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Original Article

Epidemiological evaluation of associated risk factors of *Helicobacter pylori* infection using noninvasive methods: A case study of peptic ulcer patients in Lafia, Nigeria

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Abstract

Background: Due to its persistent nature, ulcers brought on by *Helicobacter pylori* have been a significant public health concern. This study looked at how specific risk factors affected the prevalence of Helicobacter pylori infection among peptic ulcer patients visiting medical institutions in Lafia, Nigeria.

Methods: The blood and stool samples of 180 individuals (71 men and 109 women) were collected randomly, checked for *H. pylori* using test strips for *H. pylori* antibodies and antigens (Azure Biotech Inc.), and the feces also were grown on Columbia blood agar base (TITAN Biotech Ltd). Using a standardized questionnaire, some participant risk data was also gathered.

Results: A positive culture method (CM) test result was obtained from 14/71 (19.72%) of the 71 male patients and 37/109 (33.94%) of the 109 female subjects out of a total of 210 subjects. For CM alone, it was discovered that female participants had a considerably greater incidence of *Helicobacter pylori* infection than their male counterparts ($p=0.038$). Nevertheless, all analytical techniques discovered no evidence of a significant difference between age groups ($p>0.05$). Only the blood antibody (BAB) approach showed a substantially greater prevalence ($p=0.021$) in married patients, with 79/116 (68.10%) reactive instances. The presence of drinking water source ($p < 0.001$, 0.001, 0.002 using CM, BAB, and SAG, respectively) and number of occupants per room ($p < 0.001$, 0.001, 0.002 using CM, BAB, and SAG, respectively) as potential risk factors for *H. pylori* infection was also demonstrated.

Conclusion: The majority of risk factors that were taken into consideration for this study demonstrated a strong correlation with *Helicobacter pylori* infection in Lafia, Nigeria.

Keywords: *Helicobacter pylori*, risk factors, peptic ulcer, noninvasive methods, Epidemiology, Nigeria

Introduction

An infection with the human pathogen Helicobacter pylori has been linked to a number of benign and malignant gastroduodenal conditions, such as non-cardiac gastric cancer, peptic ulcer, atrophic gastritis, chronic active gastritis, and mucosa-associated lymphoid tissue lymphoma (1,2). Its capacity to infect the digestive tract despite the stomach's acidity accounts for its pathogenic potential in the stomach (3). This characteristic can be seen in their ability to release enzymes that assist in turning urea into ammonia and lowering stomach acidity (4). H. pylori infections also have the capacity to damage the stomach's protective coatings, allowing the digestive juices to irritate the stomach lining and cause stomach ulceration and perforation (5). They also have the capacity to cause cancer (6).

Epidemiologically, *H. pylori* is present in half of the world's population despite their being no outward indications or symptoms of the illness (7). Numerous studies found that the prevalence of *Helicobacter pylori* was significantly higher in developing nations—over 90%—than it was in urbanized nations—under 60%. (8). According to Cano-Contreras and colleagues (9), impoverished nations have a prevalence of *H. pylori* infection of between 70% and 90% while affluent countries have a prevalence of between 30% and 50%. The most contaminated people are said to be those with Arica, with 87% in South Africa (10) and 91% in Ibadan, Nigeria (11). In Nigeria, *H. pylori* is present in 82% of patients with gastric ulcers and nearly 100% of those with duodenal ulcers (12).

Infected person to non-infected person (13), feces to mouth (faces-oral), vomit to mouth (gastro-oral), contaminated food or drink, and poor toilet cleanliness are among the reported modes of entrance and transmission of the infectious agent (14). Race, social class, living in a rural region, age, poor hygienic conditions, congestion, a bad diet, inadequate water supplies, and a low level of education are among risk factors cited as ways to get the disease (6, 15). *H. pylori* appears to enhance the risk of stomach cancer among smokers (4). Smokers with *H. pylori* infections appear to be more likely to develop stomach cancer than non-smokers without *H. pylori* infections (14). Although the prevalence of *H. pylori* infection has decreased over time in industrialized countries, its persistence is still concerning in developing countries. This fall is likely attributable to better sanitation, socioeconomic development, and improved living conditions (16). Therefore, the dynamics of this infection depend on the severity of the dominant elements that are unique to the location under consideration.

