Seroprevelance of *Helicobacter pylori* Infection among Students of Bingham University, Karu in North-Central Nigeria

Abioye, Joshua Omoniyi Kolawole[1]*, Anarado, Kosisochukwu Sylvia[1] and Babatunde, Seye[2]

[1]*Department of Biological Sciences, Bingham University, P.M.B. 005, Karu, Nasarawa State, Nigeria.*
[2]*Centre for Health and Development, College of Health Sciences, University of Port Harcourt, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Helicobacter pylori infection occurs worldwide, though the burden differs greatly between countries and within populations. Studies have shown that *Helicobacter pylori* infection is higher in developing countries, including Nigeria and among populations of low socio-economic status. The aim of this study was to ascertain the prevalence of *Helicobacter pylori* infection amongst students of Bingham University, Karu, Nassarawa State, Nigeria. A total of 565 blood samples were collected from students with their consents after completing a self-administered questionnaire. Each blood sample was spun for 5 minutes at 1000 rpm to get the serum, which was used to determine the presence of *H. pylori* antibody using a *Helicobacter pylori* test cassette. Of the 565 students screened, 31 were found to be positive, giving a prevalence of 5.5% (95%CI=3.6-7.4). Prevalence among the female students was higher at 6.3% in contrast to the male 4.5%, though this difference was not statistically significant (chi-square=0.904, *P*-value=0.34). Students aged 26-30 years showed the highest prevalence of 8.8% above 4.2%, 5.6% of the age ranges 15-20 and 21-25 years, respectively. Seropositivity of *H. pylori* increased with students' year of study, with 100 Level having 9.3%, followed by 6.3% in 200 level. The 300 and 400 Levels had 5.8% and 2.5,

---

*Corresponding author: Email: jabioyek@gmail.com;

respectively. Also, the students who were knowledgeable about the infection and those who were not had 15.7% and 3.2% seroprevalence, respectively. The low prevalence of the infection obtained in this study did not show sex or age differencesand could be as a result of the good sanitary living conditions or good feeding habits of the students. It is recommended that infected students should eat at regular intervals, obtain adequate treatment after stool analysis to confirm the infection, and also practice good sanitary habits. The school authority should keep on improving the living conditions of the students as this will enhance lower prevalence or total elimination of the infection.

1. INTRODUCTION

Helicobacter pylori (*H. pylori*) infection is a bacterial infection that causes stomach inflammation (gastritis), peptic ulcer disease, and certain types of stomach cancer. The infection is caused by a type of bacteria called *Helicobacter pylori.* The bacterium resides in the mucous layer of the human stomach and duodenum, and unless treated persists there for decades. It induces chronic inflammation of the underlying mucosa. It is usually contacted in the first few years of life and tends to persist indefinitely unless treated [1]. The organism can survive in the acidic environment of the stomach partly owing to its remarkably high urease activity; urease converts the urea present in gastric juice to alkaline ammonia and carbon dioxide [2].

Transmission of *Helicobacter pylori* is largely by the fecal–oral routes. A lack of proper sanitation, safe drinking water, and of basic hygiene, as well as poor diets and overcrowding, these all play a role in determining the overall prevalence of infection [3].

Globally, different strains of *Helicobacter pylori* appear to be associated with differences in virulence, and the resulting interplay with host factors and environmental factors leads to subsequent differences in the expression of the disease [4]. Its prevalence increases with older age and with lower socioeconomic status during childhood and thus varies markedly around the world [5]. The overall prevalence is high in developing countries and lower in developed countries and within areas of different countries the global prevalence of *Helicobacter pylori* infection is more than 50% [6].

In a recent review, Park et al [7] discussed a changing prevalence of *Helicobacter pylori* infection in children and adolescents. They concluded that age and sex are not significantly associated with *H. pylori* infection in children and adults. *H. pylori* infection may occur in early childhood and the probability of persistence is high unless it is eradicated, they added.

