Available online at https://asric.africa/natural-sciences
ASRIC Journal on Natural Sciences Vol 5(1) (2025) 12-25

Detection and Seroprevalence of Helicobacter Pylori Among Patients Attending Primary Health Care Badarawa, Kaduna, Nigeria

Muhammad, Jamila[1]*, Ahmad Asmau[1]., Musa, Fatima Mohammed[1]., Aliyu, Aishatu Mohammed[1]., Sanusi, Shuaibu Babaji[1].

[1]Department of Microbiology, Faculty of Life Science, Kaduna State University,
jamila.muhammad@kasu.edu.ng, asmauj08@gmail.com, fmmusa1@gmail.com
aisha.mohdaliyu@kasu.edu.ng, sanusishuaibu@gmail.com

*Corresponding author: jamila.muhammad@kasu.edu.ng

Received 29 April 2025; revised 08 May 2025; accepted 02 June 2025

Abstract

Helicobacter pylori (*H. pylori*) is a gram-negative, microaerophilic spiral bacterium thriving in the stomach lining which led to various gastrointestinal ailments such as gastritis, peptic ulcers, and gastric cancers. Its distinctive spiral shape and adaptability to the acidic stomach environment facilitate chronic colonization, triggering inflammatory responses and a spectrum of clinical symptoms. This study aimed to serologically explores the seroprevalence of *Helicobacter pylori* among patients attending Primary Health Care Badarawa to detect specific antibodies of *H. pylori* using rapid test strip. A total of 90 blood samples were collected into an EDTA bottles. The serological test was done in compliance with quality control (QC) protocols and in accordance to the manufacturer's instructions. The overall seroprevalence of *H. pylori* infection among patients attending PHC Badarawa was 83%. The prevalence of *H. pylori* infection varied significantly by age with the highest prevalence occurring in individuals aged 7-10 (100%), 51-60 (100%), 61-70 years old (100%) and the lowest in the 11 to 20 (76.2%) age group. Regarding symptoms of *H. pylori* infection, this study revealed that the most common frequent symptoms were Heartburn 33(6.1), followed by Upper abdominal pain 27(18.5), Loss of appetite 15 (13.3), Nausea and vomiting 13(7.7), Burping10(0), and Persistent stomach pain 16(0), while Bloody stool 3(33.3), which was the least reported. The investigation compared socio-demographic factors (Gender, Occupation, Educational status, and Marital status) with various risk factors, including Source of water, Eating habits, Exposure to pets, Contact with ulcer infected individuals and the Number of people in the household. Among these, significant associations were found between Occupational status and the Source of water (p-value = 0.019), Educational status and Eating habits (p-value = 0.019), Gender and Exposure to pets (p-value = 0.009), Gender and Contact with infected individuals (p-value = 0.048), Educational level and Frequency of food intake (p-value = 0.041), and Marital status with the Number of people in the household (p-value = 0.011). This study sheds light on the prevalence and associated factors of *H. pylori*, emphasizing the importance of considering socio-demographic factors in understanding risk factors and informing targeted public health interventions.

Keywords: Prevalence, Epidemiology, *Helicobacter pylori,* Peptic ulcer, Gastric adenocarcinoma, Gastric mucosa associated lymphoid tissue, Clinical signs and Treatment.

Introduction

Helicobacter pylori previously known as *Campylobacter pylori* belongs to the family *Helicobacteraceae*. It is a gram-negative, microaerophilic and helical bacterium usually found in the stomach of an individual. Its helical shape from which the genus name, *helicobacter* was derive from is thought to have evolved to penetrate the mucoid lining of the stomach and thereby establish infection (Alfarouk *et al*., 2019). *H. pylori* is a transmissible and pathogenic gram-negative bacterium thought to be a contaminant of digested food which colonize the gastric mucosa. The organism was first successfully isolated and discovered by Barry Marshall and Robin Warren in 1980, for which they were awarded the Nobel Prize in 2005. They intentionally ingested the bacterium and subsequently developed persistent gastritis. Later, the bacteria were found to be strongly associated with multiple upper gastrointestinal disorders, such as chronic gastritis, peptic ulcer disease, gastric mucosa-associated lymphoid tissue (MALT) lymphoma and gastric cancer (Bashir and Khan, 2023).

Helicobacter pylori infection is highly prevalent globally with half of the world's population carrying the pathogen (Ibrahim *et al*., 2022). It is one of the most common human pathogens, accounting for over 4.4 billion (~59%) of all infections worldwide. The organism that is present in the stomachs of roughly 50% of people worldwide appears as normal flora in the majority of people who appear to be in good health. Clinically, *H. pylori* infection is spread, particularly in poor nations where the infection is typically acquired in childhood and symptoms appear in maturity (Ahmed, 2024). At least half of the world's population was infected by the bacterium as of 1995 making it the most widespread infection in the world. Actual infection rates vary from nation to nation with the developing world having much higher infection rates than the developed one. The global prevalence of the bacterium declined markedly in the decade following 2010, with a particular reduction in Africa (Li *et al.,* 2023). In developed nations, it is currently uncommon to find infected children, but the percentage of infected people increases with age, with about 50% infected for those over the age of 60 compared with around 10% between 18 and 30 years. The higher prevalence among the elderly reflects higher infection rates in the past when the individuals were children rather than more recent infection at a later age of the individual. In the United States, prevalence appears higher in African-American and Hispanic populations, most likely due to socioeconomic factors. The lower rate of infection in the west is largely attributed to higher hygiene standards and widespread use of antibiotics. Despite high rates of infection in certain areas of the world, the overall frequency of *H. pylori* infection is declining. However, antibiotic resistance is appearing in *H. pylori* as many metronidazole and clarithromycin resistant strains are found in most parts of the world (Brown, 2023).

