

Prevalence of Malaria among Biological Science Students in Federal University of Technology Akure, Nigeria

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Abstract: The prevalence of malaria parasites among the students of Biological Sciences of the Federal University of Technology Akure, Ondo State was studied from May to November, 2014. Two hundred and ninety-seven (297) students whose ages range from 16-30 years were selected at random for this study. Thin and thick films were prepared from the blood collected from the respondents using sterilized lancets; blood group test was also carried out to determine the blood groups while heights and weights were collected using a structured questionnaire. The results showed a total prevalence of 45.79% (n=136) among the study group. Significant difference in the prevalence among age groups ($p < 0.05$) was observed, where age group 16-20 years had the highest prevalence of 47.7% and the lowest prevalence of 21.1% was found in age group 26-30 years. Similarly, prevalence of malaria infection was higher in male (55.9%) than the female (35.2%). Prevalence of malaria among the blood groups was significantly different ($P < 0.05$) with blood group A+ showing the highest prevalence of 92.9% and the blood group O- showing the lowest prevalence of 17.6%. It was generally observed in the study that susceptibility to malaria parasites increased with the presence of Rhesus factor in the blood and decreased when this factor is absent. However, three species of *Plasmodium*: *P. falciparum*, *P. malariae* and *P. vivax* were identified to be the causative agents of the disease among the study group but *P. falciparum* was the most prevalent parasite (57.3%). The results of the study have revealed that malaria is still a major public health problem among the students therefore proper environmental management such as well maintained drainage system within and around the university premises should be maintained in order to reduce mosquito population and consequently reduce prevalence of malaria in the study area.

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1. Introduction

Malaria is the world's most deadly parasitic disease and is caused by infection with single-celled parasites of the genus *Plasmodium* belonging to the apicomplexan phylum. Female *Anopheles* mosquitoes transmit these parasites from one person to another in their bites (WHO, 1992). The disease is characterized by periodic bouts of severe chills and high fever. Serious cases of malaria can result in death if left untreated. It also constitutes a major public health problem with an estimated two million children worldwide dying of it yearly. Regardless of the fact that it is one of the oldest recorded diseases, malaria remains one of the world's most deadly infectious diseases. It is arguably, the greatest menace to modern society in terms of morbidity and mortality. Though preventable, treatable and curable, there is no known immunity (Holding *et al.*, 2001). This makes it an efficient and unrepentant killer. Several centuries after its discovery, malaria still remains a devastating human infection, resulting in 300-500 million clinical cases and three million deaths every year. It is estimated that in Africa, malaria is responsible for over one million deaths yearly particularly of infants and young children (Angyo *et al.*, 1996; Ofowwe and Eregie, 2001). The

sub-Saharan African region has the greatest number of people exposed to malaria transmission and the highest malaria morbidity and mortality rates in the world (WHO, 2005). Malaria is endemic throughout Nigeria (WHO, 2005) and the country is one of Africa's hardest-hit, accounting for between 30 and 40 percent of malaria deaths on the continent. This magnitude of occurrence in this part of the world correlates with poverty, ignorance and social deprivations in the community (WHO, 2009).

In Nigeria, statistics show that malaria accounts for 25% of under-five mortality, 30% of childhood mortality and 11% of maternal mortality (Murphy *et al.*, 2001). The disease is known to have a negative impact on performance and learning in children (Holding *et al.*, 2001). It also aggravates anaemia and malnutrition in children and pregnant women (Murphy *et al.*, 2001). All Nigerians are at risk of malaria and the problem is compounded by the increasing resistance of malaria to hitherto cost-effective antimalaria drugs. Over the years, a lot of efforts have gone into controlling malaria in Nigeria and other African countries, the most affected by the disease, but the problem has not shown any sign of abating. The reasons for the limited success in efforts to eradicate

malaria, a disease of poverty in Nigeria include lack of political will and commitment, low awareness of the magnitude of malaria problem, poor health practices by individuals and communities and resistance to drugs (Yusuf, 2007). Similarly, the effort of public health officials to wipe out malaria during 20th century has also been frustrated by the parasites and vector developing resistant against many antimalaria drugs and insecticides respectively. This response, known as drug resistance, makes the drugs less effective.

