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Original Article **Open Access**

Sero-prevalence of and risk factors associated with *Helicobacter pylori* infections among individuals with peptic ulcer in Owerri, Imo State, Nigeria during 2020-2021

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Abstract:

Background: *Helicobacter pylori*, which is a causative agent of chronic gastritis, duodenal ulcer and gastric cancer, presently affects approximately one half of the world population. This study was conducted to assess the epidemiology and risk factors for acquisition of *H. pylori* among individuals with and without peptic ulcer symptoms in Owerri, Nigeria, in order to provide baseline data and create awareness for effective management and prevention of infection caused by this pathogen.
Methodology: A total of 384 participants, symptomatic and asymptomatic for peptic ulcer, were recruited from the three Local Government Areas (LGAs) of Owerri, Imo State, Nigeria. The symptomatic participants were randomly recruited among patients attending outpatient clinics with symptoms of peptic ulcer disease at the Federal Medical Center Owerri, general hospitals and primary healthcare centers across Owerri LGAs, while asymptomatic patients were recruited from the community. Information on socio-demographic characteristics of each participant and potential risk factors were collected with a pre-tested structured questionnaire. Blood samples were collected for detection of antibodies (IgG) using a one-step *H. pylori* test device while faecal samples were collected for detection of occult blood (from peptic ulceration) using faecal occult blood (FOB) test. Data were analyzed using SPSS version 25.0 and association of risk factors with *H. pylori* sero-prevalence was determined by the Chi-square or Fisher Exact test (with Odds ratio). P value < 0.05 was considered statistically significant.
Results: The sero-prevalence of *H. pylori* infection among the study participants was 72.4% (285/384) while the prevalence of ulcer by FOB test was 71.1% (273/384). A total of 78.4% (214/273) of those with ulcers were sero-positive for *H. pylori* while 64.0% (71/111) of those without ulcers were sero-positive for *H. pylori* (p=0.0045). Factors significantly associated with high sero-prevalence of *H. pylori* were age groups 41-50 (100%), 21-30 (78.4%) and 31-40 (67.6%) years (X^2=66.964, p<0.0001), illiteracy (OR=6.888, p<0.0001), unemployment (OR=2.427, p<0.0001), low social class status (X^2=28.423, p=0.0003), drinking of unclean water (OR=5.702, p<0.0001), living in crowded rooms (OR=2.720, p<0.0001), eating food bought from food vendors (OR=3.563, p<0.0001), family history of ulcer (OR=12.623, p<0.0001), habits of eating raw vegetables and unwashed fruits (OR=6.272, p<0.0001), non-regular hand washing practices before meal (OR=2.666, p<0.0001) and presence of ulcer (OR=2.043, p=0.0045). However, smoking (OR=0.7581, p=0.2449) and gender (OR=0.6538, p=0.0796) were not significantly associated with sero-prevalence of *H. pylori.*
Conclusion: There is need for comprehensive strategy including public health education campaign to create awareness on *H. pylori*, improve personal hygiene and environmental sanitation, provision of safe drinking water by the government to the populace, and discourage indiscriminate and open defecation.

Keywords: *Helicobacter pylori*; peptic ulcer; serology; risk factors; association; Owerri

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Séroprévalence et facteurs de risque associés aux infections à *Helicobacter pylori* chez les personnes atteintes d'ulcère gastro-duodénal à Owerri, État d'Imo, Nigéria en 2020-2021

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Résumé:

