SS3	208	52.0
Religion		
Christianity	314	78.5
Islam	77	19.3
Others	9	2.2
Fathers' educational status		
No formal Education	12	3.0
Primary	39	9.8

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Secondary	221	55.3
Tertiary	128	32.0
Mothers' educational status		
No formal Education	12	3.0
Primary	80	20.0
Secondary	185	46.3
Tertiary	123	30.7

Mean age=17.2±1.71 years, Minimum age = 14 years, Maximum age = 19 years.

Prevalence of *H pylori* Infection

The prevalence of *H pylori* among secondary school students was found to be 32% (128/400) as shown in figure 1. Out of 172 males examined, 52 (40.6%) were infected with *H. pylori*, compared to 76 out of 228 females (59.4%) (p = 0.510). Among individuals aged under 15 years (48 examined), 32 (25.0%) were infected, whereas among those over 15 years (352 examined), 96 (75.0%) were infected (p = 0.001).

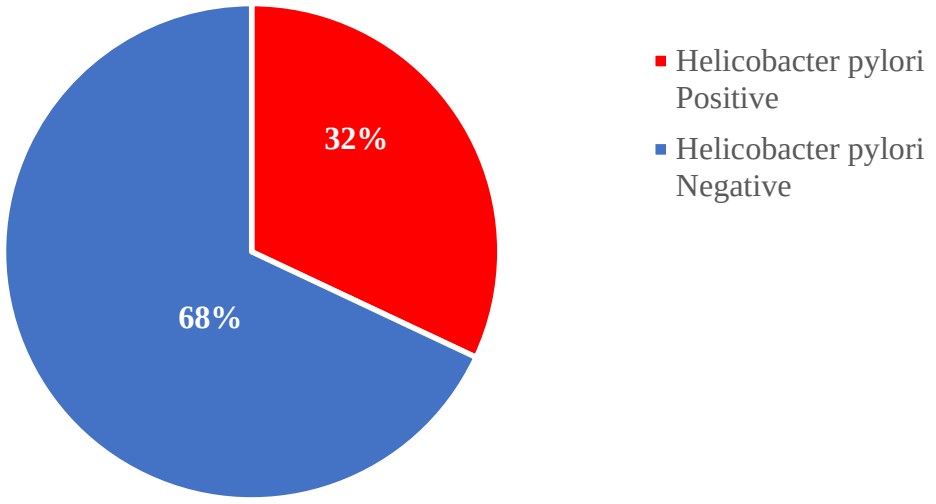

Figure 1: Prevalence of *Helicobacter pylori* infection among secondary school students

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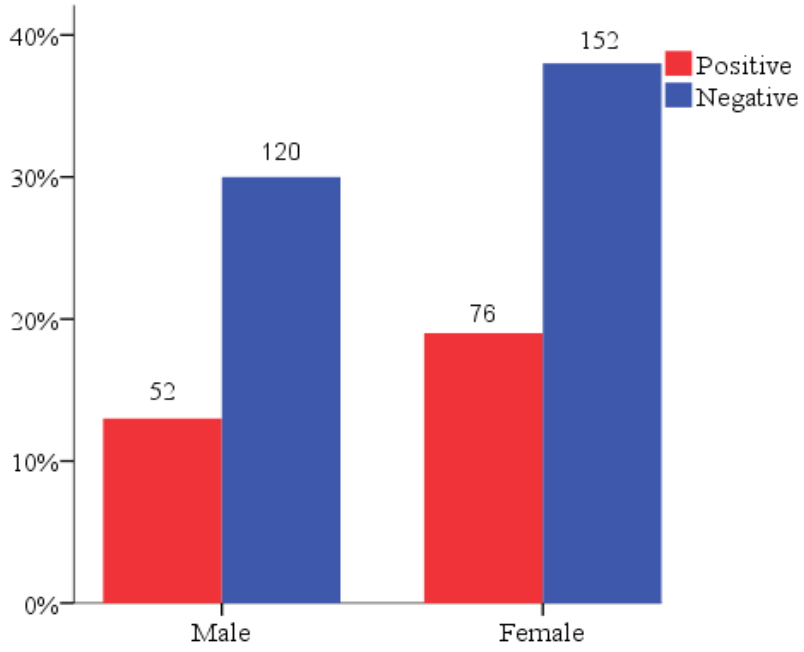