In a cross- sectional study among adult dyspeptic patients in Ethiopia, Belay et al [3] recorded a high prevalence of 42.8%. Family size, shared bed, presence of domestic animals, storage and reuse of water, toilet type, sources of drinking water and occupation, were significant factors associated with *Helicobacter pylori* infection.

Variances in prevalence, even within a region, such as Asia, is demonstrated by a number of studies. Ding et al in China, investigated the prevalence of *H. pylori* infection in inflammatory bowel disease patients and recorded 9.6% seroprevalence, including newly diagnosed patients. They concluded that *H. pylori* infection had a negative association with inflammatory bowel disease [8].

This contrasts with results reported by Horuichin and colleagues who studied the prevalence of *H. pylori* among residents and their environments in Japan [9]. They obtained a seroprevalence of 20%; though they considered this prevalence to be low and suggested a correlation between recurrent infection and cag A-positive *H. pylori* strains.

Conducting a study of seroprevalence of *Helicobacter pylori* infection among 240 patients with gastroduodenal disorders in Iraq, Majeed and Khoshnaw [10] reported 53.3% seropositivity, with a significant difference between male and female patients (43.75% and 59.72%, respectively). They considered their seropositivity high, and reported higher frequency of anti *H. pylori* antibodies among rural dwellers, females and patients with O blood group. They also found that seroprevalence of anti-*H. pylori* antibodies increased with the age group.

Determination of the true prevalence of *Helicobacter pylori* is difficult in a hyper endemic area like Nigeria with use of serological tests because of their low discriminatory power between previous and current infections [11]. Previous studies conducted in the University College Hospital, Ibadan in which patients were investigated for *Helicobacter pylori* with the use of either histology or serology showed prevalence rates of 60.5% to 73% [12].

Seroprevalence studies conducted in Kwara State showed prevalence rates as high as 88% to 92.5% [13]. A study conducted at the University College Hospital, Ibadan showed a frequency of 13.4% for gastritis while normal mucosal was the commonest finding with a frequency of 53% [14]. Many other studies were carried out in other parts of Nigeria such as Nasarawa State University, Keffi, which had the seroprevalence of 54% out of 200 samples screened [15], Kaduna state university with the seroprevalence of 80.4% out of the 225 samples screened [16]; also among Nigerians with dyspepsia in Ibadan which had the prevalence of 93.6% out of the 125 patients screened [14] and Warri teaching hospital with the prevalence of 60% amongst the admitted patients [17].

Studying the prevalence and possible risk factors for *Helicobacter pylori* seroposivity among peptic ulcer patients in Nnewi, Chukwuma et al [18] recorded a prevalence rate of 51.4%, with the 24-30 years as the predominant seropositive age group. Females were more positive to *H. pylori* than males (27.9%, 23.5%, respectively), with no significant difference. Source of drinking was also not significant; they suggested that increased levels of interferon gamma may contribute to the development of *H. pylori* associated diseases.

Conducting a prospective cross-sectional study on 252 adult patients with dyspepsia in a tertiary institution in South Western Nigeria, Jemilohun et al [19] recorded 31% *H. pylori* seropositivity. They considered their prevalence low when compared with other works in Nigeria but correlates well with the low prevalence of gastric cancer in the Nigeria population.

In a preliminary study, Alkali and colleagues [20] investigated the seroprevalence of *H. pylori* antibodies among asymptomatic rural population in Bauchi-Nigeria, and recorded 44.8% seropositivity, with increased prevalence with age group, but no significant difference. They considered their result low in the community with high predisposing risk factors.

Helicobacter pylori is one of the major indicators of peptic ulcer [21]. *H. pylori* causes chronic gastritis and has been associated with several serious diseases of the gastrointestinal tract, including duodenal ulcer and gastric cancer [22]. The vast majority of individuals with *Helicobacter pylori* infection do not have any related clinical symptoms nor are they aware of the causative bacteria within them [23]. The devastating effects of this disease on human health makes this study imperative. There is a high possibility too that students of Bingham university may be oblivious of the disease; also most students are known to go about their daily activities on empty stomachs.

