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## Original article

# The seroprevalence trend of *Helicobacter pylori* infection in Gombe, Nigeria: A 5-year retrospective study

***Yakubu Ibrahim [*1,4], Lateef Famoriyo [2], Fatima Muhammad Sani [2,3], Nurul Iftida Basri [4], Amilia Afzan Mohd Jamil [4], Muhammad Shuaibu Abdurrahman [2], Idris Nasir Abdullahi [1]***

1- *Department of Medical Laboratory Science, Faculty of Allied Health Sciences, College of Medical Sciences, Ahmadu Bello University, Zaria, Nigeria.*
2- *Department of Medical Laboratory Services, State Specialist Hospital, Gombe, Nigeria.*
3- *Department of Microbiology, Faculty of Science, Gombe State University, Gombe, Nigeria.*
4- *Department of Obstetrics and Gynaecology, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia.*

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**ABSTRACT**

**Background:** *Helicobacter pylori (H. pylori)* infection is highly prevalent globally and half of the world's population are carrying the pathogen with infection rates higher in low and middle-income countries. The study aim was to retrospectively determine the seroprevalence trend of *H. pylori* infection among patients suspected to have dyspepsia and identify socio-demographic determinants for *H. pylori* seropositivity. **Methods:** This retrospective study was conducted at the State Specialist Hospital, Gombe, Nigeria from January 2015 to December 2019. A total of 11,935 patients were included in the study and lateral flow immunochromatographic immuno assay was used to screen for total anti *H. pylori* antibodies. **Results:** The overall sero-prevalence of *H. pylori* infection was 58.9%. There was significant association between *H. pylori* seroprevalence rate and age of subjects, ($\chi^2$=20.86; $p$<0.001). The study subjects between the age group 31-40 years had the highest seroprevalence, 62.3%. The seroprevalence of *H. pylori* was associated with sex of subjects ($\chi^2$=39.73; $p$<0.0001). The seroprevalence trend of *H. pylori* was highest in 2016 with 61%, followed by 2019 (60.8%), then 2017 (59.3%), 2018 (54.7%) and least in 2015 (50.5%). **Conclusion:** Findings from the study showed a steady rise in the seroprevalence of *H. pylori* infection over the five years of study. Furthermore, *H pylori* infection appears to be higher among adults in their most productive years. Based on these, it is needful to develop strategies for eradication of the infection, encourage health education by creating awareness towards improving environmental and household sanitation, water, personal and food hygiene.

## Introduction

*Helicobacter pylori* (*H. pylori*) infection is highly prevalent globally with half of the world's population carrying the pathogen [1]. *Helicobacter pylori* infection typically occurs in early childhood and can often present with no symptoms while in symptomatic cases, nausea, vomiting, abdominal pain, and peptic ulcers are among the most common clinical manifestations [2]. Infection rates are higher in low-resource settings and developing countries, with prevalence rates above 70% reported in Africa, the highest worldwide [3]. Almost 70% to 90% of the population harbouring the bacteria are from low and middle-income countries (LMICs), the majority of which is acquired during childhood, while the incidence in developed countries is smaller, varying

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* *Corresponding author:* Yakubu Ibrahim
E-mail address: ibrahimyakubu@abu.edu.ng

from 30% to 40% [4,5]. To our knowledge, there is paucity of local reports on the seroprevalence trend of *H. pylori* infection in our study area. Therefore, this study aims to determine the 5-year seroprevalence trend of *H. pylori* infection among patients at Gombe State Specialist Hospital, Gombe, North-Eastern Nigeria, and identify socio-demographic determinants for *H. pylori* infection seroprevalence.

## Materials and Methods

### Study design

The study was a hospital-based cross-sectional retrospective study.

