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CASE STUDY

Association of Lewis blood group with *Helicobacter pylori* Infection amongst Undergraduates of Rivers State University, Port Harcourt, Nigeria.

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Abstract

Background: There are possibilities that the presence of a particular blood group antigen can predispose an individual to certain diseases. It is therefore necessary to carry out studies in relation to this, and the presence of Lewis blood group antigen has been associated with susceptibility to *Helicobacter pylori* infection. The aim of the study is to determine the association of Lewis blood group with *Helicobacter pylori* infection amongst undergraduates of Rivers State University, Port Harcourt, Nigeria.

Method: This cross-sectional study was aimed to elucidate the association between Lewis blood group and *Helicobacter pylori* among one hundred (100) male and female undergraduates of Rivers State University recruited randomly from different ethnic groups in Nigeria. Conventional tube method was used for Lewis blood grouping, and serology for the *Helicobacter pylori* infection using Top Tech Rapid Diagnostic Test Kit. Statistical analysis was by percentage calculation and the use of Graph Pad Prism version 8 Statistical Package to determine Odd Ratios, Relative Risk and Likelihood Ratio; p-value of <0.05 was considered statistically significant.

Result: The prevalence rate of Le^a antigen in total population is 81% (with a frequency of 29 (35.8%) in males and frequency of 52 (64.2%) in females; while that of Le^b antigen is 65% and with a frequency of 25 (38.5) in males and frequency of 40(61.5) in females. The Lewis antigen is more prevalent in females than males. The prevalence of *Helicobacter pylori* in the total population is 10%. Based on odd ratios of 0.02 for Le^a, and 0.06 for Le^b ($p<0.0001$); relative risks of 0.11 for Le^a and 0.16 for Le^b ($p<0.0001$); likelihood ratios of 0.12 for Le^a and 0.17 Le^b ($p<0.0001$), there is no association of Lewis antigen a and b with occurrence of *Helicobacter pylori* infection.

Conclusion: From the odd ratios of 0.02 for Le^a, and 0.06 for Le^b ($p<0.0001$), no risk of being infected with *Helicobacter pylori* can be

associated with the presence of Lewis antigen a and b.

Keywords: Lewis blood group, *Helicobacter pylori*, infection, agglutination

Introduction

As of December 2022, the International Society of Blood Transfusion has recognized 44 human blood group systems, consisting of 354 red cell antigens. These 44 systems are determined by 49 genes (1).

One of the recognized blood group systems is the Lewis blood group system. This system involves classifying human blood based on the presence of glycoproteins called Lewis (Le) antigens on the surface of red blood cells. The Lewis blood group is represented by the ISBT symbol/number LE (007). The Lewis antigen is located on chromosome 19p 13.3, and its gene name in the ISBT system is LE (FUT 3). It is associated with various antigens, including Le^a, Le^b, Le^{bh}, $ALe^{b,}$ and BLe^b (2, 3). Both Lewis antibodies, anti-$Le^{a,}$ and anti-Lea^b, belong to the IgM antibody type and exhibit reactivity at room temperature. They typically emerge within the initial months of life with active complement properties (4). Haemolytic transfusion reactions due to anti-Le^a antibodies are uncommon, whereas those caused by anti-Lea^b antibodies are absent. Neither of these antibodies leads to Haemolytic Disease of the Newborn. Anti-Le^a is often encountered during pregnancy, while anti-Lea^b is considered clinically insignificant (5).

Helicobacter pylori (*H. Pylori*) is a Gram-negative, microaerophilic bacterium that can infect humans. It commonly resides in the stomach, leading to inflammation and ulcers (6). This bacterium affects up to half of the global population and is more prevalent in developing countries (7). Lewis antigens are found in tissues and fluids such as bowel mucosa and endothelium. *Helicobacter Pylori* expresses several lipopolysaccharides on its outer membrane, facilitating colonization and adhesion to the gastric epithelium (8).

