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MALARIA IN SYMPTOMATIC PATIENTS ATTENDING A FEDERAL MEDICAL CENTRE IN CENTRAL NIGERIA

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ABSTRACT

Malaria remains an ongoing problem in Nigeria even though a lot has been achieved in the past years; millions of people are still at risk of contracting the parasite. Thus, this study determined the malaria prevalence in symptomatic patients attending a Federal Medical Centre in Central Nigeria. Five milliliters (5mls) of blood was collected from 250 patients between July and December 2023 by the use of a well labeled ethylene diamine tetraacetic acid (EDTA) vacutainer tube and malaria parasite test was conducted using microscopy and Rapid Diagnostic Test (RDT). Out of a total of 250 patients examined for malaria parasite in this study, 132 (52.8%) were significantly ($P<0.05$) positive to microscopy while RDT recorded 55 (22.0%) positive. Males had higher malaria prevalence of 61.3% in microscopy and 28.6% in RDT than 45.0% (microscopy) and 16.0% (RDT) recorded in females. Age groups, < 5, 5 – 10 and 50 and above years had the highest positive cases of 51.8%, 56.1% and 65.6%, respectively. A significant difference ($P<0.05$) was also recorded in relation to educational background, amongst rural and urban dwellers, and net usage status, respectively. The inhabitants of Keffi Local Government Area should observe regular sanitation to clear out all potential malaria vectors breeding grounds and avoid human-vectors contact by sleeping under long lasting insecticide treated bednets.

Key Words: Keffi, Malaria, Parasites, Symptomatic patients.

1.0 Introduction

Malaria is one of the world's most important parasitic infections having approximately 249 million cases causing approximately 608, 000 deaths worldwide with Africa carrying a excessive high share of worldwide malaria burden (World Health Organization [WHO], 2023). Managing this disease is challenging due to several reasons, which includes the resistance to anti-malarial drugs by the parasites, increasing resistance among some of the agents of the infections, and knowledge about their life cycle and habitats (WHO, 2022). Africa enables the efficient growth and multiplication of malaria vectors by providing stable and ecologically

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diverse habitat (WHO, 2023) and is likely to remain so in the face of global climate change (Peterson, 2019).

The Federal Ministry of Health, Abuja accounted that at least 50.0% of Nigerians suffered from one form of malaria or the other making it the most significant health problem in Nigeria (Amini *et al*., 2020). The high transmission rate and prevalence of malaria is as a result of the diverse mosquitoes breeding sites, which include places that holds water, such as tins, cans, old tyres, tree holes, cisterns, open pools, drainage, stream and pond (Grech *et al*., 2019; Oguche *et al*., 2022).

The aim of this study is to educate the public and contribute to the body of existing literatures on this field and to determine the malaria infection in symptomatic patient attending a Federal Medical Centre (FMC) in Central Nigeria.

2.0 Materials and Methods

2.1 Study Area

This study was conducted in Keffi metropolis, the headquarters of Keffi Local Government Area of Nasarawa State, Nigeria. Keffi is about 58km from the Federal Capital Territory (Abuja) and 128km from Lafia, the Nasarawa State Capital. The town is situated on latitude 8° 5′ North and longitude 7°5′ East and about 850 meters above the sea level. Keffi has population of 92,664 by the national population census of 2006, which makes it the second largest city of the State (Akwa *et al*., 2007).

2.2 Study duration

The Study was conducted within the period of six (6) months (July to December 2023).

2.3 Sample size determination

The sample size was determined by employing the formula by Bartlett *et al*. (2001) for calculating appropriate sample size in a prevalence study.

$$n = \frac{p(100-p)z^2}{E^2}$$

n is the required sample size

P is the percentage occurrence of a state or condition

E is the percentage maximum error required

Z is the value corresponding to level of confidence required

Therefore, the total number of subjects screened in this study was two hundred and fifty (250) after substituting the variables.

