**The influence of socio-economic, demographical characteristics and related factors in the acquisition of *h. Pylori* infection**

**ABSTRACT**

*Helicobacter pylori* (*H. pylori*) infection remains a significant public health concern globally, particularly in developing countries like Nigeria. This cross-sectional research evaluated the influence of socio-demographic characteristics and related factors in the acquisition of *H. pylori* infection in Nnewi North Local Government Area Anambra State, Nigeria. Four hundred (400) participants aged 2 years and above were recruited by simple random sampling method. A well-structured standard questionnaire was used to diagnose dyspepsia consisting of 24 items clearly written in understandable language and related to the cardinal symptoms of dyspepsia. Data on personal, demographical variables, environment and life style factors were obtained using the structured questionnaire with closed and open-ended questions, which were answered under the guidance of the researcher at point. The data obtained was analyzed using Statistical Package for Social Sciences (SPSS) version 25. Chi-square test was used to check for the relationship between groups. P value < 0.05 was considered statistically significant. Result showed 43.6% males were infected compared to 56.4% female indicating a higher prevalence among females. Individuals who consumed carbonated drinks showed a significantly higher infection rate (56.4%) compared to those who did not (43.6%). Also, there was a significant relationship between age (X2 = 14.107; p=0.015), carbonated drink consumption (X2 = 11.597; p=0.001) and *H. pylori* infection status. This study found 43.6% males were infected compared to 56.4% female indicating a higher prevalence among females. Also, there was a significant relationship between age, carbonated drink intake and *H. pylori* infection status. Thus there is need for further studies.

**Key words:** *H. Pylori*, Socio-demographic factors, Hygiene profile, Food habits, Health history.

**INTRODUCTION**

*Helicobacter pylori* (*H. pylori*) infection remains a significant public health concern globally, particularly in developing countries like Nigeria. It can affect about 50% of the global population (Zhou *et al.,* 2023). The organism is able to change its morphology to be able to survive in many adverse environmental conditions such as antibiotics, temperature, pH and increased oxygen tension (Elbehiry *et al.,* 2023). This bacterium colonizes the human stomach, and, although the majority of people (>80%) can remain asymptomatic throughout their life, it is largely related to gastrointestinal diseases and in the absence of treatment, its manifestations can range from pathologies, such as chronic gastritis, peptic ulcers, and atrophic gastritis to intestinal metaplasia, gastric cancer, and mucosa-associated lymphoid tissue (Smith *et al.,* 2019; Smith *et al.,* 2021).Although the mode of transmission of *H. pylori* has not been fully elucidated, but studies had revealed that person-to-person transmission, fecal-oral and oral-to-oral routes can lead to the transmission of this infection (Che *et al.,* 2023). School children in developing countries are at high risk of getting the infection; several factors control the transmission of *H. pylori* including low socioeconomic status, poor quality of drinking water, overcrowding, poor personal and environmental hygiene, and food contamination. Several studies have proposed that *H. pylori* can cause a broad range of other types of diseases but there have been controversial thoughts about the study (Bravo *et al.,* 2018).

Moreover, several researchers had reported that stomach ulcer caused by *H. pylori* has predisposing or risk factors such as age, occupation, personal hygiene, educational background, nutrition, and location (Borka *et al.,* 2022; Cheok *et al*., 2022; Che *et al.,* 2023). The global report had shown that people in developing countries are more susceptible to the disease compared to people in de1eveloped countries, and this report is similar to the observation made by Liang *et al*. (2022) on high level of the disease among rural dwellers who are tender and poorly educated. Several factors control the transmission in developing countries including low socioeconomic status, poor quality of drinking water, overcrowding, poor personal and environmental hygiene, and food contamination (Tsongo *et al.,* 2015).

According to Kotilea *et al*. (2019), the primary risk factor for *H. pylori* infection in children is the socioeconomic position of the household. Additionally, the global prevalence of *H. pylori* infection is significantly influenced by dietary and water sources. The prevalence of H. pylori is influenced by personal hygiene and population socio-demographics. Overcrowding, an unsanitary environment, and the type of toilet facilities are some risk factors for H. pylori infection (Mnichil *et al*., 2023). The risk factors for H. pylori infection in Nnewi North Local Government Area, Anambra State Nigeria, are still not well studied, despite the fact that many studies have already looked at them in the context of clinical and environmental risk factors. Therefore, we conducted a cross-sectional study in Nnewi North, Anambra State with the objectives to examine the socio-demographic characteristics and related factors as determinants of *H. pylori* infection status.

