MALARIA PARASITE DISTRIBUTION AND KNOWLEDGE AMONG STUDENTS OF FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE, NIGERIA

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ABSTRACT

Malaria remains a major challenging infectious disease across the globe particularly in sub-Sahara Africa and is a leading cause of morbidity and mortality. Management strategy depends majorly on reliable epidemiological information. Thus, this study is to investigate the malaria parasite distribution and knowledge among students of Federal University of Technology, Akure, Nigeria. Blood samples were obtained from volunteered subjects. Thick and thin blood films stained with Giemsa were prepared and viewed under the x100 objective lens of the light microscope to determine the presence or absence of malaria parasite. A well-structured questionnaire was employed to collect relevant epidemiological information such as demographic, socioeconomic, environmental variables and their knowledge regarding malaria. Of the total 203 participants examined, three-quarter (84.20 %) tested positive to malaria infection, while 80.30 % had moderate parasitaemia level. All the participants (100.00 %) identified mosquito as the malaria parasite vector. Age group (χ^2 = 11.88, p = 0.01), marital status (χ^2 = 21.81, p = 0.01), income (χ^2 = 27.52, p = 0.01) and environmental sanitation (χ^2 = 6.25, p = 0.04) were predisposing factors (p<0.05) associated with malaria infection among participants. Meanwhile, female participants are 0.92 times (CI: 0.42 - 2.02) less prone to malaria infection compare to male and monthly environmental sanitation was 3.62 times (CI: 1.21 - 10.87) prone to malaria infection than those who observed environmental sanitation weekly. The present study has revealed high prevalence of malaria infection among the students. School management and government should implement malaria control strategies among tertiary students.

Keywords: *Plasmodium falciparum*, Malaria, Parasitaemia, Knowledge, Predisposing factors

INTRODUCTION

Malaria remains one of the major challenging infectious diseases worldwide including Nigeria. It has become a major cause of morbidity and mortality particularly among pregnant women and children under the age of five (Anumudu *et al*., 2006). Globally, about 228 million cases of malaria were reported in 2018, with estimated death cases of 405, 000 people. African region shared 93 % of the global prevalence and 94 % death occurrences (WHO, 2019). Among the 6 African countries reported by WHO (2019), Nigeria shared 25 % of malaria cases and 24 % of death cases worldwide, albeit, Nigeria is making an enormous effort in the treatment and prevention of malaria (WHO, 2019). This was evident in 2018 report where Nigeria recorded the largest reduction from 153 000 deaths (2010) to about 95 000 deaths in 2018 (WHO, 2019).

Malaria infection is caused by parasites of the genus *Plasmodium*. The major species include *Plasmodium vivax*, *P. ovale*, *P. malaria*

and *P. falciparum*. They are protozoa parasites that are transmitted by female mosquito (*Anopheles gambiae*). The most infectious of the four is *P. falciparum* and it is the most widespread and constitutes major threat in sub-Saharan Africa. The life cycle occurs both in the mosquito vector and in the human host (Onah *et al.*, 2017). Different people are of different immune response to malaria infection. The normal day of manifestation of symptoms after the mosquito bite is seven days but some people can be asymptomatic of the illness for days or months. Such asymptomatic people are potential reservoir of the parasite transmission to the uninfected ones. There are many factors contributing to persistence of malaria infection in Nigeria such as education, income, housing patterns, social groups, leadership challenge, infrastructure deficiency, water storage, behavioural challenge and lack of knowledge about causes and control (Onah *et al.*, 2017; Aju-Ameh, 2020).

The environment where most Nigeria students of tertiary institution live are below standard educational environment, either off campus or within the campus. This can be attributed to unconducive environment which are breeding sites for mosquitoes, the malaria vector (Adeyemo *et al.*, 2014). This unconducive environment is characterized by stagnant water, bush, poor drainage, indiscriminate dumping of refuse, poor building structure, unhygienic living and unkempt environment. This might make the students living in such environment to be prone to malaria infection. A number of studies have revealed the effects of malaria on class attendances and learning performances in educational institutions in Brazil and Nigeria (Thuilliez, 2009; Vitor-Silva *et al.*, 2009; Adeyemo *et al.*, 2014). Therefore, this study aimed to investigate the level of malaria infection and its knowledge among the students of Federal University of Technology Akure, Ondo State, Nigeria.