Figure 2: Prevalence of *H pylori* infection among male and female participants (p=0.510, OR=0.867, 95CI=0.566-1.327)

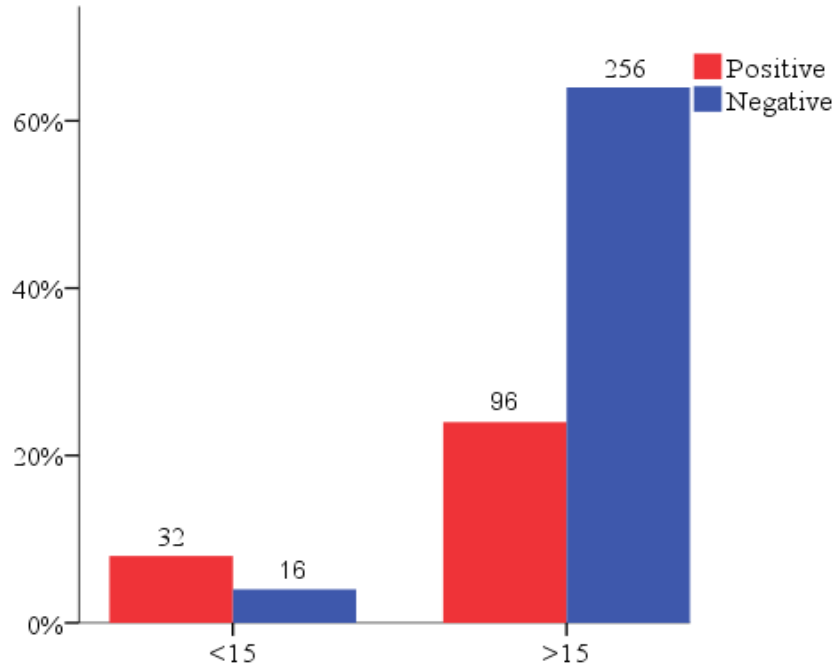

Figure 3: Prevalence of *H pylori* infection in relation to age (p=0.001, OR=5.333, 95CI=2.800-10.158)

Factors Associated with *H pylori* Infection

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Housing Conditions

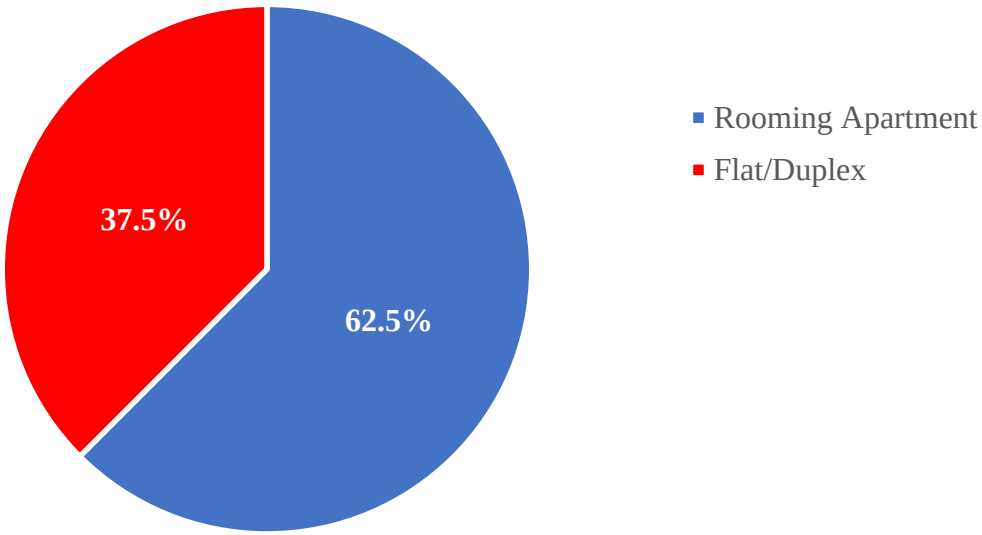

Figure 4: Types of housing used among participants

Among participants residing in Rooming Apartments, 99 (77.3%) were infected with *H. pylori*, while among those in Flats/Duplexes, 29 (22.7%) were infected, showing a significant difference (p = 0.001) with an odds ratio (OR) of 2.736 (95% CI: 1.696-4.412). Regarding the number of person per room, 66 out of 214 individuals (51.6%) with 1-3 persons per room were infected, compared to 36 out of 88 individuals (28.1%) with 4-6 persons per room, and 26 out of 98 individuals (20.3%) with more than 6 persons per room. However, the difference in infection rates based on the number of persons per room was not statistically significant (p = 0.096) (Table 2).