2.4 Ethical consideration

After a successful defense of the research proposal in the Committee's ethical screening interview, the work received ethical permission from the Health Research Ethics Committee, Federal Medical Centre, Keffi, Nigeria (FMC/KF/HREC/0236/23). The approval was on the agreement that the internationally acceptable ethical standards governing conducts of research is expected to be strictly adhered accordingly and all rights and privileges of the volunteering participants be respected.

Administrative clearance for this study was obtained from the Head of Laboratory Department, Federal Medical Centre, Keffi and consent was sought from the participants.

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2.5 Sample collection

The entry criterion of this study was based on the patient's complaints of a symptom similar to that of malaria infections such as pain, fever, and nausea. Five milliliters (5mls) of whole blood was collected from the patient using a well labeled EDTA tube (WHO, 2010; Center for Disease Control [CDC], 2020).

2.6 Microscopic analysis

Microscopy examination was carried out at Federal Medical Center Keffi. Thin and thick blood films were prepared on the same labeled slides using peripheral blood samples in the field. The slides were fixed in methanol and stained using 10% Giemsa stain solution for ten minutes. Giemsa stock solution was diluted with distilled water of pH 7.2. The stain was washed off gently and slides air-dried before being examined under ×100 oil immersion lens (Cheesbrough, 2017). The blood slides were read by a certified medical laboratory scientist.

2.7 Rapid Diagnostic Test (RDT) Sample Analysis

Rapid Diagnostic Test (RDT) test as described by the World Health Organization (2008) was used to detect the histidine rich protein II (HPR-II) antigen specified to Plasmodium falciparum. Two distinct lines indicated positive, in which it shows in the control region (C) and in the test region. If one line shows on the control region without a line on the test region, this indicates a negative result.

2.8 Data analysis

The data generated were entered in Microsoft Excel Spreadsheet and analyzed using SPSS version 23.0. Simple frequencies and tables were generated, while categorized variables were compared using Chi-square test. P-value less than 0.05 ($p<0.05$) was considered statistically significant.

3.0 Results and Discussion

3.1 Malaria infection among Out-patients attending Federal Medical Centre Keffi

Out of the total of 250 patients examined for malaria parasite in this study, 132 (52.8%) were infected with malaria based on microscopy screening while RDT recorded an output of 55 (22.0%) positive cases as shown in table 1. Therefore, there was a significant difference in the prevalence of malaria infection between microscopy and RDT (Microscopy: $\chi^2 = 2.415$, df = 1, p = 0.120; RDT: $\chi^2 = 3.756$, df = 1, p=0.05). The prevalence of malaria in this study was 52.8% and 22.0% using microscopy and RDT respectively. This prevalence is comparable to the overall risk map of 56.3% in Rivers State by Egbom *et al.*, 2023 and to the 56.8% prevalence rate by Jemimah *et al.*, 2019 in Central Nigeria. However, the findings of this study is lower than the 84% prevalence of malaria in febrile patients reported by Nas, *et al.*, (2017) in Kano, Northern Nigeria and higher than the 15.83% prevalence rate documented by Kurmi *et al.*, 2023 in a study in Bauchi State of Nigeria. This variation in prevalence of malaria in different places in Nigeria may be due to inadequate protection against mosquito bites or insufficient knowledge about malaria transmission, climatic differences, period of study and socio-cultural factors. Also, according to Ombugadu *et al.*, 2021, the outdoor nocturnal activities and negligence of people continually expose them to mosquito bites. The prevalence of malaria using microscopy was significantly ($p<0.05$) higher than RDT method in this study. The positivity of the RDT is likely to be affected by storage temperature which may have been responsible for the low positive cases in this study. Also, it is possible that some patients may have been medicated prior to appearance of malaria symptoms and provided no such

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information while giving their consent for this study. The finding in this study contradicts other studies who reported higher prevalence rate in RDTs than microscopy (Opoku *et al.*, 2023,