MATERIALS AND METHODS

Study Area: Federal University of Technology, Akure (FUTA) is located in Akure the capital city of Ondo State, Southwest Nigeria. Akure is located in the rain forest zone between latitude 7°15 '0''N and longitude 5°11 '42''E (Ayeni, 2011). Akure has two seasons, which includes the rain (wet) season that ranges from April to October and the dry season that ranges from November to March. Akure has an annual rainfall of 2378 mm, with temperatures ranging from 25.2 to 28.1°C and relative humidity of about 80 % (GeoNames Geographical Database, 2012).

Study Population: The population in this study comprised of 203 students of Federal University of Technology, Akure (FUTA), Akure South Local Government, Ondo State, Nigeria.

Sample Size: The sampled size was obtained according to the following equation: $N = t^2 \times P (1 - p) / M^2$. Where N = Sample size, t = the normal standard deviate (t = 1.96), P = the frequency of occurrence of malaria (0.16 %) and M = degree of precision (0.05 %) (Araoye, 2004). From the formula, 203 FUTA students were sampled. Out of the 203 subjects, males were 64.00 % compared to their female counterpart who accounted for 36.00 %. For the age distribution, 21 – 25 years had the highest (52.70 %) subject while ≥31years were the least (1.00 %) subject.

Ethical Clearance: Prior to the commencement of the research work, an ethical clearance for the study was obtained from Ministry of Health, Akure, Ondo State, Nigeria. Approval was given by the Head of the Medical Laboratory at FUTA Health Centre for collection of blood samples. The aims and objectives of the research were clearly explained to the volunteered students.

Sampling and Laboratory Analysis

Data Collection: Demographic information such as age, sex and location, socioeconomic data such as occupation, income, knowledge about malaria vector and infection of each participant were collected using well-structured questionnaires. The income of the participants was classified as ≤₦18,000; ₦19,000-₦49,000 ≥₦50,000. Moreover, information on blood

group and genotype were obtained from subjects' medical record.

Blood sample collection: Blood samples were collected between February and July 2018 with the aid of needle and 5 ml syringe. 3 mL of venous blood was collected from each participant through the assistance of an expert phlebotomist. After collection, the blood samples were transferred into an Ethylenediaminetetraacetic acid (EDTA) container to prevent coagulation of the blood sampled for microscopic examination.

Microscopic Examination: After fixing thin blood films with absolute methanol, both thick and thin blood films were stained with 10 % Giemsa for 20 minutes and examined under the x100 (oil immersion) objectives of a light microscope, for the detection and identification of malaria parasites, respectively. Slides were declared negative if no asexual parasites were found after examination. The asexual parasites density was counted against 200 WBCs. Parasite density (parasite/µl of whole blood) was then calculated as follows: Number of parasites counted / WBC counted x Total WBC count/µl, where the average WBC counts = 8000/µl (WHO, 2015). The World Health Organization has defined severe anaemia complicating falciparum malaria as a haemoglobin concentration < 50 gL^{-1} or a haematocrit < 15 % in the presence of a parasitaemia > 10,000 µL with a normocytic blood film and moderate malaria falciparum with parasitaemia > 1,000 but < 10,000µL with a normocytic blood film (Warrell *et al.*, 1990).

Statistical Analysis: The data obtained were analyzed using the Statistical Package for the Social Sciences (SPSS) Version 22. The statistical tools that was used for the analysis of the data were descriptive, crude odd ratio and Pearson's Chi-Square Test. P-value less than 0.05 ($p<0.05$) was considered significant. All Figures were created using Microsoft Excel.