The routes of transmission of *H. pylori* are yet unknown, and socioeconomic variables are thought to play a role in its spread, according to Eusebi and colleagues (16). Additionally, it has been observed that host and environmental factors have a role in the disproportionate incidence of gastric cancer (GC) and peptic ulcer disorders (PUD) linked to *H. pylori* infections (17). Another theory puts out transmission from person to person, particularly among families (18). Although, in underdeveloped nations like Nigeria, the majority of the risk factors for *H. pylori* infection are concentrated in rural and semi-urban areas; however, the majority of research on *H. pylori* infections in Nigeria has only included metropolitan areas.

Despite its many drawbacks, the culture method continues to be the accepted standard for diagnosing *H. pylori* in the study population. It has been demonstrated that diagnostic methods have an impact on pathogen isolation (19). Additionally, there is very little epidemiological data on the prevalence of *H. pylori* and the risk factors linked to it. Therefore, the objective of this study was to assess the effects of several predisposing factors on the infection status of *H. pylori* in suspected patients with peptic ulcer symptoms in Lafia, a semi-urban town in Nigeria (a country with a high prevalence of the infection).

Materials and Methods

Study Area

The study area was Lafia, the capital of Nasarawa State and a semi-urban town in North Central Nigeria (figure 1). There are 330,712 people living there in total, most of whom are farmers, businesspeople, and artisans. The majority of settlements are typically crowded and unhygienic. There aren't many healthcare facilities, largely primary and secondary care facilities. Dalhatu Araf Specialist Hospital (DASH), Jafamek Medical Laboratory and Diagnostic Centre, and Haske Hospital, all of which are situated in the study area, served as the medical facilities used in this investigation.

The sample size of 180 was estimated using the formula described by Thrusfield (20) and the prevalence rate of 86.5% came from the study conducted by Ejilude and colleagues (21).

Experimental Design

This cross-sectional study included suspected cases of patients who had been sent to medical facilities after complaining of dyspepsia. For this investigation, a total of 180 suspected patients with peptic ulcer or dyspeptic symptoms who were presenting to one of the three medical institutions in Lafia Metropolis were used. While 50 samples (each consisting of blood and feces) were gathered from suspected patients at Jafamek and Haske Hospitals, 80 blood and stool samples were taken from suspected patients at DASH.

Ethical Consideration

Prior to starting the study, the Nasarawa State Ministry of Health's Ethical Committee granted their approval with reference number NHREC18/06/2017 dated 15th January, 2020.

Eligibility of Subjects

Inclusion criteria: Patients who visited these medical facilities and had dyspepsia symptoms and indicators

were included. According to the World Health Organization's ICD-10-CM code K30, dyspepsia is the presence of two or more of the following symptoms: heartburn, acid regurgitation, increased abdominal bloating, nausea, abnormally slow digestion, or early satiety (22).

Exclusion criteria: Patients who did not have dyspepsia or peptic ulcer symptoms were not accepted. Patients who have recently had proton pump inhibitor (PPI), antibiotic medication, H2-receptor blockers, H2-receptor antagonists, or non-steroid anti-inflammatory medicines were excluded. Pregnant women, those with nephropathy in advanced stages, and people with cirrhosis were also excluded from this study.
Consent: Each eligible participant whose blood and stool collection was used for the study gave their informed consent. The participants were given a thorough explanation of the study's goals, advantages, and protocol as well as assurances regarding its secrecy and voluntariness.

Data Collection

The study was conducted from January to April of 2021. On Mondays and Fridays of each week, the medical institutions were visited between the hours of 9 am and 1 pm. Each individual had samples of their blood and stool taken. Gastroenterologists were consulted to assess each participant's diagnostic significance..

Venous blood collection: Each subject's venous blood was drawn into a vacutainer bottle using a tourniquet and a sterile needle to get about 5 ml. Within two hours, the blood samples had been sent to the lab and were being processed. The blood sample was centrifuged at 3000 rpm for 5 minutes to separate the serum, which was then immediately placed into sterile tubes and refrigerated at 2 °C to 8 °C for up to 3 days before analysis. Samples were kept below -20ºC for long-term storage.

Stool sample collection: Each participant was asked to provide samples of their own feces. They were instructed on how to gather their stool samples aseptically in private and were supplied sterile leak-proof single use universal bottles with screw-capped lids. Within two hours, the laboratory processed the transported stool samples. If a delay was also anticipated, samples were maintained in the refrigerator at 4oC for long-term storage (23).