One of the clinical symptoms of malaria is fever which may explain the frequent use of paracetamol and antimalarials for febrile children. These medicines are frequently adulterated in Nigeria, thus losing their efficacy. In addition, they may become substandard as a result of chemical instability from inappropriate importation and storage conditions or due to poor quality control during their manufacture (Bonati, 2009). Counterfeiting therefore has contributed to resistance of chloroquine and sulphadoxine-pyrimethamine to malaria parasites (Federal Ministry of Health, 2005). Quinine or artemisinin derivatives have been recommended by the WHO for severe malaria treatment (WHO, 2006). In addition, several efforts had been directed to the control of the vector which include the use of insecticides but *Anopheles* mosquitoes that transmit the disease have become resistant to many insecticides (WHO, 2009). To address the problem of drug-resistant malaria, scientists are conducting research on the genetic mechanisms that enable *Plasmodium* parasites to avoid the toxic effects of malaria drugs. Understanding how those mechanisms work should enable scientists to develop new medicines or alter existing ones to make drug resistance more difficult. By knowing how the parasite survives and interacts with the human host during each distinct phase of its development, researchers also hope to develop drugs that attack the parasite at different stages (Bonati, 2009).

Previous studies have shown that *Anopheles* mosquito breeding decreases with increasing proximity to the center of urban areas (Robert *et al.*, 2003) and the World Malaria Report by WHO (2009) also reported that the number of annual malaria cases worldwide is actually decreasing, yet the impact of the disease burden remains an enormous challenge, for sheer numbers and threat to human life. In addition, the disease burden varied significantly among different age groups, genders and blood groups. However, the correlation of severity of malarial infection to the patient's blood group has been of recent interest in the quest for the answers to the factors influencing clinical course of the disease. The observation by Miller *et al.* (1994) that human erythrocytes lacking the Duffy blood group antigens are refractory to invasion by *P. vivax* parasites indicate the usefulness of studying the

association of blood group with malaria. In the Nigerian scenario, the literatures relating to malaria and the blood groups are sparse and have mixed results. Therefore, there is need for proper diagnosis of the disease to evaluate the current prevalence especially among the age groups, genders and blood groups in the endemic areas in order to further increase public enlightenment on the prevention and control of this killer disease.

2. Materials And Methods

2.1 Study Area

This research was undertaken among the Biological Science students of the Federal University of Technology Akure, Ondo State from May to September, 2014. Biological Sciences of the Federal University of Technology Akure consists of 3 departments namely Biology, Biochemistry and Microbiology with a population of 1500 students. 297 students between the ages 16 to 30 years were randomly selected across the departments for the study.

2.2 Ethical Consideration And Informed Consent

Prior to the commencement of the research, approvals for the study were obtained from the Department of Disease Control of the Ondo State Ministry of Health and the Heads of Departments of Biology, Microbiology and Biochemistry in Federal University of Technology Akure, Ondo State. Also, informed consent of the respondents was obtained after focus group discussion in English Language, where the participants were made to know the benefits and discomfort of their participation in the study. 297 students of both sexes, whose ages are between 16-30 years, were randomly selected for the study. Structured questionnaire was administered to obtain useful epidemiology information such as age, sex, weight and height.

2.3 Blood Collection And Preparation For Microscopy

Blood samples were aseptically collected from the left thumb of the respondents using a sterile lancet. Before collection, the thumb was cleaned with cotton wool dampened with 70% ethanol to remove dirt and oils from the ball of the finger. Then the thumb was stroked to stimulate blood circulation and gentle pressure was applied on the finger before it was gently punctured by the sterile lancet. Drops of the blood were collected in the EDTA bottles for thin and thick film preparation and blood grouping. Respondent fingers were immediately swabbed with cotton wool soaked with 70% ethanol to prevent entry of pathogen into the wound.

Thin and thick smears of the samples were prepared on sterile slides and subsequently stained with Giemsa at pH 7.2. The thick smears were viewed under x100 objective lens of the microscope to detect the

presence of malaria parasite (*Plasmodium spp*), subsequently, the thin smear was used to identify the species of the parasite. Prevalence of the parasite was estimated for age groups, gender and blood groups. In addition, the most prevalent species of *Plasmodium* among the population was also identified.

2.4 Blood Grouping Test

Blood groups of the participants were determined by placing three drops of the blood samples on separate points on the sterile white tiles. A drop of each anti-sera was placed beside the blood, the blood and the anti-sera were thoroughly mixed together to obtain homogenous mixtures with the aid of a sterile rod and the tile was rocked gently to ensure uniform mixing. The mixtures were separately observed for agglutination reaction and these reactions were compared with the blood group chart to ascertain the results. Based on these observation and confirmation, the respondents were grouped into eight major blood groups namely; A+, A-, B+, B-, O+, O-, AB+ and AB-

(the positive ones are those with interaction with anti-sera while the negative ones have no interaction with anti-sera).

2.5 Statistical Analysis

Data obtained were subjected to Chi-square (X^2) using SPSS 17.0 (Statistical Package for Social Sciences) at 95% level of confidence. The P-values were used to determine whether the prevalence was significantly different or not.