Peptic ulcers are usually found in the stomach but can also reside in the esophagus. Peptic ulcer refers to the acid peptic injury of the digestive tract, resulting in mucosal break reaching the sub-mucosa. Over the past two centuries, PUD has been a major threat in fourfold higher in *H. pylori*–infected individuals than in non-infected individuals. *H. pylori* along with non-steroidal anti-inflammatory drugs (NSAIDs) such as aspirin is the main cause of gastric and duodenal ulcers (imbalance is aggressive gastric luminescence and pepsin and protective mucosal barrier function) (Sabbagh *et al*., 2019). Worldwide, gastric cancer (GC) is the fifth most commonly diagnosed malignancy and the fourth leading cause of cancer related deaths per year. On the other hand, *H. pylori* has been implicated as the strongest risk factor in the pathogenesis of gastric adenocarcinoma; thus, it has been classified as a class I carcinogen by the World Health Organization (WHO). GC is triggered by a multifactorial process, beginning with *H. pylori* induced chronic gastritis, which results in atrophic gastritis, intestinal metaplasia, dysplasia, and eventually gastric cancer (Weren *et al*., 2018). The molecular pathogenesis of MALT lymphoma is incompletely understood, but it seems to include strain-specific. *H. pylori* factors as well as host genetic factors, such as polymorphisms in inflammatory cytokine promoters such as TNF and IL-1β. *H. pylori* is the cause of some gastric disorders (peptic ulcer disease (PUD), gastric adenocarcinoma, and gastric mucosa associated lymphoid tissue (MALT) lymphoma, which are the results of an interaction between bacterial virulence factors, host and environmental factors. Several extra-gastric manifestations have

been reported to be linked to *H. pylori* infection such as neurological, dermatological, hematologic, ocular, cardiovascular, metabolic and allergic diseases.

H. pylori infections usually shows no clinical manifestation. However, signs and symptoms associated with the disease are primarily due to gastric or peptic ulcer illness or duodenal inflammation. Furthermore, other symptoms such as abdominal pain, nausea and vomiting may be attributed to other gastrointestinal diseases (Gravina *et al*., 2018). The treatment of *H. pylori* infection consists of a combination of antibiotics, proton pump inhibitors (PPIs), and sometimes bismuth compounds. The most commonly used antibiotics for treating *H. pylori* infection are clarithromycin, amoxicillin, metronidazole, and tetracycline (Rokkas *et al*., 2021).

Materials and Methods

Study Design

The study is a hospital based cross sectional study.

Study Population

The study population were patients attending PHC Badarawa hospital, which consisted of both children and adults from age 7-70.

Inclusion criteria:

- Participants who were willing to undergo laboratory testing or other procedures as part of the study.
- Participants who were willing to provide signed consent and agree to have their data used for research purposes.

Exclusion criteria:

- Participants with mental health conditions or cognitive impairments.
- Participants who were currently experiencing acute symptoms or illness that may affect the study results.

Sample Size Determination

The sample was determined using the Cochran formula below:

Where $N=Z^2\ pq\ /d^2$

N = Sample size

Z= Standard normal distribution at 95% Confidence level= 1.96

P = Prevalence rate of *Helicobacter pylori* 6%= 0.06 (Adedoyin and Ishaleku, 2020).

Q=1-p

D = Allowable error= 0.05

$N= (1.96^2) \times 0.06 \times (1-0.06)/0.05^2$

$N= 3.84\times0.056/0.0025$

N= 0.22/0.0025

N= 86

Therefore, the sample size was 86 but it was rounded to 90. Ninety blood samples were collected into an EDTA bottle.

Experimental Design

This is a hospital based cross sectional study to determine the prevalence of *Helicobacter pylori* infection. A total of 90 samples of blood specimens randomly from interested 90 infected patients, age range from 7-70 years old was obtained from Badarawa Kaduna North local government area of Kaduna State.

Ethical Approval

Ethical approval was obtained from ministry of health and human service Kaduna, Nigeria and Badarawa hospital, Kaduna. A printed consent form was also given to the patients to sign.

Administration of Questionnaire

The socio-demographic data were collected by structured questionnaire. These include their sex, age, and socio-economic status.

Sample Collection

The test was done in compliance with quality control (QC) protocols and in accordance to the manufacturer's instructions. The 2ml of blood sample were collected from each patient via vein puncture into clean Vacutainer tube using a syringe and then transferred into an EDTA container.

Detection of *Helicobacter pylori*

The blood sample were centrifuged (spinned) for 5minutes at 3000rpm speed and then using a micropipette about 50 µl of serum sample was added into the sample area of the strip and allowed to run for 10 minutes. The plasma was separated using pasture pipette and the result was then read under sufficient light (Ahmed *et al.,* 2024).

Statistical Analysis

The statistical analysis was conducted using the statistical package for social science (SPSS). Chi-square test was then used to determine any association between seroprevalence and the socio-demographic factors. P-value less than or equal to 0.05 at 95% confidence interval (CI) were considered as statistically significant.

Results

Distribution of *Helicobacter pylori* in Relation to Age-Groups

Helicobacter pylori in relation to age-group in which the highest percentage of positive samples was found in 21-30 age-group and the lowest percentage of positive sample was found in the 61-70 age-group (Table 1).