The aim of this study was to determine the prevalence and and pattern of occurrence of *Helicobacter pylori* infection amongst Bingham university students, as well as to assess their level of knowledge regarding the infection.

The study was limited because it only examined the prevalence of *Helicobacter pylori* in Bingham University, Karu, Nasarawa State of Nigeria, using serology strips, and also the fact that only a group of young people (Students) in the university was included in the study. Most students were scared of the syringe needle penetrating their skin; however after persuasion and explanation on the beneficial outcome of the investigation many volunteers gave their blood for screening.

2. MATERIALS AND METHODS

2.1 Study Area

The study area for this research is Bingham University Karu, Nasarawa State; Nigeria. The research covered mainly the students of the above named institution. The university is located at Auta-Balefi town, Karu Local Government, Nasarawa State, central Nigeria. The university covers a land mass of 200 square meters. It is at 26Km away from the Federal Capital Territory (Abuja) and geographically located at latitude 8° - 50°N and longitude 7° - 50°E.
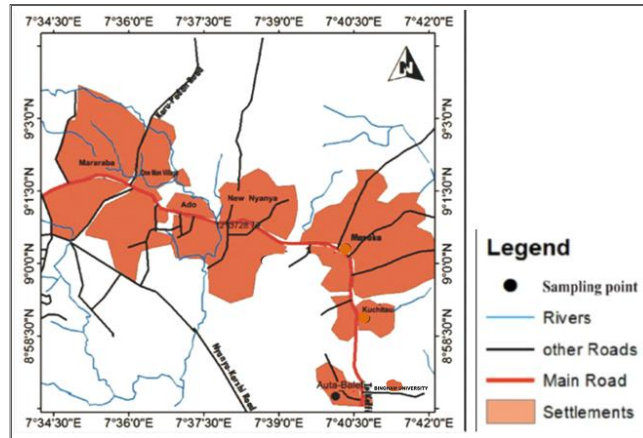
Map 1.

2.2 Study Population

A total of 565 students of Bingham University participated in the study.

2.3 Sample Collection

The research was carried out between June and August 2020. Samples were collected through Phlebotomy, using venipuncture method.

Five hundred and sixty-five blood samples were collected from volunteers (Bingham University students) and transported to the laboratory in the Department of Biological Sciences in the University.

2.4 Laboratory Investigation

2.4.1 Principle of the *Helicobacter pylori* (HP) test cassette

In this work, Joypertest rapid diagnostic test kit (Germany) was used. This is a lateral flow, immunochromatographic screening test. Purified recombinant antigens of HP are precoated onto membrane as a capture reagent on the test band region. If the antibody of HP is present in the sample in concentration above the anti-human IgG-dye, a colour complex will be formed [24]. This complex is then captured by antigens immobilized in the Test Zone of the antigens immobilized in the Test Zone of the membrane, producing a visible pink-rose color band on the membrane. The colour intensity will depend on the concentration of the anti-HP present in the sample. This one step is very sensitive and only takes about 15-20 minutes. Test results are visually interpreted to derive conclusion without the aid of any instrument [24].

2.5 Test Procedure

Blood Samples collected from volunteered students were taken to the laboratory for analysis. The whole blood samples collected in the plain sample bottles were spun using the laboratory centrifuge (Zhenjiang Model 800D, Japan) at 1000 rmp for 3-5 minutes to separate the cells from the serum. One pouch containing a cassette was opened, the cassette was retrieved and laid flat on the work bench. Using a pipette (plastic pipettor), 2 drops of sample (serum) was put into the sample well of the test cassette. The result was being read after 10 to 15 minutes but not after 20 minutes.

2.6 Interpretation of Results

Negative: Only one pink band appeared on test region of the cassette. This indicates that there was no detectable anti-HP in the plasma.

Positive: Two pink bands appeared on test region of the cassette. This indicates that the specimen contained detectable amount of anti-Hp.

