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Prevalence of Malaria Parasitemia and Associated Risk Factors among Asymptomatic Population in a Tertiary Institution in Kogi State, Nigeria

Joshua Idakwo[1]; Omatola C. Arome[2]; Chris I. Okoye[3]; Gabriel U. Amana[1]; Linus S. Egwu[1] and Emmanuel T. Idowu[4]

[1]Department of Animal and Environmental Biology, Prince Abubakar Audu University, Anyigba, Nigeria.
[2]Department of Microbiology, Prince Abubakar Audu University, Anyigba, Nigeria.
[3]Department of Zoology and Environmental Biology, Faculty of Biological Sciences, University of Nigeria Nsukka, Nigeria.
[4]Department of Zoology, Faculty of Sciences, University of Lagos, Nigeria.
***E-mail :** jodakwo@gmail.com ; etidowu@yahoo.com

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ABSTRACT

Background: Malaria remains a significant health concern in the tropics. Objectives: The study aimed to determine the prevalence of malaria among asymptomatic students of Kogi State University living off campus. **Method:** A cross-sectional study was carried out among 250 students of Kogi State University living off campus, using the rapid diagnosis test method. **Results:** The result revealed that 40(16%) students were infected with Plasmodium falciparum, with a high prevalence of 25(23.81%) recorded in males compared to 15(10.35%) in females. Students of age 25-29 years had the highest prevalence of 20(25%), followed by those of 15-19 years and 20-24 years with prevalence of 10(22.22%) and 10(10%) respectively, while no case was recorded for age 30 years and above. Genotype-related prevalence shows that students with the genotype "AS" had the highest prevalence of 15(25%), while "AA" had 25(13.51%) and "SS" had the lowest. Students with blood group of A+, O-and O+ had the prevalence of 15(37.5%), 5(25%) and 15(20%) respectively. Higher prevalence of 23.53% was observed among students who reside at the back of the school while those at Stadium Road and front of school had 15(27.27%) and 5(4.55%), respectively. Statistically, there was no significant difference between malaria parasitemia and genotype ($p<0.05$) but there was a difference between malaria parasitemia and sex, age, blood group, and location of students ($p<0.05$). **Conclusion:** This study indicated a substantial rate of malaria infection among students of Kogi State University living off campus. Awareness creation among students on malaria predisposing risk factors should be intensified to reduce the transmission rate.

INTRODUCTION

Malaria is a life-threatening disease caused by genus of protozoan parasite *Plasmodium* which is vectored by female *Anopheles* mosquito (Murray *et al*., 2018). Common species infecting humans are *P. falciparum, P. vivax P. malariae* and *P. ovale* (WHO, 2018). The epidemiological distribution of malaria and prevalence patterns usually depend on climatic factors such as temperature, humidity and rainfall which constitute determinants of the arthropod vector abundance (CDC, 2017).

Malaria remains a major public health problem in 97 countries and territories in the tropics and subtropics. World malaria reports recently show that there is an estimated 263 million cases and 597,000 malaria deaths worldwide in 2023 (WHO, 2024). This represents about 11 million more cases in 2023 compared to 2022, and nearly the same number of deaths majority of which is in the WHO African Region (WHO, 2024). In 2015 alone, approximately 438,000 deaths were reported in association with malaria with sub-Saharan Africa accounting for >90% mortality. Similarly, World health statistics showed malaria is still responsible for about 228 million morbidity cases and over 405 000 deaths across the globe (WHO, 2019).

Nigeria carries the largest malaria burden globally, with an estimated 66.7 million cases in 2022, representing 27% of global cases and 31% of deaths (WHO, 2023). However, there has been an overall decline in parasite prevalence in children under 5 years from 42% in 2010 to 22% in 2021 which was as a result of the intervention of Community Health Influencers and Promoters of services (CHIPS) network (NMEP, 2022). This infectious menace affects the country's economic productivity, resulting in an estimated monetary loss of approximately 132 billion Naira (~700 million USD) in treatment of cases as well as prevention which include provision of long-lasting insecticidal treated nets (LLINs), indoor residual spraying (IRS) insecticide, and other indirect costs (Ye *et al*., 2013; Nwanne *et al*., 2015).