Contexte: *Helicobacter pylori*, qui est un agent causal de la gastrite chronique, de l'ulcère duodénal et du cancer gastrique, affecte actuellement environ la moitié de la population mondiale. Cette étude a été menée pour évaluer l'épidémiologie et les facteurs de risque d'acquisition de H. pylori chez les personnes présentant ou non des symptômes d'ulcère peptique à Owerri, au Nigeria, afin de fournir des données de base et de sensibiliser à la gestion et à la prévention efficaces de l'infection causée par cet agent pathogène.
Méthodologie: Un total de 384 participants, symptomatiques et asymptomatiques de l'ulcère peptique, ont été recrutés dans les trois zones de gouvernement local (LGA) d'Owerri, dans l'État d'Imo, au Nigeria. Les participants symptomatiques ont été recrutés au hasard parmi des patients fréquentant des cliniques externes présentant des symptômes d'ulcère peptique au Federal Medical Center Owerri, des hôpitaux généraux et des centres de soins de santé primaires dans les LGA d'Owerri, tandis que des patients asymptomatiques ont été recrutés dans la communauté. Des informations sur les caractéristiques sociodémographiques de chaque participant et les facteurs de risque potentiels ont été recueillies à l'aide d'un questionnaire structuré pré-testé. Des échantillons de sang ont été prélevés pour la détection d'anticorps (IgG) à l'aide d'un dispositif de test *H. pylori* en une étape, tandis que des échantillons fécaux ont été prélevés pour la détection de sang occulte (provenant d'une ulcération peptique) à l'aide d'un test de sang occulte fécal (FOB). Les données ont été analysées à l'aide de la version SPSS 25.0 et l'association des facteurs de risque avec la séroprévalence de *H. pylori* a été déterminée par le test Chi-carré ou Fisher Exact (avec rapport de cotes). La valeur $p < 0,05$ a été considérée comme statistiquement significative.
Résultats: La séroprévalence de l'infection à *H. pylori* parmi les participants à l'étude était de 72,4% (285/384) tandis que la prévalence de l'ulcère par test FOB était de 71,1% (273/384). Au total, 78,4% (214/273) de ceux qui avaient des ulcères étaient séropositifs pour *H. pylori* tandis que 64,0% (71/111) de ceux qui n'avaient pas d'ulcères étaient séropositifs pour *H. pylori* (p=0,0045). Les facteurs significativement associés à une séroprévalence élevée de *H. pylori* étaient les groupes d'âge 41-50 (100%), 21-30 (78,4%) et 31-40 (67,6%) ans (X^2=66,964, p<0,0001), l'analphabétisme (OR=6,888, p<0,0001), chômage (OR=2,427, p<0,0001), statut social inférieur (X^2=28,423, p=0,0003), consommation d'eau insalubre (OR=5,702, p<0,0001), vie dans des pièces surpeuplées (OR=2,720, p<0,0001), manger des aliments achetés à des vendeurs de nourriture (OR=3,563, p<0,0001), antécédents familiaux d'ulcère (OR=12,623, p<0,0001), habitudes de manger des légumes crus et non lavés fruits (OR=6,272, p<0,0001), pratiques non régulières de lavage des mains avant le repas (OR=2,666, p<0,0001) et présence d'ulcère (OR=2,043, p=0,0045). Cependant, le tabagisme (OR=0,7581, p=0,2449) et le sexe (OR=0,6538, p=0,0796) n'étaient pas significativement associés à la séroprévalence de *H. pylori*.
Conclusion: Il est nécessaire de mettre en place une stratégie globale comprenant une campagne d'éducation à la santé publique pour sensibiliser à *H. pylori*, améliorer l'hygiène personnelle et l'assainissement de l'environnement, fournir de l'eau potable à la population par le gouvernement et décourager la défécation aveugle et à l'air libre.

Mots clés: *Helicobacter pylori*; ulcère peptique; sérologie; facteurs de risque; association; Owerri

Introduction:

Helicobacter pylori (H. pylori) is a spiral-shaped, Gram-negative microaerophilic bacterium, measuring approximately 3–5 µm in length, presently affecting approximately one half of the world population and causing chronic gastritis, the most frequent chronic inflammation worldwide (1). Infection is mostly asymptomatic, but when could cause pathologies such as gastritis, gastric and duodenal ulcers. About 90 - 100% of all duodenal ulcers, and 70 - 80% of all gastric ulcers are caused by *H. pylori* infection (2,3). An International Agency for Research on Cancer (IARC), an arm of the World Health Organization (WHO) classified *H. pylori* as a class I carcinogen for gastric cancer, a definition given to highest cancer-causing microbial agent (4). In Pune, Maras-htra India, Rahul et al., (5), reported 51.0% of *H. pylori* infection among 180 participants diagnosed in their assessment of risk factors of

H. pylori infection and peptic ulcer disease. Beyond its role in several gastroduodenal disorders, *H. pylori* has been involved in many extra-gastroduodenal disorders, such as idiopathic thrombocytopenic purpura, cardiovascular diseases, chronic liver diseases, iron-deficiency anaemia, and diabetes mellitus (6,7,8).