Table 2: Housing Conditions and *Helicobacter pylori* Positivity

Variable	No. Examined (%)	No. Infected (%)	OR	95%CI	p value
Types of Housing					
Rooming Apartment	250 (62.5)	99 (77.3)	2.736	1.696-4.412	0.001
Flat/Duplex	150 (37.5)	29 (22.7)			
Number of Persons per Room					
1-3	214 (53.5)	66 (51.6)			0.096
4-6	88 (22.0)	36 (28.1)			
>6	98 (24.5)	26 (20.3)			

Hygiene Practices

Concerning toilet type, 60.2% with Water Cistern toilets and 39.8% with Pit/Local toilets were infected, with no statistically significant difference observed (p = 0.910). Regarding hand washing after defecation, 68.8% who always washed their hands were infected, compared to

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14.8% who sometimes washed their hands and 16.4% who did not wash their hands. This difference was statistically significant (p = 0.027). In terms of cleanup behaviour after defecation, 67 out of 184 individuals (52.3%) who used water for cleanup and 61 out of 216 individuals (47.7%) who used toilet paper were infected. The difference was not statistically significant (p = 0.081) (Table 3).

Table 3: Hygiene Practices and *Helicobacter pylori* Positivity

Variable	No. Examined (%)	No. Infected (%)	OR	95%CI	p value
Toilet Type					
Water Cistern	239 (59.8)	77 (60.2)	1.025	0.668-1.574	0.910
Pit/Local	161 (40.2)	51 (39.8)			
Handwashing after Defecation					
Always	256 (64.0)	88 (68.8)			0.027
Sometimes	91 (22.8)	19 (14.8)			
No	53 (13.3)	21 (16.4)			
Cleanup Behavior after Defecation					
Water	184 (46.0)	67 (52.3)	1.455	0.954-2.219	0.081
Toilet Paper	216 (54.0)	61 (47.7)			

Symptoms Associated with *H pylori* Infection

Among participants experiencing epigastric Pain (188 examined), 72 (56.3%) were infected with *H. pylori*, compared to 56 out of 212 individuals (43.2%) without epigastric Pain. This difference was statistically significant (p = 0.011). Regarding Bloating, 33 out of 107 individuals (25.8%) with Bloating and 95 out of 293 individuals (74.2%) without Bloating were infected (p = 0.764). Regarding Blood in Stool, 55 out of 142 individuals (43.0%) with Blood in Stool and 71 out of 258 individuals (57.0%) without Blood in Stool were infected. This difference was statistically significant (p = 0.032). Similarly, for Loss of Appetite, 28 out of 86 individuals (21.9%) with Loss of Appetite and 100 out of 314 individuals (78.1%) without Loss of Appetite were infected, with no statistically significant difference observed (p = 0.900) (Table 4).

Table 4: Symptoms and *Helicobacter pylori* Positivity

Variable	No. Examined (%)	No. Infected (%)	OR	95%CI	p value
Epigastric Pain					
Yes	188 (47.0)	72 (56.3)	1.729	1.132-2.642	0.011
No	212 (53.0)	56 (43.2)			
Bloating					
Yes	107 (26.8)	33 (25.8)	0.929	0.576-1.499	0.764
No	293 (73.2)	95 (74.2)			
Blood in Stool					
Yes	142 (35.5)	55 (43.0)	1.602	1.039-2.470	0.032
No	258 (64.5)	71 (57.0)			
Loss of Appetite					

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Yes	86 (21.5)	28 (21.9)	1.033	0.621-1.720	0.900
No	314 (78.5)	100 (78.1)			