Invalid: If no colored band appeared on test region, this is an indication of a possible error in performing the test. Such was repeated using a new cassette.

The results obtained in this study were entered in Microsoft Excel, and analyzed using SPSS version 21 and WinPepi (R) software.

3. RESULTS AND DISCUSSION

3.1 Results

Table 1 shows the socio-demographic characteristics of the 565 students that were recruited. As displayed, females were slightly more than males, while the majority was within the age group of 21-25 years. Similarly, students in their 4th year were in the majority. Social status, as determined by the income of their parents showed that majority of the students screened were of medium class. Majority of the students were not knowledgeable about *H. pylori* infection.

Of the 565 students screened, 31 were seropositive to *Helicobacter pylori* giving a prevalence rate of 5.5% (31/565).

Based on the chi square statistics of the prevalence in relation to sex; the X^2cal < X^2tab at confidence interval 0.05, df 1; shows a significant difference hence the prevalence of the infection here was sex related.

The chi square statistics based on the prevalence in relation to age; X^2cal>X^2tab at confidence interval 0.05, df 3; thus shows no significant difference, hence the infection here was not age related.

Also the chi square analysis of the prevalence of the infection in relation to the knowledge of infection; X^2cal>X^2tab at confidence interval 0.05, df 1; shows no significant difference, hence the infection prevalence was not related to knowledge-ability about the infection.

Table 2 shows the prevalence rate for *Helicobacter pylori* with respect to sex of the students in the study population. The infection rate was highest among the females where 20 out of 318 (6.3%) tested positive for *Helicobacter pylori* in contrast to the infection rate among the males where 11 out of 247 (4.5%) tested positive to *Helicobacter pylori*.

Table 3 shows the prevalence rate of *Helicobacter pylori* with respect to the different age groups where students in the age group 26-30 had the highest rate of infection 8.8% (5 out of 57) while the age group 31-35 had zero prevalence. Other age groups, 15-20 and 21-25 had the prevalence of infection of 4.2% (7 out of 166) and 5.6% (19 out of 339), respectively.

Table 1. Socio-demographic characteristics of the subjects

Sex	Respondents	No. Positive	Seroprevalence (%)
Male	247	11	1.95
Female	318	20	3.54
Age			
15-20	166	7	1.24
21-25	339	19	3.36
26-30	57	5	0.88
31-35	3	0	0
Level of Study			
100 Level	129	12	2.12
200 Level	96	6	1.06
300 Level	138	8	1.42
400 Level	202	5	0.88
Social Status			
Low Class	126	5	0.88
Medium Class	228	20	3.54
High Class	211	6	1.06
Knowledge ability about *H. pylori*			
Knowledgeable	102	16	2.83
Not knowledgeable	463	15	2.65

Table 2. Prevalence of *Helicobacter pylori* in relation to sex

Sex	No Screened	No Positive	No Negative	Prevalence (%)
Male	247	11	236	4.5
Female	318	20	298	6.3
Total	565	31	534	

X^2 = 0.85 at CI 0.05, df 1

Table 3. Prevalence of *Helicobacter pylori* in relation to age

Age (Ranges)	No. Screened	No. Positive	No. Negative	Prevalence (%)
15-20	166	7	159	4.2
21-25	339	19	320	5.6
26-30	57	5	52	8.8
31-35	3	0	3	0.0
Total	565	31	534	

X^2 = 45.69 at CI 0.05, df 3

Table 4 shows the prevalence of *Helicobacter pylori* with respect to level of study of students in the university. Subjects at 100 level had the highest prevalence of 9.3% (12 out of 129), followed by 200 level subjects with 6.3% (6 out of 96). Levels 300 and 400 came up with 5.8% (8 out of 138) and 2.5% (5 out of 202), respectively.

Table 5 shows the prevalence rate of *Helicobacter pylori* infection in relation to the social status of the students with medium recording the highest of 20 positive samples, while the low classes recorded 5 positive samples.