Although, Africa has the highest prevalence of *H. pylori* infections in the world (9), there is paucity of data on *H. pylori* prevalence in the general population across different regions of Africa including Nigeria. The majority of data published on the prevalence of *H. pylori* included patients presenting with symptoms of gastroduodenal diseases. *H. pylori* is reported to infect over 50% of the world population, and its distribution is influenced by factors such as age, gender, geographical location, ethnicity, and socio-economic factors (10,11), with higher prevalence in the developing countries compared to the developed countries especially in younger age groups.

With majority of the countries in Africa classified as developing or underdeveloped, *H. pylori* is therefore largely ubiquitous in this continent. In Rwanda, southern Africa, Walker et al., (12) reported 75% positivity rate to *H. pylori* in patients attending the University Hospital Butare over a period of 12 months. In a study from Kenya (13) among patients who presented with dyspepsia, *H. pylori* prevalence of 73.3% was reported in children and 54.8% in adults, while Awuku et al., (14), using a lateral flow immunochromatographic assay for the qualitative detection of *H. pylori* antigen in faecal specimens, reported 14.2% prevalence among asymptomatic children in a rural setting in Ghana.

In Nigeria, Aje et al., (15) reported a 67.4% prevalence of *H. pylori* among dyspeptic patients in the southwest region of the country, Gide et al., (16) reported 51.95% prevalence among patients with dyspeptic symptoms in Damaturu metropolitan, Yobe State, Jemilohun et al., (17) reported 63.5% prevalence in patients with gastritis in Ibadan, Olokoba et al., (18) reported prevalence rates of 93.6% by serology and 80.0% by histology among Nigerians with dyspepsia, while Ezeigbo and Ezeigbo (19) reported 39.7% rate amongst apparently healthy adults residing in Aba, Abia State, southern Nigeria. Recently, Smith et al., (20) reported *H. pylori* prevalence of 68.4% among type 2 diabetes mellitus patients in southwest and south-south Nigeria, and Nwachukwu et al., (21) reported 52.0% prevalence among patients with gastritis attending the Nnamdi Azikiwe Teaching Hospital (NAUTH), Nnewi, Anambra State, Nigeria. In Kano, northwest Nigeria, Bello et al., (22) reported high prevalence of 81.7% for *H. pylori* infection particularly amongst subjects with low socio-economic status. Factors such as unclean water source, overcrowding and cigarette smoking were significant risk factors noted for high prevalence of *H. pylori* infection in these studies. Nevertheless, in southwest Nigeria, Smith et al., (23), reported that most characteristics studied such as smoking, alcohol consumption, and sources of drinking water were not significantly associated with *H. pylori,* but previous antibiotic use, overcrowding and family history of ulcer/gastritis were significantly associated.

In Imo State, Nigeria, there are no documented evidence in the literature on the prevalence or burden of *H. pylori* infections and risk factors associated with its acquisition. Particularly in Owerri, the burden of the disease continues to mount from observations and history. Based on the lack of awareness and reports in this part of the country, it is apt that this kind of study be conducted to determine the burden and risk factors associated with *H. pylori* infections. Therefore, the objective of our study was to determine the prevalence and associated risk factors for *H. pylori* infections among the populace in Owerri in Imo State, southeast Nigeria.

Materials and method:

Study area:

Owerri is the capital of Imo State in Nigeria, with three Local Government Areas (LGAs); Municipal, North and West, and has an estimated population (predominantly Christian) of about 1,401,873, as of 2016, and is approximately 100 square kilometres (40 sq miles) in area. The city is bordered by the Otamiri river to the east and the Nworie river to the south (24) and has an airport 23 kilometres (14 miles) southeast of the city located in Obiangwu, Ngor Okpala LGA. Owerri sits in the rain forest and produce many agricultural products such as yams, cassava taro, corn, rubber and palm products.