DISCUSSION

The prevalence of the *H. pylori* infection among secondary school students in Benin city, Nigeria was 32%. This prevalence is similar to the findings of Samson *et al*. (2018) in Ogun state who reported a prevalence of 28% infection rate of *H pylori* among school students. However, our result is lower when compared to a previous study in Lagos state where the prevalence of *H. pylori* was 59% (Mynepalli *et al*., 2014). Another study carried out by Yucel *et al*. (2008) among students also reported a high prevalence (63%) of *Helicobacter pylori* infection. Other studies have also reported lower prevalence of *H pylori* when compared to this study. Emerenini *et al*. (2021) reported a prevalence of 20% among children in Owerri while Kolawole *et al*. (2021) reported a prevalence of 5.5% among students in northern Nigeria. The prevalence of *H. pylori* infection in other parts of Africa ranged between 40% and nearly 90% (Kimanga *et al*., 2010; Cherian *et al*., 2008) while the overall global prevalence has been pegged at 32.3% which is similar to the result obtained in this present study (Yuan *et al*., 2022). These disparities in prevalence can largely be attributed to geographical and environmental factors. Regions with poor sanitation and contaminated water supplies tend to have higher transmission rates of *H. pylori*. Differences in climate and local environmental conditions can also affect the survival and transmission of the bacterium, contributing to the observed variations in prevalence across different regions (Hastings *et al*., 2014). Additionally, differences in diagnostic methods can lead to variations in reported prevalence, as some tests may be more sensitive and specific than others. The social class of participants also plays a crucial role; lower socioeconomic status is often associated with higher *H. pylori* prevalence (Chen *et al*., 2014).

The comparison of infection rates between males and females in this study indicates that sex does not significantly influence the prevalence of *H. pylori* infection in this cohort. This aligns with previous research that showed no strong gender predilection for *H. pylori* infection, indicating that other factors may play more critical roles in influencing infection rates (Mbang *et al*., 2019). Age, however, appears to be a significant factor in *H. pylori* positivity. This study indicates that individuals younger than 15 years are at a significantly higher risk of *H. pylori* infection compared to those older than 15 years. The reason for this may be due to the fact that younger individuals might be more susceptible because of their less developed immune systems and higher exposure rates in communal settings such as schools. However, this finding is in contrast to the finding of Aitila *et al*. (2019) who reported that prevalence of *H. pylori* infection increased with increase in age. The disparities in infection rates by age could be influenced by several factors, including exposure to contaminated food and water, and varying levels of hygiene practices between age groups.

This study demonstrated a significant association between the type of housing and *H. pylori* positivity. Rooming apartments often involve higher population densities, limited personal space, and potentially compromised hygiene standards compared to flat/duplex accommodations, thus providing favourable conditions for the transmission of *H. pylori*. However, there is a disagreement between this study and that of Mynepalli *et al*. (2014) who observed no relationship between type of housing and *H pylori* infection. The number of persons per room had no influence on *H pylori* positivity. Nonetheless, overcrowding and

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increased interpersonal contact in rooms may contribute to the higher prevalence of *H pylori* (Aljaberi *et al*., 2023).

This study showed a relationship between some hygiene practices and *Helicobacter pylori* infection. While toilet type did not show a significant association with infection rates, handwashing habits after defecation emerged as a significant factor. Individuals who reported always washing their hands after defecation exhibited a notably higher infection rate compared to those who sometimes or never washed their hands, indicating that hand hygiene alone might not play a crucial role in *H pylori* transmission as other factors may come into play. This finding conforms to that of Mynepalli *et al*. (2014) who reported that most students who had *H. pylori* did hand washing after defecation with water and soap. Additionally, cleanup behaviour after defecation showed a trend towards higher infection rates among individuals using water for cleanup compared to those using toilet paper, although this association did not reach statistical significance.

Epigastric pain emerged as a significant predictor of *H. pylori* infection, with individuals reporting this symptom exhibiting a higher infection rate (56.3%) compared to those without epigastric pain (43.2%). This association aligns with previous research indicating that epigastric pain is a common symptom of *H. pylori* infection, often attributed to gastritis or peptic ulcer disease caused by the bacterium (De Giacomo *et al*., 2002). Similarly, the presence of blood in stool was significantly associated with *H. pylori* infection. This finding is consistent with previous studies linking *H. pylori* infection to gastrointestinal bleeding, which can manifest as blood in stool (Izaldeen *et al*., 2022). Conversely, symptoms such as bloating and loss of appetite did not show a significant association with *H. pylori* positivity, with comparable infection rates observed between individuals with and without these symptoms. This finding contrasts with some previous studies that have reported associations between bloating and *H. pylori* infection (Rosenstock *et al*., 1997).