Table 1: Distribution of *H. pylori* in Relation to Age-Groups

Age group	Number examined	Number of positive samples	Frequency occurrence %
7-10	4	4	100
11-20	21	16	76.2
21-30	40	33	82.5
31-40	11	9	81.8
41-50	7	6	85.7
51-60	6	6	100
61-70	1	1	100
Total	90	75	83.3

$X^2 = 2.3867$

Df= 6

P-value= 0.8034

Common Symptoms of *Helicobacter pylori* Infection among Patients

The common symptoms of *H. pylori* infection are shown in Table 2. Heartburn was the common symptoms of *H. pylori* infection while the bloody stool was the least.

Table 2: Common Symptoms of *Helicobacter pylori* Infection among Patients

Symptoms	Number of Positives (Yes)	Number of Negatives (No)	Frequency (%)
Upper abdominal pain	27	5	18.5
Nausea and vomiting	13	1	7.7
Bloody stool	3	1	33.3
Loss of appetite	15	2	13.3
Heartburn	33	2	6.1
Burping	10	0	0
Persistent stomach pain	16	0	0
Total	117	11	9.4

$X^2 = 4.4711$

Df= 6

P-value= 0.608

Socio-demographic Characteristics of Patients with *H. pylori* Infection

Table 3.1, 3.2 and 3.3 shows the socio-demographic characteristics of patients with *H. pylori* infection including the breakdown of gender, marital status, education level, occupation, chronic health conditions and source of drinking of each patient. The majority of patients were females and also the majority of patients were self-employed while a small number of patients had chronic health conditions like asthma, high blood pressure and bronchitis.

Table 3.1: Socio-demographic Characteristics of Study Subjects

Characteristic	Category	Number of examined	Positive	Frequency (%)
Gender	Male	27	21	77.8
	Female	63	54	85.7
Marital status	Married	54	45	83.3
	Single	36	30	83.3
Educational level	Tertiary	36	29	80.6
	Secondary	34	30	88.2
	Primary	12	9	75
	None	8	7	87.5
Occupational status	Employed	18	15	83.3
	Unemployed	23	20	86.9
	Self-employed	49	40	81.6
Any chronic health condition	Yes	8	7	87.5
	No	82	68	82.9
Source of drinking water	Tap water	13	12	92.3
	Bottled water	8	6	75
	Well water	3	3	100
	Sachet water	66	54	81.8
Eating habits	Seldom	23	20	86.9
	Often	67	55	82.1
Food eaten frequently	Sugary drinks	16	14	87.5
	Red meat	12	11	91.7
	Fried food	23	18	78.3
	Fruits	15	11	73.3
	Vegetables	24	21	87.5
Drinks taken frequently	Coffee	10	7	70
	Alcohol	0	0	0
	Tea	78	66	84.6
	None	2	2	100

Table 3.2: Socio-demographic Characteristics of Study Subjects

Characteristic	Category	Number examined	Positive	Frequency (%)
Smoke cigarettes	Yes	1	1	100
	No	89	74	83.1
Pets or frequently exposed to animals	Yes	21	17	80.9
	No	69	58	84.1
Sanitation	Daily	15	13	86.7
	Weekly	22	18	81.8
	Monthly	53	44	83.0
Number of people in household	One	0	0	0
	Two	7	6	85.7
	Three	10	9	90
	More than three	73	60	82.2
Washing of hands after using the toilet	Yes	87	72	82.8
	No	3	3	100
Washing of hands before and after meals	Yes	86	72	83.7
	No	4	3	75
Sharing of eating utensils	Yes	47	41	87.2
	No	40	34	85
In contact with ulcer infected individual	Yes	61	55	90.2
	No	26	20	76.9
Experience symptoms	Yes	66	59	89.4
	No	24	16	66.7

Table 3.3: Socio-demographic Characteristics of Study Subjects

Characteristic	Category	Number examined	Positive	Frequency
Subdue symptoms	Milk products	15	13	86.7
	Eating	4	3	75
	Antacid	36	33	91.7
	Other	6	5	83.3
	None	29	5	17.2
Ever received information from health care	Yes	27	23	85.2
	No	63	52	82.5
Undergone any test before	Yes	22	20	90.9
	No	68	55	80.9
Treatment	Yes	38	35	92.1
	No	52	40	76.9
Know how transmission occur	Yes	7	5	71.4
	No	83	70	84.3
Know symptoms	Yes	28	24	85.7
	No	62	51	82.3

Relationship Between Socio-demographic factors and some Risk Factors

The relationship between socio-demographic factors and some risk factors are detailed in Table 4. Additionally, Figures 1-6 visually observed relationships through bar charts.

Table 4: Relationship Between Socio-demographic factors and some Risk Factors

Characteristics being Compared		Statistical comparison/ result		
		X^2	Df	P
Gender	source of water	2.249	3	0.522
	eating habit	0.866	1	0.35
	exposure to pets	6.783	1	**0.009**
	in contact with ulcer	3.910	1	**0.048**
Educational level	source of Water	13.197	9	0.154
	eating habits	8.040	3	**0.019**
	food eaten frequently	21.700	12	**0.041**
	in contact with ulcer infected individual	1.410	3	0.703
Marital status	eating habit	0.000	1	1.00
	food eaten frequently	2.131	4	0.710
	exposure to animals	1.534	1	0.216
	number of people in Household	9.097	2	**0.011**
Occupational status	source of water	15.104	6	**0.019**
	eating habit	3.239	2	0.198
	food eaten frequently	2.633	8	0.955
	number of people in Household	6.243	4	0.182

X^2- chi square, Df- degree of freedom, P values in bold are statistically significant