The prevalence of malaria has been reported by different studies in different risk groups in Nigeria. In Kogi State, the evidence of malaria has been reported among pregnant women accessing hospital care in different locations (Okolo *et al*., 2017; Mofolorunsho *et al*., 2014) but little or no study has been reported in asymptomatic community setting in the study area. Malaria has been hypothesized to be the commonest cause of ill health among students at Nigerian universities (Mgbemena *et al*., 2016). Malaria parasites often sequester leading to unexpressed malaria symptoms which may serve as a reservoir for continued transmission and furthermore complicates diagnostics. Early diagnosis and treatment of such conditions can go a long way to reducing the transmission rate of malaria among students. Current study therefore sought to determine the prevalence of asymptomatic malaria parasitemia among students of Prince Abubakar Audu University, Anyigba, and to assess influence of some socio-demographic and genetic parameters on the occurrence of malaria in the study setting.

MATERIALS AND METHODS

Study Area:

The study was conducted in Anyigba area which lies in the moderate rainfall belt of Nigeria. There is a short dry season from November to March in the area while rainy season is from April to October. The harmattan season runs between December and January and is characterized by low relative humidity and dusty wind. Generally, the average monthly temperature is high throughout the year with a mean annual temperature estimated at 32ºC (Ifatimehin *et al*., 2014). Prince Abubakar Audu University is located in Anyigba, a town situated on geographical coordinates 7º 15'' N and 7º 32'' E and on an altitude of 420m above sea level (Ifatimehin *et al*., 2014). (Fig. 1).

Study Population Design:

A cross-sectional study was carried out amongst 250 students (105 males, 145 females) of Prince Abubakar Audu University living in their clusters outside the school campus. Students were randomly selected based on three locations of their residence with dense population (Front of University, Back of University and Stadium Road) in order to have a good representation of the sample size. For each of the three applicable locations of residence, a

systematic sampling of students was employed having selected the first at random Socio-demographic data such as age, gender, and residential area were obtained with a well-structured questionnaire. Discretionary informed consent was sought and obtained from each participant at the respective sampling locations using an informed consent form which must be certified before proceeding to sample collection. Ethical approval for the study was obtained from the Ethical Review Committee (ERC), College of Health Sciences, Prince Abubakar Audu University with reference number "COHS/02/22/2020".

Sample Size Determination:

The sample size of 250 was determined for the study based on the formula described by Taherdoost for estimating sample size (Taherdoost, 2016).

$n = p\,(100-p)\,Z^2 / E^2$

n is the required sample size

P is the percentage occurrence of a state or condition.

E is the percentage maximum error required.

Z is the value corresponding to level of confidence required.