### Study area

Gombe State lies between the latitude 10° 15'N longitude 11º 10'E. It has an area of 20,265 Km² and a population of about 3 million. The Hospital serves as the referral centre for all primary and secondary health facilities in Gombe State and renders both primary, secondary and tertiary health services such as general outpatient services, specialist clinics, antenatal care, radiology, pharmaceutical and laboratory services. The hospital serves as a hub for internship training programme for medical doctors, nurses, pharmacists, medical laboratory scientists and radiographers. The facility also serves the population of the entire local councils of the state as well as other patients from neighboring states. The hospital renders services to an average of 135,787 out-patients and 27,168 in-patients per year. The study was conducted in the serology unit, laboratory Services department of the hospital. All patients suspected to have *H. pylori* infection and was referred to the laboratory by the clinicians for laboratory diagnosis between January 2015 to December 2019 were included in the study.

### Ethical consideration

The study was conducted in accordance with the standards of human experimentation as enshrined in the Helsinki Declaration of 1975, as revised in 2013. Written informed consent was not required due to the retrospective nature of the work. Further permission was sought from the laboratory manager of the hospital before commencing data collection. All patients' data were kept confidential.

### Study population

A total of 11,935 patients were screened for *H. pylori* at State Specialist hospital, Gombe, Gombe State, from January 2015 through December 2019.

### Subjects' selection criteria

All patients who were suspected to have *H. pylori* infection and were referred from the General outpatient department, emergency unit and in-patients to the laboratory for *H. pylori* test were included in the study.

### Data collection

Sociodemographic characteristics (age and sex) of the study subjects were collected using a checklist. The age and sex of patients were collected from the laboratory worksheet and was confirmed with the patient's records in the clinic. *Helicobacter pylori* results were obtained from the laboratory worksheet record and entered into Microsoft Excel sheet.

### Laboratory analytical methods

The immunochromatographic immunoassay method using one-stop rapid test strips (LabAcon®, Hangzhou Biotest Co., Ltd., Mainland, China) was used to detect total anti-*H. pylori* antibody in the serum of patients. Analysis was done in compliance with quality control (QC) protocols and in accordance to the manufacturer's instructions. Using automatic micropipette (Eppendorf®, Fisher Scientific, Germany), about 50 µl of serum/plasma sample was added into the sample area of the strip and was allowed to run for 15 minutes. The result was read under sufficient light; a red line appearing on both the control and test window was considered as positive while a single red line appearing on the control window was regarded as negative. Red line appearing on the test window only was considered as invalid. Quality control per run for each of the batch of 10 samples was performed using positive and negative control sera.

### Statistical analysis

The data collected from the study was analysed using Statistical Package for Social Sciences (SPSS) version 26.0 (IBM, California Inc., USA). The frequency distribution of variables was presented and a two-tailed Chi-square test was used to test for the presence of an association between seroprevalence of *H. pylori* and sociodemographic characteristics. *p*-value less than or equal to 0.05 at 95% confidence interval (CI) were considered as statistically significant.

## Results

Out of the 11,935 patients, 5,899 (49.4%) were males and 6,036 (50.6%) were females. 1,359 (11.4%) were between the age of 11-20 years and 2,620 (21.9%) were between the age of 21-30 years. Subjects within 31-40 years constituted the highest

population 3,112 (26.1%) among all the study participants. While participants between 41-50 years were 2,661 (22.3%). Participants 51 years and above were 2,183 (18.3%) of the study subjects examined as shown in **table (1)**.

Among the study participants, 7,024 (58.9%) were found to be seropositive for *H. pylori* antibody while the remaining 4,911(41.1%) were found to be seronegative for *H. pylori* antibody. The seropositivity trend of *H. pylori* among gender found, 2,936 (24.6%) males tested positive while 4,088 (34.3%) females tested positive **(Figure 1)**. The prevalence of *H. pylori* infection was higher (67.7%) among female subjects as compared to male subjects (49.8%) in our study. We found a significant association between *H. Pylori* seroprevalence and sex of subjects ($\chi^2$=39.73; $p$<0.0001) presented in **table (1)**.

The prevalence of *H. pylori* seropositivity was higher among participants between the age of 31-40 years (62.3%) followed by 21-30 (57.8%), 41 – 50 years (57.7%), 51 years and above (57.5%) while 11-20 years was having the least prevalence values (57.4%). Moreover, there was a statistically significant difference ($\chi^2$=20.86; $p$<0.0001) between the *H. pylori* seropositivity values among the age groups in the present study, as shown in **table (1)**.