According to the Köppen-Geiger system, Owerri has a tropical wet climate. Rain falls for most months of the year with a brief dry season. The harmattan affects the city in the early periods of the dry season and is noticeably less pronounced than in other cities in Nigeria. The average temperature is 26.4°C. The city is home to many tertiary institutions including Imo State University, Federal University of Technology, Federal Polytechnic and others.

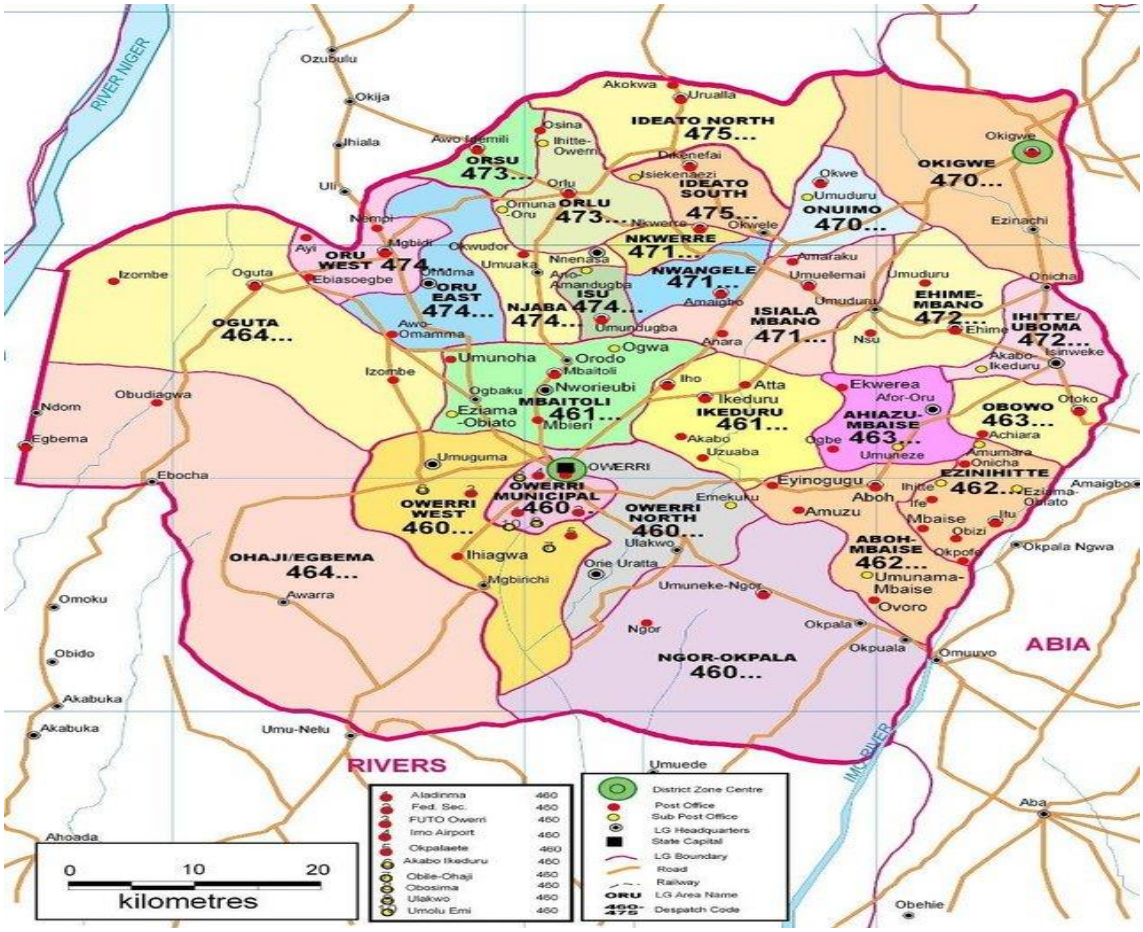

Fig. 1: Map of Imo State, Nigeria showing Owerri

Study design

This is a descriptive cross-sectional study to determine the sero-prevalence and risk factors associated with *H. pylori* infections in symptomatic and asymptomatic populations in Owerri, Imo State, Nigeria.