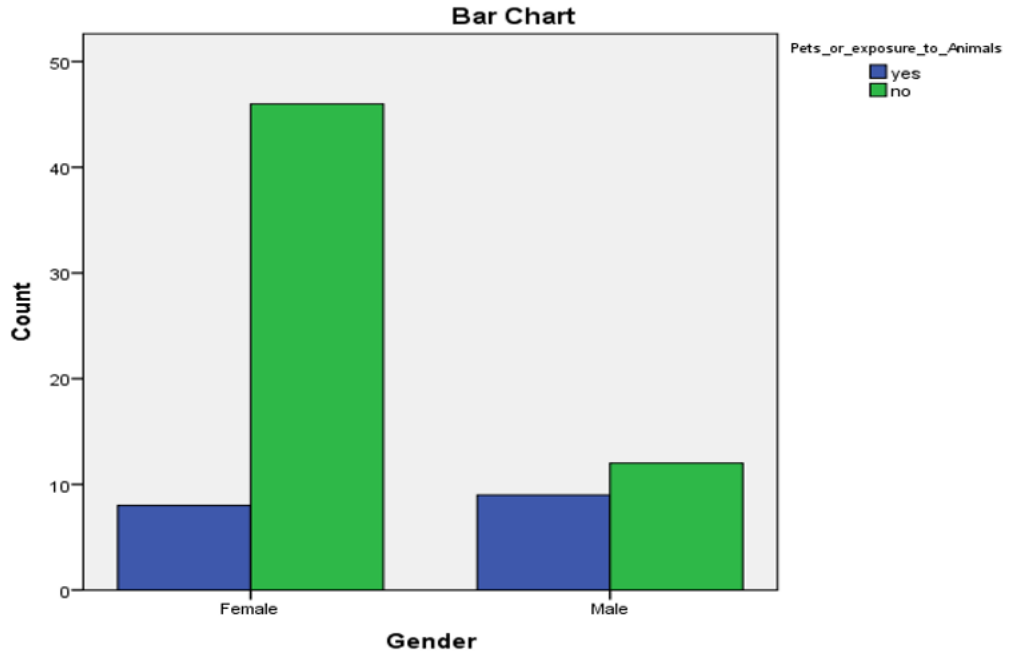

Fig. 1: Gender* exposure to animals

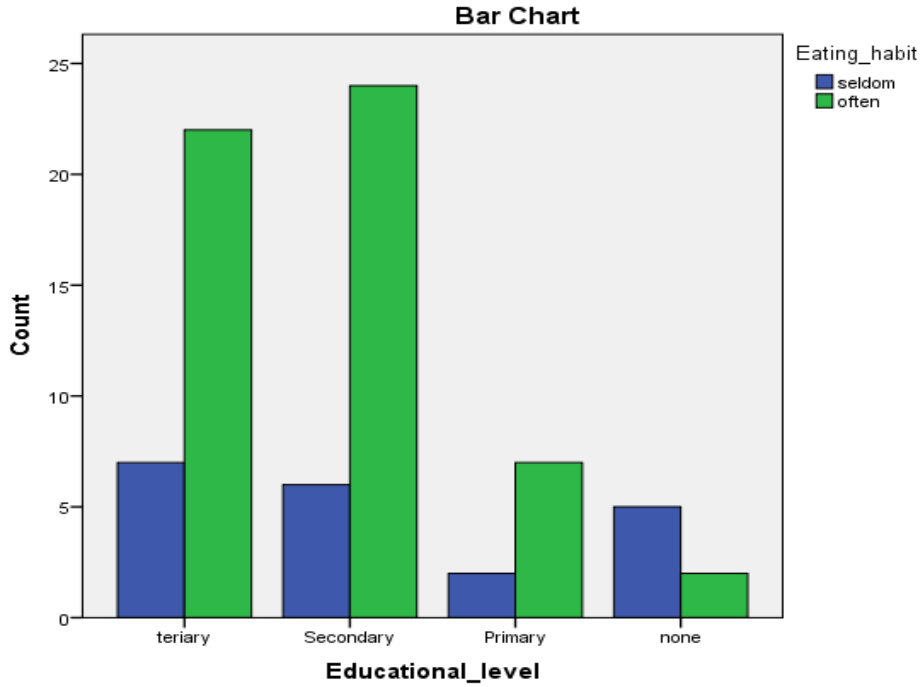

Fig. 2: Gender*in contact with ulcer infected individuals

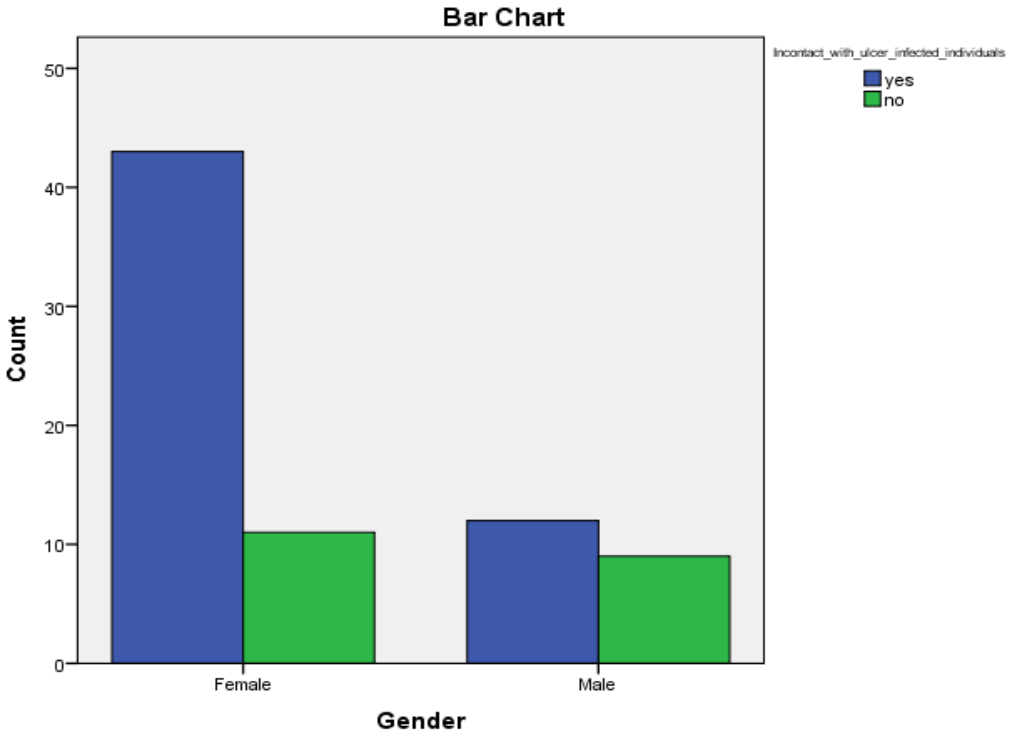

Fig. 3: Educational level* eating habit

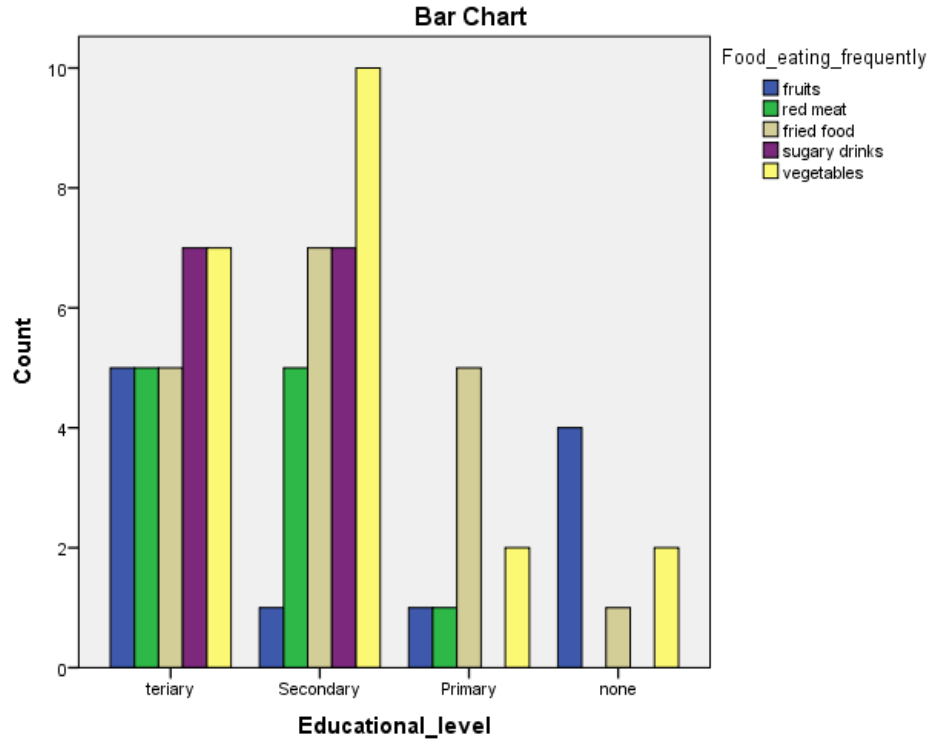

Fig. 4: Educational level* food eaten frequently

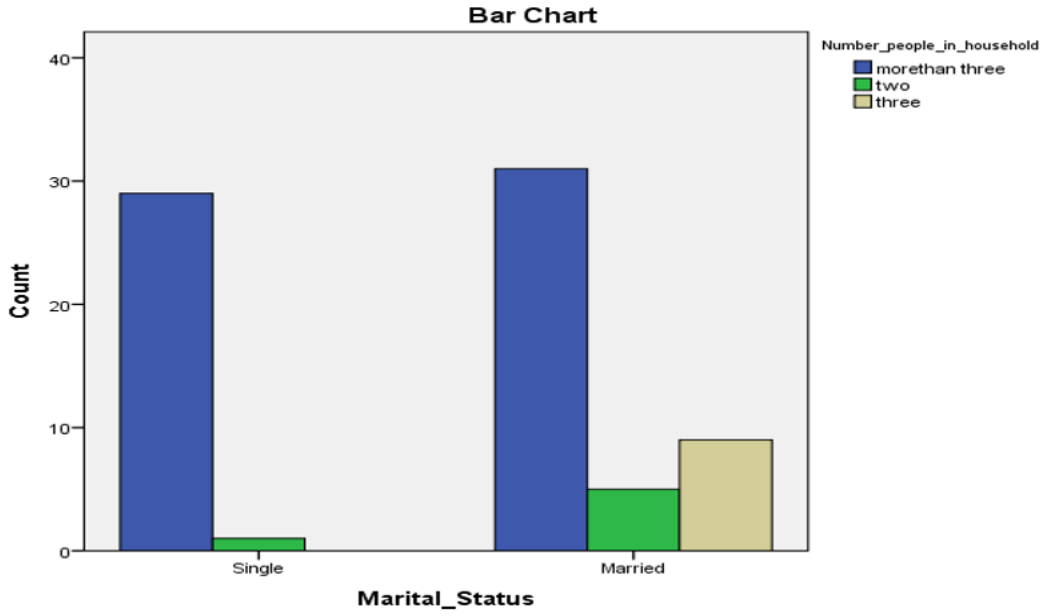

Fig. 5: Marital status*number of people in household

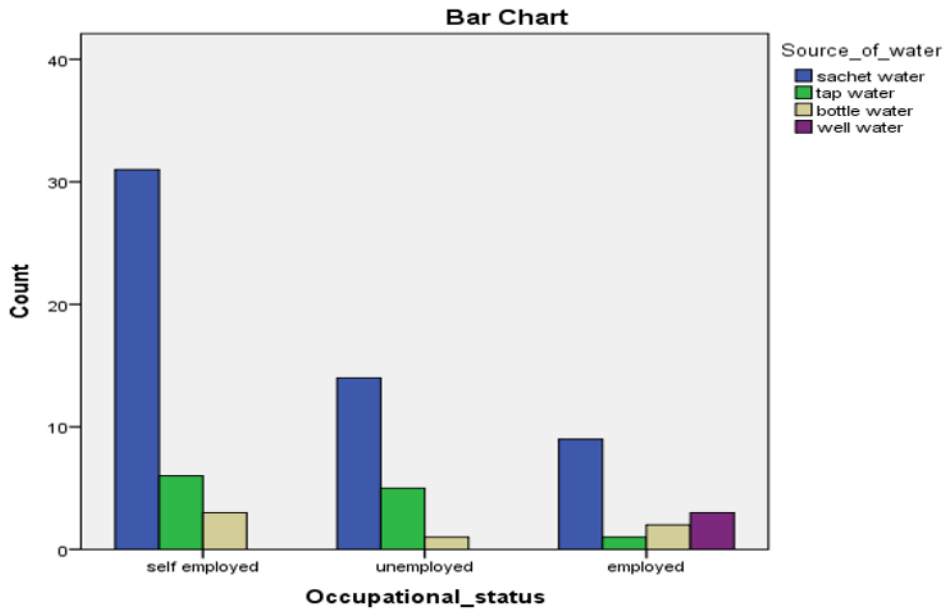

Fig. 6: Occupational status*source of water

Discussion

The study was conducted at Primary Health Care Badarawa on "seroprevalence of *Helicobacter pylori* among patients attending primary health care Badarawa". This study provides information on the prevalence and risk factors associated with *H. pylori* infection among patients.

The overall seroprevalence of *H. pylori* infection among patients attending PHC Badarawa was 83%. This result aligns with the findings of Omosor *et al*. 2017 who reported the prevalence rate at 52.5% and the findings was based on different population this suggest that *H. pylori* infection was more common than previously thought.

The prevalence of *H. pylori* infection varied significantly by age with the highest prevalence occurring in individuals aged 7-10, 51-60 and 61-70 years old. These findings suggest that young adults may face heighted risk of *H. pylori* infection which has important implications for public health. Interestingly, these results differ from the findings of Niknam *et al*. 2018, where the highest prevalence was observed in the age group 41-50 (78.8%).

