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DETERMINATION OF *PLASMODIUM FALCIPARUM* INFECTION RATE AMONG KADUNA STATE UNIVERSITY STUDENTS IN MARAFA ESTATE, KADUNA

Musa, F.M.[1] Muhammad, J.[1] Enoch, S.E.[1] Ibrahim, B.[2] Muhammad-Idris, Z.K.[3]

1. Department of Microbiology, Faculty of Sciences, Kaduna State University, Kaduna, Nigeria.
2. Department of Biology, Faculty of Sciences, Kaduna State University, Kaduna, Nigeria.
3. Department of Community Medicine, Faculty of Medicine, Kaduna State University, Kaduna

Corresponding author's email: fmmusa1@gmail.com

ABSTRACT

Aim: This study was conducted to determine the *Plasmodium falciparum* infection rate among students of Kaduna state university. **Methods**: The study was conducted within Kaduna metropolis. A total of 217 students were sampled at random for malaria parasite infection using Microscopy (thin and thick film) and Rapid Diagnostic Test (RDTs). **Results**: Out of 217 patients in this study, overall prevalence of 72% (156) malaria infection was recorded among the study participants with microscopy and RDT having prevalence of 162 (74.65%) and 150 (69.12%) respectively there was no statistically significant difference between the microscopy and RDT prevalence ($P<0.05$). It was found that 101 participants between the ages of 20-25 have the highest prevalence rate of 79 (78.21%), which was not statistically significant ($P<0.05$). **Conclusion**: The results obtained showed high rate of malaria infection in the studied area and this result could be important in guiding policies targeted at encouraging environmental sanitations. **Recommendations**: Legal dumping of wastes are needed in the control of malaria within the study area and enlightenment on the importance of early malaria diagnosis.

Key words: -Malaria, *Plasmodium falciparum*, Microscopy, Rapid Diagnostic Test (RDTs)

1.0 INTRODUCTION

Malaria is a life-threatening disease of man caused by parasites of the genus *Plasmodium* and is transmitted exclusively by the bite of an infected female Anopheles mosquito [1]; [2]. However, cases also occur through exposure to infected blood product or transplanted organ, as well as through congenital transmission [3]. There are four species of *Plasmodium* that commonly affect man which includes; *Plasmodium malariae, Plasmodium vivax, Plasmodim ovale and Plasmodium falciparum* [4]; [1]. *Plasmodium falciparum* is the leading microorganism causing malaria in West Africa [5].Malaria infection is largely distributed throughout the warmer regions of the world where the vector breeds. In Nigeria, malaria is holo-endemic. It is worst hit in the poorest countries and those under difficult and impoverished conditions [6]. Malaria distribution and prevalence depend mainly on climatic factor such as temperature, humidity and rainfall [7]. Nigeria has more reported cases of malaria and deaths than any other country in the world [8].World malaria report indicated that Nigeria accounted for a quarter of all malaria cases in the 45malaria endemic countries in Africa showing clearly the challenges of malaria in Nigeria . Malaria contributes greatly to the increase in hospital attendance across the six geopolitical zones of Nigeria [4].The clinical symptoms of malaria are caused by the development of the parasite in red blood cells [6]. The principal symptom of malaria is fever. Others are headache and in acute cases, paroxysm, high fever, chills, fatigue, chest, abdominal pain and nausea. In malignant malaria, enlargement of the spleens, kidneys and liver

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occurs. Global malaria incidences have increased by five million in 2016 and mortality remains almost similar, as reported by the World Health Organization (WHO) in Nigeria 2019 [2]; [9]. Malaria affected an estimated 219 million people causing 435,000 deaths in 2017 globally. This burden of morbidity and mortality is a result of more than a century of global effort and research aimed at improving the prevention, diagnosis, and treatment of malaria [10].

The genus *Plasmodium* is an amoeboid intracellular parasite which accumulates malaria pigment (an insoluble metabolite of hemoglobin), multinucleate and naked mass of cytoplasm that contains many diploid nuclei. The resulting structure, a coenocyte, is created by many nuclear divisions without the process of cytokinesis which in other organisms pulls newly-divided cells apart. In some cases, the resulting structure is a syneytium, created by fusion of cells [11]; [12].