Study population and subject participants

The subject participants consist of 384 individuals who residents of Owerri, Imo State, Nigeria. The subjects include those with symptoms of dyspepsia such as burning pain in the abdomen, indigestion, bloating, nausea, vomiting, loss of appetite, belching, and weight loss, attending the outpatient clinics of different tiers of healthcare facility across Owerri, and asymptomatic individuals recruited from the Owerri community. The healthcare facilities included Federal Medical Center Owerri, general hospitals, and primary healthcare centers across the city.

Sample size and sampling technique

The sample size of 384 was determined using the sample size formula for simple proportion (25) given as; $n=N^2P(1-P)/d^2$, where n =sample size, N=1.96 (statistical constant), P= prevalence of 52.0% (0.52) adopted because there was no similar study previously conducted in the study area, and d=margin of error of 5.0% (0.05). This gave a calculated sample size of 384.

Participants were eligible for recruitment if they were resident, schooling, working or doing business within the three LGAs of Owerri. Participants below 10 and above 65 yrs of age, non-residence of Owerri, and menstruating females were excluded. The participants were recruited randomly at the healthcare facilities and the community until the sample size of 384 was obtained.

Ethical clearance

Written informed consent was obtained from the study participants. The purpose of the study, procedures, possible risks and benefits, rights and responsibilities of participants including right to withdraw from the study at any time were described.

Data collection

A structured questionnaire was interviewer-administered to each participant to obtain information on socio-demographic characteristics, behavioral and hygiene practices. Information obtained included daily habits, households, potential sources of infection, age, gender, educational level (primary, secondary tertiary), social class status (high, middle, low), source of drinking water (pipe, well, stream), overcrowding, consumption of food from food vendors, and family history of ulcer, cigarette smoking). The questionnaire was pre-tested using 50 people outside the study population.

Sample collection

Participants were provided with clean, dry, disinfectant-free, wide-mouthed plastic container labeled with identifiers such as name, age and date, to collect about 10.0 grams of faecal specimen for faecal occult blood (FOB) test. Written instruction was given on how to avoid contamination of the faecal specimen stool with water and urine.

For blood specimen, 1 ml of venous blood was collected from each participant into test tube and allowed to clot by standing at room temperature for 30 to 45 minutes. Clear serum sample was obtained by centrifugation at 3000 revolutions per minute for 4 to 5 min and this was used for detection of antibodies (IgG) against *H. pylori.*

Laboratory analysis

Faecal occult blood (FOB) was performed by the one-step rapid screen test to infer the presence of peptic ulcer. A small portion of the faecal sample was transferred to a vial with diluents, vigorously agitated for 15 to 30 sec to obtain homogenous solution of faecal matters. Two to three drops of the homogenous solution were squeezed on the test pad. The test result was read within 5 to 10 min in accordance with the manufacturer's instruction, and interpreted based on the appearance of coloured lines on the test pad. Only color-band on the control region of the test pad meant negative for ulcer, two colour bands on the positive and control regions was positive for ulcer while no visible band at meant invalid result.

Serology test for *H. pylori* infection was done using the one-step *H. pylori* test device (whole blood/serum/plasma), which is a rapid immunochromatographic test for the qualitative detection of antibodies (IgG) to *H. pylori* in whole blood, serum or plasma. Briefly, the test device and serum were allowed to equilibrate at room temperature prior to testing. The test device was removed from the foil pouch and placed on a clean working bench. The dropper was held vertically and used to transfer 3 drops of the testing serum to the specimen well of the device, avoiding trapping air-bubble in the process. The timer was started, and result read after 10 mins when the red line was supposed to appear (manufacturer's instructions). The result was interpreted based on the appearance of the red-coloured lines. Two distinct red lines, one in the control and the other in the test region of the device indicate positivity for *H. pylori* while one red line in the control region was interpreted as negative and absence of the red line at both regions was interpreted as an invalid result.