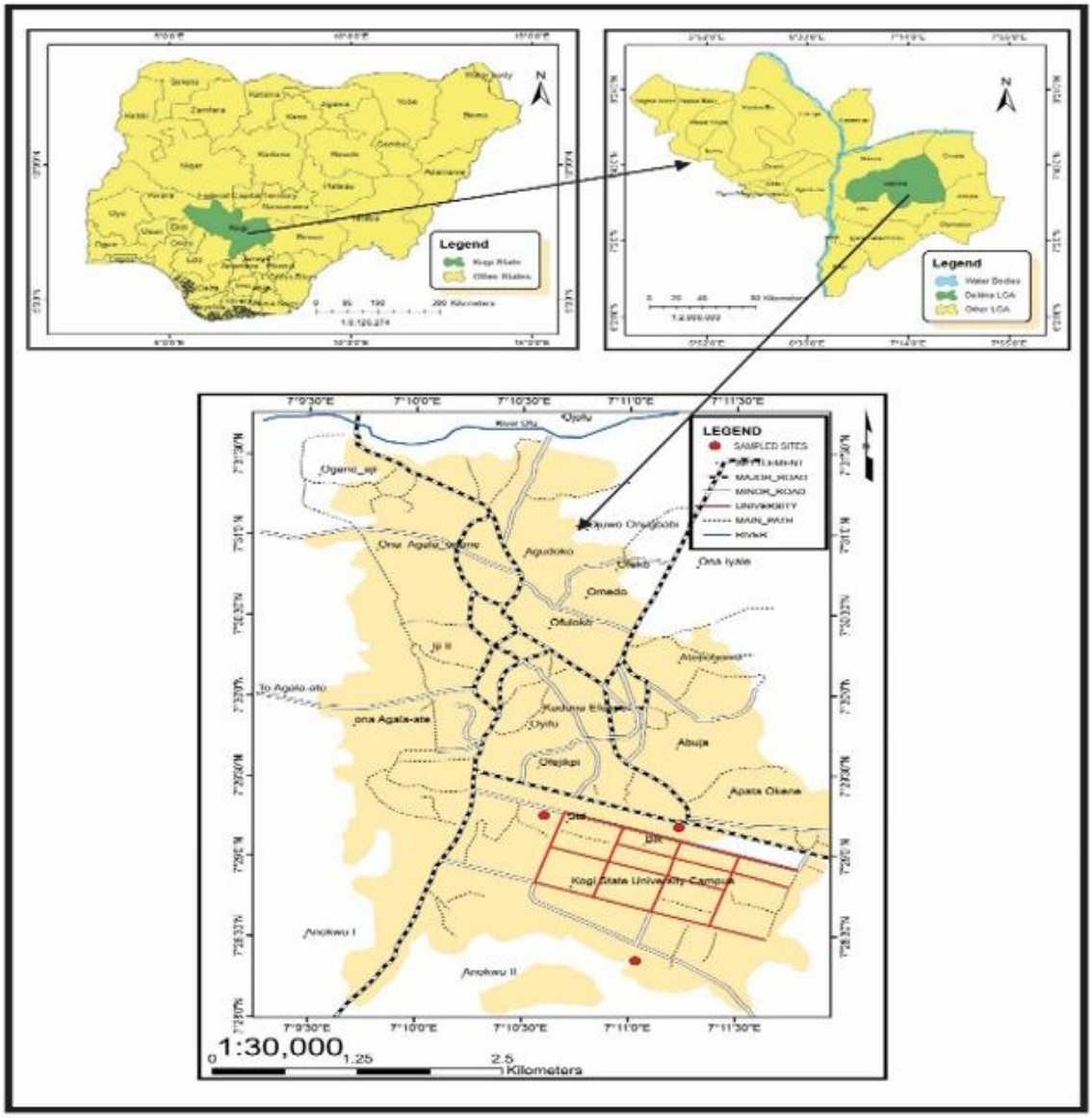

Fig. 1: Map of the study area

Source: Department of Geography and Planning, Prince Abubakar Audu University, Anyigba.

Data and Sample Collection:

A standardized questionnaire was used to obtain socio-demographic and other relevant data from each consented participant. This was immediately followed with the collection of blood samples by finger-pricking to be applied on the cassette of the Rapid Diagnostic Test Kit. A total of 250 blood samples were randomly collected for malaria parasite assay.

Rapid Diagnostic Test (RDT) Procedure:

The qualitative immunoassay RDT kit CareStart^{TM} impregnated with monoclonal antibody which target the immune-dominant HRP2 antigen of P. *falciparum* in serum was used. All test procedures and interpretation were directed by the kit's manufacturer.

Statistical Analysis:

Data obtained from this research was analyzed using statistical packages for social sciences (SPSS) version 22.00 for windows. Chi-square test was used as measure of association and the level of statistical significance was set at $P<0.05$.