The trend of *H. pylori* seropositivity rates shows that, in 2015, a total of 310 samples were examined, in which 177 (57%) were found to be positive. In 2016. The seroprevalence of 61% was recorded in 2016 with 295 seropositive patients out of 484 patients tested. The trend decreased to 59.3% and 54.7% in 2017 and 2018 respectively.

The *H. pylori* seroprevalence values increased in 2019 (60.8%) whereby 4,279 patients were tested and 2,603 patients found positive. The highest seroprevalence values (61% and 60.8%) were recorded in 2016 and 2019 respectively as shown in **figure (3)**.

The association of gender with *H. pylori* seropositivity values in the present study reported that, in 2015, a total of 188 males and 122 female subjects were examined, about 95 (50.5%) males were positive with 82 (67.2%) females were also positive. The *H. pylori* seropositivity values was significantly higher ($\chi^2$=8.34; $p$=0.004) among female subjects as compared to males as observed in the present study. Similarly, in 2016, a total of 263 male patients were tested along with 221 female patients out of which, 140 (53.2%) males were positive and 155 (70.1%) females were positive. This showed that there was statistically significant higher seropositivity values ($\chi^2$=14.25; $p$<0.0001) of *H. pylori* among females as compared to the male subjects in the year. In 2017, a total of 1,504 male and 1,231 female patients were tested, about 786 (52.3%) males and 836 (67.9%) females were found to be seropositive for *H. pylori* antibodies. The seropositivity values was higher ($\chi^2$=6.81; $p$<0.001) among female patients as compared to their male counterparts.

In 2018, 1,908 male and 2,219 female patients were tested and 870 (45.6%) males and 1,412 (63.6%) females were found positive. There was a significantly higher seropositivity values ($\chi^2$=13.42; $p$<0.0001) among female subjects as compared to males during the year. The number has further increased in 2019 in which 2,036 male and 2,243 female subjects were tested, out of which 1,000 (49.1%) males and 1,603 (71.5%) females were found *H. pylori* seropositive. The seropositivity value of *H. pylori* was statistically significant higher ($\chi^2$=22.31; $p$<0.0001) among female participants as compared to males during the year, as shown in **table (2)** and **figure (3)**