**MATERIALS AND METHODS**

**Study Area.**

The study was carried out at Nnewi North Local Government metropolitan commercial city in Anambra State, Nigeria. Nnewi is located in the South-East zone in Anambra state, Nigeria. It is the second largest commercial city in Anambra State in south-eastern Nigeria with two local government areas, Nnewi North and Nnewi South. Nnewi North is commonly referred to as Nnewi central and is the center of commercial activities. The city spans over 1,076.9 square miles (2,789 km2) in Anambra State with four autonomous quarters: Otolo, Uruagu, Umudim, and Nnewichi. It has a land mass area of 60.0 km2, density of 3, 428 /km2 as of (2016) - change + 2.84%/year (2006-2016), and the city spans over 1,076.9 square miles in Anambra State. Nnewi metropolitan area and its satellite towns is home to nearly 2.5 million residents as of 2005 and Nnewi–North Local Government Area, with a land mass of 128 Km sq. and estimated number population of 121,063 and population density of 946 (Anambra State Statistical Year Book, 2010).

The average monthly maximum temperature is 27.46oC and a minimum of 23.65 0C in 2010, and annual monthly relative humidity of 79.66 by 2010. The commercial city is located in Nnewi north. Nnewi is bounded in the west by Ekwusigo, in the north-west by Idemili, in the North-east by Aniocha, in the east-east by Aguata, and in the south-west by Ihiala local government areas. The occupation of the inhabitants includes trading especially motor-cycle spare parts, civil servants and farming. The study area is known for bad bumpy roads, poor hygiene and sanitation control (Chukwuma *et al*., 2020).

**Nnewi**, a city in Anambra State, Nigeria, which is a major industrial and commercial hub, the key landmarks include:

* **Religious Centers:** Nnewi Catholic Cathedral (Our Lady of Assumption Cathedral), A prominent religious landmark in Nnewi.
* **Markets:** Nkwo Nnewi Market, known as the largest spare parts market in West Africa, it is a crucial economic landmark in Nnewi.
* **Hospitals:** Nnamdi Azikiwe University Teaching Hospital (NAUTH), a major healthcare and training facility in Nnewi.
* **Educational Institutions:** Nnamdi Azikiwe University College of Health Sciences, a key part of the educational setup in Nnewi.
* **Historical and Cultural Sites:** Ichi Community Shrines and Monuments, reflecting traditional heritage and culture near Nnewi.
* **Industrial Areas:** Innoson Vehicle Manufacturing Plant. The first indigenous vehicle manufacturing company in Nigeria, located in Nnewi.

**Research Design**

This is a cross-sectional research to evaluate the socio-demographic characteristics and related factors as determinants of *H. pylori* infection status in Nnewi North Local Government Area Anambra State Nigeria. A well-structured standard questionnaire was used to diagnose dyspepsia consisting of 24 items clearly written in understandable language and related to the cardinal symptoms of dyspepsia as noted by Chukwuma *et al., (*2020). The structured questionnaire was used to collect information about the research subjects. Consent and assents from parent, guardian and children was sort respectively depending on age. Some parents helped in filling the questionnaires, detailing the weights and heights of the children to enable the calculation of their Body Mass Index (BMIs), using the BMI Percentile graph. It is an open-ended questionnaire which was anonymously answered voluntary by the respondents before commencement of the exercise. The questionnaire includes a system of qualification levels for each symptom taking into account its frequency and intensity of presentation in the previous two weeks. Three criteria were used to define, the questionnaire; data on personal, demographical variables, environment and life style factors were obtained using the structured questionnaire with closed and open-ended questions, which were answered under the guidance of the researcher at point.

**Sample Size**

The sample size was calculated to be 400 using the formula described in the study by Chukwuma *et al., (*2020) by taking 5% as the marginal error, 95% CI, and 51.4% prevalence from previous research by Chukwuma et al., 2020

**Study Population**

The study consists of a total of four hundred (400) participants of the age-range of 2 years and above.

**Sampling Technique**

Random sampling technique was used to recruit participants in the study. Those who presented with or without the symptoms and signs that were suggestive of ulcers or gastritis. They were educated about the study and those willing to participate gave their consent in writing and that of their parents/guardian until the required sample size was attained.

**Inclusion Criteria**

1. All willing subjects within age range of 2 and above.
2. Those not on antibiotics or herbal therapy one week prior to sample collection.
3. Those attending clinic in the selected hospitals, Schools and Laboratory in Nnewi metropolis.
4. Male and Female.
5. Patients not on active immune suppressive therapy, coagulation drugs or showing coagulation effect, and malignant diseases (cancer) or are allergic to drugs used.

