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Prevalence of Malaria And Distribution of Plasmodium Species Among Febrile Out-Patients In Makurdi, North-Central Nigeria

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Abstract
Background: Malaria is a major public health concern in Nigeria with an estimated 68 million cases and 194,000 deaths due to the disease in 2021. Accurate parasitological malaria diagnosis remains a cornerstone in the control of malaria infection in endemic regions.
Objective: This study aimed to determine the prevalence of malaria positivity using mRDT and blood film microscopy as well as assess the distribution of plasmodium species among febrile patients seen at the General Outpatient Clinic of Benue State University Teaching Hospital (BSUTH), Makurdi, Benue state, Nigeria.
Methods: This was a hospital-based cross-sectional descriptive study involving 120 consecutive febrile patients aged ≥5 years who gave consent/assent, over a period of six months at the GOPC of BSUTH Makurdi. Data on socio-demographics, clinical and laboratory information were collected using a pre-tested semi-structured interviewer administered questionnaire. Blood samples were examined for malaria parasite using mRDT and microscopy for malaria diagnosis. Data were analyzed with SPSS version 25. Descriptive statistics summarized the data.
Results: A total of 120 patients were seen. The majority of participants were below 40 years of age, while 72 (60.0%) were females. The prevalence of malaria was 48.3% by mRDT and 47.5% by microscopy. *Plasmodium falciparum* was the predominant species (45.8%), followed by *P. malariae* (1.7%).
Conclusion: Malaria positivity among febrile patients in Makurdi remains high, with a preponderance of the plasmodium falciparum specie. Strengthening the routine use of diagnostic tests prior to treatment is recommended to enhance malaria control efforts.

Keywords: Malaria, mRDT, microscopy, febrile patients, Benue State

Introduction

Malaria is a major public health concern in Nigeria with an estimated 68 million cases and 194,000 deaths due to the disease in 2021 [1]. In Nigeria, malaria affects individuals of all ages, gender and socio-economic status with associated increased risk of complications. It is a disease that impacts negatively on the economy as it imposes substantial costs to both individuals and the government, despite various concerted efforts by individuals, governments and non-governmental organisations to curb it.

Malaria is an infectious disease caused by the plasmodium parasite, transmitted mostly by the bite of an infected female Anopheles mosquito. There are five species of the parasite that cause malaria, namely, plasmodium falciparum, P. vivax, P. ovale, P. malariae, P. knowlesi. Malaria in Nigeria is principally due to P. falciparum and, to a lesser extent to P. malariae and ovale [2].

Malaria is classified into uncomplicated malaria with no life-threatening complications such as fever, headache, body aches, joint pain, chills/rigors, vomiting etc and severe malaria with life threatening complications like severe anaemia, jaundice, loss of consciousness, convulsions, pulmonary oedema, bleeding etc [3].

The new policy on malaria promotes parasite-based diagnosis. Thus, all individuals presenting with clinical symptoms of malaria must be diagnosed using microscopy or rapid diagnostic test. This is because the symptoms of malaria are non-specific and can occur as a result of many other diseases. Therefore, confirmation of malaria parasite through microscopy or positive result with mRDT is a precondition for making malaria diagnosis in all individuals [3, 4]. However, in our environment, clinical suspicion usually centres around fever or history of fever which more often than not is equated to malaria.

mRDT are tests based on colour change to detect plasmodium-specific antigens in a blood sample. The test can be performed in approximately 15 minutes using recommended test kits. It does not require electricity or special equipment and the result is comparable to those of microscopy. The type of mRDT kit approved for use in Nigeria is the Histidine Rich Protein 2 (HRP2) which has been evaluated by WHO/FIND and passed Quality Control. This is justified by the predominance of P. falciparum species in Nigeria accounting for 97% of uncomplicated malaria and also the specie most responsible for severe malaria [2, 4, 5]

Malaria microscopy is considered the gold standard in malaria diagnosis; however, this is subject to the skills and experience of the microscopist as well as availability of electricity. It is done by examining a stained thick and thin film of blood for presence of malaria parasite [6].

Although the prevalence of malaria declined from 27% in 2015 to 22% in 2021, Nigeria still has the highest burden of malaria globally, accounting for nearly 27% of the global

malaria burden.[2] The national malaria prevalence according to RDT and microscopy are 39.6% and 22.3% respectively in 2021 [2].

In 2019, of the six countries accounting for more than half the 229 million cases of malaria worldwide, Nigeria contributed to 23%. During the same year, Nigeria also contributed 24% of the twenty countries that were responsible for 85% of the 409,000 global deaths attributable to malaria [1].