Table 1: Malaria Infection in symptomatic patients attending Federal Medical Centre Keffi

Demographics	No. tested	Microscopy No. positive (%)	RDT No. positive (%)	t-test	p-value
Gender					
Male	119	73 (61.3)	34 (28.6)		
Female	131	59 (45.0)	21 (16.0)		
Total	**250**	**132 (52.8)**	**55 (22.00)**	4.030	0.053
χ^2		**2.415**	**3.756**		
P-value		**0.120**	**0.053**		
Age (Years)					
< 5	27	14 (51.8)	6 (22.2)		
5 – 10	39	25 (64.1)	9 (23.0)		
11 – 20	20	11 (55.0)	5 (25.0)		
21 – 30	56	27 (48.2)	12 (21.4)		
31 – 40	35	18 (51.4)	6 (17.1)		
41 – 49	29	16 (55.2)	7 (24.1)		
50 and above	32	21 (65.6)	10 (31.3)		
Total	**250**	**132 (52.8)**	**55 (22.00)**	2.894	0.120
$\chi 2$		**3.581**	**4.574**		
p-value		**0.611**	**0.470**		
Educational Level					
Primary	89	52 (58.4)	25 (28.1)		
Secondary	52	28 (53.8)	13 (25.0)		
Tertiary	65	25 (38.5)	7 (10.8)		
None	44	27 (61.4)	10 (22.7)		
Total	**250**	**132 (52.8)**	**55 (22.0)**	0.667	0.445
χ^2		**5.396**	**7.667**		
p-value		**0.145**	**0.053**		

Kangming *et al.*, 2024 and Madkhali *et al.*, 2022), and corroborates the findings of Zeleke *et al.* (2023), Tolulope *et al.* (2021), Alshamrani *et al.* (2020) and Runmonkun *et al.* (2019), who reported that microscopy has higher malaria positive cases than RDTs. However, RDTs should be used alone when expert microscopy is unavailable else it should complement microscopy.

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3.2 Demographic-wise Prevalence of Malaria in Symptomatic Patients Attending Federal Medical Center Keffi.

In this study, males' subjects had higher malaria prevalence of 61.3% and 28.6% in microscopy and RDT, respectively than 45.0% (microscopy) and 16.0% (RDT) recorded in females (Table 1). Hence, there was no significant difference in the prevalence of malaria between males and females $p>0.05$ (Microscopy: $\chi^2 = 2.415$, df = 1, $p=0.120$; RDT: $\chi^2= 3.756$, df = 1, $p=0.053$). This study revealed that the prevalence of malaria is higher in males than females, this could be as a result of the outdoor activities of men such as cultural and occupational exposure and protection measures as most men are the sole providers of their houses. This finding corroborates the report of Zeleke, *et al.* (2023), Madkhali *et al.* (2022) and Runmomkun *et al.* (2019), who stated that males may be more prone to the disease than the females and contradicts the report of Otojareri, *et al.* (2023), Jemimah, *et al.* (2019) and Briggs *et al.* (2020) who stated females are more prone to malaria infection. However, till date, there has not been any scientific evidence documented to prove the higher prevalence of malaria was associated to sex susceptibility because *Anopheles* mosquito which is vector of malaria is not sex discriminatory during biting.