**Exclusion Criteria**

1. Unwilling patients.
2. Children below 2 years of age.
3. Those on antibiotics or herbal therapy three weeks before sample collection.
4. Those with a history of underlying diseases like diabetes, asthma, physical or mental impairment, pregnant or breastfeeding women.
5. Patients on active immune suppressive therapy, proton pump inhibitors or Pepto-Bismol for at least 2 weeks, coagulation drugs or showing coagulation effect, and malignant diseases (cancer) or signs of allergy to drugs used.

**Statistical Analysis**

The data obtained was analyzed using Statistical Package for Social Sciences (SPSS) version 25. Chi-square test was used to check for the relationship between groups. P value < 0.05 was considered statistically significant.

**RESULTS**

The result of the relationship between *H. pylori* infection status and socio-demographic factor of participants is presented in Table 1. The result revealed intriguing insights into the prevalence rates and their associations. Gender-wise, varying infection rates were observed between males and females across the villages. Males at Umudim (41.2%) were more infected compared to other villages. For females, Otolo had the highest infected (40.9%) while Nnewichi had the lowest in both male (5.9%) and female gender (4.5%). Overall, 43.6% males were infected compared to 56.4% female indicating a higher prevalence among females. Age groups displayed varied infection rates across the villages. Otolo had the highest number of infected babies (100%), Umudim had the highest number of infected children (63.3%) and teens (50%) while Uruagu showed the highest number of infected adults (50%). Overall adults (41%) were more infected when compared to other age groups. Marital status did not show a significant association with infection status, although there were slight variations. Married individuals in Otolo had higher infection rate of 42.9%, compared to other villages. Conversely, the infection rate among singles was higher at Umudim (41.9%). Only the divorced individual in Nnewichi {100%) was infected. However, singles had the highest infection rate (79.5%). Education-wise, discrepancies in infection rates were observed among individuals with different levels of education across the villages. However, those with tertiary education had the highest Prevalence (43.6%) of infection. The prevalence of *H. pylori* infection differed among students, teachers, cleaners, lecturers, business owners, nurses, lab assistants, barbers, and civil servants across villages, moreover, students were more infected (69.2%) compared to other groups. Differences in infection rates were evident among individuals with varying numbers of children across the villages. At Umudim, individuals with 5 or more children had the highest infection rate (41.7%), while in Nnewichi, prevalence rates were higher among those with no children (35.4%). Otolo and Uruagu showed varying patterns, with no consistent trend observed across the number of children. Overall, those with no children had the highest infection rate (48.7%) compared to others. Concerning BMI, underweight individuals demonstrated notably high prevalence rates at Otolo (40%), and Umudim (60%). Conversely, obese individuals showed the highest prevalence (62.5%) at Umudim. However, normal weight individuals showed the highest infection rate (33.3%) while overweight and obese individuals showed the lowest (20.5% each). People living 4-7 were mostly infected (53.8%) while those who were living more than 7 were least infected (17.9%). Moving to type of apartment of participants, those living in flat had the highest infection rate while the lowest was observed among individuals living in duplex. Generally, there was no significant relationship between any of the socio demographic factors and infection status (p-values >0.005)