Statistical analysis of data

Data were analyzed using the Statistical Package for Social Sciences (SPSS version 25.0). Association of risk factors with sero-prevalence of *H. pylori* was done using Chi-square or Fisher Exact test (with Odds ratio). The level of significance was set at $p < 0.05$.

Results:

A total of 384 participants comprising 202 symptomatic and 182 asymptomatic, and 211 males and 173 females, were enrolled into the study. Of these, 285 (74.2%) were positive for *H. pylori* antibody (Table 1) while 273 (71.1%) were positive for ulcer by the FOB test (Table 2). One hundred and forty-nine of the 211 (70.6%) male participants were sero-positive for *H. pylori* while 136 of the 173 (78.6%) female participants were sero-positive (p= 0.0796) (Table 1). Also, 149 of 211 (70.6%) males were positive for ulcer by the FOB test while 124 of 173 (71.1%) females were positive (p=0.9100) (Table 2).

One hundred and eighteen (64.8%) of the 182 asymptomatic participants were sero-positive for *H. pylori*, while 167 of 202 (82.7%) symptomatic participants were sero-positive (OR=2.588, p<0.0001) (Table 3). In the age-related sero-prevalence of *H. pylori*, the age-group 41-50 years had the highest prevalence (100.0%), followed by age groups 21-30 (78.4%), 31-40 (67.6%), and 10-20 (42.5%), while age-groups 51-60 (48.0%) and 61-70 years (48%) had the lowest sero-prevalence (X^2=66.964; p<0.0001) (Table 4).

Table 5 is bivariable analysis of factors associated with sero-prevalence of *H. pylori* among the participants, which showed significant association with factors such as age group (X^2=66.964, p<0.0001), educational level (OR =6.888, p<0.0001), occupational status (OR =2.427, p<0.0001), social class status (X^2=

28.423, p=0.0003), water source for drinking (OR=5.702, p<0.0001), living in over-crowded rooms (OR=2.720, p<0.0001), eating from food vendors (OR=3.563, p< 0.0001), family history of ulcer (OR=12.623, p<0.0001), regular habits of eating raw vegetables and unwashed fruits (OR=6.272, p<0.0001), hand washing practices before meal (OR=2.666, p<0.0001) and ulcer disease status (OR= 2.043, p=0.0045). However, smoking (OR= 0.7581, p=0.2449) and gender (OR=0.6538, p=0.0796) were not significantly associated with sero-prevalence of *H. pylori.*

Table 1: Gender-related sero-prevalence of *Helicobacter pylori* among participants in Owerri, Imo State, Nigeria

Gender	No. screened	No. sero-positive (%)	No. sero-negative (%)
Male	211	149 (70.6)	62 (29.4)
Female	173	136 (78.6)	37 (21.4)
Total	384	285 (74.2)	99 (25.8)

OR=0.6538; 95% CI= 0.4091-1.045; p=0.0796

Table 2: Gender-related prevalence of ulcer by faecal occult blood among participants in Owerri, Imo State, Nigeria

Gender	No. screened	No. positive (%)	No. negative (%)
Male	211	149 (70.6)	62 (29.4)
Female	173	124 (71.7)	49 (28.3)
Total	384	273 (71.1)	111 (28.9)

OR=0.9497; 95% CI=0.6091-1.481; p=0.9100

Table 3: Sero-prevalence of *Helicobacter pylori* among asymptomatic and symptomatic participants in Owerri, Imo State, Nigeria

Participants	No. screened	No. positive (%)	No. negative (%)
Asymptomatic	182	118 (64.8)	64 (35.2)
Symptomatic	202	167 (82.7)	35 (17.3)
Total	384	285 (74.2)	99 (25.8)

OR=2.588; 95% CI=1.610-4.161; p<0.0001

Table 4: Age-related sero-prevalence of *H. pylori* among the participants in Owerri, Imo State, Nigeria.