The adherence of *Helicobacter pylori* to H and Le^b antigens in gastric mucosa and babA on the bacterium's outer membrane mediates attachment to Le^b antigens on the mucosa (9, 10). This could contribute to a higher incidence of chronic gastritis and gastric adenocarcinoma in individuals with the O and Le (a−b+) phenotypes (11). Lewis antigens are present on the surface of *Helicobacter pylori* as part of their lipopolysaccharide structure (12). Most *Helicobacter pylori* strains in Western populations express type II glycoconjugate antigens, Lewis X (Lex) and Ley, while a smaller proportion expresses type I glycoconjugates, Le^a and Le^b (13). These Lewis antigens can induce pathogenic antibodies. Upon infection, *Helicobacter pylori* lipopolysaccharides may trigger anti-Lex/y antibodies that bind to bacteria and host gastric epithelium, leading to complement activation and tissue damage. In fact, *Helicobacter pylori* infection in mice generates autoreactive anti-Lex/y antibodies (14).

There is a lack of published research on the percentage distribution and frequency of the association between the Lewis blood group and *Helicobacter pylori* amongst apparently healthy subjects. Therefore, it is necessary to conduct serological identification of *Helicobacter pylori* to determine its prevalence among individuals with the Lewis blood group.

The determination of the Lewis antigenic phenotypes amongst Students of Rivers State University, Nigeria, has necessitated this investigation because of the paucity of scientific information about Lewis blood group antigenic distribution, unlike ABO and Rh blood group systems that have gained massive global attention to the scientific community and as well ascertain its association with *Helicobacter pylori* infection.

Materials and Methods

Study Design

This is a cross-sectional study carried out among undergraduate students of Rivers State University, Nigeria, specifically to determine the association of Lewis blood group with *Helicobacter pylori* infection.

Study Area

Rivers State University is located in Rivers State, which is in the South-South geopolitical zone of Nigeria and the Niger Delta region. Rivers State borders include Imo to the North, Abia and Akwa Ibom to the East, Bayelsa and Delta to the North. Rivers State University is a government-owned university located in the Nkpolu-Oroworukwo area of Port Harcourt, the state capital. Port Harcourt lies within latitude 4° 43′ 07″ and 4° 54′ 32″N and longitude 6° 56′ 04″ and 7° 03′ 20″E. All participants were recruited from Rivers State University, irrespective of the department. The analysis was conducted at Nimi Briggs Hospital, Rivers State University, Port Harcourt.

Study Population

A total of one hundred (100) undergraduate students of Rivers State University aged 17 to 30 years were recruited during this study. Thirty-seven (37) were males and sixty-three (63) were females.

Eligibility of Subjects and Informed Consent

Only willing undergraduate students of Rivers State University were enrolled for the study. Informed consent was obtained from apparently healthy human subjects before enrolment after approval by the Department of Medical Laboratory Science, Rivers State University.

Sample Collection and Storage.

After pre-test counseling and explanations, venous blood collection was drawn from the antecubital fossa of the subject with the use of a needle and syringe. A volume of 3.5ml of venous blood was collected into a sample bottle containing 0.5ml of 1.2mg/ml of Ethylene Di-amine Tetra-acetic acid (EDTA) and then well mixed for serological determination of *Helicobacter pylori* infection and Lewis blood grouping. Blood samples collected in EDTA were analyzed within 24 hours of collection. Collected samples were all transported under a cold chain (ice packs/crushed ice in air-tight and sealed thermo containers at 2-8°C).

Determination of Lewis-a and Lewis-b Blood Grouping using anti-Lea Monoclonal and anti-Leb antibody

Method: Tube method as described by Lorne Laboratory Limited.

Procedure: A 2-3% suspension of washed red cells in an isotonic solution was prepared. 1 volume of Lorne Lewis-a or Lewis-b reagent and 1 volume of red cell suspension were placed in a labeled test tube. The test tube was mixed thoroughly and incubated at room temperature (25°C) for 15 minutes. The tube was centrifuged for 20 seconds at 1000rcf. The red cell button was re-suspended gently and read macroscopically for agglutination. This was done using anti-le^b monoclonal produced by Lorne Laboratories Ltd. UK. Lot No; 63216-A1; Expiry Date: 2024/11/9, and anti-Le^b Monoclonal Produced by Lorne Laboratories Ltd, UK. Lot No: 631100-A1; Expiry Date: 2024/11/24.

Agglutination of the red cells constitutes a positive test result and indicates the presence of the Lea or Leb antigen on the red cells. No agglutination of the red cell constitutes a negative result and indicates the absence of the Lea or Leb antigen on the red cells.