**Table 1: Relationship between *H. pylori* infection status and socio-demographic factor of participants**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Otolo  | Umudim  | Uruagu | Nnewichi | Grand Total |  |  |
| Variables |  | Infectedn(%) | Not Infectedn(%) | Infectedn(%) | Not Infectedn(%) | Infectedn(%) | Not Infectedn(%) | Infectedn(%) | Not Infectedn(%) | Infectedn(%) | Not Infectedn(%) | X2 | p-value |
| Gender  | Male | 3(25%) | 18(45%) | 7(46.7%) | 19(51.4%) | 6(60%) | 16(38.1%) | 1(50%) | 24(57.1%) | 17(43.6%) | 77(47.8%)  | 0.226 | 0.634 |
|  | Female | 9(75%) | 22(55%) | 8(53.3%) | 18(48.6%) | 4(40%) | 26(61.9%) | 1(50%) | 18(42.9%) | 22(56.4%) | 84(52.2%) |
|  | Total  | 12(30.8%) | 40(24.8%) | 15(38.5%) | 37(23%) | 10(25.6%) | 42(26.1%) | 2(5.1%) | 42(26.1%) | 39(100% | 161(100%) |
| Age  | 2-12 year | 4(33.3%) | 18(45%) | 6(40%) | 15(40.5%) | 1(10%) | 11(26.2%) | 0(0%) | 23(54.8%) | 11(28.2%) | 67(41.6%) | 14.107 | 0.015\* |
|  | 13-23 years | 4(33.3%) | 10(25%) | 4(26.7%) | 10(27%) | 6(60%) | 13(31%) | 0(0%) | 15(35.7%) | 14(35.9%) | 48(29.8%) |
|  | 24-34 years | 1(8.3%) | 7(17.5%) | 0(0%) | 5(13.5%) | 1(10%) | 14(33.3%) | 0(0%) | 3(7.1%) | 2(5.1%) | 29(18%) |
|  | 35-45 years | 1(8.3%) | 2(5%) | 3(20%) | 3(8.1%) | 1(10%) | 4(9.5%) | 1(50%) | 0(0%) | 6(15.4%) | 9(5.6%) |
|  | 46-56 years | 1(8.3%) | 1(2.5%) | 1(6.7%) | 2(5.4%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 2(5.1%) | 3(1.9%) |
|  | 57-67 years | 1(8.3%) | 2(5%) | 1(6.7%) | 2(5.4%) | 1(10%) | 0(0%) | 1(50%) | 1(2.4%) | 4(10.3%) | 5(2.5%) |
|  | Total  | 12(30.8%) | 14(24.8%) | 15(38.5%) | 37(23%) | 10(25.6%) | 42(26.1%) | 2(5.1%) | 42(26.1%) | 39(100% | 161(100%) |
| Marital status | Married | 3(42.9%) | 5(33.3%) | 2(28.6%) | 5(33.3%) | 2(28.6%) | 5(33.3%) | 0(0%) | 0(0%) | 7(100%) | 15(100%) | 4.111 | 0.250 |
| Single | 9(29%) | 33(23.1%) | 13(41.9% | 32(22.4%) | 8(25.8%) | 36(25.2%) | 1(3.2%) | 42(29.4%) | 31(100%) | 143(100%) |
| Widowed | 0(0%) | 2(100%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 2(100%) |
| Divorced | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 1(100%) | 1(100%) | 0(0%) | 1(100%) | 1(100%) |
| Total  | 12(30.8%) | 40(24.8%) | 15(38.5%) | 37(23%) | 10(25.6%) | 42(26.1%) | 2(5.1%) | 42(26.1%) | 39(100% | 161(100%) |
| Education | Primary school | 4(40%) | 12(40%) | 5(50%) | 11(36.7%) | 1(10%) | 5(16.7%) | 0(0%) | 2(6.7%) | 10(100%) | 30(100%) | 5.888 | 0.117 |
|  | Secondary school | 5(50%) | 7(33.3%) | 5(50%) | 7(33.3%) | 0(0%) | 1(4.8%) | 0(0%) | 6(28.6%) | 10(100%) | 21(100%) |
|  | Tertiary | 2(11.8%) | 16(16%) | 4(23.5%) | 14(14%) | 9(52.9%) | 36(36%) | 2(11.8%) | 34(34%) | 17(100%) | 100(100%) |
|  | Non-educated | 1(50%) | 5(50%) | 1(50%) | 5(50%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 2(100%) | 10(100%) |
|  | Total  | 12(30.8%) | 40(24.8%) | 15(38.5%) | 37(23%) | 10(25.6%) | 42(26.1%) | 2(5.1%) | 42(26.1%) | 39(100% | 161(100%) |
| Occupation  | Student | 8(29.6%) | 28(22.6%) | 11(40.7%) | 25(20.2%) | 7(25.9%) | 29(23.4%) | 1(3.7%) | 42(33.9%) | 27(100%) | 124(100%) | 8.149 | 0.410 |
|  | Teacher | 1(20%) | 8(30.8%) | 1(20%) | 8(30.8%) | 2(40%) | 10(38.5%) | 1(20%) | 0(0%) | 5(100%) | 26(100%) |
|  | Cleaner | 0(0%) | 1(50%) | 0(0%) | 1(50%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 2(100%) |