Table 6 shows the prevalence rate of *Helicobacter pylori* infection in relation to students who had the knowledge concerning *Helicobacter pylori* and its infection and those who did not have any knowledge amongst all the students screened 15.7% (16 out of 102) had knowledge of *Helicobacter pylori* infections while 3.2% (15 out of 463) had no knowledge about the *Helicobacter pylori* infection at all.

Table 4. Prevalence of *Helicobacter pylori* in relation to level in the University

Level in University	Number Examined	Number Positive	Number Negative
100	129	12	117
200	96	6	90
300	138	8	130
400	202	5	197
Total	**565**	**31**	**534**

X^2 = 7.29 at CI 0.05, df 3

Table 5. Prevalence of *H. pylori* infection in relation to Social status

Class	No. Examined	No. Positive	No. Negative
Low	126	5	121
Medium	228	20	208
High	211	6	205
Total	**565**	**31**	**534**

X^2 = 8.1481 at CI 0.05, df 2

Table 6. Prevalence of *Helicobacter pylori* in relation to the knowledge about the infection by the students

Knowledge of the infection	No. Screened	No. Positive	No. Negative	Prevalence (%)
Yes	102	16	86	15.7
No	463	15	448	3.3
Total	565	31	534	

X^2 = 23.57 at CI 0.05, df 3

3.2 Discussion

More than 50% of the world population is infected by *Helicobacter pylori*, which makes it an infection of the public health concern in the world though little is known about its prevalence [25].

The result of this study revealed that the seroprevalence rate of *Helicobacter pylori* among the students of Bingham University is 5.5%. This result is similar to studies carried out in Netherlands with low prevalence of 1.2%, and Canada with 7.1% [26]. It is also comparable to the result of [8] in China where they reported 9.6% seropositivity.

Our result here, however, is lower to those obtained in other parts of the world such as Asia; Bangladesh (>90%), India (88%), Japan (70%), the Middle East; Libya (94%), Saudi Arabia (80%) and Egypt (90%), and South America; Chile (70%) and Brazil (82%) were positive for *Helicobacter pylori* [27], in contrast to the result of this study.

Particularly, the low prevalence here is at great variance with the claim of [28] and [22], that the prevalence among middle-aged adults (of which Bingham students are), is over 80 percent in many developing countries. Also comparing this result to the works done in some parts of the African continent, it is deduced that the prevalence of the disease is lower: Ethiopia which had the prevalence of 96% [29], Gambia with the prevalence of 80% and Ivory Coast with the prevalence of 65% [28]; Zimbabwe and Kenya showed a prevalence of 80% in both countries [30].

Our value is also very low compared to those obtained in other parts of Nigeria. For instance, [20] reported 31% seropositivity in Southwestern Nigeria, which is still higher than our result. The work done by [25] in Ibadan also showed high prevalence of 60.5%, while another work done by [13] in Kwara had a prevalence of 88%.

Most of the results stated above with high seropositivity of *H. pylori* their subjects were symptomatic patients having gastritis or various kinds of ulcers; or the studies were conducted in rural areas with high risk factors. Our results were obtained from asymptomatic subjects having no sign of gastritis or ulcer. The subjects were from average economic homes studying under hygienic conditions, hence the low seroprevalence. The endemic nature of the disease in Nigeria as claimed by [11], was not indicated in this study.

The particularly low prevalence obtained in this study could be related to the high level of personal hygiene of the students generally, the good environmental sanitation and hygienic source of food and water that prevail in the University campus, with very remote chance of contact with the causative organism.

Also the undergraduate students were not from poor socioeconomic background since their parents could afford the high school fees of the private University, as the infection is said to be closely related to socioeconomic condition [31,5]. The low prevalence could also be a result of frequent use of antibiotics when prescribed for other purposes [32].