RESULTS

The demographic characteristics of the study participants are shown in Table 1. The ages of students were more of 21 – 25 years 107(52.70 %) and majority of the participants were single 199(98.00 %). The most prevalent blood group was O type 141(69.50 %) while that of genotype was AA 173(85.20 %). The income level of most participants 196(96.60 %) were below ₦18, 000:00 and only 2.50 % engaged in working (civil servants and farmer).

Table 1: Demographic characteristics of the study participants from Federal University of Technology, Akure, Nigeria

Characteristics		Frequency	Percent (%)
Age	16-20	90	44.30
	21-25	107	52.70
	26-30	4	2.00
	≥31	2	1.00
Marital Status	Single	199	98.00
	Married	4	2.00
Blood Group	O	141	69.50
	A	44	21.70
	B	8	3.90
	AB	10	4.90
Genotype	AA	173	85.20
	AS	25	12.30
	SS	5	2.50
Occupation	Student	198	97.50
	Civil servant	4	2.00
	Farming	1	0.50
Income	≤ ₦18,000	196	96.60
	₦19,000 - ₦49000	4	2.00
	≥ ₦50,000	3	1.50
Religion	Christian	191	94.10
	Muslim	12	5.90

Table 2 indicated that age group ($\chi^2 = 11.89$, $p = 0.01$), marital status ($\chi^2 = 21.81$, $p = 0.01$), income ($\chi^2 = 27.52$, $p = 0.01$) and environmental sanitation ($\chi^2 = 6.26$, $p = 0.04$) were significant predisposing factors ($p<0.05$) of malaria infection among participants. Crude odd ratio test showed that female participants were 0.92 times less prone to malaria infection compare to male.

Table 2: Prevalence of malaria parasite in relation to demographic, economic and environmental variables among students of Federal University of Technology, Akure, Nigeria

Variables		Status of malaria infection		χ2	P-value	Crude OR (CI; 95%)
		Negative	Positive			
Gender	Male	20(15.40)	110(84.60)	0.04	0.84	
	Female	12(16.40)	61(83.60)			0.92(0.42-2.02)
Age group	16-20	11(12.20)	79(87.80)	11.89	0.01	
	21-25	18(16.80)	89(83.20)			0.69(0.31 - 1.55)
	26-30	1(25.00)	3(75.00)			0.42(0.04 - 4.38)
	≥31	2(100.00)	0(0.00)			0.00
Marital status	Single	28(14.10)	171(85.90)	21.81	0.01	
	Married	4(100.00)	0(0.00)			0
Blood group	O	24(17.00)	117(83.00)	0.63	0.89	
	A	6(13.60)	38(86.40)			1.29(0.49 - 3.42)
	B	1(12.50)	7(87.50)			1.44(0.17 - 12.21)
	AB	1(10.00)	9(90.00)			1.85(0.22 - 15.26)
Genotype	AA	28(16.20)	145(83.80)	0.36	0.84	1.29(0.14 - 12.02)
	AS	3(12.00)	22(88.00)			1.83(0.15 - 22.37)
	SS	1(20.00)	4(80.00)			
Income(₦)	< 18000	26(13.30)	170(86.70)	27.52	0.01	
	19000-49000	3(75.00)	1(25.00)			0.05 (0.01 - 0.51)
	> 50000	3(100.00)	0(0.00)			0.00
Sleep under Mosquito net	Yes	9(17.00)	44(83.00)	0.08	0.78	
	No	23(15.30)	127(84.70)			1.13(0.49 - 2.63)
How far is bush away from your residence?	< 20 m	15(15.80)	80(84.20)	3.96	0.27	Ref
	40 m	2(6.90)	27(93.10)			2.53(0.54 - 11.79)
	60 m	3(11.50)	23(88.50)			1.44(0.38 - 5.40)
	> 100 m	12(22.60)	41(77.40)			0.64(0.28 - 1.49)
How far is the stagnant water from your house?	< 20 m	3(10.70)	25(89.30)	5.53	0.24	
	40 m	0(0.00)	17(100.00)			
	60 m	1(10.00)	9(90.00)			1.08(0.09 - 11.76)
	100 m	5(15.20)	28(84.80)			0.67(0.15 - 3.10)
	Not applicable	23(20.00)	92(80.00)			0.48(0.13 - 1.74)
How frequently do you do environmental sanitation?	Weekly	26(19.70)	106(80.30)	6.26	0.04	
	Monthly	4(6.3)	59(93.70)			3.62(1.21 - 10.87)
	Don't know	2(25.0)	6(75.00)			0.74(0.14 - 3.86)