The gold standard method for malaria diagnosis is light microscopy of stained blood films by Giemsa [14]. Due to a lack of proper staining material and trained technicians, this method is not available in many parts of sub-Saharan Africa. The sensitivity of the method depends on the professional expertise and it is possible to detect an infection with 10-100 parasites/of blood. A negative finding in patients with symptoms does not exclude malaria but smears should be repeated three times in intervals of 12-24 h if the disease is still suspected [2]. RDT, on the other hand, was developed to improve the sensitivity and objectivity of malaria diagnosis through less reliance on microscopy. It is an immune-chromatographic capture procedure which targets antigens abundant in all asexual and sexual stages of the parasite.

Current RDTs detect Histidine-Rich Protein 2 (PfHRP2) from *Plasmodium falciparum* and Parasite-Specific Lactate Dehydrogenase (pLDH) or *Plasmodium* aldolase from the parasite glycolytic pathway found in all species. The tests that utilize PfHRP2 have been found to be more sensitive than pLDH based ones, especially at low parasite densities, with certain exceptions. Both PfHRP2 and pLDH RDTs have been found to be more sensitive than aldolase-based test [13]. The PfHRP2 based RDTs can detect antigen when *P. falciparum* parasites are sequestered either in placental tissues or elsewhere, which makes them not to be present in peripheral blood for detection by microscopy. The FDA approved the first RDT test in 2007. It is recommended that the results of all RDT test should be confirmed by microscopic blood analysis [14].

This aim of this study was to determine the *Plasmodium falciparum* infection rate among the Kaduna State University students residing in Marafa Estate, Kaduna.

2.0 MATERIALS AND METHODS

2.1 Study Area/ Design

The study was conducted at Marafa Estate, situated in Kaduna North Local Government Area, Kaduna. It was prospectively designed to detect the presence of *Plasmodium falciparum* among Kaduna State University students residing in Marafa Estate.

2.2 Sample size

Using the Cochran's formula, $\mathbf{n = \frac{Z^2\ p\ (1\text{-}p)}{e^2}}$

Where Z is the confidence interval,

P is the prevalence rate, e is the level of precision and n is the sample size.

n =? Z =1.96, p =17%, e =5%

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$$n = \frac{(1.96)^2 \times 0.17(1-0.17)}{(5\%)^2}$$

$$n = \frac{3.8416 \times 0.1411}{0.0025}$$

n =216.8199 but was rounded up to 217

2.3 Blood Specimen Collection and Processing

The patient hands were tied with a tourniquet, then using a syringe and needle a suitable site was punctured and then pulling the plunge to collect 0.5ml of the blood. The blood was transferred into an EDTA container. After allowing the blood samples in the EDTA containers to settle down, a pipette was then used to take serum into RDT casket, it was allowed for about 5 minutes and then result was recorded.

The thick film smear methods was carried out on a clean grease-free slide, then a drop of blood sample was applied on the slide at the middle making it a bit thick and allowed for about 5 minutes and then stained with Giemsa stain and viewed under microscope while the thin film, a drop of blood was applied on the slide, another slide was used to spray the blood samples carefully and then allowed to dry for about 5 minutes before staining it with Giemsa stain and after drying, the slides were viewed under the microscope [14]. The presence of two colour bands indicated a positive result while only one band implied negative result. The test was declared invalid if the line did not appear. In such cases the test was repeated using new strip.

3.0 RESULTS AND DISCUSSION

During this study, a total of 162 (74.65%) of Microscopy and 150 (69.12%) of RDT positive samples were obtained from 217 students of Kaduna State University residing at Marafa Estate. Malaria is indeed by far the most important tropical parasitic disease causing great suffering and loss of lives. Out of 217 students in this study, overall prevalence of malaria of 156 (72%) were recorded among the study participants (Table 1), with microscopy and RDT having prevalence of 162 (74.65%) and 150 (69.12%) respectively there was no statistically significant difference between the microscopy and RDT prevalence ($P<0.05$).This result was found to be higher than the 43.1% prevalence recorded by Wogu *et al,* [15] in University of Port Harcourt Teaching Hospital, 7.4% previously reported among University of Maiduguri students, and other prevalence reports from the Southeast, Nigeria [6]; [16]. But the result of this study is in agreement with prevalence rate of 77% and 83.5% in a similar work conducted by Omolade and Adejoke, [17] in southern Nigeria. This is an indication of the endemicity of malaria in Nigeria and Otuoke particularly, according to the report of World Health Organization [9].