Age-groups	No. screened	No. positive (%)	No. negative (%)
10-20	87	50 (57.5)	37 (42.5)
21-30	111	87 (78.4)	24 (21.6)
31-40	37	25 (67.6)	12 (32.4)
41-50	99	99 (100.0)	0
51-60	25	12 (48.0)	13 (52.0)
61-70	25	12 (48.0)	13 (52,0)
Total	384	285 (74.2)	99 (25.8)

X^2=66.964; p<0.0001

Table 5: Bivariate analysis of risk factors associated with sero-prevalence of *H. pylori* infection among participants in Owerri, Imo State, Nigeria

Variables	No. screened	No. positive (%)	OR	X^2	p-value
Age-group (years)					
10-20	87	50 (57.5)			
21-30	111	87 (78.4)		66.964	<0.0001*
31-40	37	25 (67.6)			
41-50	99	99 (100.0)			
51-60	25	12 (48.0)			
61-70	25	12 (48.0)			
Gender					
Male	211	149 (70.6)	0.6538		0.0796
Female	173	136 (78.6)			
Educational status/Literacy level					
Illiterate	105	98 (93.3)	6.888		<0.0001*
Literate	279	187 (67.0)			
Occupational status/Employment state					
Unemployed	185	153 (82.7)	2.427		0.0003*
Employed	199	132 (66.3)			
Social class status					
Higher social class	110	65 (59.1)			
Middle social class	120	85 (70.8)		28.421	<0.0001*
Lower social class	154	135 (87.7)			
Drinking of pipe/filtered/boiled water					
Yes	214	131 (61.4)	5.702		<0.0001*
No	170	153 (90.0)			
Living in over-crowded room					
Yes	180	151 (83.9)	2.720		<0.0001*
No	204	134 (65.7)			
Consumption of food from food vendors					
Yes	190	163 (85.8)	3.563		<0.0001*
No	194	122 (62.9)			
Family history of ulcer					
Yes	200	187 (93.5)	12.623		<0.0001*
No	184	98 (53.3)			
Smoking					
Yes	182	130 (71.4)	0.7581		0.2449
No	202	155 (76.7)			
Eating raw vegetables and unwashed fruits					
Yes	200	179 (89.5)	6.272		<0.0001*
No	184	106 (57.6)			
Hand washing habit before meal					
Always (regular)	201	132 (65.7)	2.666		<0.0001*
Sometimes (non-regular)	183	153 (83.6)			
Ulcer disease status					
Yes	273	214 (78.4)	2.043		0.0045*
No	111	71 (64.0)			

OR=Odds ratio; X^2=Chi square; * = statistically significant

Discussion:

Helicobacter pylori infection has been a very huge challenge to the world and in particular, African countries. It is of great public health importance, considering the fact that it is associated with serious health issues of chronic gastritis, duodenal and gastric ulcer, gastric cancer, and other extra-gastric pathologies. This infection presently affects approximately half of the world population (1). The result of our study showed that sero-prevalence of *H. pylori* is high (74.2%) among the population studied, and this may constitute a major public health threat to the entire people of Imo State, and by inference to the populace in Nigeria and other countries, especially in Africa.

The high sero-prevalence of *H. pylori* in our study is consistent with reports of previous studies across Nigeria (15-18,20,22). For instance, Aje et al., (15) and Jemilohun et al., (17) reported *H. pylori* prevalence rates 67.4% and 63.5% respectively in southwest Nigeria, Olokoba et al., (18) reported 93.6% prevalence by serology and 80.0% by histology among Nigerians with dyspepsia in northcentral Nigeria, Smith et al., (20) reported 68.4% among patients with type 2-diabetes mellitus in south-south and south-west Nigeria, while Bello et al., (22) reported 81.7% rate amongst subjects with low socio-economic status in north-west Nigeria. For other African countries, Laure et al., (26) reported 64.39% rate in Cameroun, Walker et al., (12) reported 75.0% in Rwanda, while, Kimang'a et al., (13) in Kenya reported 73.3% in children and 54.8% in adults among patients who presented with dyspepsia. Elsewhere, Rahul et al., (5) reported 51.0% in Pune, Marashtra, India. The wide range reported in the different studies including ours, may partly be due to differences in the method used for *H. pylori* detection, geographical locations, which could reflect environmental and personal hygiene levels, ethnicity, socio-economic factors and age of participants studied (10,26).