3. Results

A total number of 297 students were examined for *Plasmodium spp*, the students ages range from 16-30years. The results show that highest prevalence (47.7%) was recorded in age group (16-20 years) while the lowest prevalence (21.1%) was expressed in the age group (26-30 years) as shown in (Table 1). Chi-Square analysis of the data shows that there is significant difference in the prevalence among the age-groups ($X^2=6.00$, $P=0.199$, $P<0.05$).

Table 1: Prevalence of Malaria among Age Groups

Age group (Years)	Number Examined	Number positive	Prevalence (%)
16-20	109	52	47.7
21-25	169	80	47.3
26-30	19	04	21.1
Total	297	136	45.79

$X^2= 6.00$; $P= 0.199$

Among the 297 students examined for malaria parasite, 152(51.2%) were males while 145(48.8%) were females. 85(55.9%) males were infected for *Plasmodium spp* while 51(35.2%) females were infected with *Plasmodium spp* as shown in (Table 2).

The highest percentage prevalence recorded in males might be as a result of the various activities they are involved in. Chi-Square analysis of the data shows that there is significant difference in the gender-related prevalence ($X^2 =136.00$, $p=0.001$ and $p<0.05$).

Table 2: Prevalence of Malaria among Genders

Sex	Number Examined	Number Positive	Prevalence (%)
Male	152 (51.2%)	85	55.9
Female	145 (48.8%)	51	35.2
Total	297 (100.0%)	136	45.79

Prevalence of malaria among the blood groups revealed that blood group A+ had the highest prevalence (92%) while the lowest prevalence was observed in blood group O- (17.6%) (Table 3). Among the same blood groups, it was generally observed that susceptibility to malaria parasites increases with the

presence of Rhesus factor in the blood and decreases when this factor is absent as seen in Table 3. Chi-Square analysis of the data shows that there is significant difference among blood groups ($X^2 =40.00$, $P=0.258$ and $P<0.05$).

Table 3: Prevalence of Malaria among Different Blood Groups

Blood Group	No. Examined	Number Positive	Total Prevalence (%)	<i>P. f</i>	<i>P. m</i>	<i>P. v</i>
A+	56	28	15	9	52	92.9
A-	6	2	1	0	3	50.0
B+	50	27	8	6	41	82.0
B-	7	1	2	1	4	57.1
O+	150	15	8	5	28	18.7
O-	17	2	0	1	3	17.6
AB+	7	3	1	0	4	57.1
AB-	4	0	1	0	1	25.0
Total	297	78	36	22	136	45.79

Keys: *P.f*=*Plasmodium falciparum* *P.m*= *Plasmodium malariae* *P.v*=*Plasmodium vivax*

Significant difference ($p < 0.05$) of malaria infection was also observed across the weight range of the respondents. This prevalence of malaria was observed to decrease as the age of the respondent increases. Thus the highest prevalence was observed in

respondents with weight range (41-50kg) while the lowest prevalence was recorded in respondents with weight range (81-90kg) (Table 4) ($X^2=30.00$ and $P=0.224$).

Table 4: Prevalence of Malaria among Different Weights

Weights (kg)	Number Examined	Number Positive	Prevalence (%)
41-50	70	49	70.0
51-60	95	38	40.0
61-70	50	21	42.0
71-80	32	13	40.6
81-90	35	10	28.6
91-100	15	5	33.3
Total	297	136	45.79

Table 5: Prevalence of *Plasmodium* species as Observed in the Blood Samples of Respondents

<i>Plasmodium spp</i>	No. of Individuals Infected	Prevalence (%)
<i>P. falciparum</i>	78	57.3
<i>P. malariae</i>	36	26.5
<i>P. vivax</i>	22	16.2
Total	136	45.79

Examination of the thin smear of the respondents' blood revealed that three species of Plasmodium were the causative agents of malaria among this study group this include: *Plasmodium falciparum*, *P. ovale* and *P. vivax*. Out of these *Plasmodium* spp, *P. falciparum* had the highest prevalence of 57.3% among the respondents while *P. vivax* had the lowest prevalence of 16.2% (Table 5). This shows that the *P. falciparum* was the most dominant species in the among the study group.

4. Discussion

The great loss of lives, loss of useful man-hours of labour, the cost of treatment of patients and the negative impact of the disease make malaria a major social and economic burden, it is an infectious disease which is as old as man and as such demands a thorough investigation for effective prevention (Chaves *et al.*, 2010). Out of the 297 students examined for malaria parasite infection, a total prevalence of 45.79% was observed in the study group. This result shows that the prevalence of malaria is still relatively high among the students in the study area. The students in tertiary institution are prone to mosquito bites as many of them prefer to read in the lecture theatres and classrooms where they are easily exposed to mosquito bites. This result is supported by the findings of Mature *et al.* (2001), who reported a prevalence of 61.1% among undergraduate students in Abuja. Similarly, the prevalence of malaria among the school-age group concur with the findings of Chaves *et al.* (2010) that malaria is holoendemic in Nigeria and that it is one of the reasons of high mortality rate in youths. In contrast, Anumudu *et al.* (2006) recorded a low prevalence of 17% for students of University of Ibadan, Oyo State. This disparity might be due to environmental and climatic differences in various parts of the country. Another contributing factor might be the season when the survey was carried out. Although the latter study was conducted between June and September (rainy season) which is similar to the season this research was conducted, a good knowledge of the disease, prompt treatment upon infection and control measures taken by the students probably brought about the low prevalence of infection.