Determination of *Helicobacter pylori* Infection

Procedure: The blood in the Ethylene diamine tetra-acetic acid (EDTA) bottle was centrifuged and plasma separated. The test device was removed from the foil pouch and placed on a clean and level surface. Two (2) drops of the plasma specimen were placed vertically on the test device using a dropper, and the timer started for about 10-15 minutes. The presence of agglutinated red cells indicates *helicobacter pylori* infection. This was done using Top Tech rapid diagnostic test kit, Lot no: 20220630; Expiry Date: 2026/06/29.

A positive test result indicates two distinct red lines appearing. One line is the control region (C), and the other is the test region (T). A negative test result indicates one red line in the control region (C) and no apparent red or pink line in the Test region. An invalid test result is indicated when the control line fails to appear. Insufficient specimen volume or incorrect procedural techniques are likely reasons for failure in the control line.

Statistical Analysis

The statistical analysis involved calculating percentages for prevalence determination and using the Graph Pad Prism version 8 statistical package to determine odd ratios, relative risks, and likelihood ratios. The results are presented in Tables.

Results

Demographic Details of Studied Population.

A total of 100 subjects between the ages of 16 and 30 were recruited for the study. There were 37 males and 63 females. Details are shown in Table 1.

Frequency and Percentage Occurrence of *Helicobacter pylori* Infection

The frequency and percentage occurrence of *Helicobacter pylori* infection were analyzed and recorded as 10 percent. Table 2 shows details.

Frequency and Percentage Occurrence of Le^a and Le^b Antigen.

Table 3 shows the frequency and percentage occurrence of Le^a and Le^b Antigen in the studied \population, with 81% for Lewis-a and 65% for Lewis-b. Details are shown in Table 3.

Frequency Occurrence and Percentage Distribution of *Helicobacter pylori* in Studied Population Based on Gender.

The frequency and percentage distribution of *Helicobacter pylori* were analyzed and recorded. Males with *Helicobacter pylori* infection were 2, while females with *Helicobacter pylori* infection were 8. Details are shown in Table 4.

Frequency Occurrence and Percentage Distribution of Lea and Leb Antigen in Studied Population based on Gender.

The frequency and percentage distribution of Le^a and Le^b antigens were analyzed based on gender and recorded. The total number of males with Lea antigens was 29, while the total number of females with Lea antigens was 52. The total number of Leb antigens in males was 25, and the total number of Leb antigens in females was 40. Details are shown in Table 5.

Comparison of Odd Ratios, Relative Risks and Likelihood Ratios of Studied Parameters in Relation to Risk of being infected with *Helicobacter pylori* based on Blood Group and Gender Differences

Table 6 compares the associated risk of being infected with *Helicobacter pylori*. All variables analyzed indicated a lower risk; however, based on odds ratios, the Lewis-a blood group is less likely than the Lewis-b blood group, with odds of 0.02 and 0.06 at a 95% confidence interval. Based on gender, the odds are in favour of females than males, in the order (female < male; at 0.09 < 0.1 odds) at a 95% confidence interval.

Discussion

Lewis antigenic profile on students of Rivers State University is rare and has not been published. *Helicobacter pylori* has been associated with Lewis antibodies, but these disorders are yet to be scientifically and clinically associated with Lewis blood groups among students at Rivers State University. Due to low stipends and not having a good diet, most RSU students usually skip meals and can be hungry for a long time (15). As a result of *Helicobacter pylori* infection interference with gastric acid secretion, it may impair the absorption of many nutrients and compromise the nutritional status of infected individuals, causing different clinical manifestations (16, 17, 18).

The present study comprises one hundred subjects (100), 37 males (37%) and 63 females (63%), all students of Rivers State University. The study was focused on determining the association of the Lewis blood group with Helicobacter pylori infection. The prevalence of Lewis antigens in the present study was as follows: Lea 81 (81%) and Leb 65 (65%), and *Helicobacter pylori* infection was 10%.