Sample Analyses

Three techniques—the stool antigen immunoassay test method, blood antibody test method, and culture method—were used to identify the presence of *Helicobacter pylori* infection in the patient samples.

Blood antibody test: Utilizing the Accu-Bind antibody test device (Diasure diagnostic test, Azure Biotech Inc.) for the identification of the presence of *H. pylori* Serum Immunoglobulin-G (HpS-IgG) antibodies to *H. pylori* in the samples, all preserved sera samples collected from the suspected patients were examined (22).

Stool antigen immunoassay test: Prior to examination, frozen samples were fully thawed and well mixed. A little (5 mg) piece of feces was added to 1 ml of Sample Treatment Solution (STS) in a test tube, and the mixture was quickly stirred.
The sample was examined utilizing a lateral flow chromatographic immunoassay for the detection of *Helicobacter pylori* Stool antigen (HpS-Ag) in human stool samples called the Diasure fast diagnostic test by Azure Biotech, Inc. (22).

Interpretation of serology test: Regardless of whether band emerged first, a positive outcome was signalled by the appearance of two-color bands (Control - "C" band and Test - "T" band) within the result window. A bad outcome was signalled by the result window's single pink color band. If the control line didn't show up, the test was invalid. The test was deemed faulty and the sample retested if no distinct color was evident in both the test and control regions or if a line was only visible in the test region and not the control region.

Culture and Isolation of *Helicobacter pylori*

This was done using the technique Amin and colleagues (23). Stool samples were streaked on Columbia blood agar basis (TITAN Biotech Ltd) and incubated for three to five days at 37°C under microaerophilic conditions (candle jar incubation) with an oxygen content of less than 0.5%. To obtain a pure isolation of *H. pylori*, growths were further sub-cultured. Gram staining and an evaluation of the motility of hanging drops were done for confirmation of the identity.

Assessment of Socio-demographic and Environmental Factors

In accordance with the collection of samples, the sociodemographic and environmental data of the participants were gathered using ready-made questionnaires that were given to the participants. The name of the health facility and a special participant

identification number were included on each questionnaire. The structured, standardized, interviewer-administered questionnaire was created to collect information on variables related to *H. pylori* infection. It included systematic questions on socio-demographic factors such gender, age categories (infants through 15 years old, adolescents through 30 years old, adults through 60 years old, and seniors over 60), marital status, occupation, and educational background. Environmental elements including household and drinking water sources, the number of inhabitants per room, and eating patterns were also taken into account. Clinical elements like infection symptoms and antibiotic use were also assessed. The pre-test questionnaires were given to the participants directly. In order to maintain secrecy, only the patient number for each participant was entered on the laboratory forms.

Statistical Analyses

Frequency and percentage results were displayed. Contingency The relationship between test methodologies and socio-demographic and environmental factors was investigated using chi square tests. The Statistical Package for Social Sciences version 26 (IBM SPSS Inc., IL, Chicago, USA) for Windows was used to analyze the data that had been gathered. Significant two-tailed p-values were those < 0.05.

Results

Association between gender and prevalence of *Helicobacter pylori* infection

The prevalence of *H. pylori* infection was correlated with participant gender, as shown in Figure 2. For the culture method, it was discovered that the prevalence of *H. pylori* infection was significantly higher (33.95%) in female participants than in male participants (19.70%), but no significant difference was found (at p>0.05) for either the blood antibody (BAB) or stool antigen (SAG) test methods.

Association between age groups and prevalence of *Helicobacter pylori*

Table 1 illustrates the association between the prevalence of *H. pylori* infection among the participants and the various age groups. Results from the various analytical techniques revealed that the age range of 1 to 5 years had the highest prevalence, as measured by CM and BAB analyses at 35 and 70 percent, respectively, while the age range of > 60 years had the highest prevalence, as measured by SAG analysis at 16.67 percent. However, none of the three analytical methods—CM, BAB, and SAG—found a significant variation in the prevalence values across the different age groups (p>0.05; x2 = 0.73, 1.72, and 1.91; p = 0.947, 0.787, and 0.752 for CM, BAB, and SAG, respectively).