From this research it is deduced that the prevalence of female students is higher (6.3%) in contrast to that of the male students which is 4.5%. This work is similar to that carried out in China, (female 60% and male 45%); Taiwan (Female>59% and male 23%) and Egypt (Female 66% and males 32%). Similarly, [10] in Iraq reported a higher seroprevalence of 59.72% in females as against 43.75% in males. All these works showed the prevalence of the disease in women to be higher than that of men and was said to be as a result of the high social activities of women in the homes [27]. Also, the high prevalence of female to males is also similar to work done in Nigeria by [25] in Ilorin which showed a prevalence of females to be >60% higher than that of the males which was 30%. [18] in Nnewi equally reported a higher seroprevalence of *H. pylori* in females than in males.

The highest prevalence in respect to age occurred among the age range of 26-30 where prevalence of 8.8% was obtained. This is similar to the study done by [26] that showed a higher prevalence of 94% among adults (26-30) in Libya. This also relates to the work done in Ethiopia by [29] which showed the prevalence of 96% amongst adults (26-30) to be highest than that of the younger age groups. Also this result is similar to that gotten from various researches done within Nigeria; the research done in Ibadan by [33] showed that age range 25-30 years had a highest prevalence of 60% compared to other age ranges, [17] in Warri Teaching Hospital reported that patients with age range 20-30 had the highest prevalence of 84%.

In this study, seroprevalence of *H. pylori* *increased* with the level of study in the university, with the highest prevalence of 9.3% in 100 level, followed by 200 level with 6.3% seropositivity. Levels 300 and 400 followed suit with 5.8% and 2.5%, respectively. The 100 level students were fresh students and youngest. They could have been infected by *H. pylori* from their previous background and the infection persisted as they came into the university, hence the high seropositivity. The decrease in seroprevalence as they progressed to 200, 300, and 400 levels could be as a result of improved level of hygiene in the university, and the use of antibiotics for other disease conditions [32].

Contrary to the assumption that Bingham students, in view of their level of education, should be very knowledgeable concerning *H. pylori* infection, and ulcer being a common disease, majority of them (81.95%) had no knowledge about the infection. However, the prevalence of the infection was higher among the students that were knowledgeable about the disease (15.7%) than those that were not knowledgeable (3.3%). Statistically, there was no significant difference in disease prevalence of the two groups, thus other factors, apart from the students knowledgeability could be responsible for the distribution of the infection among the population studied.

Helicobacter pylori infection in adults is usually chronic and will not heal without specific therapy; on the other hand, spontaneous elimination of the bacterium in childhood is probably relatively common, aided by the administration of antibiotics for other reasons [32]. Based on this assertion, infection among the studied population here could have been due to childhood infection [1,5] and [7] that still persisted within the infected individuals.

Low prevalence of the disease among the studied population has proved that going on empty stomach for a long time, as usually practiced by the majority of the students, does not cause ulcer. Empty stomach could aggravate already existing infection but it is not a cause of the infection as many people wrongly adduce.

4. CONCLUSION

This work was done using the serology method to check the prevalence rate of *Helicobacter pylori* infection amongst Bingham university students, and from the screening carried out it was discovered that there is a very low prevalence (5.5%) of this infection among the university students which may be attributed to the good sanitary living, good personal and environmental hygiene of the students.

5. RECOMMENDATIONS

Despite the low prevalence of the *Helicobacter pylori* infection amongst Bingham university students the following are recommended for reduced prevalence or total elimination of the infection from the University community:

- Public enlightenment concerning the disease should be intensified, especially the diagnosis and transmission of the disease.
- Students should eat at regular intervals, particularly those infected, so as not to aggravate their condition.
- All students should adhere to good sanitary habits.
- The school authority should keep on improving the living conditions of students as this will enhance a low prevalence.
- Infected students should be adequately treated with appropriate antibiotics.