This study revealed that Le^a blood group antigen showed a percentage distribution of 81% in the Total population, having a frequency of 81 out of 100 subjects, with a frequency of 29 (35.8%) in males and a frequency of 52 (64.2%) in females. The finding in terms of percentage distribution is higher in frequency than the findings reported by Lorne laboratories (19) where they reported 23% amongst Afro-Americans. A study carried out by Christian and colleagues (20) also revealed that Le^a blood group antigen showed a percentage distribution of 17.82% among their subjects from Ogoni, and the difference in prevalence may be as a result of ethnicity compared to different ethnic populations in the present study; while Jacob and colleagues (21) also revealed the presence of Le^a antigen amongst Bonny descent with a total of 12 (10%) of the study population positive for the Le^a blood group antigen.

For the Lewis-b (Le^b) blood group, this study revealed a percentage distribution of 65% in the total population with a frequency occurrence of 65 out of 100. Based on gender, a frequency of 25 (38.5%) in males and 40 (61.5%) in females. This is not in tune with the 33% as reported by Lorne laboratories (22) and also in discord with Reid *et al*. and Leger (4, 23). Findings from this study also differ from that of Yusuf and colleagues (24) by 49.9%, as reported by 15.1% of blood donors in Kano State, Nigeria. In their study, Christian and colleagues (20) revealed a percentage distribution of Leb as 11.88%. This disparity in percentage distribution may be attributed to the study considering mixed ethnic populations.

In this study, the prevalence of *Helicobacter pylori* is 10%. In Nigeria, research was carried out, and the prevalence of *Helicobacter pylori* was 80% when tested using histology, with a higher prevalence of 93.6% with serology (25). In Benin, Aguemon *et al* (26) had a prevalence of 74% with a total population of 96 (54 urban and 42 rural). This prevalence is higher than the prevalence of this study, which is 10%. This high prevalence is due to the recruitment of participants with diverse geographical characteristics. According to Agi and colleagues (27), a study was carried out on two hundred and forty participants (240), and the prevalence of *Helicobacter pylori* was found to be 55% in Rivers State University Teaching Hospital (27). The results of these studies do not agree with this work. Ishaleku and Ihiabe (28) sampled 200 students in Nasarawa State, and the prevalence of *Helicobacter pylori* was 54%. This prevalence is higher than the prevalence of this study. A prevalence of 81% was reported by Bashir and Ali (29) in Kano, Nigeria. In Jos, Nigeria, a prevalence of 87% was reported (30); in Gombe, Nigeria, a prevalence of 77% was reported (31); in Ile–Ife, Nigeria, a prevalence of 73% was also reported (32); all these findings portray high prevalence than that of this study with over 50% prevalence. Although Ayodele and colleagues [33] reported a prevalence of 19.6%

at the University of Port Harcourt Teaching Hospital, Nigeria, a prevalence which is a little above that of this study (by 9.6%). This correlates with the prevalence of this study. The low prevalence in this study is due to the recruitment of participants within a single or similar geographical characteristic. This means that some of the factors that influence the transmission of *Helicobacter pylori* infection are influenced by the environment (34, 35).

There is no association between Lewis antigens a and b and the prevalence of *Helicobacter pylori* infection; hence, there is a lower risk of infection. According to Umlaift and colleagues (36), there was no correlation between *Helicobacter pylori* and Lewis blood group phenotype. Two hundred and twenty-five blood samples were collected, and Enzyme-Linked Immunosorbent Assay (ELISA) technique, chi-square test, and odds ratio were used. The association seroprevalence for *Helicobacter pylori* was 80.4% (181) (36). Another study in 2013 showed that there was no significant association between Le^a and Le^b antigens and this infection (25).

The results from this study indicate a notably reduced risk of *Helicobacter pylori* infection associated with Lewis-a and Lewis-b antigens. The low Odds Ratios and Relative Risks for individuals expressing these antigens suggest a protective effect against *Helicobacter pylori* infection. This observation could have implications for understanding the pathogenesis of *Helicobacter pylori* and may influence future research directions focused on the interaction between specific blood group antigens and the bacterium.

The gender-based analysis reveals a lower risk of *Helicobacter pylori* infection in females and males, as evidenced by the low Odds Ratios and Relative Risks. This finding prompts considerations regarding the potential influence of gender-related factors on susceptibility to *Helicobacter pylori*. It may inspire further investigations into hormonal, immunological, or sociodemographic factors that could contribute to the observed gender differences in infection risk.