**Figure 1.** *H. pylori* sero-positivity values among gender of the study participants**.**

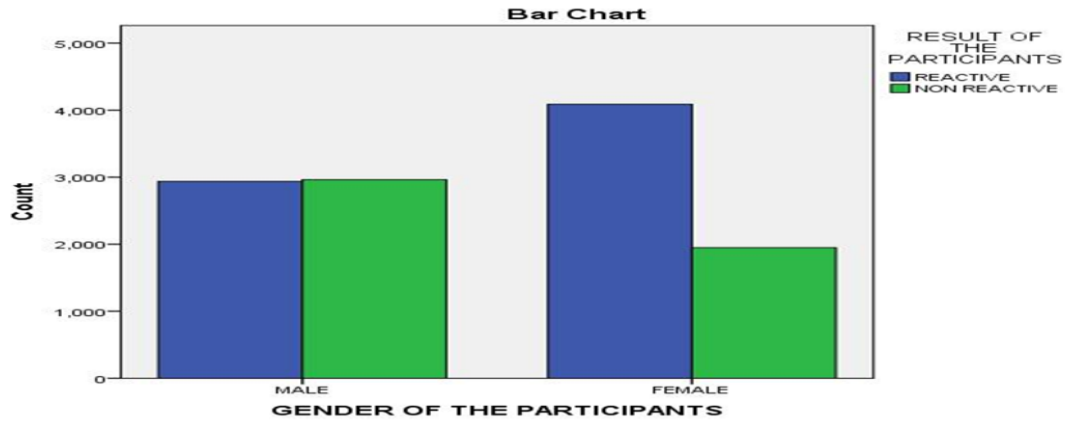

**Figure 2.** Sero-prevalence trend of *H. pylori* infection during the 5-year period.

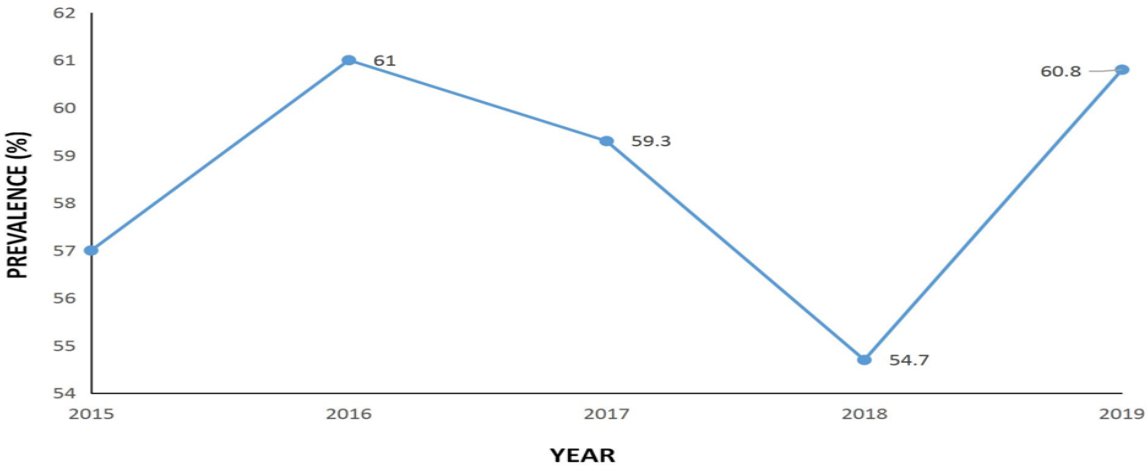


**Figure 3.** *H. pylori* seropositivity trend among gender of the study participants within the 5 year study duration.

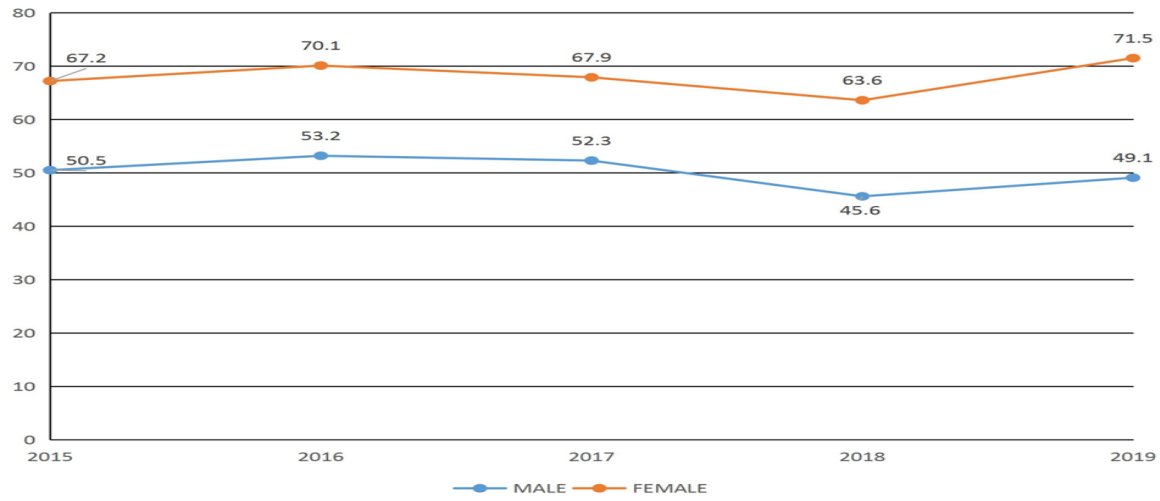


**Table 1.** Overall seroprevalence of *H. pylori* among the study subjects from January 2015 to December 2019.

| Variables | n (%) | Positive (%) | Negative (%) | $\chi 2$ | *p*-value |
|---|---|---|---|---|---|
| Male | 5,899 (49.4) | 2,936 (49.8) | 2,963 (50.2) | 39.73 | < 0.0001 |
| Female | 6,036 (50.6) | 4,088 (67.7) | 1,948 (32.3) | | |
| Age group | | | | | |
| 11-20 | 1,359 (11.4) | 780 (57.4) | 579 (42.6) | 20.86 | < 0.0001 |
| 21-30 | 2,620 (21.9) | 1,514 (57.8) | 1,106 (42.2) | | |
| 31-40 | 3,112 (26.1) | 1,939 (62.3) | 1,173 (37.7) | | |
| 41-50 | 2,661 (22.3) | 1,535 (57.7) | 1,126 (42.3) | | |
| ≥51 | 2,183 (18.3) | 1,256 (57.5) | 927 (42.5) | | |

Where *p*-value of less than or equal to 0.05 is considered statistically significant.

**Table 2.** Seroprevalence rate of *H. pylori* infection from January 2015 to December 2019.

| Year | Total tested | Positive (%) | Male Positive (%) | Female Positive (%) | $\chi^2$ | *p*-value |
|---|---|---|---|---|---|---|
| 2015 | 310 | 177 (57) | 95 (50.5) | 82 (67.2) | 8.34 | 0.004 |
| 2016 | 484 | 295 (61) | 140 (53.2) | 155 (70.1) | 14.25 | 0.0001 |
| 2017 | 2,735 | 1,622 (59.3) | 786 (52.3) | 836 (67.9) | 6.81 | 0.001 |
| 2018 | 4,172 | 2,282 (54.7) | 870 (45.6) | 1,412 (63.6) | 13.42 | 0.0001 |
| 2019 | 4,279 | 2,603 (60.8) | 1,000 (49.1) | 1,603 (71.5) | 22.31 | 0.0001 |

Where *p*-value of less than or equal to 0.05 is considered statistically significant.

## Discussion

### *Pooled / overall Seroprevalence of H. pylori infection during the five-year period*

*Helicobacter pylori* are normal flora of the upper gastrointestinal tract (GIT) in some individuals and a known culprit in peptic ulcer diseases [1, 6-9]. Though, several factors have been attributed to *H. pylori* infection, a wide variation in the seroprevalence was previously reported across the globe [10, 11-16]. The present study determined the seroprevalence trend of *H. pylori* infection in symptomatic patients attending a healthcare facility in Gombe State, North-Eastern, Nigeria.