Age group 21 – 25 years (0.69 times) and ≥ 31 years (0.42 times) were less prone to malaria when compared to age 16 – 20 years.

Participants with much income were less prone (0.05 times) than income below ₦18,000:00 per month. Meanwhile students that observed monthly environmental sanitation were 3.62 times prone to malaria infection than those who observed weekly environmental sanitation.

In Table 3, all the participants 203(100 %) identified that mosquito is the vector for malaria. About half of the participants 101(49.80 %) had mosquito nets, while it was only 53(26.10 %) of them that normally slept under mosquito nets, and majority of the students 86(42.40 %) were not comfortable using it. Majority 167(82.30 %) of the participants live off campus. Additionally, 95(46.80 %) of the participants live 20 m away from the bush. Not less than 13.80 % of participants live 20 m near stagnant water and majority 132(65.00 %) frequently observe environmental sanitation in a week. All the participants have had malaria before and 71(35.00 %) had malaria a month ago (Table 3).

Table 3: Knowledge about malaria vector among the students of Federal University of Technology, Akure, Nigeria

Questions	Response	Frequency	Percent (%)
Malaria vectors	Mosquitoes	203	100.00
	Blackflies	0	0.00
	Houseflies	0	0.00
Do you have mosquito net?	Yes	101	49.80
	No	102	50.20
Do you sleep under mosquito net?	Yes	53	26.10
	No	150	73.90
If no, why?	Not comfortable	86	42.40
	Make room untidy	10	4.90
	Afraid of chemicals	9	4.40
	Heat	41	20.20
	Not applicable	57	28.10
What do you use your mosquito net for?	Preventing mosquito	84	41.40
	Kept inside unused	23	11.30
	Not applicable	96	47.30
Where do you live?	On campus	36	17.70
	Off campus	167	82.30
How far is bush away from your residence?	20 m and below	95	46.80
	40 m	29	14.30
	60 m	26	12.80
	100 m and above	53	26.10
Do you have pond/stagnant water around your house?	Yes	49	24.10
	No	154	75.90
How far is the stagnant water from your house?	20 m and below	28	13.80
	40m	17	8.40
	60 m	10	4.90
	100 m and above	33	16.30
	Not applicable	115	56.70
How frequently do you do environmental sanitation?	Weekly	132	65.00
	Monthly	63	31.00
	I don't know	8	3.90

Participants identified to treat malaria with drugs were 136(67.00 %), herbs 6(3.00 %) and both 54(26.60 %). More than three-quarter of the participants 171(84.20 %) tested positive to malaria infection (Figure 1), while 80.30 % had moderate parasitaemia level (Figure 2).

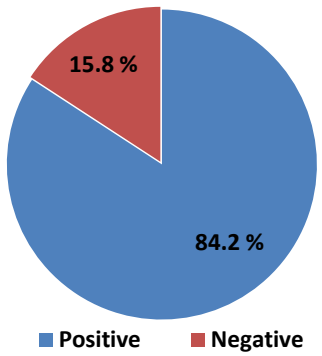

Figure 1: Status of malaria infection among the students of Federal University of Technology, Akure, Nigeria