RESULTS

Two hundred and fifty (250) students of Prince Abubakar Audu University living off campus were screened during the study period, out of which 40(16%) students were positive for *Plasmodium falciparum*. Infection was higher among males 25(23.81%) than their female counterparts who had 15(10.35%) rates of malaria parasitemia. Statistics shows a significant difference in rates of infection between male and female participants ($P<0.05$). Current study indicated a significant difference in malaria prevalence among the different age groups ($P<0.05$). Students aged 25-29 years recorded the highest prevalence (25%) followed by those aged 15-19 (22.22%) and 20-24 years (10%) while the least prevalence of (0%) was recorded among students aged >30 years (Table 1). Chi square analysis of disease distribution by students' residence showed that students who live at back of school accounted for 23.53% of cases while those who were positioned front of school and along stadium road had 5(4.55%) and 15(27.27%) prevalence rates, respectively. There was a high significant difference between malaria prevalence and location of students living off campus (Table 1). Table 2 shows the prevalence of malaria with respect to blood group and genotype make-up. The result showed students with blood group A^+ had the highest prevalence of 15(37.5%) followed by those with blood group O^-, O^+ and B^+ which had 5(25%), 15(20%) and 5(7.69%) respectively while those having blood group A^-,B^-, AB^+ and AB^- had 0% parasitemia rate. These differences were highly significant statistically ($P<0.05$). Analysis by genotype indicated higher malaria parasitemia (25%) rate among students with genotype AS and lower prevalence (13.51%) in those with genotype AA. The lowest (0%) was recorded among students with genotype SS. This was not statistically related to malaria parasitemia in this study ($P>0.05$).

Table 1: Malaria infection and socio-demographic characteristics of Students of Prince Abubakar Audu University, Anyigba Kogi State, Nigeria from April to August 2024

Variable	No Examined (%)	No Positive (%)	No Negative (%)	X^2	P-value
Sex					
Male	105(42)	25(23.81)	80(76.19)	8.12	0.004*
Female	145(58)	15(10.35)	130(89.65)		
Age group					
15-19	45(18)	10(22.22)	35(77.80)	13.55	0.004*
20-24	100(40)	10(10.00)	90(90.00)		
25-29	80(32)	20(25.00)	60(75.00)		
Above 30	25(10)	0(0)	25(100)		
Residence					
Back of School	85(34)	20(23.53)	65(76.47)	19.52	0.000*
Front of School	110(44)	5(4.55)	105(95.45)		
Stadium Road	55(22)	15(27.27)	40(72.73)		
Total	**250(100)**	**40(16.00)**	**210(84.00)**		

Values in parenthesis indicate percentage. *=Significant at p<0.05.

Table 2: Malaria infection distribution in relation to students' blood group and genotype of Students of Prince Abubakar Audu University, Anyigba Kogi State, Nigeria from April to August, 2024

Variable	No Examined (%)	Positive (%)	Negative (%)	X^2	P-value
Blood Group					
O^+	75(30)	15(20.00)	60(80.00)	28.71	0.00*
O^-	20(8)	5(25.00)	15(75.00)		
A^+	40(16)	15(37.50)	25(62.50)		
A^-	25(10)	0(0)	25(100.00)		
B^+	65(26)	5(7.69)	60(92.31)		
B^-	10(4)	0(0)	10(100.00)		
AB^+	15(4)	0(0)	15(100.00)		
AB^-	0(0)	0(0)	0(0)		
Genotype					
AA	185(74)	25(13.51)	160(86.49)	5.41	0.06ns
AS	60(24)	15(25.00)	45(75.00)		
SS	5(2)	0(0)	5(100.00)		
Total	**250(100)**	**40(16.00)**	**210(84.00)**		

Values in parenthesis indicate percentage. Ns=Not significant at p>0.05.*=Significant at p<0.05.

DISCUSSION

In this study, the overall prevalence rate of malaria among asymptomatic students is 16%, which is comparable with 17.4% and 30.59% (Taherdoost, 2016; Adesina, 2018) earlier reported among students at University of Maiduguri and children in Kano, respectively. The prevalence rate obtained in this study is lower when compared with

similar work done in Senegal where they recorded a prevalence rate of 77% (Fernando *et al*., 2018) and 83.3% among students of Federal University Otueke, Bayelsa State (Ezenwaka and Iyoh, 2018). The fact that this study was conducted in a university environment, among individuals of higher learning and understanding, may have contributed to the low level of asymptomatic prevalence obtained in this study when compared with other studies (Ezenwaka and Iyoh, 2018). Ignorance of control measures has been correlated with high prevalence in other studies (Mgbemena *et al*., 2016). Thus, the current rate might be suggestive of the fact that the studied population were better informed about vector control such as the use of insecticide treated nets (ITN) and other control measures which had been previously attributed to lower infection (Mgbemena *et al*., 2016). The differences between periods of study is another likely explanation for the observed difference in overall prevalence estimates.