The statistical significance of the results, indicated by the low p-values across all variables, adds robustness to the findings. This underscores the reliability of the associations between Lewis antigens, gender, and *Helicobacter pylori* infection risk within the studied population.

Understanding the relevance of these results in a broader context is crucial. Identifying specific blood group antigens and gender as potential factors influencing *Helicobacter pylori* infection can guide healthcare professionals in risk assessment and targeted interventions. For instance, individuals lacking the protective Lewis antigens may be considered a higher-risk group and could benefit from tailored preventive measures or monitoring.

Moreover, these findings contribute to the growing body of knowledge on host-pathogen interactions. The associations between blood group antigens and infectious diseases affect vaccine development, personalized medicine, and population health strategies. Recognizing these associations allows for a more nuanced understanding of the factors influencing infection susceptibility, facilitating the development of effective public health interventions.

Conclusion and Recommendation

Conclusion

Le^a antigen in the total population has a percentage distribution of 81%, with a percentage distribution of 35.8% in males and 64.2% in females. Le^b antigen in the total population has a percentage distribution of 65% with a percentage distribution of 38.5% in males and 61.5% in females. *Helicobacter pylori* infection has a percentage distribution of 10% in the total population, out of which the percentage ratio is 20% in males and 80% in females. From odd ratios, no risk of being infected with *Helicobacter pylori* can be associated with the presence of Lewis antigens

a and b, as seen in the study.

Recommendations

Further investigations such as the mechanisms underlying the association of Le^a and Le^b antigens against *Helicobacter pylori* infection should be carried out molecularly. Gender-related factors that may influence susceptibility to *Helicobacter pylori* infection such as exploring hormonal, immunological or sociodemographic factors and their potential impact on infection risk and intensive studies should be carried out on a larger population and also extended to other students of various universities in Rivers State and Nigeria. Given the differences in prevalence rates reported by various studies, researchers should work towards standardizing methodologies.

Table 1: Demographic Details of Studied Population.

Population	Numbers	Percentage %
Total number of subjects	100	100
Total number of Males	37	37
Total number of Females	63	63
Age bracket	17 – 30	

Table 2: Frequency and Percentage Occurrence of *Helicobacter pylori* Infection

Parameters	Frequency	Percentage (%)
Helicobacter pylori in total population	10	10

Table 3: Frequency and Percentage Occurrence of Le^a and Le^b Antigen.

Parameters	Frequency	Percentage (%)
Le^a antigen in total population	81	81
Le^b antigen in total population	65	65

Table 4: Frequency Occurrence and Percentage Distribution of *Helicobacter pylori* in Studied Population based on Gender.

Parameters	Frequency	Percentage (%)
Helicobacter pylori in males in the Total population	2	2
Helicobacter pylori in females in Total population	8	8

Table 5: Frequency Occurrence and Percentage Distribution of Le^a and Le^b Antigen in Studied Population based on Gender.

Parameters	Frequency	% based on study Population	% based on Gender
Le^a antigen in males	29	29	35.8
Le^a antigen in females	52	52	64.2
Le^b antigens in males	25	25	38.5
Le^b antigen in females	40	40	61.5

Table 6: Odd Ratios, Relative Risks and Likelihood Ratios of Studied Parameters in Relation to Risk of being infected with *Helicobacter pylori* based on Blood Group and Gender Differences.

Variables	Odd Ratio	Relative Risk	Attributable Risk	Likelihood Ratio	p-value
Lewis-a	0.02 CI 0.011 to 0.063	0.11 CI 0.058 to 0.215	0.70 CI 0.605 to 0.825	0.12	<0.0001 S
Lewis-b	0.06 CI 0.025 to 0.152	0.16 CI 0.075 to 0.306	0.53 CI 0.415 to 0.671	0.17	<0.0001 S
Females	0.09 CI 0.039 to 0.202	0.19 CI 0.095 to 0.355	0.49 CI 0.369 to 0.633	0.20	<0.0001 S
Males	0.10 CI 0.022 to 0.389	0.14 CI 0.038 to 0.487	0.31 CI 0.193 to 0.469	0.15	0.0002 S

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