|  | Lecturer | 0(0%) | 1(100%) | 1(1000%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 1(100%) | 1(100%) |
|  | Business | 0(0%) | 2(100%) | 2(100%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 2(100%) | 2(100%) |
|  | Nurse | 1(100%) | 0(0%) | 0(0%) | 1(100%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 1(100%) | 1(100%) |
|  | Lab Assistant | 1(100%) | 0(0%) | 0(0%) | 1(100%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 1(100%) | 1(100%) |
|  | Barber | 1(100%) | 0(0%) | 0(0%) | 1(100%) | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 1(100%) | 1(100%) |
|  | Civil servant | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 1(100%) | 3(100%) | 0(0%) | 0(0%) | 1(100%) | 3(100%) |
|  | Total  | 12(30.8%) | 40(24.8%) | 15(38.5%) | 37(23%) | 10(25.6%) | 42(26.1%) | 2(5.1%) | 42(26.1%) | 39(100% | 161(100%) |
| No of children | None | 7(36.8%) | 17(17.7%) | 6(31.6%) | 17(17.7%) | 6(31.6%) | 28(29.2%) | 0(0%) | 34(35.4%) | 19(100%) | 96(100%) | 2.895 | 0.408 |
|  | One | 0(0%) | 3(25%) | 0(0%) | 3(25%) | 2(100%) | 4(33.3%) | 0(0%) | 2(16.7%) | 2(100%) | 12(100%) |
|  | 2-4 | 2(33.3%) | 9(40.9%) | 4(66.7%) | 8(36.4%) | 0(0%) | 4(18.2%) | 0(0%) | 1(4.5%) | 6(100%) | 22(100%) |
|  | 5 and above | 3(25%) | 11(35.5%) | 5(41.7%) | 9(29%) | 2(16.7%) | 6(19.4%) | 2(16.7%) | 5(16.1%) | 12(100%) | 31(100%) |
|  | Total  | 12(30.8%) | 40(24.8%) | 15(38.5%) | 37(23%) | 10(25.6%) | 42(26.1%) | 2(5.1%) | 42(26.1%) | 39(100% | 161(100%) |
| BMI | Underweight | 4(40%) | 8(42.1%) | 6(60%) | 6(31.6%) | 0(0%) | 2(10.5%) | 0(0%) | 3(15.8%) | 10(100%) | 19(100%) | 6.066 | 0.108 |
|  | Normal weight | 2(15.4%) | 12(16%) | 2(15.4%) | 11(14.7%) | 8(61.5%) | 23(30.7%) | 1(7.7%) | 29(38.7%) | 13(100%) | 75(100%) |
|  | Overweight | 4(50%) | 12(29.3%) | 2(25%) | 14(34.1%) | 1(12.5%) | 9(22%) | 1(12.5%) | 6(14.6%) | 8(100%) | 41(100%) |
|  | Obese | 2(25%) | 8(30.8%) | 5(62.5%) | 6(23.1%) | 1(12.5%) | 8(30.8%) | 0(0%) | 4(15.4%) | 8(100%) | 26(100%) |
|  | Total  | 12(30.8%) | 40(24.8%) | 15(38.5%) | 37(23%) | 10(25.6%) | 42(26.1%) | 2(5.1%) | 42(26.1%) | 39(100% | 161(100%) |
| No living together at home | 0-3 | 3(27.3%) | 8(13.8%) | 4(36.4%) | 9(15.5%) | 3(27.3%) | 21(36.2%) | 1(9.1%) | 20(34.5%) | 11(100%) | 58(100%) | 2.309 | 0.315 |
| 4-7 | 6(28.6%) | 25(28.7% | 8(38.1%) | 20(23%) | 6(28.6%) | 21(24.1%) | 1(4.8%) | 21(24.1%) | 21(100%) | 87(100%) |
| >7 | 3(42.9%) | 7(43.8%) | 3(42.9%) | 8(50%) | 1(14.3%) | 0(0%) | 0(0%) | 1(6.3%) | 7(100%) | 16(100%) |
| Total  | 12(30.8%) | 40(24.8%) | 15(38.5%) | 37(23%) | 10(25.6%) | 42(26.1%) | 2(5.1%) | 42(26.1%) | 39(100% | 161(100%) |
| Type of apartment  | One room | 2(25%) | 5(11.4%) | 1(12.5%) | 5(11.4%) | 4(50%) | 13(29.5%) | 1(12.5%) | 21(47.7%) | 8(100%) | 44(100%) | 0.900 | 0.825 |
| Room and parlour | 3(60%) | 6(28.6%) | 0(0%) | 9(42.9%) | 2(40%) | 6(28.6%) | 0(0%) | 0(0%) | 5(100%) | 21(100%) |
| Flat  | 6(27.3%) | 25(31.6%) | 11(50%) | 21(26.6%) | 4(18.2%) | 18(22.8%) | 1(4.5%) | 15(19%) | 22(100%) | 79(100%) |
| Duplex  | 1(25%) | 4(23.5%) | 3(75%) | 2(11.8%) | 0(0%) | 5(29.4%) | 0(0%) | 6(35.3%) | 4(100%) | 17(100%) |
| Total  | 12(30.8%) | 40(24.8%) | 15(38.5%) | 37(23%) | 10(25.6%) | 42(26.1%) | 2(5.1%) | 42(26.1%) | 39(100% | 161(100%) |