Association between socio-demographic factors and *Helicobacter pylori* infection

Table 2 demonstrates the relationship between a few sociodemographic characteristics and *H. pylori* infections among suspected patients. According to marital status, married participants (68.10%) had a substantially greater prevalence of *H. pylori* infection than singles (44.68%) and divorced participants (58.82%) (p=0.021; x2 = 7.26; p=0.021). Using the other techniques, there were no relationships between marital status and the prevalence of *H. pylori* (p>0.05). In addition, it was found that the prevalence of *H. pylori* infection was significantly higher among students (48.28%) according to the CM method (x2 = 15.17; p = 0.004) and farmers (77.27%) according to the BAB method (x2 = 11.02; p = 0.026), though no significant association was found using the SAG method (p >0.05).

In just the BAB test technique, participants with informal educational backgrounds had a higher prevalence of *H. pylori* infections with a significant correlation (p < 0.05) than their counterparts with formal educational backgrounds (27.00%) (x2 = 14.88; p < 0.001).

With prevalence values of 40.00% using CM (x2 = 4.64; p < 0.031) and 80.00% using BAB test (x2 = 10.39; p < 0.00), *H. pylori* was substantially more prevalent (p < 0.05) in respondents who claimed no prior history of peptic ulcer/stomach cancer disease.

In cases where drugs had previously been administered, it was found that using BAB (x2 = 6.45; p=0.011) that the prevalence was significantly higher (p < 0.05) among those who had not previously received gastric/peptic ulcer medications (78.95%), but no significant association was found using CM or SAG test methods.

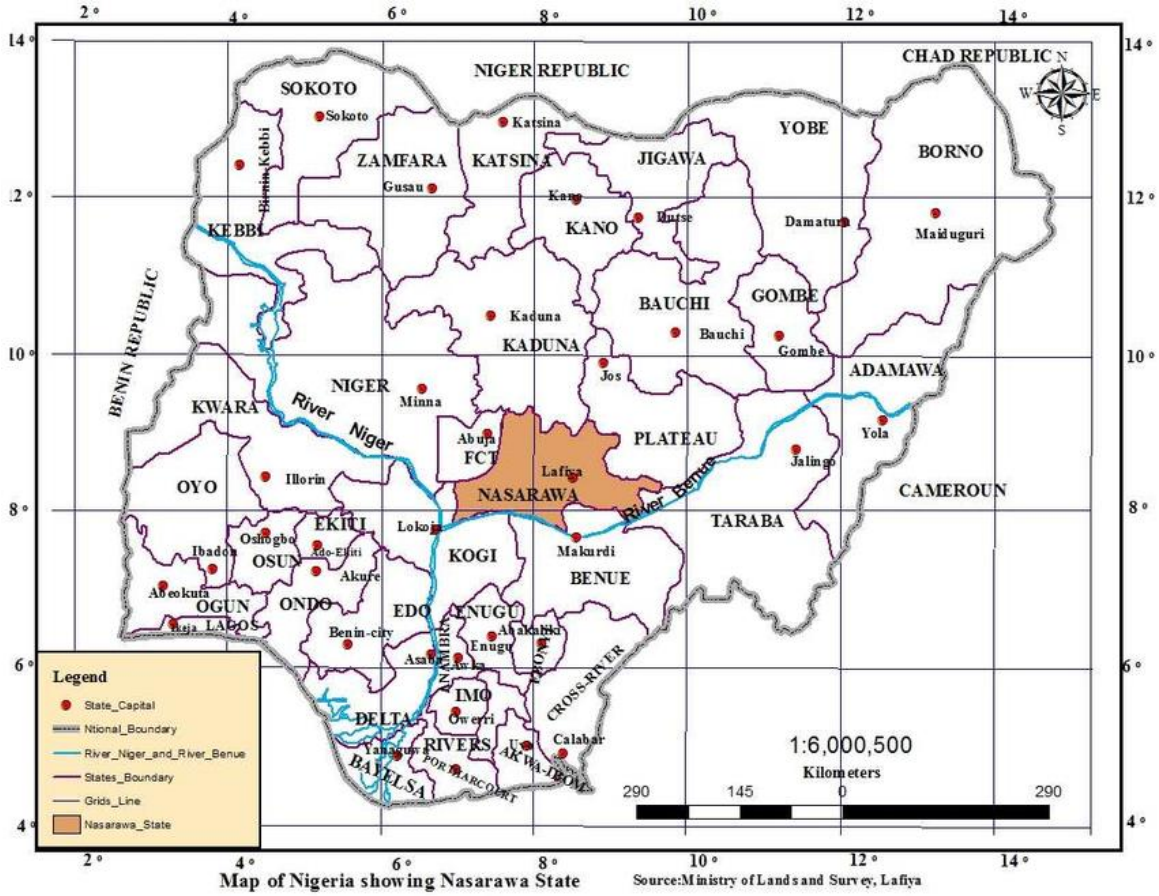

Figure 1. Map of Nigeria showing Nasarawa State and the study community (Lafia).