CONCLUSION

This study found a 32% prevalence of Helicobacter pylori among secondary school students. While gender did not significantly influence infection rates, age emerged as a significant predictor, with higher rates observed in individuals over 15 years old. Housing conditions, particularly residing in rooming apartments, were strongly associated with higher infection rates. Handwashing after defecation was significantly linked to *H. pylori* infection. Symptoms like epigastric pain and blood in stool were also significantly associated with *H. pylori* positivity. These findings highlight the need for targeted interventions to reduce transmission and address associated symptoms among secondary school students.

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DOI URL: https://doi.org/10.52589/IJPHP-ZOINZ4IF

REFERENCES

Aitila P, Mutyaba M, Okeny S, Ndawula Kasule M, Kasule R, Ssedyabane F, Okongo B, Onyuthi Apecu R, Muwanguzi E, Oyet C. Prevalence and risk factors of Helicobacter pylori infection among children aged 1 to 15 years at Holy Innocents Children's Hospital, Mbarara, South Western Uganda. *Journal of tropical medicine*. 2019(1):9303072.

Aljaberi HS, Ansari NK, Xiong M, Peng H, He B, Wang S. Current Understanding of the Transmission, Diagnosis, and Treatment of H. pylori Infection: A Comprehensive Review. *International Journal of Medical, Pharmacy and Drug Research*. 2023; 7:2.

Chen HL, Chen MJ, Shih SC, Wang HY, Lin IT, Bair MJ. Socioeconomic status, personal habits, and prevalence of Helicobacter pylori infection in the inhabitants of Lanyu. *Journal of the Formosan Medical Association*. 2014 May 1;113(5):278-83.

Cherian S, Forbes D, Sanfilippo F, Cook A, Burgner D. The epidemiology of Helicobacter pylori infection in African refugee children resettled in Australia. *Medical Journal of Australia*. 2008 Oct;189(8):438-41.

Chi H, Bair MJ, Wu MS, Chiu NC, Hsiao YC, Chang KY. Prevalence of Helicobacter pylori infection in high-school students on Lanyu Island, Taiwan: risk factor analysis and effect on growth. *Journal of the Formosan Medical Association*. 2009 Dec 1;108(12):929-36.

De Giacomo C, Valdambrini V, Lizzoli F, Gissi A, Palestra M, Tinelli C, Zagari M, Bazzoli F. A population-based survey on gastrointestinal tract symptoms and Helicobacter pylori infection in children and adolescents. *Helicobacter*. 2002 Dec;7(6):356-63.

De Martel C, Georges D, Bray F, Ferlay J, Clifford GM. Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis. *The Lancet Global Health*. 2020 Feb 1;8(2): e180-90.

Emerenini FC, Nwolisa EC, Iregbu FU, Eke CB, Ikefuna AN. Prevalence and risk factors for helicobacter pylori infection among children in Owerri, Nigeria. *Nigerian Journal of Clinical Practice*. 2021 Aug 1;24(8):1188-93.

Fagoonee S, Pellicano R. Helicobacter pylori: molecular basis for colonisation and survival in gastric environment and resistance to antibiotics. A short review. *Infectious Diseases*. 2019 June 3;51(6):399-408.

Hastings EV, Yasui Y, Hanington P, Goodman KJ, Working Group TC. Community-driven research on environmental sources of H. pylori infection in arctic Canada. *Gut Microbes*. 2014 Sep 3;5(5):606-17.

Izaldeen Sowaid Y, Ali OM, Saad Abdul Hussain S. Extra-Gastroduodenal Manifestation and Helicobacter pylori Infection. *Archives of Razi Institute*. 2022 June 30;77(3):1017-26.

Jemilohun AC, Otegbayo JA, Ola SO, Oluwasola OA, Akere A. Prevalence of Helicobacter pylori among Nigerian patients with dyspepsia in Ibadan. *Pan African Medical Journal*. 2010;6(1).