Table 1: Distribution of Malaria Parasites among Students of Kaduna State University (n = 217)

Method	Sample	Positive	%	Negative	%	P value
Microscopy	217	162	74.65	55	25.35	0.9124
RDT	217	150	69.12	67	30.88	0.9171

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Moreover, sometimes it is difficult to determine the species of *Plasmodium* by microscopy; consequently, some species are not reported in the country, such as *Plasmodium ovale,* which has morphology similar to *P. vivax.* Microscopy has low sensitivity when performed by poorly trained personnel in endemic areas, especially in primary and secondary healthcare facilities. This may result in over- or under-diagnosis of malaria, with excessive use of anti-malarial drugs or negligent treatment which invariably contributes to malaria morbidity and the development of resistance. Therefore, in the absence of well-prepared technicians for microscopic diagnosis in many areas of sub-Saharan Africa, the WHO recommends RDTs as a good alternative method for malaria diagnosis or confirmation of malaria [18]; [15]. The differences in prevalence of malaria parasites in the locations could be attributed to poor sanitary conditions of these areas and the socio- economic status of the students which influenced their spending power. This was reflected in their approach to malaria prevention. The higher prevalence recorded here (78.75%) may be explained by the facts that there is a lot of natural vegetation and stagnant water around the places students live which create favourable breeding sites for Anopheles species and most of the students belong to the low socio-economic status and therefore cannot afford using insecticides, sleeping under insecticide treated bed nets, installing nets on doors and windows. On the other hand, the natural vegetation in Temporary site is not much although stagnant water could be seen around and most students that reside there are of the high socioeconomic status and therefore can afford sleeping under insecticide-treated bed nets, using insecticides and installing nets on their doors and windows.

Table 2: Distribution of Malaria Parasites among Different Age Groups (n = 217)

Age group	Sample	Positive	%	Negative	%	P value
17-19	41	32	78.05	9	21.95	0.7169
20-25	101	79	78.21	22	21.78	0.9581
26-30	54	35	64.82	19	35.19	0.6876
30 and above	21	16	76.19	5	23.81	0.7050
Total	217	162	74.65	55	25.35	

The distribution of malaria parasites according to age groups showed that 101 students between the ages of 20-25 had the highest prevalence rate of 79 (78.21%) which was not statistically significant (P<0.05)and lowest in those between 30-above years with 16 (76.19%) of age presented in Table 2. In the present study, high malaria infection was seen in early reproductive and sexually active age group. This result is in conformity with the work of Adeyemo *et al,* [4] who reported that most of the malaria infections in students with significant infection in Benin were between 20 and 25 years. This may be explained by the fact that this age group is attributable to the variations in the frequency and density of exposures to the mosquito vector responsible for the transmission of *Plasmodium* parasites. This agrees with findings of Adeyemo *et al,* [4]. However, the result of this study contradicts the findings of Saini, [19] as recorded in this study, could be because of the disparity in the sample size.

4.0 CONCLUSION

Out of 217 blood samples investigated, overall prevalence of malaria of 156 (72%) were recorded among the study participants with microscopy and RDT having prevalence of 162 (74.65%) and 150 (69.12%) respectively and there was no significant difference between the microscopy and RDT prevalence ($P<0.05$).The distribution of malarial parasites according to age groups showed that 101 students between the age of 20-25 have the highest prevalence rate of 79 (78.21%) and lowest in those between 30-above years with 16 (76.19%) of age. The result of the study revealed a high prevalence (74.65 %) of malaria among students of Kaduna State University, which depicts the endemicity of the infection in the area.

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Competing Interests: Authors have declared that no competing interests exist among them**.**

Authors' Contributions

Musa, F.M & Enoch, S.E' designed the study and wrote the protocol, Muhammad, J. wrote the first draft of the manuscript and managed the literature searches Ibrahim, B & Muhammad-Idris, Z.K' managed the analyses of the study. All authors read and approved the final manuscript."

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