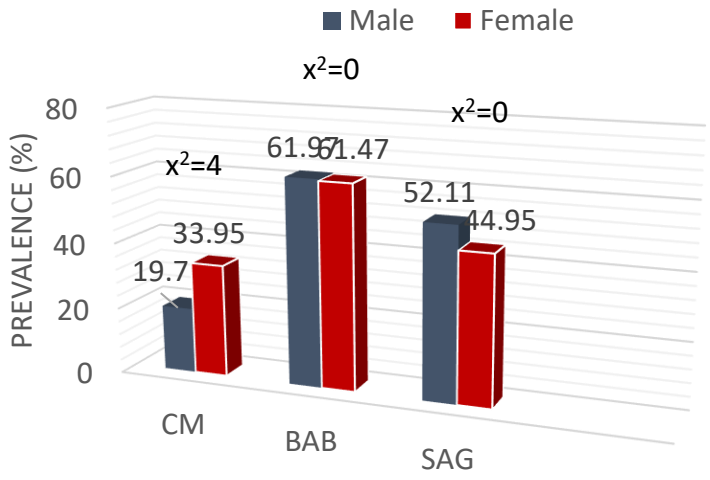

Figure 2. Occurrence of *H-pylori* infections with respect to gender of suspected patients using different analytical methods CM = Culture method; BAB = Blood antibody method; SAG = Stool antigen method; *= p-values with significant difference.

Table 1. Association between different age groups and prevalence of *Helicobacter pylori*

	Total no. of Participants N	CM Reactive cases			BAB Reactive cases			SAG Reactive cases		
		n (%)	χ^2	p	n (%)	χ^2	p	n (%)	χ^2	p
Age (yrs.)										
1 – 15	20	7(35.00)	0.73	0.95	14(70.00)	1.72	0.79	8(40.00)	1.91	0.75
16 – 30	62	17(27.42)			38(61.29)			29(46.77)		
31 – 45	58	15(25.86)			36(62.07)			30(51.72)		
46 – 60	34	10(29.41)			18(52.94)			15(44.11)		
> 60	6	2(33.33)			4(66.67)			4 (66.67)		

N= total number of individuals; n= number of positive cases;*= p- values with significant difference. CM= culture method; BAB= Blood antibody method; SAG= Stool antigen method

Table 2. Association between sociodemographic factors and prevalence of Helicobacter pylori

	Total no. of Participants	CM Reactive cases			BAB Reactive cases			SAG Reactive cases		
	N	n (%)	χ^2	p	n (%)	χ^2	p	n (%)	χ^2	p
Marital status										
Single	47	15(31.91)	0.52	0.77	21(44.68)	7.76	0.021*	17(36.17)	4.72	0.094
Married	116	32(27.59)			79(68.10)			58(50.00)		
Divorced	17	4 (23.53)			10(58.82)			11(64.71)		
Occupation										
Civil servants	70	23(32.86)	15.17	0.004*	40(57.14)	11.02	0.026*	35(50.00)	3.45	0.49
Farmers	22	5(22.73)			17(77.27)			12(54.55)		
Students/pupils	29	14(48.28)			17(58.62)			13(44.83)		
Unemployed	25	7(28.00)			10(40.00)			14(56.00)		
Trading	34	2 (5.88)			26(76.47)			12(35.29)		
Educational background										
Formal	80	21(26.25)	0.41	0.52	37(46.25)	14.88	<0.001*	38(47.50)	0.79	0.84
Informal	100	30(30.00)			73(73.00)			48(48.00)		
Previous peptic ulcer/stomach cancer health condition.										
Yes	130	31(23.85)	4.64	0.031*	70(53.85)	10.39	<0.001*	57(43.85)	2.90	0.09
No	50	20(40.00)			40(80.00)			29(58.00)		
Drug administration										
Yes	142	36(25.35)	2.94	0.086	80(56.34)	6.45	0.011*	67(47.20)	0.10	0.78
No	38	15(39.47)			30(78.95)			19(50.00)		

