

In the Absence of Effective Malaria Parasite Sentinel System: A Cross-Sectional Study to Assess Prevalence of Plasmodium Spp Infection and Malaria Among Patients at Federal Medical Centre Birnin-Kebbi, Kebbi State, Nigeria.

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Abstract

Background: Local knowledge of the prevalence, burden and features of diseases as well as effective disease surveillance system to identifying population at risk are important at achieving malaria elimination of the National Malaria Strategic Plan (2014-2020).

Methods: The study utilized a retrospective cross-sectional descriptive data collected from January to December, 2018 to determine the prevalence of malaria parasite infection and prevalent *Plasmodium spp* infection among different age groups and sexes among patients attending Federal Medical Centre, Birnin Kebbi, Kebbi State, Nigeria. We analysed secondary data of hospital records of 5,645 feverish patients attending general out patients' department and medical laboratory department at the study area. Blood samples from the patients were collected and examined using thin and thick-blood smear slides technique for the presence or absence of parasites. Stained slides were examined using two levels of examination by trained microscopists and WHO certified expert microscopists as validators.

Results: The prevalence of malaria parasite in the study area was 17.1%. *P.falciparum* was the most prevalent species of malaria parasite (99.69%) among the positive cases in the study area, while *P.malariae* was identified in 3 of the positive slides representing 0.31% case. Malaria positivity was highest (52.49%) among children aged 0-10years. Test of association between malaria positivity and patients' age was statistically significant ($p < 0.05$). Among patients who tested positive to malaria parasite, more than half (53.37%) of them were females.

Conclusion: Presence of *Plasmodium malariae* may be indicative of trans-border transmission of the disease due to the proximity of the study area to international border and thus calls for effective malaria parasite surveillance system and further inter boarder research.

Introduction

Globally, malaria remains one of the major public health concerns leading to high morbidity and mortality. Concerns on the importance of controlling and eventual elimination of malaria and malaria-related deaths in the world led to its inclusion in the Sustainable Development Goals (SDGs) and Goal 3 (Target 3.3) was to end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases [1]. Symptoms of malaria include fever, headaches, chills, vomiting, muscle pain and fatigue, which are often neglected or misdiagnosed as other illnesses. Hence, the high morbidity and mortality of malaria among poor populations with limited health care facilities especially in Nigeria, where elimination of malaria remains a challenge [2], [3].

Malaria remains endemic in Nigeria with more than three-quarter of the population reporting more than one episode per year [4]. Children under-five and pregnant women were at higher risk of malaria infection and death. For instance, malaria accounted for 36.3% and 23.7% (based on Expert Algorithm Verbal Autopsy vs Physician Coded Verbal Autopsy) of death among children aged 1–59 months in Nigeria [5].

Data revealed that the country's microclimate, topography, population densities, cultural practices, etc also contribute towards the spread of the disease [6]. In the last decade, the fight against malaria and its propagating agents in Nigeria and across Africa has not been as effective due to the emergence of resistant species of the parasites, coupled with the advent of vectors that appear resistant to commercially available insecticides [7].

In 2014, forty Malaria Parasite Sentinel Surveillance (MPSS) sites were established across the country to collect data on malaria incidence, signals of emergence of possible treatment failure or parasite resistance to currently administered antimalarial medicines and document non-routine data on slide positivity rate, parasite density, parasite species and strains. Establishing these sites was aimed at systematic collection of basic information on febrile cases presented in MPSS centres and provision of information on trend of malaria burden in the respective localities in the states. Invariably, a functional MPSS site plays a vital role in the quest of eliminating malaria in malaria burdened countries like Nigeria. However, in the absence of a functional MPSS, a community-based malaria surveys as a means of monitoring the impact and effectiveness of malaria control measures and programs at different levels becomes critical. Data obtained from such studies would aid in defining up-to-date malaria burden as well as develop suitable measures of intervention whilst attempting to address adequate control measures for the disease throughout the country.

To this end, this study assessed the prevalence of malaria in patients attending Federal Medical Centre Birnin-Kebbi, Kebbi State, Northern Nigeria and also attempted to establish the prevalence of *Plasmodium spp* infection among different age groups and sexes of the patients, to analyse the relationship of malaria infection and gender and to study the relationship between malaria infection and age groups. This is with a view to provide relevant policy information to relevant government agencies involved in the control of malaria. The study also assessed the incidence of other species of Plasmodium responsible for malaria infection in the health facility.

Methods And Materials

The Study Area

The study was carried out at the Medical Laboratory department of the Federal Medical Centre Birnin Kebbi, Kebbi State, Nigeria. The Hospital is a tertiary health care facility located in Birnin Kebbi, Kebbi State Capital. It serves as a referral centre for more than 4 million Nigerians, particular Sokoto, Niger and Kebbi States; and neighboring Niger and Benin Republic among other West African countries in the sub-region.

Study Design

The study is a retrospective cross-sectional descriptive study that was carried out from January to December, 2018.

