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SOME EPIDEMIOLOGICAL STUDIES OF *PLASMODIUM FALCIPARUM* AND MALARIA DIAGNOSTIC METHODS AMONG STUDENTS OF BENUE STATE POLYTECHNIC, UGBOKOLO, NIGERIA.

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ABSTRACT

Malaria is caused by parasites of the Plasmodium family and transmitted by female Anopheles mosquitoes. This study aimed to determine the prevalence of *Plasmodium falciparum* and malaria diagnostic methods amongst students of Benue State Polytechnic Ugbokolo. A total of 420 students were examined in this study. Blood samples were collected by finger prick onto clean slides and into the round sample well of *PfRDTs*. Thick and thin blood films were prepared for microscopic examination. The prevalence of malaria infection using microscopy, *Pf*RDTs and combination of microscopy and *Pf*RDTs was 35.6%, 31.7%, and 29.5% respectively. A questionnaire was used to determine some demographic factors. The Prevalence of malaria in relation to age groups, age between 16-19 and 20-22 years recorded higher infection rate of 42.2 % and 27.2% respectively. While, age group 26-28 recorded 15.8%. The result was statistically different ($P<0.05$). The prevalence was higher among the male students (37.1%) were more infected than in their females counterparts (21.9%), the difference was significant statistically. A significant difference ($P<0.05$) was observed between students that do not used malaria preventive methods (70.3%) compared to students that used combined methods of prevention (8.8%). Malaria still remains prevalent among students in Ugbokolo, Benue State, Nigeria. There is need to intensify campaigns on preventive and control methods.

KEYWORDS: Epidemiology, *Plasmodium falciparum*, Diagnostic Methods, Students, Ugbokolo.

BACKGROUND TO THE STUDY

Malaria is caused by parasites of the Plasmodium family and transmitted by female Anopheles mosquitoes (Nwoke, 2018). There are four major human malaria species (*Plasmodium falciparum, Plasmodium vivax, Plasmodium malariae* and *Plasmodium ovale*), also, *Plasmodium knowlesi* is a zoonotic plasmodium that is also known to infect humans (WHO 2015). *Plasmodium falciparum* is the most pathogenic and major causes of uncomplicated and severe malaria in Nigeria (FMoH, 2014). In 2018, there were 25% cases of malaria and 24% deaths in Nigeria (WHO,2019), There are several studies on children under 5 and pregnant women ; because they are mostly susceptible to infection, illness and death (Manyi , *et al*., 2018;Amuta,*et al*., 2014). However, malaria in students in higher learning has negative impacts on their health and livelihoods; it is a major cause of absenteeism and probably reduces effectiveness of their education and social activities (Nwoke, 2018).

Malaria diagnosis is one of the most neglected area of malaria research. Improving diagnostic accuracy in malaria control systems can be both technically and financially challenging (Wongsrichanalai, *et al.*, 2007). However, the common malaria diagnostic methods are clinical diagnosis and routine parasitological- based tests (FMoH, 2014). The clinical diagnosis is not exact, but remains the basis of therapeutic care for the majority of febrile patients in malaria endemic areas, where majority do not have access medical laboratory (Wongsrichanalai, *et al.*, 2007). Two types are available to confirm a clinical diagnosis of malaria. These are microscopy and Rapid diagnostic Test (RDTs). Microscopic examination - conventional light microscopy is considered the "gold standard" for malaria parasitological-based diagnosis. It is the most economic, preferred, and reliable diagnosis of malaria. (Nwoke,2018, Otubanjo, 2013.,While, Rapid Diagnostic Test (RDTs) is a device that detects malaria antigen in a small amount of blood, usually 5–15 µl by immunochromatographic assay with monoclonal antibodies directed against the target parasite antigen and impregnated on a test strip. It is simple and do not require

laboratory facilities (WHO,2009;Wongsrichanalai, *et al.*,2007)).According to FMoH,(2014), histidine rich protein 2 (HRP-2) based RDTs antigen remains in the blood stream for at least two weeks after all viable parasites have been killed by treatment. This test therefore cannot be used to retest an individual patient who returns with symptoms within two – three weeks of treatment. Microscopy should be used for such patient.

Despite government interventions such as the distribution of insecticide-treated bed nets (ITN), indoor residual spraying (IRS), improved diagnostic testing, treatment by artemisinin combination therapy (ACT) and campaigns on preventive and control methods ,malaria still remains endemic in Benue State (NMFS,2011., NMCP/RBM . 2009). Hence, this study focused on *Plasmodium falciparum* and malaria diagnostic methods used among students of Benue State Polytechnic Ugbokolo, Nigeria.