N= total number of individuals; n= number of positive cases;*= p-value with significant difference; CM= culture method; BAB= Blood antibody method; SAG= Stool antigen method

Table 3. Association between environmental factors and prevalence of *Helicobacter pylori*

	Total no. of Participants	CM Reactive cases			BAB Reactive cases			SAG Reactive cases		
	N	n (%)	χ^2	P	n (%)	χ^2	P	n (%)	χ^2	p
Domestic water source										
Tap	92	8 (8.70)	64.54	<0.001*	54(58.70)	8.32	0.016*	35(38.04)	8.14	0.017*
Well	35	6 (17.14)			16(45.71)			18(51.43)		
River	53	37(69.81)			40(75.47)			33(62.26)		
Source of drinking water										
Sachet	46	8 (17.39)	6.18	0.103	19(41.30)	15.34	0.002*	20(43.48)	2.98	0.395
Bottle	25	5 (20.00)			12(48.00)			13(52.00)		
Underground	41	13(31.71)			30(73.18)			16(39.02)		
Surface	68	25(36.76)			49(72.06)			37(54.41)		
Occupants per room										
Single	33	1(3.03)	23.61	<0.001*	17(51.52)	41.46	<0.001*	11(33.33)	12.34	0.002*
2 – 4	77	17(22.08)			30(38.96)			30(38.96)		
≥5	70S	33(47.14)			63(90.00)			45(64.29)		
Eating habits										
Households	47	6(12.77)	9.24	0.010*	22(46.81)	8.23	0.016*	18(38.30)	3.20	0.202
Hawkers	66	19(28.79)			39(59.10)			31(46.97)		
Restaurants	67	26(38.81)			49(73.13)			37(55.22)		

N= total number of individuals; n= number of positive cases;* = p-value with significant difference; CM= culture method; BAB= Blood antibody method; SAG= Stool antigen method

Association between environmental factors and Prevalence of *Helicobacter pylori* infection

The prevalence of *H. pylori* among the participants and various environmental factors were correlated, as shown in Table 3.

Regarding domestic water supply, it was discovered that the prevalence of *H. pylori* infection was significantly higher ($p < 0.05$) in those who used river water, with values of 69.81%, 75.47%, and 62.26% using CM ($x^2 = 64.54$; $p = 0.001$), BAB ($x^2 = 8.32$; $p = 0.016$), and SAG ($x^2 = 8.14$; $p = 0.017$), respectively. According to data collected only using BAB ($x^2 = 15.34$; $p = 0.002$), the prevalence of *H. pylori* infection was substantially greater ($p < 0.05$) among people who drank underground water (73.18%) than among those who did not.

When compared to households with fewer inhabitants, the results showed that households with five or more residents had higher prevalence values for CM ($x^2 = 23.61$; $p < 0.001$), BAB ($x^2 = 41.46$; $p < 0.001$), and SAG ($x^2 = 12.34$; $p < 0.002$), respectively. Using every analytical technique, the difference was statistically significant ($p < 0.00$).

Regarding Eating Habits, it was discovered that people who dine in restaurants utilizing CM ($x2 = 9.24$; $p = 0.010$) and BAB ($x^2 = 8.23$; $p=0.016$) had considerably higher prevalence of *H. pylori* infection ($p < 0.05$) with values of 38.81% and 55.22%, respectively. However, the results obtained with SAG ($x^2 = 3.20$; $p = 0.202$) did not differ substantially ($p > 0.05$).

Discussion

Using existing analytical techniques and epidemiological procedures, the relationship between several socio-demographic and environmental parameters as they influence the transmission and prevalence of *H. pylori* infection among suspected gastric ulcer patients in Lafia, Nigeria, was assessed.