More than half of the patients experienced symptoms like upper abdominal pain, nausea and vomiting, bloody stool, loss of appetite, heartburns, burping and persistent stomach pain. The study found that the most common symptom experienced by patients with *H. pylori* infection is heartburns which was similar with the findings of Anaemene and Ochogu, 2022 who also reported heartburns (46.4%) as the highest symptom. This suggests that heartburn is a key symptom of *H. pylori* infection and should be considered by healthcare providers when diagnosing and treating patients. Consequently, participants reported that dietary changes including the consumption of milk products, antacids and eating foods were the most commonly used self-treatment for their symptoms. This suggest that many individuals with *H. pylori* infection attempt to manage their symptoms with dietary changes rather than seeking professional medical treatment and this aligned with the findings of Eniojukan *et al*. 2017 which found that dietary changes were more commonly used than seeking professional medical treatment.

While the study uniquely combined gender, education, occupation and source of water in the context of *Helicobacter pylori* risk factors, existing literature has mostly examined these socio-demographic factors in isolation. Notably, Odigie *et al*. 2020 conducted an in-depth analysis of gender and water

sources, shedding light on the layered dynamics influencing water access patterns. Similarly, Mynepalli *et al*. 2014 explored the impact of education on water sources, revealing differences that resonate with our non-significant findings in the combined analysis. In the realm of occupational influences on water-related behaviors, Shiferaw and Abera, 2019 offer valuable insights. Their study, though not directly mirroring our approach, emphasizes the significance of occupation in shaping individuals' interactions with water sources. While the studies referenced focused on individual socio-demographic factors rather than their combined effect, they provide necessary foundation for understanding the complex nature of water-related challenges. The study bridges these gaps by simultaneously examining gender, education, occupation, and source of water, contributing to a more comprehensive understanding of *Helicobacter pylori* risk factors.

In examining the relationship between socio-demographic factors and eating habits, this study uncovered intriguing patterns. When considering gender and eating habits no significant association was found, challenging assumptions found in the existing literature of Ogundijo *et al*. 2022. This suggests that within the studied population, gender may not be a key factor influencing specific eating habits. Similarly, the analysis of marital status and eating habits revealed a non-significant relationship, aligning with the previous finding of Monno *et al*. 2019 which also found no significant relationship between *H. pylori* infection with marital status and consumption of foods and beverages. The findings indicate that marital status might not play an important role in shaping the eating choices of individuals within the sample. In contrast, an interesting insight emerged concerning the link between educational status and eating habits. A statistically significant association was observed; aligning with prior research by Xia *et al*. 2016 which found that participants with *H. pylori* infection had lower education level compared to those without infection. This suggests that individuals with higher educational levels may exhibit different eating habits compared to those with lower educational levels. These findings emphasize the impact of socio-demographic influences on eating habits and highlight the importance of considering educational status when developing interventions aimed at promoting healthier eating choices.