DISCUSSION

The results of this study showed a steady prevalence of malaria among FUTA students. The prevalence of malaria infection among the students examined was 84.20 %, with 80.30 % having moderate parasitaemia level. This indicated high level of malaria infection among the students and that most of them were potential reservoir for the transmission of the infection, as majority of the students were asymptomatic. This result was relatively higher than the prevalence of 80.30 % recorded in the same institution by Adepeju (2017). Likewise, Nyahoga and Bochkaeva (2018) reported a much higher prevalence (89.40 %) of malaria among Tanzanian College Students. Furthermore, Ibekwe *et al.* (2009) reported 80.00 % malaria prevalence among first year

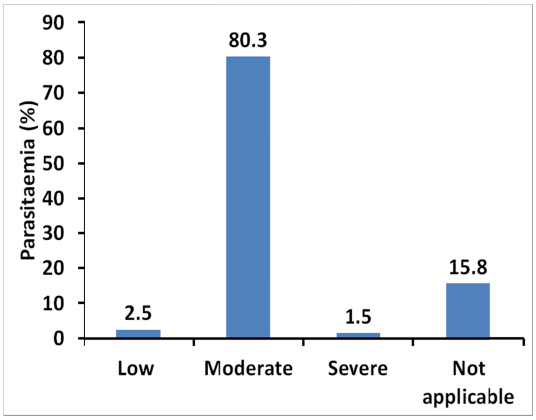

Figure 2: Malaria parasitaemia levels among the students of Federal University of Technology, Akure, Nigeria

students of Nnamdi Azikiwe University, Awka, Southeastern Nigeria. The high prevalence of malaria recorded in this study may be attributed to the presence of bushes and stagnant water around the homes of most students participating in this study. This can enhance the breeding of mosquitoes in the environment and the consequent transmission of infections to people living in such area. This finding on enhanced breeding of mosquitoes in the environment was similar to reports from Southwest Cameroon (Nkuo-Akenji *et al.*, 2006; Ndamukong-Nyanga *et al.*, 2014).

All of the recruited students knew about malaria and its vector. This was similar to the report by Tanzanian College Students that were aware of the vector, parasite, and preventive measures against malaria infection (Nyahoga and Bochkaeva, 2018). Education has really improved the effectiveness of malaria campaign and Spjeldnæs *et al.* (2014) opined that education helps in the understanding of the epidemiology and predisposing factors associated with diseases and also improves the ability to evaluate and use epidemiological information.

Furthermore, our findings showed that about half of the participants (50.20 %) does not have mosquito net, while only 26.10 % of those who had mosquito net slept under it at night. This was in agreement with the findings of Ukibe *et al.* (2019) who revealed that only 39.90 % of the premedical undergraduate students of Nnamdi Azikiwe University, Nigeria slept under insecticide treated mosquito nets. Majority of the students complained of being not comfortable when using it.

This study also revealed that gender, age, marital status, income and environmental sanitation practice were factors that influence malaria infection among the students examined. Meanwhile, female participants were 0.92 times less prone to malaria infection compare to male. Age groups 21 – 25 and ≥31 years were 0.69 and 0.42 times less prone to malaria when compared to age 16 – 20 years. This suggested that younger ages were at high risk of malaria infection than older people who have higher body immunity. According to Ukibe *et al.* (2019), age is a risk factor in asymptomatic malaria infection. Participants with much income were less prone (0.05 times) than income below ₦18,000. Malaria is a poverty-associated disease (Nyahoga and Bochkaeva, 2018; Awosolu *et al.*, 2019) thus, about half of the students 101(51.50 %) who are not using mosquito nets were of the least income level. Meanwhile monthly environmental sanitation was 3.62 times prone to malaria infection than those who observed environmental sanitation weekly. Cleaning the environment frequently and evacuating the breeding site is a key measure in eliminating the malaria vector.

Conclusion: The present study has revealed high prevalence of malaria infection among the students examined. It is a fact that malaria illness has negative impact on education. So, the government and other stakeholders should equip the health facility of higher institution with enough drugs, including antimalarial drug and also make sure each student have access to mosquito net.

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