CONSENT AND ETHICAL APPROVAL

Ethical approval for the study was sought from the University Registrar, who granted the permission. The research and ethical committee of the university also gave its approval to conduct this research. Likewise, consent of the adult subjects was sought before collecting samples from them. For the children 15 years and below, consent was obtained from their parent that brought them to the clinic. Only the volunteers were screened for *Helicobacter pylori* infection.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Backhed F, Rokbi B, Torstensson E, Zhao P, Nilsson C, Seguin D, Normark S, Buchan AM, Richter-Dahlfors A. Gastric mucosal recognition of *Helicobacter pylori* is independent of Toll-like receptor 4. J. Infectious Disease. 2003;187:829–836.

2. Amedei A, Bergman P, Appelmelk J, DelPrete G. Molecular mimicry Between *Helicobacter pylori* antigens and H_,K_ – adenosine triphosphatase in human gastric autoimmunity. J. Exp. Med. 2003;198: 1147–1156.

3. Belay AS, Abateneh DDE, Yehualashet SS. Seroprevalence of *Helicobacter pylori* infection and associated factors among adult dyspeptic patient in public health facilities. Mizan Aman town, southwest ethopia. Institutional based cross-sectional study. International Journal of General Medicine. 2020;13(5): 77-85.

4. Kusters J, Van VA, Kuipers EJ. Pathogenesis of *Helicobacter pylori* infection. Clinical Microbiology Reviews. 2006;19 (3): 449–490.

5. Barnard FM, Loughlin L, Fainberg H, Messenger M, Ussery D. Global regulation of virulence and the stress response by CsrA in the highly adapted human gastric pathogen *Helicobacter pylori*. Molecular Microbiology. 2004;51:15–32.

6. Megraud L, Brassens-Rabbe M, Denis F. Seroepidemiology of campylobacter pylori Infection in various populations. Journal of Clinical Microbiology. 2004;27(8):1870–1873.

7. Park, Ji Sook, Jun Jin Su, Seo Ji Hyun, Youn Hee-Shang, Rhee Kwang-Ho. Changing prevalence of *Helicobacter pylori* infection in children and adolescent. Clinical Pediatric (CEP). 2021;64(1):21-25.

8. Ding ZH, Xu XP, Wang TR, Lang X, Ran ZH. The prevalence of *Helicobacter pylori* infection in inflammatory bowel disease in China: a case control study. Plos One Journal. 2021;5:1-7.

9. Horuichin S, Nakano R, Nakano A, Hishiya N, Uno K, Suzuki Y, Kakuta N, Kakuta R, Tsubaki K, Jojima N, Yano H. Prevalence of *Helicobacter pylori* among residents and their environment in Naro Prefective Japan. Journal of infection and Public Health. 2021;14:271-275.

10. Majeed PD, Khoshnaw K J S. Seroprevalence of *Helicobacter pylori* infection among patient with gastroduodenal disorders in Erbil city. Dyala Journal of Medicine. 2020;18(1):91-101.

11. Ajao OG. Gastric carcinoma in a tropical African population. East Africa Medical Journal. 2002;5(9) 70-75.

12. Jemilohun AC, Otegbayo JA, Ola OS, Akere A. Prevalence of *Helicobacter pylori* among Nigerian patients with dyseptia in Ibadan. Pan African Medical Journal. 2011;5(2)45-49

13. Oluwasola AO, Ola SO, Saliu L, Solanke TF. *Helicobacter pylori* infection In Southern Nigerians: a serological study of dyspeptic patients and healthy individuals. West African Journal of Medicine 2002; 21(2):138-141.

14. Olokoba AB, Gashau W, Bwala S, Adamu A, Salawu FL. *Helicobacter pylori* infection in Nigeria with Dyspepsia: Ghana Medical Journal. 2013;4:123-127.

15. Ndububa DA, Agbakwuru AE, Adebayo RA, Olasode BJ, Olaomi OO, Adeosun OA, Arigbabu AO. Upper gastrointestinal findings and incidence of *Helicobacter pylori* infection among Nigerian Patients with dyspepsia. West African Journal of Medicine. 2001;20(2):140-145.

16. Nwodo EN, Yakubu SE, Jatau ED. Seroprevalence of *Helicobacter pylori* infection in patients with gastritis and peptic ulcer disease in Kaduna, Nigeria. African Journal of Basic and Applied Sciences. 2009;1(6):123-128.