MATERIAL AND METHOD

Study area: The study was conducted in Benue State Polytechnic Ugbokolo, Okpokwu Local Government Area of Benue State. The state is located in the north central of Nigeria, with its capital at Makurdi. Its geographic coordinates are Latitude 7° 79' and 8°7' East, longitude 7°15'and 8°7' North. Based on Köppen climate classification, Benue State lies within the AW climate and experiences two distinct seasons, the Wet season and the Dry season. The rainy season lasts from April to October with annual rainfall in the range of 100-200mm. The dry season begins in November and ends in March. Temperatures fluctuate between 21 – 37 degrees Celsius in the year. Agriculture is the mainstay of the economy, engaging over 75% of the state farming population.

Ethical Clearance

Permission was sought for and obtained from the Ethical Committee of the Benue State Polytechnic research committee and Hospitals Ministry of Health, Makurdi. Students were duly informed on the significance of the study. Informed consent of students were obtained before blood sample collection for the tests and administration of questionnaire

Study population /Sample size estimation and study design

The study was conducted between December, 2019 and February, 2020. The Taro- Yamane's formula and proportional sampling were used for sample size estimation and it gave a minimum of 420 students by taking proportion from a previous record. The study was cross-sectional. A random sampling was done to enroll the students that gave their consent.. Students' epidemiological data were obtained using questionnaires.

Sample collection and Parasitological Technique

The left thumb of participants was thoroughly cleaned with methylated spirit and a sterile lancet was used to prick the finger to obtain blood sample. Thick and thin blood films were made on clean slides and a drop of the blood was used with an RDT kit, the "CareStart Malaria HRP2 from Access Bio, Inc."and labeled accordingly . The RDTs were used according to manufacturer's instructions. (WHO,2009).Thick and thin blood films were prepared on microscope slides collected by finger prick blood samples. After proper fixation, the prepared slides were then stained with 10% Giemsa (v/v). Blood films were examined microscopically using X 100 (oil immersion) objectives as described by Cheesbrough (2010). The thick films were used to determine the parasite densities while thin films were used to identify the parasite species (Cheesbrough,2010).

Statistical Analysis: Simple percentage and Chi-squared test were used for data presentation. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software (version 20.0, SPSS Inc., Chicago, IL., USA). Chi-squared test was used to compare prevalence of malaria infection between age, sex and preventive methods of the subjects. The significance level was considered at $P \leq 0.05$.

RESULTS

Table 1: A total of 420 students were screened for malaria parasite in Benue State Polytechnic Ugbokolo. The results of the diagnostic tools shows that microscopy recorded 35.6% (147), while, RDTs recorded 31.7% (133). Both microscopy and RDTs gave a total prevalence of 124 (29.5%). There was no significant difference ($P > 0.05$) between diagnostic tools. Table shows the age groups 17-19 years recorded the highest prevalence of 53 (42.4%), followed by those between age groups 20-22 years old 39(27.2%), while the age group 26-28 years recorded east prevalenceof (15.8%). However, there was a significant difference ($P < 0.05$) between the rate of infection and the age of the Students.

Table 3 shows *Plasmodium falciparum* infections in relation to gender, the male gender recorded the highest infection rate of 78(37.1%), while the females recorded the lowest infection rate of 46(21.9%).There was significant difference ($p<0.05$) in the overall prevalence of malaria infection in relation to gender.

Table 4 shows malarial infection rates in relation to preventive measures used among students in the study area. Those that failed to use any of the preventive methods recorded infection rate of 19(70.3%), followed by those that used window nets recorded 27(42.1%). While, 51(36.4%) and 17(22.3%) were observed among those that used insecticide spray and ITNs (bed nets) respectively. The least prevalence rate was observed among those that used combined method with 10(8.8%). A significant difference was observed in malarial infection rate between students that did not use any malaria preventive methods and those that used ($P<0.5$).

Table 1: Prevalence of Plasmodium falciparum infection rate using microscopy and RDTs.

Diagnostic Tools	Number positive (%)	Total Number examine
Microscopy	147(35,6)	420
RDTs	133(31.7)	420
Microscopy	124(29.5)	420

+RDTsχ^2=1.994, df=2 (P>0.05)

Table 2: Prevalence of *Plasmodium falciparum* infection among students with respect to Age.

Age (Years)	Number examined	Number infected (%)
17-19	125	53(42.4)
20-22	143	39(27.2)
23-25	95	23(24.2)
26-28	57	9(15.8)
Total	420	124(29.5)

X^2=35.349, df=3 (P<0.05)

Table 3: Prevalence of *Plasmodium falciparum* infection among students with respect to Gender.