The present study has shown that *Plasmodium* infections are more common in the male than in the female students. As seen in the study, 85(55.9%) males were infected compared to 51(35.2%) females who were infected. This report correlates with the findings of other authors such as Vlassoff and Bonilla, 1994; Robert *et al.*, 2003 and Ezugbo-Nwobi *et al.*, 2011. The authors in their separate studies reported that prevalence of malaria among the male gender is higher than of the female. This significant difference

might be as a result of increased exposure of male to mosquito bites than the female because males spend more time sitting outside in the evening during the peak biting period of mosquitoes. In addition, male dominated types of work such as agricultural work extending to the evening or sleeping away from settlements especially in forests may increase the risk of malaria among the males and subsequently makes men to be more vulnerable than women. Also, studies have shown that females have better immunity to parasitic diseases than the males; this is attributable to genetic and hormonal factors (Zuk and McKean, 1996). The present results also conform to works of Ani (2004) and Ibekwe *et al.* (2009) in Ebonyi State and Southeastern Nigeria respectively. The authors reported higher prevalence of infection in male than the female.

It was generally observed from this study that the prevalence of malaria is higher among the blood groups with Rhesus factor (+ve) than the blood groups without Rhesus factor (-ve). Similarly, blood group A+ was found to be the most susceptible to *Plasmodium* spp (92.9%) while the blood group O- was the least susceptible (17.1%). This report is similar to the report of Fischer and Boone (1988) who reported favourable outcomes for group O individuals compared with group A. Among 489 patients examined in Zimbabwe with *P. falciparum* malaria, there was a prevalence of 84.2% for group A individuals and 19.3% for group O individuals. Lell *et al.* (1999) report in Gabon also supports the findings of this research. The authors reported that all groups A individuals examined for malaria in Gabon, 71% had severe malaria and only 29% had mild malaria. In contrast, among all group O cases 46% had severe malaria and 54% had mild malaria. This suggests that group O individuals may have a survival advantage in severe malaria than the other blood groups. Contrary, Thakur and Verma (1992) in their study concluded that ABO blood groups do not show differential susceptibility to malaria. Joshi *et al.* (1987) reported no correlation between ABO blood groups and malaria in Delhi.

Susceptibility of malaria infection among the age groups revealed those age groups 16-20 years are more susceptible (47.7%) than other age groups (21-30 years). The high infection rate in age bracket 16-20 years could be due to inadequate protection against mosquito bites or insufficient knowledge about transmission of malaria. Moreover, the age group consists of youths who habitually expose themselves to incessant bites of vectors of malaria by remaining bare bodied especially when the weather is hot. Similar results were reported by Pullan *et al.* (2010) that a high prevalence of 56.2% was recorded for age group 16-20 years.

Age-specific prevalence shows that infection rates decreased with increasing age. This is in line with the study in Igbo Ora (Nwuba *et al.*, 2002), where it was found that parasitaemia of malaria declined with age. The acquisition of immunity by age may be due to gradual build up of immunological memory covering higher and larger parts of the parasites antigenic repertoire, or to a physiological effect of age, which makes adults more effective in combating disease.

Examination of the thin smear of the respondents' blood revealed that three species of *Plasmodium* were the causative agents of malaria among this study group this include: *Plasmodium falciparum*, *P. ovale* and *P. vivax*. Out of these *Plasmodium* spp, *P. falciparum* had the highest prevalence of 57.3% among the respondents while *P. vivax* had the lowest prevalence of 16.2% (Table 5). This shows that the *P. falciparum* was the most dominant species in the among the study group. This report agrees with the findings of Okonkwo *et al.* (2009) who reported a high prevalence of 69% for *Falciparum* malaria in Abeokuta, Nigeria but different from the findings of Atif *et al.* (2009) who reported higher prevalence of infection of *vivax* malaria than *falciparum* malaria in Hyderabad, India.

In conclusion, prompt diagnosis and treatment of malaria among the school-age will help in reducing the morbidity and mortality of the disease in the endemic areas. Also public enlightenment on the prevention and control of the disease among the students will not only reduce the prevalence of the disease but also increase the performance of these students at school as many of the students suffer bouts malaria infection during the examination.

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