Kim J, Wang TC. Helicobacter pylori and gastric cancer. *Gastrointestinal Endoscopy Clinics*. 2021 July 1;31(3):451-65.

Kimang'a AN, Revathi G, Kariuki S, Sayed S, Devani S. Helicobacter pylori: prevalence and antibiotic susceptibility among Kenyans. *South African Medical Journal*. 2010;100(1).

Kolawole A, Omoniyi J, Sylvia A, Seye B. Seroprevalence of Helicobacter pylori Infection among Students of Bingham University, Karu in North-Central Nigeria. *International Journal of Pathogen Research*. 2021 Aug 25;7(4):38-47.

Konturek SJ, Konturek PC, Konturek JW, Plonka M, Cześnikiewicz-Guzik M, Brzozowski T, Bielanski W. Helicobacter pylori and its involvement in gastritis and peptic ulcer formation. *Journal of Physiology and pharmacology*. 2006 Sep 1; 57:29.

Article DOI: 10.52589/IJPHP-ZOINZ4IF
DOI URL: https://doi.org/10.52589/IJPHP-ZOINZ4IF

Lupu A, Miron IC, Cianga AL, Cernomaz AT, Lupu VV, Munteanu D, Ghica DC, Fotea S. The relationship between anaemia and helicobacter pylori infection in children. *Children*. 2022 Aug 30;9(9):1324.

Malfertheiner P, Camargo MC, El-Omar E, Liou JM, Peek R, Schulz C, Smith SI, Suerbaum S. Helicobacter pylori infection. *Nature reviews Disease primers*. 2023 Apr 20;9(1):19.

Mbang KA, Uchenna O, Emmanuel U, Aniekan E, Evaristus C, Donald E, Ogbu N. Prevalence of Helicobacter Pylori infection among dyspepsia patients in Calabar. *Global Journal of Pure and Applied Sciences*. 2019 Sep 6;25(2):145-51.

Mehata S, Parajuli KR, Pant ND, Rayamajhee B, Yadav UN, Mehta RK, Jha P, Mehta N, Dhimal M, Singh DR. Prevalence and correlates of Helicobacter pylori infection among under-five children, adolescent and non-pregnant women in Nepal: Further analysis of Nepal national micronutrient status survey 2016. *PLoS Neglected Tropical Diseases*. 2021 June 21;15(6): e0009510.

Mynepalli SK, Maureen O, Mumuni A. Prevalence of Helicobacter pylori and hygiene practices among public secondary school students in Ikeja Local Government Area, Lagos, Nigeria. *Health*. 2014 Feb 18;2014.

Perez-Perez GI, Rothenbacher D, Brenner H. Epidemiology of Helicobacter pylori infection. *Helicobacter*. 2004 Aug; 9:1-6.

Rosenstock S, Kay L, Rosenstock C, Andersen LP, Bonnevie O, Jørgensen T. Relation between Helicobacter pylori infection and gastrointestinal symptoms and syndromes. *Gut*. 1997 Aug 1;41(2):169-76.

Samson ES, Okeleke OJ, Richard AY, Gideon FT, Olutoyosi AL, Damilola O. Screening for Helicobacter pylori infection among undergraduate students of a tertiary institution using serum antibody and stool antigen detection methods. *Science and Technology Research*. 2018;3(2):10.

Sikandar KS, Haider SS, Kazmi SU. Helicobacter pylori: Gastric ulcer and cancer-causing burg. *International Journal of Advance Research*. 2013; 1:399-405.

Stefano K, Marco M, Federica G, Laura B, Barbara B, Gioacchino L, Gian LD. Helicobacter pylori, transmission routes and recurrence of infection: state of the art. *Acta Bio Medica: Atenei Parmensis*. 2018; 89(Suppl 8):72.

Yuan C, Adeloye D, Luk TT, Huang L, He Y, Xu Y, Ye X, Yi Q, Song P, Rudan I. The global prevalence of and factors associated with Helicobacter pylori infection in children: a systematic review and meta-analysis. *The Lancet Child and Adolescent Health*. 2022 Mar 1;6(3):185-94.

Yücel T, Aygin D, Şen S, Yücel O. The prevalence of Helicobacter pylori and related factors among university students in Turkey. *Japanese Journal of Infectious Diseases*. 2008 May 28;61(3):179-83.

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