Benue state with a population of 6,627,000 in 2021, is among stable malaria arrears with all year-round transmission of malaria, though there may be seasonal variations. The state contributed an estimated 2.5% of Nigeria's 68 million malaria cases in 2021 [2]. From 2018 to 2021, the estimated malaria cases increased from 1.5 million to 1.7 million, while the estimated incidence increased from 240.3 to 257.2 per 1,000 [3]. However, malaria prevalence by microscopy decreased from 44.5% in 2015 to 17.6% in 2021 while the malaria prevalence according to RDT was 34% [2]. In the same year, the estimated malaria cases were 1,704,000, while the estimated incidence per thousand of the population was 257.2/1000 [2]. Thus, overall, malaria continues to exert a huge burden on the people of the state despite the progress that has been made.

Also, despite recent improvement, malaria parasitological diagnosis remains low in Benue state in particular, and Nigeria in general, leading to inappropriate treatment of patients, irrational use of anti-malaria and wastage of resources [7, 8]. This low level of diagnosis undermines the quality and reliability of malaria data reported through the health system [9].

In Benue state, North Central Nigeria, where this study was conducted, to the best of the author's knowledge, the prevalence of malaria and distribution of plasmodium species in febrile out-patients has not been examined. Therefore, there was a need to explore the prevalence of malaria using mRDT and microscopy as well as assess the distribution of plasmodium species in febrile patients seen at the GOPC of BSUTH Makurdi. This study provided some information to fill this gap and created a platform and data for future studies, especially in Benue state.

Materials and Method

This study was a hospital-based cross-sectional descriptive study conducted between May 2022 and November 2022 involving 120 febrile patients aged 5 years and above who attended the General Out-Patient Clinic (GOPC) of the Benue State University Teaching Hospital in Makurdi, the capital of Benue State, North-Central Nigeria. The Benue State University Teaching Hospital Makurdi is a three hundred (300) bed capacity tertiary health institution. It has a Family Medicine Department which runs the GOPC where first contact with most of the undifferentiated patients of all ages and gender seeking medical care at the facility occurs.

The sample size was predetermined. A purposive sampling technique was employed to consecutively recruit febrile patients aged 5 years and above presenting at the GOPC who provided informed consent/assent, until the sample size of 120 was attained. Those who were too ill to participate in the study; serious diseases or medical emergencies, were excluded.

Demographic and clinical information of the participants such as age, sex, body temperature and test results were collected using a pre-tested interviewer-administered questionnaire.

All patients presenting daily (during working days) at the GOPC of BSUTH who met the selection criteria for the study were seen by the researchers. The nursing team at the nurses' station were informed and educated accordingly. All selected patients were sent to the researchers' consulting rooms for consent and recruitment after consultation. Informed consent was obtained as a signature or thumb print in the consent form and assent for minors with parent/legal guardian where applicable, in the presence of a witness. This was done from Monday to Friday until the sample size was reached. The folders of recruited patients were marked behind with "s" at the top right corner to avoid subsequent repeat selection of same patients.

Fever was confirmed using FIT CARE® digital thermometer, and was defined as an axillary temperature ≥37.5°C, consistent with WHO malaria case definition guidelines [9]. About 2–3 mL of venous blood was collected from each participant aseptically into EDTA tubes by a trained phlebotomist. Rapid Diagnostic Test (RDT) using Bioline Malaria Ag P.f/Pan by Abbott Diagnostics Korea Inc, was performed immediately on-site, according to the manufacturer's instructions, ensuring no degradation of antigens. The Histidine Rich Protein 2 (HRP2) type mRDTs that detect plasmodium-specific antigens were used having been evaluated by WHO/FIND and passed Quality Control. Positive mRDT was reported as "POS", while negative mRDT was reported as "NEG". Thick and thin blood films - were prepared and stained with 10% Giemsa stain for 10 minutes. The slides were examined by an experienced medical laboratory scientist who is a WHO level 2 microscopist, using oil immersion at 100x magnification. Species identification (e.g., *P. falciparum*, *P. vivax*, *P. malariae*, *P. ovale*) – was based on morphological characteristics visible in the thin film. Malaria positive slide was reported as "Malaria parasite seen" indicating the parasite specie, stage and quantity, while malaria negative slide was reported as "No malaria parasite seen" A 10% subset of slides were re-examined by a second independent microscopist. Discrepancies were resolved by consensus or by a senior reviewer.

Data was analysed using the Statistical Package for Social Sciences version 25.0 software. Descriptive statistics (frequencies, means, and proportions) were used to summarise the data. The prevalence malaria and distribution of each identified Plasmodium species was calculated.