17. Jemikalajah DJ, Okogun GR. Health point prevalence of *Helicobacter pylori* in Central Hospital Warri, Nigeria. African Journal of Cellular Pathology. 2014;3(20) 57-60.

18. Chukwuma OM, Chukuwma GO, Manafa PO, Akulue JC, Jeremiah ZA. Prevalence and Possible risk factors for *helicobacter pylori* seropositivity among peptic ulcerative individuals in Nnewi Nigeria. Biomed research Journal. 2021;4(1):165-171.

19. Jemilohun AC, Ajani MA, Solaja TO. *Helicobacter pylori* and precancerous lesions of the stomach in southern Nigerian Population. West African Journal of Medicine. 2020;37(4):373-380.

20. Alkali M, Kenneth OO, Yusuf BJ, Sabo U, Abdulrazak T, Godiya ID, Farouk B, Sulayman TB, Binta L. Sero-Prevalence of *H. pylori* Antibodies among Asymptomatic Rural Population in Bauchi State, Nigeria—A Preliminary Study. 2020;10(11):12-22.

21. Al-Ghoul L, Wessler T, Hundertmark S, Kruger W, Fischer C, Wunder R, Roessner A, Naumann M. Analysis of the type IV secretion system dependent cell motility of *Helicobacter pylori* infected epithelial cells; Biochemistry and Bio Physiology Research Community. 2004;322:860–866.

22. Brown LM. *Helicobacter pylori*: Epidemiology and routes of transmission.

Epidemiologic Reviews. 2000;22(2):283-297.

23. Baako BN, Darko R. Incidence of *Helicobacter pylori* infection in Ghanaian patients with dyspeptic symptoms referred for upper gastrointestinal endoscopy. West African Journal of Medicine. 1996;15(4): 223-227.

24. Zagari RM, Bazzoli F, Pozzato P, Fossi S, De Luca L, Nicolini G, Berretti D, Rhoda E. Non-invasive methods for the diagnosis of *Helicobacter pylori* infection. Journal Gastroenterology Hepatology. 1999;31: 408–415.

25. Adesanya AA, Oluwatowoju IO, Oyedeji KS, Rocha-Afodu JT, Coker AO, Afonja OA. Evaluation of a locally-made urease test for detecting *Helicobacter pylori* infection. Niger Postgrad Medical Journal. 2002;9(1):43-47.

26. Testerman TL, McGee DJ, Mobley HJ. *Helicobacter pylori* growth and urease detection in the chemically defined medium Ham's F-12nutrient mixture. Journal Clinical Microbiol. 2001;39:3842–3850.

27. Telford JL, Ghiara P, Dell'Orco M, Comanducci B, Burroni L, Bugnoli F, Xiang G. Gene structure of the *Helicobacter pylori* cytotoxin and evidence of its key role in gastric disease; Journal Experimental Medicine. 1994;179:1653–1658.

28. Holcombe C. *Helicobacter pylori* the African enigma. Gastroenteritis. 1992;3(3): 429-431

29. Tovey FI, Tunstall M. Duodenal ulcer in black populations in Africa South of the Sahara; Gastroenteritis. 2001;16:564-576.

30. Mustapha S. Review article, Natural history and epidemiology of *Helicobacter pylori* infection. Ailment Pharmacol Ther. 2002; 16(1):3-15.

31. Allen L. What's the story *Helicobacter pylori*? Lancet. 2002;357:694.

32. Achtman M, Suerbaum S. Sequence variation in *Helicobacter pylori*. Trends Microbioiology. 2000;8:57–58.

33. Oluwasola AO, Ogunbiyi JO. Chronic gastritis and *Helicobacter pylori* infection in University College Hospital Ibadan, Nigeria-a study of 85fibre optic gastric biopsies. Nigerian Journal of Medicine. 2004;13(4):372-378.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/72469