SAMPLING TECHNIQUES

Participants' Selection

Hospital records of a total of five thousand, six hundred and forty-five (5,645) feverish patients attending general out patients' department and medical laboratory department of the federal medical centre Birnin Kebbi were retrieved and analysed for the study. The procedures followed in getting the information from the patients include: patients' evaluation by the Consultant general at the out patients' department, obtained informed consent and, administration of a structured hospital laboratory form to elicit data on subject's demographic characteristics, age, gender, and laboratory investigation.

Blood Samples Collection and Processing

A sterile 22G needle fitted with syringe was used to collect five milliliters (5ml) of whole blood using standard technique of vein puncture and transferred into ethylene diamine tetra acetic acid (EDTA) bottles, allowed to properly mixed and samples properly labeled. Thick and thin blood smears were prepared together on a single slide from the blood collected in the EDTA bottles using with well labelled identifications numbers, WHO recommended malaria slides template was use to guide the process of making of blood smears. The thin film was fixed with absolute methanol, the slides were allowed to air dry and blood slides were stained with a 3% Giemsa solution for 30mins, clean water was use to float off the iridescent scum on the slides surface of the stain, each of the stained slides was remove one by one placing them downwards in drying rack to drain and dry, making sure that thick film does not touch the edge of the rack

Light microscopic Examination

To generate the record used in the study, thick-blood smear slides were examined for the presence or absence of parasites by expert microscopists who had been trained in 10-days basic malaria microscopy by USAID-PMI funded malaria project in Kebbi State by Malaria Action Programme for States (MAPS), validation and second stage reading was conducted by WHO expert microscopist with level 1 certification through the World Health Organization (WHO) External Competency Assessment for Malaria Microscopy scheme.). Two independent microscopists examined a minimum of 100 high-power magnification fields before the slide was classified as negative as per national and WHO guidance. Each microscopist read a maximum of 20 slides per day. Accurate malaria diagnosis was defined as concordance in the presence or absence of parasites in 100phf. Two independent expert microscopists cross-checked each of the slides and a third independent expert microscopist was called when necessary as a tie-breaker when the first two expert readers disagreed. To further validate the reading and ensuring quality, 25% of total slides were re-examine by WHO level 1 expert malaria microscopist.

Inclusion Criteria

All patients with fever attending general out patients' department and medical laboratory department of the federal medical centre Birnin Kebbi in all age group and both sexes were included.

Exclusion Criteria

All patients with fever attending general out patients' department but not medical laboratory department of the federal medical centre Birnin Kebbi in all age group and both sexes were excluded.

Data Analysis And Result

The data obtained were analyzed using STATA 12 employing relevant statistics. The analysis was done at univariate and bivariate level of the analysis to explore the objectives of the study.

Table 1 shows the distribution of participants by their demographic characteristics and result of malaria test carried out during the study. Highest proportion (44.50%) of the patients was children (dependant/unemployed) aged 0–10 years. The least represented patients were aged 51–60 years (2.29%). Furthermore, sex distribution among the respondents' shows that there were more females (54.33%) than males (45.67%) among the respondents. Less than twenty percent of the respondents however tested positive with malaria parasite.

Table 1
Percentage distribution of participants by demographic characteristics

Characteristics	Frequency	Percent
Age group		
0–10	2,512	44.50
11–20	1,010	17.89
21–30	976	17.29
31–40	627	11.11
41–50	232	4.11
51–60	129	2.29
61 and above	158	2.79
Sex		
Male	2,578	45.67
Female	3,067	54.33
Malaria Test		
Positive	965	17.09
Negative	4,680	82.91
Total	5, 645	100

Table 2 shows the prevalence of species of malaria parasites within the study area. A total of 5,645 cases were examined. Of the total cases examined, 965 cases were positive for malaria parasite. Further microscopic examination was carried out on the 965 positive cases to determine the species of malaria parasite presents in the study area. *P.falciparum* was the most prevalent species of malaria parasite (99.69%) among the positive cases in the study area. Other specie identified in the study area was *P.malariae* (0.31%).

Table 2
Distribution of various malaria *Plasmodium* species

Number Examined	Result	<i>P. falciparum</i>	<i>P. vivax</i>	<i>P. malariae</i>	<i>P. ovale</i>	<i>P. knowlesi</i>
965	Positive	962	-	3	-	-
4,680	Negative	-	-	-	-	-
5,645		99.69%		0.31%		

Table 3 explores the relationship between malaria positivity and gender in the study area. Among the patients who tested positive to malaria parasite, more than half (53.37%) of them were females. The chi-square test of the relationship between patients' sex and malaria test result was however not statistically significant ($p > 0.05$).

Table 3
Bivariate analysis of the relationship between malaria positivity and gender.