*\*Statistically significant at p<0.05.*

The result of the relationship between *H. pylori* infection status and the hygiene profile of participants is presented in Table 2. Regarding home drinking water sources, individuals consuming borehole water showed a higher infection rate (53.8%) compared to those using sachet water (46.2%). However, the difference was not statistically significant (X2 = 2.861, p = 0.581). Similarly, the type of drinking water at school did not show a significant association with infection status (X2 = 1.194, p = 0.275), with comparable infection rates between safe (48.7%) and unsafe water (51.3%) sources. Concerning sanitary facilities at home, individuals that had access to sanitary facilities recorded a higher infection rate (97.4%) compared to those that had no access (2.6%). However, this difference was not statistically significant (X2 = 0.803, p = 0.370). Also, the presence of sanitary facilities at school showed no significance (X2 = 2.875, p = 0.090), with individuals having access to such facilities exhibiting a higher infection rate (76.9%) compared to those that had no access (23.1%). In terms of hand hygiene practices, individuals who washed hands after toileting showed a slightly lower infection rate (74.4%) compared to those who did not (25.6%). However, this difference was not statistically significant (X2 = 1.639, p = 0.201).

**Table 2: Relationship between *H. pylori* Infection status and hygiene profile of participants**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable  | Categories | InfectedN(%) | Not InfectedN(%) | Grand total  | X2 | P-value |
| Home drinking water | Borehole | 21(53.8%) | 70(43.5%) | 91(45.5%) | 2.861 | 0.581 |
| Sachet water | 18(46.2%) | 83(51.6%) | 101(50.5%) |
| Rainwater | 0(0%) | 4(2.5%) | 4(2%) |
| Tap water | 0(0%) | 1(0.6%) | 1(0.5%) |
| Boiled water | 0(0%) | 3(1.9%) | 3(1.5%) |
| Total  | 39(19.5%) | 161(80.5%) | 200(100%) |
| School drinking water | Safe  | 19(48.7%) | 94(58.4%) | 113(56.5%) | 1.194 | 0.275 |
| Unsafe  | 20(51.3%) | 67(41.6%) | 87(43.5%) |
| Total  | 39(19.5%) | 161(80.5%) | 200(100%) |
| Sanitary facility at home | No  | 1(2.6%) | 10(6.2%) | 11(5.5%) | 0.803 | 0.370 |
| Yes  | 38(97.4%) | 151(93.8%) | 189(94.5%) |
| Total  | 39(19.5%) | 161(80.5%) | 200(100%) |
| Sanitary facility at school | No  | 9(23.1%) | 20(12.4%) | 29(14.5%) | 2.875 | 0.090 |
| Yes | 30(76.9%) | 141(87.6%) | 171(85.5%) |
| Total  | 39(19.5%) | 161(80.5%) | 200(100%) |
| Wash hands after toileting | Yes | 29(74.4%) | 134(83.2%) | 163(81.5%) | 1.639 | 0.201 |
| No  | 10(25.6%) | 27(16.8%) | 37(18.5%) |
| Total  | 39(19.5%) | 161(80.5%) | 200(100%) |

*\*Statistically significant at p<0.05.*

The result of the relationship between *H. pylori* Infection status and food habits of the participants is presented in Table 3. When considering whether individuals cooked their own food, those who did not cook showed a slightly lower infection rate (0%) compared to those who did (100%). However, this difference was not statistically significant (X2 = 1.498, p = 0.221), with the vast majority of infected individuals who cooked their own food. Regarding eating outside the home, individuals who eat outside showed a higher infection rate (38.5%) compared to those who did not (61.5%). the difference was not statistically significant (X2 = 2.362, p = 0.124), indicating that other factors may also influence infection risk. In terms of consuming spicy food, individuals who consumed spicy food showed a slightly lower infection rate (30.8%) compared to those who did not (69.2%). However, this difference was not statistically significant (X2 = 0.936, p = 0.333). When examining the consumption of carbonated drinks, individuals who consumed carbonated drinks showed a significantly higher infection rate (56.4%) compared to those who did not (43.6%). This difference was statistically significant (X2 = 11.597, p = 0.001), indicating a potential association between carbonated drink consumption and *H. pylori* infection risk. Regarding the consumption of fast food, there was no significant difference in infection rates between individuals who consumed fast food and those who did not. Both groups showed infection rates (38.5% and 61.5%, respectively), and the difference was not statistically significant (X2 = 0.001, p = 0.974).

**Table 3: Relationship between *H. pylori* infection status and food habits of the participants**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable  | Categories | InfectedN(%) | Not InfectedN(%) | Grand total | X2 | P-value |
| Cook at food | No | 0(0%) | 6(3.7%) | 6(3%) | 1.498 | 0.221 |
| Yes | 39(100%) | 155(96.3%) | 194(97%) |
| Total  | 39(19.5%) | 161(80.5%) | 200(100%) |
| Eat outside | No | 24(61.5%) | 77(47.8%) | 101(50.5%) | 2.362 | 0.124 |
| Yes | 15(38.5%) | 84(52.2%) | 99(49.5%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Spicy food | No | 27(69.2%) | 98(60.9%) | 125(62.5%) | 0.936 | 0.333 |
| Yes | 12(30.8%) | 63(39.1%) | 75(37.5%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Carbonated drink | No | 17(43.6%) | 29(18%) | 46(23%) | 11.597 | 0.001 |
| Yes | 22(56.4%) | 132(82%) | 154(77%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Fast food | No | 24(61.5%) | 97(60.2%) | 121(60.5%) | 0.001 | 0.974 |
| Yes | 15(38.5%) | 64(39.8%) | 79(39.5%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |

*\*Statistically significant at p<0.05.*

The result of the relationship between *H. pylori* Infection status and health history of participants is presented in Table 4. Firstly, regarding the presence of peptic ulcer disease in the family, individuals with a family history of the disease showed a slightly higher infection rate (43.6%) compared to those without it (3.7%). Concerning the history of cancer, individuals with a history of cancer showed a lower infection rate (7.7%) compared to those without it (92.3%). Regarding symptoms such as burping, heartburn, regurgitation, chest pain, epigastric pain, abdominal bloating, constipation, diarrhea, and satiety. There was no significant difference (P > 0.05) observed in the infection rates of symptomatic and asymptomatic reporting subjects. In all cases, the majority of participants did not report these symptoms. Lastly, when considering the use of non-steroidal anti-inflammatory drugs (NSAIDs), individuals who reported using NSAIDs showed a slightly higher infection rate (38.5%) compared to those who did not (56.4%). Overall, while certain health history factors showed trends towards association with *H. pylori* infection status, all of these associations were not statistically significant, (P > 0.05) suggesting that other factors may play a more significant role in determining infection risk.

**Table 4: Relationship between *H. pylori* Infection status and health history of participants.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable  | Categories | InfectedN(%) | Not InfectedN(%) | Grand total | X2 | P-value |
| Peptic ulcer disease in family | No | 17(43.6%) | 76(47.2%) | 93(46.5%) | 0.771 | 0.380 |
| Yes | 22(3.7%) | 85(52.8%) | 107(53.5%) |
| Total  | 39(19.5%) | 161(80.5%) | 200(100%) |
| History of cancer | No | 36(92.3%) | 153(95%) | 189(94.5%) | 0.448 | 0.503 |
| Yes | 3(7.7%) | 18(5%) | 11(5.5%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Burping | No | 36(92.3%) | 149(92.5%) | 185(92.5%) | 0.095 | 0.758 |
| Yes | 3(7.7%) | 12(7.5%) | 15(7.5%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Heart burn | No | 26(66.7%) | 109(67.7%) | 135(67.5%) | 0.030 | 0.863 |
| Yes | 13(33.3%) | 52(32.3%) | 65(32.5%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Regurgitation | No | 37(94.9%) | 150(93.2%) | 187(93.5%) | 0.150 | 0.699 |
| Yes | 2(5.1%) | 11(6.8%) | 13(6.5%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Chest pain | No | 26(66.7%) | 119(73.9%) | 145(72.5%) | 0.827 | 0.363 |
| Yes | 13(33.7%) | 42(26.1%) | 55(27.5%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Epigastric pain | No | 37(94.9%) | 141(87.6%) | 178(89%) | 1.706 | 0.191 |
| Yes | 2(5.1%) | 20(12.4%) | 22(11%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Abdominal bloating | No | 16(41%) | 88(54.7%) | 104(52%) | 2.338 | 0.126 |
| Yes | 23(59%) | 73(45.3%) | 96(48%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Inflammation | No | 39(100%) | 161(100%) | 200(100%) | - | - |
| Yes | 0(0%) | 0(0%) | 0(0%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Constipation | No | 30(76.9%) | 109(67.7%) | 139(69.5%) | 1.259 | 0.262 |
| Yes | 9(23.1%) | 52(32.3%) | 61(30.5%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Diarrhea | No | 19(48.7%) | 79(49.1%) | 98(49%) | 0.002 | 0.969 |
| Yes  | 20(51.3%) | 82(50.9%) | 102(51%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Satiety | No | 38(97.4%) | 150(93.2%) | 188(94%) | 1.014 | 0.314 |
| Yes | 1(2.6%) | 11(6.8%) | 12(6%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |
| Use of non-steroidal anti-inflammatory drugs | Yes | 15(38.5%) | 65(40.4%) | 80(40%) | 1.489 | 0.685 |
| No | 22(56.4%) | 83(51.6%) | 105(52.5%) |
| Never | 1(2.6%) | 2(1.2%) | 3(1.5%) |
| Past | 1(2.6%) | 11(6.8%) | 12(6%) |
| Total | 39(19.5%) | 161(80.5%) | 200(100%) |

*\*Statistically significant at p<0.05.*

**Discussion**

It has been reported that *H. pylori* infection is acquired via several routes including oral-oral or faecal-oral transmission and from drinking contaminated water (Okongo *et al*., 2019). Several studies have reported high prevalence of this organism in Africa (Peleteiro *et al.,* 2014; Okongo *et al.,* 2019). It has also been reported that the onset of *H. pylori* infection from childhood, which once established, may prevail throughout life.