Gender	Number examined	Number infected (%)
Males	210	78 (37.1)
Females	210	46 (21.9)
Total	420	124 (29.5)

X^2=8.223, df=1(P<0.05)

Table 4: Prevalence of *Plasmodium falciparum* with respect to Preventive measures.

Preventive measures	Number examined	Number infected (%)
Window nets	64	27(42.1)
Insecticide spray	140	51 (36.4)
ITNS (Bed nets)	76	17 (22.3)
Combined method	113	10 (8.8)
Non- users	27	19 (70.4)
Total	420	124 (29.5)

X^2=40.516, df=4 (P<0.05)

DISCUSSION

The results of this study shows no significant difference in the prevalence of 35.6% and 31.7% recorded by microscopy and RDTs respectively, this agrees with an earlier report in Kastina-Alas Benue Nigeria in 2017(Ikpa *et al*., 2017) which stated an agreement between the sensitivity of microscopy and RDTs in malaria diagnosis. However, the prevalence reported observed in this study is lower than 57.1% and 34.9% and 59% and 64% reported by Egbuche *et al.*(2019)and Azikiwe *et al.* (2012).The slight different in the results, could be due to false positive or false negative reading. Wongsrichanalai, *et al*.(2007) observed that the different may be due to microscopist experience or several factors in the manufacturing process as well as environmental conditions may affect RDT performance. Also, false negative results may be caused by deletion or mutation of the *hrp-2* gene. The overall prevalence of *Plasmodium falciparum* infection rate among students using both microscopy and RDTs recorded in this study was 29.5% which is considerably moderate. This is lower than the overall malaria prevalence of 62% in Uli, Anambra State (Onyido, *etal* .,2010); 79.1% in Ebonyi State (Opara, *et al* 2011) ; 80.4% in Abia State (Kalu *et al* .,2012) and 55% in Nnamdi Azikiwe University, Nnewi Campus, Anambra State (Ukibe,*et al.*,2019).However, the prevalence in this study was higher than 17.0% in Eastern Nigeria Anumudu, *et al.* (2006) and 27.3% in Sokoto State. Abdullahi, *et al.*,(2009). The prevalence in this study could be related to poor environmental sanitation and climatic factors such as rainfall, temperature and relative humidity. Also, it could be the behavioural patterns of students which promote Anopheles mosquitoes breeding and susceptibility of people to mosquito bites.

In this study, the highest malaria prevalence of 42.4% was observed in students in the age groups 17- 19 years, while, the least prevalence of 15.8% was recorded in the age group 26-28 years This finding is however, not consistent with the reports of Houmsou, *et al* .,(2017); who observed the high malaria prevalence in patients of the age groups 61-70 and 1-10 years with 55.6% and 52.9% respectively in Benue State. The prevalence was statistically significant in different age groups (P <0.05).The high rates of infection observed among these age groups could be due to inadequate protection against

mosquito bites and staying outdoors during nighttime when these vectors bite, Also, it is possible that practices and lifestyle of young adults whose ages range from 17-28 years may make them more susceptible to these mosquito borne diseases. This finding is consistent with the reports of Nassar, *et al*.(2019) who reported high prevalence rate among participants. He opined that infections have their peak rate among participants age ranged 16 and 45 years whose some risky behavioural patterns expose them to these infections.

This study has reported a higher rate of malaria infection among male (37.1%) than in female (21.9%) counterparts. This findings is comparable to the work of Nassar,*et al*.(2019) who reported that malaria infection is higher in male than female. This could be due to exposure of body parts by male than female. However, Yohanna,*et al.*,(2019)opined that gender did not affect the prevalence of malaria among patients.

The preventive methods are variously effective, but the combination of Insecticide treated nets (ITNs} and indoor insecticide spray seemed to be more effective than the use of single method. The present study reveals that non-users of ITNS recorded the highest prevalence rate of (70.3%) while, combination of ITNs and indoor spray insecticide recorded the least prevalence of (8.8%). Amuta, *et al*., (2014) observed that good result of this combination of preventive methods could just reflect a synergy between the chemical components against mosquitoes.

CONCLUSION /RECOMMENDATIONS

The study revealed that the RDT for malaria diagnosis is as reliable as microscopy. The present study reveals that malaria remains moderately high among students in Ugbokolo; it clearly shows that malaria is still a major public health problem in Benue State. There is need to intensify campaigns on preventive and control methods. Students should be encouraged to use combination of preventive methods like Insecticide spray and insecticide-treated bed-nets (ITNs) / Long Lasting Insecticidal Nets (LLINS) so as to reduce the risk of Anopheles mosquitoes' bites. The use of malaria RDTs is recommended when reliable microscopy is not available, but should not be use for retest within three weeks of treatment.

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