Gender	Malaria Test Result		Chi square value (χ^2)	P-value
	Positive N(%)	Negative N(%)		
Male	450 (46.63)	2,128 (45.47)	0.4354	0.509
Female	515 (53.37)	2,552 (54.53)		
Total	965 (100.0)	4,680 (100.0)		

Table 4 shows the distribution of plasmodium parasite species among age groups of patients in the study area. Generally, malaria parasite positivity decreased as the age increased. More than half (52.49%) of patients who tested positive to malaria parasite were aged 0–10 years. Less than three percent of patients who tested positive were aged between 51 and above. The test of relationship between malaria parasite positivity and age group was statistically significant ($p < 0.01$).

Table 4
Distribution of Plasmodium species in relation to age groups

Age group	Malaria Test Result		Chi square value	P-value
	Positive N (%)	Negative N (%)		
0–10	506 (52.49)	2,006 (42.86)	92.9733	0.000
11–20	224 (23.24)	786 (16.79)		
21–30	101 (10.48)	875 (18.70)		
31–40	79 (8.20)	548 (11.70)		
41–50	26 (2.70)	206 (4.40)		
51–60	16 (1.66)	113 (2.41)		
61 and above	12 (1.24)	146 (3.12)		
Total	964 (100.0)	4,680 (100.0)		

Discussion

Malaria is holo-endemic and stable in Nigeria where more than 90% of the total population is at risk of malaria [8]. In this study, prevalence rate of malaria infection was 17.09% as assayed via the gold standard of malaria detection (microscopy). This is at par with the study carried out by Anumudu et al [9], who reported similar prevalence 17%. This prevalence is however lower compared to studies carried out in other different locations in Nigeria. For instance, Onyido et al [10] reported a prevalence rate of 70.8% in Anambra state. Igbenegbu et al [11] reported 21.1% prevalence rate in Iwo, Osun state while Oladele et al [7] recorded prevalence rate of 64.9% in Kano. Factors for variance in prevalence across different locations may be predicated upon the time of the year when the studies were carried out and the geographical zone of each locations. However, this present study cut across the whole period of a year.

Furthermore, findings from the study shows that only two species of plasmodium were identified in the study area viz; *P. falciparum* and *P. malariae*. The former was the most prevalent specie accounting for 99.69% cases in line with the established evidence from similar studies. For example, Mouzin [12] reported that the most prevalent malaria parasite species is Plasmodium falciparum (> 95%).

The malaria prevalence among sexes was not statistically significant ($p > 0.05$). Malaria parasitaemia was slightly higher in female (53.37%) than in male (46.63%) at the bivariate level of the analysis. One plausible reason for this may be as a result of low immunity especially among women with pregnancy, since all groups of female were included in the study. Pregnant women, especially primigravidae and secondigravidae, lose the acquired semi-immunity of adulthood, and are more prone to malaria than other adults [13].

Further analysis of the relationship between age and malaria parasite positivity among the patients in the study area was statistically significant ($p < 0.01$). Children aged 0–10 years were more affected as they represent more than half of patients who tested positive to malaria parasite. Similar finding was also reported by Syafruddin et al. [14] and WHO [15]. The World Malaria Report showed that infants and children under 5 years were among the population at risk of malaria infection. This may be attributed to low transferred maternal immunity or infection acquired through the mother. This suggested inadequate protection, greater exposure to mosquito bites which may be predicated upon various predisposing environmental and maternal factors.

Conclusion

The study further confirms that malaria remain an epidemiological infection of concern in the study area and Nigeria in general. The infection cut across all age groups but higher among the dependants and unemployed (0–10 years). This in turn can be a distraction to the employed and care givers in the society as well as affecting the economic productivity of the state as the sick ones are being taken care of. There is presence of other species of plasmodium (*P.malariae*) in Kebbi, however *Plasmodium falciparum* remains the predominant malaria species responsible for malaria infection in this region like most other places in Nigeria, Africa and the world generally. Meanwhile the presence of *Plasmodium malariae* may be due to the proximity of this health facility to the Republic of Niger. This may be subjected to further inter boarder research work in this direction

Abbreviations

SuNMaP2: Support to National Malaria Program (Phase 2); MPSS: Malaria Parasite Sentinel Surveillance; EDTA: Ethylene Diamine Tetra acetic Acid; MAPS: Malaria Action Programme for States; MLS: Medical Laboratory Scientist; mRDT: Rapid Diagnostic Tests; PMI: President's Malaria Initiative; USAID: United States Agency for International Development; WHO: World Health Organization

Declarations

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Availability of data and materials:

All data generated or analysed during this study are included in this published article.

Disclaimer:

The findings and conclusions presented in this manuscript are those of the authors and do not necessarily reflect the official position of Federal Medical Center, Birnin-Kebbi, Kebbi State or other author's affiliations.

Authors' contributions:

OVO conceived the idea, read the first draft and provided comments to improve the manuscript; OA wrote the first draft of the paper and coordinated data management and statistical analysis. KH and OAA coordinated blood samples collection and light microscopic examination and reviewed draft manuscript and provided input to improve the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests:

The authors declare that they have no competing interests.

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