In the present study, the overall seroprevalence of *H. pylori* infection among subjects over the 5 retrospective years was 58.9%. The seroprevalence value we found in the present study correlates with the results of other studies conducted in developing countries in Africa and other continents. A seroprevalence of 51.5% and 60.1% was reported in Cameroon [1,11], 62.4% in the Democratic Republic of Congo [17], 50.6% in South Africa [18], 53.0% in Egypt [19], 68% in Turkey [20], 58% in Guatemala [21], 61% in Saudi Arabia [22], 42.6% in Kuwait [23], 54.4 to 85% in South Korea [24] 83.5% in Iran [25], and 63.4% in Brazil [26] was found in these countries. The resemblances in the reported seroprevalence values and that reported in our study might be attributed to the similar socioeconomic status and life style practices among the study subjects in these countries. The seroprevalence found in the present study was higher than the previously reported prevalence (41.3%) in the same geographical location [7]. Conversely, much lower seroprevalence values have been reported across African populations; Uganda [29]; Tanzania [30] and Ethiopia [31]. These differences could probably be due to the differences geographical location (East Africa) and sociodemographic variations of these populations, perhaps, majority of the subjects in our study were drawn from the urban areas and not from the rural settlements. *Helicobacter pylori* infection have been associated with poor personal hygiene practices, acquisition from one person to the other via contaminated saliva or contamination of food and water sources by faecal matter or vomitus are commonly seen in rural communities. While our prevalence rate of 58.9 % was observed to be lower than the estimated overall African pooled prevalence of >70% [2], considering the significant implication of *H. pylori* infection in the aetiopathogenesis of gastric cancers and other associated morbidities, more studies are advocated to substantiate our finding. On the contrary, a higher prevalence values were reported in West African studies [5,31,32]. Though, the exact cause of the variation in the seroprevalence of *H. pylori* seropositivity is yet to be elucidated, conceivably, more studies are needed to explore the role of *H. pylori* seropositivity and geographical location. Furthermore, the variation in the seroprevalence values could also be due to differences in the analytical assay methods used and different study designs.