In understanding *Helicobacter pylori* infection, the complex relationship between socio-demographic factors and exposure to pets or animals revealed interesting patterns. The analysis of gender and exposure to pets or animals revealed a noteworthy finding, a statistically significant association. This discovery challenges assumptions found in Yu *et al*. 2020, suggesting that gender may indeed have influence over the likelihood of individuals having contact with pets or animals. However, when examining the link between marital status and exposure to pets or animals, the study revealed a non-significant association. This result contrasts with Shaaban *et al*., 2023 study, suggesting that marital status may not be the determining factor in individuals' likelihood of engaging with pets or animals. This outcome shows the complicated relationship between socio-demographic factors and exposure to pets or animals. While gender plays a significant role, marital status does not have a strong impact in this particular context. Future research could explore how gender shapes individuals' interactions with pets or animals, offering important information for the development of targeted public health interventions or awareness campaigns.

In the investigation of the connections between socio-demographic factors and contact with ulcer infected individuals, gender was found to be a significant factor while educational status exhibited non-significant associations. This result was similar with the study done by Smith *et al*. 2018 which revealed that overcrowding, having siblings/ parents or friends with a history of ulcer/gastritis/ gastric cancer was a significant factor and that level of education was not a significant factor. These findings imply a need for further exploration into the subtle dynamics influencing social interactions related to *H. pylori* infection.

The study found that educational status emerged as a significant determinant, revealing a tendency for more frequent vegetable consumption among individuals with higher educational levels. This aligns

with Ogundijo *et al*. 2022 research that emphasized the impact of education on dietary habits. The analysis, however found a non-significant association between occupation and marital status with the frequency of consuming specific food items. Breaking down the food preferences, the study revealed a ranking with vegetables ranking highest in frequency, followed by occasional consumption of fried foods, red meat, fruits, and sugary drinks. This was similar to the study conducted by Monno *et al*. 2019 which revealed three dietary patterns and the main factors leading to each pattern. These different perspective highlights the intricate relationships between socio-demographic factors and dietary preferences within the studied population. Notably, the findings emphasize the influential role of educational backgrounds in shaping eating habits, particularly the preference for frequent vegetable consumption. To gain a deeper understanding, future research could explore the mechanisms driving these associations, offering targeted insights for interventions promoting healthier dietary practices.

Contrary to expectations the study revealed a non-significant association between occupational status and the number of people in households. This suggests that occupational status do not decisively influence household number, challenging traditional assumption like the study of White *et al*. 2015 which found that occupation was a significant factor. But a significant link was found between marital status and the number of people in households and this aligned with the research on the impact of marital status on living arrangements by Chen *et al*. 2014.It is noteworthy that a substantial proportion of patients who tested positive reported residing in households with more than three individuals. This simple observation, while not statistically compared, hints at potential associations between household size and the prevalence of *Helicobacter pylori* infection. Additionally, a common pattern emerged among respondents, indicating a tendency to share utensils within these larger households, potentially contributing to the transmission process. In conclusion, our study emphasizes the complex nature of household dynamics, urging further investigation into the socio-demographic intricacies influencing household composition in our studied context. These highlighted insights prompt consideration for targeted public health interventions and awareness campaigns tailored to the unique challenges posed by varying household sizes and shared practices.

Conclusion

This study revealed an overall prevalence of *Helicobacter pylori,* reaching 83% within the patients of PHC Badarawa. The highest prevalence emerged with the 7-10,51-60 and 61-70 age group and the lowest in the individuals aged 11-20 age group. Common symptoms included upper abdominal pain and heartburn, while bloody stool ranked as the least report. Socio-demographic factors (gender, educational level, marital status and occupational status) demonstrated meaningful connections with various risk factors.

Acknowledgement

The authors extend their sincere recognition and appreciation to all Staff of PHC Badarawa and their Laboratory Technologist. Special thanks Dr. Sani Dari (Statistician) of Mathematics Department, Kaduna State University. Participating patients from Badarawa community, Kaduna State for all their efforts and all requirements of preparing useful conventional information which was very helpful in this research work.

References

Adedoyin, J.J. and Ishaleku, D. (2020). Seroprevalence of *Helicobacter pylori* infection among children attending selected hospitals in Keffi, Nigeria. *Advances in Public Health Community and Tropical Medicine*, 120: 2691-8803.

Alfarouk, K.O., Bashir, A.H., Aljarbou, A.N., Ramadan, A.M., Muddathir, A.K. and Alhoufie, S.T. (2019). *Helicobacter pylori* in gastric cancer and its management. *Frontiers in Oncology*, 9: 75.

Ahmed, I. J., Mainasara, F. and Ibrahim, B. M. (2024). Prevalence of *Helicobacter Pylori* Among Patients Attending General Hospital Potiskum, Yobe State. *Fane-Fane Int'l Multidisciplinary Journal*, 8 (1): 253-265.

Anaemene, D.I. and Ochogu, E.U. (2022). Prevalence, symptoms and lifestyle aspect of peptic ulcer disease among undergraduate students of a Nigerian university. *African Journal of Biomedical Research*, 25: 129-133.

Bashir, S.K. and Khan, M.B. (2023). Overview of *Helicobacter pylori* infection, prevalence, risk factors, and its prevention. *Advanced Gut and Microbiome Research*, 1: 98.

Brown, L.M. (2023). *Helicobacter pylori*: epidemiology and routes of transmission. *Epidemiologic Reviews*, 22: 2.