Ethical approval with reference number BSUTH/CMAC/HREC/101/V.111/XX was obtained from the Health Research Ethics Committee of BSUTH. Participants were free to withdraw at any point during the study without any consequences. Data confidentiality was maintained throughout the study, and all patient identifiers were anonymised in analysis and reporting. Participants found positive for malaria were promptly prescribed treatment according to the National Malaria Treatment Guidelines [10].

Results

Socio-Demographic Characteristics of the respondents

Table 1: Socio-Demographic Characteristics of the respondents (n=120)

Socio-demographic characteristics	Frequency	Percentage (%)
Age (in years)		
5 – 18	28	23.3
19 – 29	23	19.2
30 – 39	35	29.1
40 – 49	26	21.7
50 – 59	6	5
≥ 60	2	1.7
Gender		
Male	48	40
Female	72	60

Majority of the participants were female 72 (60.0%) while those aged between 30 – 39 years had the highest frequency with age range of 5 to 61 years.

Prevalence of Malaria Positivity among the Respondents Using RDT and Microscopy

Table 2: Prevalence of Malaria Positivity by Diagnostic Method (n = 120)

Test Method	Positive n (%)	Negative n (%)
mRDT	58 (48.3)	62 (51.7)
Microscopy	57 (47.5)	63 (52.5)

Table 2 presents the distribution of malaria test results using malaria Rapid Diagnostic Test (mRDT) and Microscopy. 58 (48.3%) of the participants tested positive for malaria using mRDT, while 57 (47.5%) were positive by microscopy. Thus, the prevalence of malaria positivity was 48.3% by mRDT and 47.5% by microscopy.

Prevalence and Distribution of Plasmodium Species

Table 3: Prevalence and Distribution of Plasmodium Species

Plasmodium Species	Frequency	Percentage (%)
P. falciparum	55	45.8
P. malariae	2	1.7
None detected	63	52.5
Total	120	100.0

Discussion

Most of the participants were aged below 40 years with range of 5 to 61 years. This could be attributed to the study location which is a state capital inhabited mostly by civil servants and students who fall under this age bracket. This study had more female participants (60.0%) than males. The female preponderance could be due to their better health-seeking behaviour compared to males.

This study revealed malaria prevalence rates of 48.3% by mRDT and 47.5% by microscopy, hence underscoring that malaria remains a significant cause of fever among patients in our environment. That the malaria prevalence was higher by mRDT compared to microscopy in this study conforms with findings in Benin Republic, but differs from reports within the same facility and another in Columbia where higher prevalence rates were recorded by microscopy [11-13]. The variations could have been from the different study populations and designs. Furthermore, the malaria prevalence rates in this study are higher than the national malaria prevalence by mRDT and microscopy of 39.6% and 22.3% respectively in 2021 [2]. The rates are also higher than the state malaria prevalence of 34% and 17.6% by mRDT and microscopy respectively in 2021 [2]. However, the present study was done among febrile patients with suspected malaria which could have accounted for the higher prevalence rates recorded.

Plasmodium falciparum was the most predominant malaria parasite species detected among the study participants 55 (45.8%). Only 2 (1.7%) samples tested positive for *Plasmodium malariae*, while no parasite was detected in 63 (52.5%) of the samples. The predominance of *P. falciparum* aligns with established findings within the state, the country and other West African countries, where this species accounts for the majority of infections and contributes to severe malaria cases [2, 4, 5, 14]. Also, the very low occurrence of *P. malariae* suggests that mixed or non-falciparum infections are uncommon in our environment, while the relatively high proportion of parasite-negative samples (52.5%) implies that over half of the febrile cases may have been due to non-malarial causes, highlighting the importance of laboratory confirmation before malaria treatment.

Conclusion

Malaria remains prevalent among febrile patients in Makurdi, with nearly half testing positive by both mRDT and microscopy, and *Plasmodium falciparum* accounting for majority of the cases. Strengthening malaria diagnostic testing and ensuring proper case management remain vital for achieving malaria control and elimination targets.

Recommendation: Benue state is among stable malaria arrears with all year-round transmission of malaria, though there may be seasonal variations. It is recommended that clinical suspicion for diagnosis of malaria which usually centres around fever or history of fever in our environment should be discouraged as much as possible because clinical diagnosis alone will among other things result in over-diagnosis of malaria and inappropriate treatment of non-malarial febrile illnesses, irrational use of anti-malaria and wastage of resources. Furthermore, parasitological confirmation of malaria in febrile patients with suspected malaria before treatment should be encouraged and institutionalised especially in non-life-threatening cases.

Limitations: This was a hospital-based study conducted in one hospital, thus the findings might not be a complete representation of what may be obtainable in other hospitals or the general population.

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