### *Seroprevalence trend of H. pylori infection in five consecutive years*

In the present study, during the 5-year period, we reported the highest seroprevalence values of 61% and 60.8% in 2016 and 2019 respectively. Conversely, low seroprevalence values were observed in the later years. The declining seroprevalence trend observed in 2015, 2017 and

2018 as reported in our study could probably be due to increased awareness towards environmental and personal hygiene, better antibiotic stewardship, prompt diagnosis and treatment leading to a significant eradication of *H. pylori* infection in those years. A study in Iran reported a constant trend of *H. pylori* seroprevalence from 2010 to 2015 [38]. Though, they utilised different diagnostic methods [39]. Our finding of the recent increasing trend in 2019 indicated subsequent and steady reinfection and increased transmission of *H. pylori* pathogen in the study area and this call for more public health education, awareness and improvement such as environmental sanitation, personal hygiene and avoidance of household overcrowding.

***Age and gender specific trend of H. pylori infection in five consecutive years***

Our finding shows that, there was a statistically significant higher seroprevalence of *H. pylori* infection among the study subjects between 31 – 40 years as compared to other age groups. In contrast, previous studies found a significant difference among participants between 41 – 50 years [27, 28] while other studies reported no significant difference among age groups [28, 34]. The observed high seroprevalence values among subjects between the ages of 31 – 40 years in the present study indicated that, the *H. pylori* infection is most prevalent among subjects in their most productive years. This could be attributed to the increase level of stress, anxiety, and depression experienced during this stage of life during work, social, economic, and or familial commitments, as reported in the previous study [40].

Perhaps, there has been mixed findings on the influence of gender on *H. pylori* seropositivity.

There was significantly higher seroprevalence of *H. pylori* infection among females compared to males in the present study. This is in accordance with the findings of the previous study in Cameroun [27], Uganda [29] and Tanzania [30]. Conversely, Workineh and Andargie [31] found a significantly higher value in males compared with females. Other studies reported no significant differences between seroprevalence values among males and females [29, 30, 35]. Our finding of the significant increase in seroprevalence rates in females compared with males could be due to variation in study design, sample size and laboratory analytical method of *H. pylori* could explain the variation in the findings.

***Implication of rising seroprevalence trend of H. pylori infection***

*Helicobacter pylori* is classified as a class I carcinogen and is the leading cause of bacterial-induced cancer in the world [42]. *Helicobacter pylori* infection in the GIT system is a well-known risk factor for stomach cancer [30]. Because of its motility with flagella and capacity to survive on stomach acids milieu and invade the cells of the GIT [43]. Epidemiologic and clinical data are extensively used to characterize *H. pylori*'s contributing risk in gastric adenocarcinoma, indicating its role in the development of 75% of non-cardia gastric malignancies and 98% of gastric-cardia malignancies [42].

Despite the reduction in the prevalence of stomach cancer over time, it is still the third leading cause of cancer-related mortality globally. These chronic diseases in no doubt could pose significant challenge to health system especially in developing countries.

The use of antibiotics is one of the key strategy to treat *H. pylori* infection, but there have been gradually increasing cases of resistance of *H. pylori* to multiple antibiotic drugs due to incessant abuse of these drugs to treat other ailments.