Chen, H., Chen, M., Shih, S., Wang, H., Lin, I and Bair, M. (2014). Socioeconomic status, personal habits and prevalence of *Helicobacter pylori* infection in the inhabitants of lanyu. *Journal of the Formoson Medical Association*, 113:5.

Eniojukan, J.F., Okonkwo, O.C. and Adje, U.D. (2017). Risk factors, management and other correlates of peptic ulcer disease in a university community in south-south Nigeria.*UK Journal of Pharmaceutical and Biosciences Journal*, 5(6):07-15.

Gravina, A.G., Zagari, R.M., De Musis, C., Romano, L., Loguercio, C. and Romano, M. (2018). *Helicobacter pylori* and extra-gastric diseases: a review. *World Journal of Gastroenterology,* 24(29): 3204–3221.

Ibrahim, Y., Famoriyo, L., Sani, F.M., Basri, N.I., Mohd, A.A.J., Abdurrahman, M.S. and Abdullahi, I. (2022). The seroprevalence trend of *Helicobacter pylori* infection in Gombe, Nigeria: A 5-year retrospective study. *Microbes and Infectious Diseases,* 3(4): 1016-1025.

Li, Y., Choi, H., Leung, K., Jiang, F., Graham, D.Y. and Leung, W.K. (2023). Global prevalence of *Helicobacter pylori* infection between 1980 and 2022: a systematic review and meta-analysis. *The Lancet Gastroenterology and Hepatology*, 8 (6): 553–564.

Monno, R., De Laurentiis, V., Trerotoli, P., Roselli, A.M., Ieradi, E. and Portincasa, P. (2019). *Helicobacter pylori* infection: association with dietary habits and socioeconomic conditions. *Clinics and Research in Hepatology and Gastroenterology*, 43(5): 603-607.

Mynepalli, S.K.C., Maureen, O. and Mumuni, A. (2014). Prevalence of *Helicobacter pylori* and hygiene practices among public secondary students in Ikeja local government area, Lagos, Nigeria. *Health*, 6(4): 250-258.

Niknam, R., Fattahi, M.R., Sepehrimanesh, M. and Saparpour, A. (2018). Prevalence of *Helicobacter pylori* in southern part of Iran. *Jundishapur Journal of Microbiology*, 11(6): e62379.

Odigie, A.O., Adewole, A.J. and Ekunwe, A.A. (2020). Prevalence and factors associated with *Helicobacter pylori* infection among treatment naïve dyspeptic adults in university of Benin teaching hospital, Benin city, Nigeria. *African Journal of Clinic*al *and Experimental Microbiology*, 21: 2.

Ogundijo, D.A., Tas, A.A. and Onarinde, B.A. (2022). Age, an important sociodemographic determinant of factors influencing consumers food choice and purchasing habits: an english university setting. *Frontiers in Nutrition*, 9: 858493.

Omosor, K.I., Omosor, O.H., Ibeh, I.N., Adejumo, B.I.G., Abdulkadir, U.I. and Dimkpa, U. (2017). Seroprevalence of *Helicobacter pylori* infection and risk factors among asymptomatic subjects in delta state, Nigeria. *Advances in Microbiology*, 7: 9.

Rokkas, T., Gisbert, J.P. and Malfertheiner, P. (2021). Comparative effectiveness of multiple different first-line treatment regimens for *Helicobacter pylori* infection: a network meta-analysis. *Gastroenterology*, 161: 495-507.

Sabbagh, P., Afrouzi, M.M., Javanian, M., Babazadeh, A.,Koppolu, V. and Vasigala, V.R.,.. (2018). Diagnostic methods for *Helicobacter pylori* infection: ideals, Options, and limitations. *European Journal of Clinical Microbiology and Infectious Diseases*, 38: 55–66.

Shaaban, S.I., Talat, D., Khatab, S.A., Nossair, M.A., Ewida, R.M. and Diab, M.S. (2023). An investigative study on the zoonotic potential of *Helicobacter pylori*. *BMC Veterinary Research,* 19(1):16.

Shiferaw, G. and Abera, D. (2019). Magnitude of *Helicobacter pylori* and associated risk factors among symptomatic patients attending at jasmine internal medicine and pediatrics specialized private clinic in addisababa city, Ethiopia. *BMC Infectious diseases*, 19:118.

Smith,S., Jolalya, T., Fowora, M., Palamides, P., Ngoka, F., Bamidele, M. and Lesi, O. (2018). Clinical and socio-demographic risk factors for acquisition of *Helicobacter pylori* infection in Nigeria. *Asian Pacific Journal of Cancer Prevention*, 19(7):1851-1857.

Weren, R.D., van-der, P.R.S, Vogelaar, I.P., van-Krieken, J.H., Spruijt, L. and Lubinski, J.…. (2018). Role of germline aberrations affecting CTNNA1, MAP3K6 and MYD88 in gastric cancer susceptibility. *Journal of Medical Genetics*, 55(10): 669–674

White, C.M., John, P.D., Cheverie, M.R., Iraniparast, M. and Tyas, S.L. (2015). The role of income and occupation in the association of education with health aging: results from population-based, prospective cohort study. *BMC Public Health*, 15: 1181.

Xia, Y., Meng, G., Zhang, Q., Liu, L., Wu, H. and Shi, H. (2016). Dietary patterns associated with *Helicobacter pylori* infection in Chinese adults: a cross-sectional study. *Scientific Reports,* 6: 32334.

Yu, X., Feng, D., Wang, G., Dong, Z., Zhou, Q. and Zhang, Y. (2020). Correlation analysis of *Helicobacter pylori* infection and digestive tract symptoms in children and related factors of infection. *Iranian Journal of Public Health*, 49(10): 1912-1920.