The study observed more males (23.81%) being infected than females (10.35%) and there was a significant difference between malaria prevalence with gender ($p<0.05$). This agrees with finding of other researcher across the country who also recorded that male students had higher prevalence than the female students (Adeyemo *et al*., 2014). However, the result of this study contradicts other findings where female individuals had a higher risk of being infected with malaria compared to the male participants (Oyinlola *et al*., 2015). The higher rate of infection among the males than their counterpart females could be attributed to the higher tendency of exposure of their body during hot weathers and sleeping outside insecticide-treated net. This increases the chances of being bitten by the mosquito vector. In some settings, males have been shown to utilize health care service less than the females, as they may assign a low priority to their health, making them reluctant to spend much time walking to health Centre even when malaria is suspected (Muller, 1998).

The finding of higher malaria prevalence among age 25-29 years is contrary to age of greater infection earlier reported among students of tertiary institutions (Mgbemena *et al*., 2016). Our study observed a level of statistical significance in association with student ages which is also at par with the findings of some researchers who posited that the prevalence of malaria was age dependent and that age increase was associated with decrease parasite load and complexity of infections. From other studies (Mgbemena *et al*., 2016; Ezenwaka and Iyoh, 2018; Adesina, 2018). asymptomatic malaria has been reported in areas with high malaria transmission. It is believed to serve as a reservoir for continued transmission, and furthermore complicates diagnostics, as not all individuals with a positive malaria test are necessarily ill due to malaria, although they may present malaria-like symptoms.

Students in this study with genotype 'AS', had the highest infection rate of 25%, while the students with genotype 'AA', had a lower infection rate of 13.51% and the lowest prevalence of 0% was recorded for genotype SS which had only five participants among the study population in the study area. This may suggest that individuals with genotype 'AS' are susceptible to malaria infection, which corresponds to the finding of other researchers within the country (Nwanne, 2015). Similarly, students who were blood group 'A^+', 'O^-' and 'O^+' had high prevalence followed by 'B^+' while those who were 'A^-' 'B^-, AB^+ and AB^- had no case of malaria infection. Findings from other researchers across Nigeria show a similar result where individuals of blood group A and O had the highest malaria prevalence among others (Olawumi, *et al,* 2014). The higher prevalence of infection in blood group A and O is an indication of greater susceptibility which had been previously observed in Mali (Rowe *et al*., 1997).

The finding of this study also shows statistical significance of the prevalence of malaria infection across locations with differences in the infection rates. This is not in agreement with the findings of other researchers across the country (Adeyemo *et al*., 2014). The differences in the various locations can be attributed to environmental factors that support the breeding of mosquito vectors as well as students' attitude to preventive measures.

In conclusion, the findings of the present study have clearly revealed that students of Prince Abubakar Audu University living off campus have a substantial rate of malaria infection whose symptoms are not expressed. There is therefore the urgent need to intensify health education of malaria prevention and control strategies among students of tertiary education and the population at large to reduce the rate of transmission and attendant consequences such as cost of antimalarial treatment, hospital admission, absenteeism of students from class, decreased students output and possibly death.

Declarations:

Ethical Approval: The study complied with ethical guidelines and was approved by ethical Review Committee (ERC), College of Health Sciences, Prince Abubakar Audu University with reference number "COHS/02/22/2020" to use data and collected specimens in the current study.

Competing Interests: The authors declare that they have no conflict of interests that appear to be relevant to the content of this article.

Availability of Data and Materials: The data used in this study are available on request from the corresponding author.

Authors Contributions: I hereby certify that all the authors listed on the title page have significant contributions to the conception and design of the study, have read and deeply revised the manuscript, confirm the authenticity and precision of the data and its interpretation and agree to its submission.

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