Increasing antibiotic resistance to *H. pylori* could be one of the cause of the increasing trend of *H. pylori* seropositivity observed over the years in the present study. Currently, the key challenges to the control of *H. pylori* infection include its widespread distribution linked to poor socioeconomic status, and difficulty in pathogen isolation in vitro. Lack of innate immunity to repeated exposures, limited efficacy of antibiotic treatment in populations where transmission is most frequent, diagnostic challenges, and incomplete knowledge regarding the reservoir of infection, other unknown mode of transmission, host genetic susceptibility factors and the potential for developing a successful candidate vaccine are among the major challenges [41].

Essentially, there have been low levels of community awareness and testing of the pathogen, rising *H. pylori* prevalence suggests that there is a need for public health education campaigns directed to urban and rural communities as well as health care providers with an aim to combat the infection.

***Strength and limitation of the study***

Our study is not devoid of limitations. In essence, the present study being retrospective makes it vulnerable to some bias, including plausible

misclassification. Likewise, our data were extracted from laboratory records. Hence, there is possibility of incomplete patient data. Other potential confounders such as clinical information, prior antibiotic use or drug treatment were not taken into consideration. It is therefore recommended that further cohort studies and community-based surveillance studies of randomly recruited subjects could provide detailed clinico-epidemiological characteristics of *H. pylori* infection in the population. Finally, immunochromatographic immunoassay method; a serology-based technique used in our study may give false positive result thereby amplifying the true burden of the infection, hence the need for adherence to robust QC protocols including use of positive and negative QC sera . Consequently, gastric biopsy histology or endoscopy, which is proved to have better diagnostic accuracy, should be considered for patients with *H pylori* reactive results. Despite these shortcomings, to our knowledge, our work is the first to demonstrate the seroprevalence pattern of *H. pylori* infection over 5-years in the entire North-eastern Nigeria. The outcome of the present study will go a long way in improving health education and awareness in the areas of environmental sanitation, water, personal and food hygiene. The study also highlighted the importance of testing for total anti *H. pylori* antibody for all cases of chronic gastrointestinal symptoms, this will aid in the early identification and treatment of *H. pylori* infection, thereby, lowering morbidity and mortality associated with the infection in Nigeria and Africa at large.

## Conclusion

Findings from this study showed a steady rise in the seroprevalence of *H. pylori* infection over the five years of study. Furthermore, *H pylori* infection appears to be higher among adults in their most productive years. Based on these, it is needful to develop strategies for eradication of the infection by encouraging health education, creating awareness towards improving environmental sanitation, water, personal and food hygiene. Earlier detection of *H. pylori* infection is crucial to allow prompt antibiotic treatment and prevent long-term sequelae.

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**Author's contribution**

**Conceptualisation and study design:** Yakubu Ibrahim, Lateef Famoriyo and Fatima Muhammad Sani

**Data collection:** Yakubu Ibrahim, Lateef Famoriyo, Fatima Muhammad Sani, Mohammed Abdurrahman Shuaibu

**Data analysis and interpretation:** Yakubu Ibrahim, Lateef Famoriyo, Fatima Muhammad Sani, Nurul Iftida Basri, Amilia Afzan Mohd Jamil, Mohammed Abdurrahman and Idris Nasir Abdullahi. **Writing and submission of the manuscript:** Yakubu Ibrahim

**Editing of the manuscript for important intellectual content approval:** Yakubu Ibrahim, Lateef Famoriyo, Fatima Muhammad Sani, Nurul Iftida Basri, Amilia Afzan Mohd Jamil, Mohammed Abdurrahman and Idris Nasir Abdullahi.

**Final approval of the manuscript:** Yakubu Ibrahim, Lateef Famoriyo, Fatima Muhammad Sani, Nurul Iftida Basri, Amilia Afzan Mohd Jamil, Mohammed Abdurrahman and Idris Nasir Abdullahi. **Agreement to be accountable for all aspect of the work:** Yakubu Ibrahim, Lateef Famoriyo, Fatima Muhammad Sani, Nurul Iftida Basri, Amilia Afzan Mohd Jamil, Mohammed Abdurrahman and Idris Nasir Abdullahi.

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