The findings of this investigation revealed a significant difference in the prevalence values of *H. pylori* ($p < 0.05$) between the male and female reactive cases produced using the culture method (CM), although values derived from the analytical methods

for blood antibodies (BAB) and stool antigens (SAG) did not significantly differ ($p>0.05$). This raises the likelihood that this disease could infect people of all genders equally. Age-related *H. pylori* prevalence rates When pylori positive was examined using all three analytical techniques, there was no discernible correlation ($p>0.05$) between it and the various age groups. This might also imply that all age groups are equally exposed to additional risk factors. Using the BAB technique alone, this study's results showed that marital status was substantially related to *H. pylori* infection ($x^2 =7.26$; $p=0.021$). Using the CM and BAB methodologies, it was shown that the prevalence values of *H. pylori* infection had a significant variation ($p < 0.05$) depending on the participants' varied occupations. As a result, a higher infection rate among farmers may be related to their poor lifestyle choices and hygiene habits. With 48.28% of students utilizing CM ($x^2 = 15.17$; $p = 0.004$) and 77.27% using BAB ($x^2 = 11.02$; $p = 0.026$), the infection incidence among students was the greatest. Based solely on data from the BAB, this study found that there were appreciable differences in the prevalence values of *H. pylori* infections among persons with various educational backgrounds. In contrast to the group with formal education, those with informal education had a greater value. Although a higher level of knowledge may be implied by formal education, this may not be the case in this study because the isolation of this virus was not done frequently. Intriguingly, the prevalence of *H. pylori* infection was statistically significant, and when using BAB and CM analyses, 80% of the positive participants had no history of infection or peptic ulcer disease. This would suggest that interfamilial transmission of the *H. pylori* infection plays a part. Eating habits have been demonstrated to significantly increase the prevalence of *H. pylori*

infection ($p < 0.005$), with the greatest results obtained using the CM and BAB methods among people who frequent restaurants. In the study community, it was very usual to see people eating at restaurants with poor hygienic standards because the food was so inexpensive. This may help to explain why they are so popular with their customers. Only when the BAB analytical test was run ($x^2 = 6.45$; $p = 0.011$) were the prevalence values related with reported cases of drug administration by the subjects statistically different ($p < 0.05$), with those without drug administration having a greater prevalence. Those who do not use medication may not have been exposed to illnesses and as a result may exhibit weak natural immunity to the virus. When compared to subjects who utilized tap water, those who obtained their household water from wells and rivers had considerably greater prevalence ($p=0.016$ and 0.017). When compared to tap water, which is often treated before distribution, well and surface water are more likely to include feces. This could be the cause of the problem.

Shimoyama and colleagues (24) reported earlier research with similar results that showed no gender differences in the prevalence of *H. pylori* positive in stool antigen and serology tests. In a rural Ugandan community, Nekaka and colleagues (25) found no appreciable difference between the prevalence rates of 28,4% for females and 23,5% for males. Molaoa (1), who treated patients in South Africa with malignant and peptic ulcer disease (PUD), observed a similar finding with no statistically significant difference between males (56%) and females (54%). It is notable that more women than men [n=109 (60.56%)] took part in the study, which may indicate that women are more aware of health-related issues and that the number of reactive instances among men may have been underreported. The age group findings are consistent with those of another study that used a large survey of healthy individuals and found no significant change in *H. pylori* infection with age (26). Additionally, research including kids and teenagers found no evidence of an age difference (27-28). According to Zanten (29), *H. pylori* cannot be transmitted through adult-to-adult sexual contact or cohabitation; hence, marital status may not be significantly linked with *H. pylori* infection. Therefore, the outcomes of this investigation employing the CM and SAG analytical procedures are supported by the data. Farmers in North-Western China's Wuwei Cohort had greater infection rates, according to similar studies (30). The majority of the farmers were low-income individuals who may not have been primarily focused on health concerns. The data from Shah and colleagues (31) who worked in Timergara City of Pakistan has supported the idea that informal educational status may have a role in the transmission of this virus. They hypothesized that people with formal education might be more aware of cleanliness and health issues than people with informal education. Prior research suggested that the primary method of *H. pylori* infection was through person-to-person transmission (18). This is further supported by the finding that, when evaluated using CM, BAB, and SAG, respectively, the number of inhabitants per room had a substantially greater prevalence among those 5 per room with values of 47.14%, 90.00%, and 64.29%. Similarly, multiple investigations conducted in Nigeria by Ejilude and colleagues (22) shown that the prevalence of *H. pylori* infection increased with the size of the household. Household overcrowding, bed sharing, and increased household contact were further risk factors for *H. pylori* infection mentioned by Khalifa and colleagues (32). According to a study by Torres and colleagues (33), the density of living