In the present study, genderwise comparison showed males at Umudim (41.2%) were more infected compared to other villages. For females, Otolo had the highest infected (40.9%) while Nnewichi had the lowest in both male (5.9%) and female gender (4.5%). Overall, 43.6% males were infected compared to 56.4% female indicating a higher prevalence among females. The high prevalence in Umudim village and Otolo village could be due to some risk factors like overcrowding, poor personal hygiene, poor food/hygiene and poor-quality water supply. This agrees with the findings of Narayaran *et al.* (2018) who reported that poor socio-economic status conditions of participants favoured the risk of the infection. It is believed that the disparities in *H. pylori* prevalence rates across various countries of the world are as a result of differences in the levels of urbanization, access to good water, sanitation and hygiene services, and socioeconomic status (Ikobah *et al*., 2023). The high prevalence recorded among females in this study could be attributed to the high number of females that participated and unsanitary habits that are exhibited by most females. This observation corroborates to the study conducted by Abebaw *et al.* (2014) who reported higher *H. pylori* infection in females. A study conducted by Odigie *et al*. (2020) at Benin Teaching Hospital, Benin City, Nigeria also agreed with this present study. Meanwhile, the observation in this study disagrees with the study conducted by Maniragaba and Atukuuma (2022) who recorded higher prevalence among male, which was attributed to lifestyles exhibited by most males such as smoking and excessive intake of alcohol.

The high prevalence of *H. pylori* infection recorded among tertiary institution participants in this study could be attributed to excessive exposure to risk factors in the environment such as skipping of meal or irregular meal. This observation corroborates to the study conducted by Saber *et al*. (2015). Meanwhile, the observation in this study disagrees with the study conducted by Abebaw *et al*. (2014) and Smith *et al*. (2018) who reported a high prevalence among participants who had no formal education, which they attributed to high level of ignorance. Also, the high prevalence among participants that had population of 4-7 people could be due to overcrowding, which results to unsanitary practices as supported by Narayaran *et al*. (2018) and Smith *et al.* (2018) who reported a high prevalence among participants that had population exceeding 3 people while Abebaw *et al*. (2014) reported that number of people has no influence in the prevalence of *H. pylori*. The high prevalence (43%) recorded among adults in this study corresponds to the findings of Abebaw *et al*. (2014) who observed that a prevalence increases with age. The increase could be attributed to high activities which predisposed them to certain factors. Contrary, Harrison *et al*. (2017) reported a low prevalence among adult participants. The variation could be attributed to differences in diagnostic tools and sampling techniques.

The high prevalence recorded among participants that drank from borehole could be attributed to consumption of untreated water, which had been described as one of the unsanitary practices that could predispose an individual to infectious agents. Similar observation was reported by Abebaw *et al*. (2014) and Smith *et al*. (2018) who observed that participants who drank water from unprotected source recorded high prevalence of *H. pylori* infection.

The high prevalence recorded among participants who had family history of ulcer could be due to unhealthy practices such as food pre-chewing from adults to children and tasting food with spoon belonging to infants before feeding them. This observation agrees with the findings of Samuel (2013) and Ogunshe *et al*. (2013) whose participants with family history of ulcer recorded high prevalence of *H. pylori* infection.

Furthermore, individuals who consumed carbonated drinks showed a significantly higher infection rate compared to those who did not. Also, there was a significant relationship between age, carbonated drink consumption and *H. pylori* infection status. This implies that age and consumption of carbonated drink may influence the rate of acquisition of *H. pylori* infection.

**CONCLUSION**

This study found 43.6% males were infected compared to 56.4% female indicating a higher prevalence among females. Also, there was a significant relationship between age, carbonated drink intake and *H. pylori* infection status. Thus there is need for further studies.

SIGNIFICANCE OF THE STUDY

This study contributes valuable insights to the scientific community by exploring the socio-demographic factors and lifestyle behaviors associated with *Helicobacter pylori* infection in a region where the infection is prevalent, particularly in developing countries. By analyzing the relationships between variables such as gender, age, food habits, and hygiene, it provides a comprehensive understanding of how these factors influence infection rates, particularly in a setting like Nnewi North, Nigeria.

Consent

Consent and assents from parent, guardian and children was sort respectively depending on age.

**Ethical Approval**

This was obtained from the ethical committee of Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Awka, Anambra State, Nigeria.

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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