Nevertheless, *H. pylori* sero-prevalence rate in our study is higher than the rates in some other studies in Nigeria such as Gide et al., (16) who reported 51.9% in Damaturu metropolitan, Yobe State, northeast Nigeria, and Nwachukwu et al., (21) who reported 52.0% in Nnewi, Anambra State, south-south Nigeria, and even much higher than other studies that reported low *H. pylori* sero-prevalence of 14.2% (14), 36.3% (28), 36.8% (27) and 39.7% (19).

The high prevalence rate reported in our study was significantly associated with low social class status, drinking of unclean water, living in crowded rooms, consumption of food from food vendors, family history of ulcer, eating raw vegetables and unwashed fruits, illiteracy, unemployment, age group 41-50 yrs as well as non-regular hand-washing habit before meal. Our findings agree with previous reports (5,16-18,22,26), which underscore the need to improve socio-economic conditions and sanitary standards as well as educational standards of the populace, since low sero-prevalence of *H. pylori* is known to occur in communities with good living conditions and hygienic standards. In Russia for instance, within a period of ten years (1995-2005), it was observed that the prevalence of *H. pylori* infection reduced remarkably due to better standards of living (29). In China, prevalence of *H. pylori* drastically reduced as a result of increase in economic growth and improvement in environmental and hygienic conditions (30).

In our study, *H. pylori* sero-prevalence was high in both the asymptomatic (64.8%, 71/111) and symptomatic (87.7%, 214/273) participants (who had positive faecal occult blood test) but the rate was significantly higher in the symptomatic than asymptomatic participants (OR=2.588, $p<0.0001$). Although *H. pylori* serology has been shown to have sensitivity and specificity in the range of 78-84% and 79-90% respectively (31), the major disadvantage of serology is the inability to distinguish current infection from previous exposure, which can result in misinterpretation of the test (32). The high seroprevalence rate in both groups of participants in our study implies that serology many not be useful in confirming *H. pylori* as the cause of peptic ulcer in many patients. In such cases, other tests such as *H. pylori* antigen test, PCR assays, and *invitro* or *invivo* urea breath test on stool or gastroduodenal samples will be preferred, although many of these tests may be expensive, technically demanding and invasive (32).

The sero-prevalence of *H. pylori* was highest among the age group 41-50 years (100.0%) in our study, but also high in the age groups 21-30 and 31-40 years with 78.4% and 67.6% respectively. This agrees with the study by Gemechu and Dessie (27), who reported highest sero-prevalence of *H. pylori* in the 43-50 years age-group among symptomatic patients attending Jasmin Internal Medicine and Paediatrics Specialized Private clinic in Addis Ababa, Ethiopia. However, Smith et al., (20) reported highest prevalence among age group 50-59 years. It is known that most people are infected with *H. pylori* in their early years and this tends to persist throughout the life time,

nevertheless, the time of infection may not be known (26,27,33). Gender and smoking were factors not significantly associated with *H. pylori* sero-prevalence in our study, which agrees with the finding of Smith et al., (20) and Laure et al., (26), but disagrees with the studies of Rahul et al., (5) and Bello et al., (22), who reported significant association of *H. pylori* with smoking.

Conclusion:

Our study shows that *H. pylori* infection is common in Owerri with high sero-prevalence of 74.2% among the study population, age group 41-50 years being mostly affected, and significantly higher prevalence in population with peptic ulcer disease. Factors such as illiteracy, unemployment, drinking of unclean water, consumption of food from food vendors, living in crowded rooms, family history of ulcer, low social class, eating raw vegetables and unwashed fruits, and non-regular handwashing habits were significantly associated with high sero-prevalence of *H. pylori*. There is need for comprehensive strategy including public health education campaign to create awareness of factors associated with *H. pylori* infections, and government at all levels should enforce policy against filthy environments, discourage indiscriminate and open defaecaction, and provide safe drinking water for the populace.

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Contribution of authors:

GIAO contributed to the concept and design of the study, ILO contributed to the analysis of the samples, while GIAO, ILO, NIU and SNM were involved in the literature review, drafting, revision, editing and final approval of the final version

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