arrangements is a key factor in the spread of the *H. pylori* infection. Crowding is substantially associated with *H. pylori* infection, as demonstrated by this study ($p < 0.001$). According to reports, diet has an impact on *H. pylori* infections, and vegetables have been linked to a putative transmission pathway (13,33). Researchers have been urged to take biopsies for diagnosis at least 3 months after the patient stops receiving antibiotics as antibiotic administration has been shown to impair the accuracy of *H. pylori* screening (34). This explains how people who were receiving medication administration can get false-negative results. According to a similar study conducted in Nigeria, drinking water from wells and rivers carries a higher risk of *H. pylori* infection than water that comes from a pipe (35). Another study by Khalifa and colleagues (32) indicated that people who drink from rivers and wells have higher rates of *H. pylori* infection than those who get their home water from the tap. *H. pylori* infection has been linked to water as a probable cause (36). They came to the conclusion that children in Colombia who drink stream water, bathe, and swim in streams and pools are substantially more likely to contract *H. pylori*. Klein and colleagues (37) conducting research in Lima, Peru, arrived at similar conclusions while studying children.

Using both stool and serology tests, a comparison research on gender revealed a considerably higher frequency in the female gender (38). Additionally, despite the fact that males had a larger frequency than females with 22,1% and 14,3% respectively, a cross-sectional study in Pakistan found a significant variation in infection prevalence among gender (31). Several other investigations (12) have noted a high prevalence of *H. pylori* infection in elderly populations, in contrast to the results of this study, which revealed no appreciable differences across various age groups. The current study contrasts with earlier research by Khan and Ghazi (39) who found that patients over 50 are more likely than younger patients to have an *H. pylori* infection. According to several research, changes in key risk variables could either raise or decrease infection rates depending on the environment (28). In contrast to those with little formal education, people in junior and senior high schools had a significantly greater risk of *H. pylori* infection, according to a paper by Zhang and colleagues (30). The discrepancy may be caused by the fact that the majority of individuals chosen for their study were largely junior and senior secondary school pupils. This might lead to the collection of homogeneous samples and make it harder to compare those who had *H. pylori* infection with those who did not.

On the other hand, persons who carry the infection should eat mostly fruits and vegetables. According to studies, eating a lot of fruits and vegetables can reduce the risk of stomach disorders brought on by *H. pylori* by 33%. (40) In the low-cost restaurants, we did not see that fruits and vegetables were frequently provided; when they were, they were prepared in an unsanitary manner. Interestingly, subjects who drank water from rivers, as well as those who swam close to polluted beaches in nearby rivers, irrigation canals, and lakes, did not pose a significant risk, according to research by Hopkins and colleagues (42) and Teh and colleagues (41) in Taiwan and Chile, respectively. Further research is needed because other studies have found that water plays an inconclusive function in the spread of *H. pylori* (43). According to the aforementioned findings, food and drink may have less of an effect on the *H pylori* infection unless personal hygiene is at risk.

In general, it was shown that a higher frequency of *H. pylori* infection was associated with the poor socioeconomic status of the residents of Lafia, as indicated by their occupation, educational background, source of drinking water, and eating habits. Therefore, the socioeconomic status of children and adolescents is a risk factor for *H. pylori* infection, as was previously stated by Seth and colleagues (14).

The numerous sociodemographic and environmental factors that may act as risk indices for the transmission of *H. pylori* in the study population have been critically analyzed in this study. A benefit over comparable studies that limited their assessment based on a particular analytical method was the concurrent use of various noninvasive methods. Given that these investigations were conducted in various areas with various traditions and employing various analytical techniques, it is possible that some regional, behavioral, and clinical aspects may have an impact on the outcomes. Analytical techniques have been demonstrated to have an impact on the isolation of *H. pylori* among suspected research participants (19). This study's lack of invasive and genetic identification methods could be one of its biggest shortcomings.

Conclusion

Using the CM, BAB, and SAG analytical methods, respectively, the study's findings demonstrated that *H. pylori* infection is present among gastric ulcer patients visiting medical institutions in the study community, with prevalence rates of 28.33%, 61.67%, and 47.78%. The majority of the investigated socio-demographic and environmental factors were found to have a substantial impact on the infection's prevalence. These results offer fresh understandings of the current risk factors for *H. pylori* infection in Lafia Metropolis and

will help in the creation of novel preventative and controlling methods for its transmission chain.

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