From microscopy, age group 50 and above had the highest malaria infectivity rate (65.6%), age group 5–10 had (64.1%), age group < 5 years had the prevalence rate of (51.8%), age group 41-49 had 55.2%, 31 – 40 years age group had 51.4% , while the least infected was recorded in age groups 21-30 with the prevalence rate of 48.2% respectively. However, there was no significant difference (Microscopy: $\chi^2=3.581$, df=6, $p=0.611$; RDT: $\chi^2=4.574$, df=6, $p=0.470$) in malaria prevalence in relation to age groups. The highest prevalence of malaria infection based on age groups was found in patients that are 50 years and above (65.6%) and less than 5-10 years (64.1%) in this study may be due to improper use of malaria control strategies like Insecticide Treated Bed Nets (ITNs), insect repellents and also, repeated exposure can lead to partial immunity in such age groups. This agrees with the study of Jemimah, *et al.* (2019) which stated that age is a risk factor in a study area. This finding also corroborates other findings that reported higher prevalence among age groups less than 20 years such as that of Otojareri *et al.* (2023), Hari *et al.* (2021) and Nwaneli *et al.* (2020) which stated that the prevalence of malaria significantly differed in different age groups and is higher with increasing age. Improper use of malaria control strategies like Insecticide Treated Nets (ITNs) usage, poor knowledge and awareness of malaria might be the reason for a high prevalence among those aged 5-10 and 50 years above.

The level of education of the patients showed group with no educational background had the highest prevalence. However, there was no significant difference $p>0.05$ (Microscopy: $\chi^2 = 5.396$, df=3, $p=0.145$) in malaria prevalence in relation to educational qualifications but with the exception of RDT technique which showed a significant difference ($\chi^2=7.667$, df=3, $p=0.053$). This study showed that malaria prevalence is linked to two factors which include level of education and residence (settlement patterns) of the patients; this is in line with the work of Enyi *et al.* (2023) who also stated that occupation and level of education may contribute to high malaria infection and that of Benjamin *et al.* (2019) who studied demographic factors associated with malaria in Zaria, Kaduna State Nigeria, and found out that the highest prevalence was detected among individuals who are not educated.

3.3 Relationship between symptoms of malaria and the prevalence of Malaria in symptomatic patients attending Federal Medical Centre Keffi.

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Table 2 showed the relationship between symptoms of malaria exhibited by the patients and prevalence of malaria. Out of 181 that complain of headache, 112 (61.9%) positive (microscopy) and 49 (27.1%) positive (RDT), whereas, of the 69 patients with no headache,

microscopical examination showed that only 20 (29.0%) for microscopy and 6 (8.7%) positive for RDT technique.

Table 2: Relationship between symptoms of malaria and the prevalence of Malaria in symptomatic patients attending Federal Medical Centre Keffi.

Symptoms	No. tested	Microscopy No. positive (%)	RDT No. positive (%)
Headache			
Present	181	112 (61.9)	49 (27.1)
Absent	69	20 (29.0)	6 (8.7)
Total	**250**	**132 (52.8)**	**55 (22.00)**
χ^2		64.12	33.618
p-value		<0.0001	<0.0001
Fever			
Present	131	91 (69.5)	42 (32.1)
Absent	119	41 (34.5)	13 (10.9)
Total	**250**	**132 (52.8)**	**55 (22.00)**
χ^2		18.936	16.071
p-value		0.007	0.010
Vomiting			
Present	144	76 (52.8)	37 (25.7)
Absent	106	56 (52.8)	18 (17.0)
Total	**250**	**132 (52.8)**	**55 (22.00)**
χ^2		3.030	6.564
p-value		0.108	0.056

Patients with fever had higher prevalence of malaria (69.5%) than patients with no sign of fever (34.5%). A significant difference was ($p<0.05$) was observed between symptomatic and asymptomatic malaria patients with the exception of those that vomited and those that did not vomit ($p=0.108$). In this study, symptoms presented by majority of the patients most especially fever and headache aligned with malaria prevalence.

3.4 Risk factors associated with prevalence of Malaria

Possible risk factors of malaria infection as shown in table 3 revealed that the prevalence of malaria among rural dwellers was (52.2%) using microscopy and (28.8%) using RDT was

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higher against 46.2% (microscopy) and 11.3% (RDT) recorded among urban settlers. A significant difference was recorded in malaria prevalence in relation to settlement patterns using both microscopy and RDT (P<0.05) in malaria prevalence in relation to settlement patterns. Patients that use mosquito net had lesser malaria prevalence of 37.3% compared to 58.5% among those that did not use net as shown in Table 3.

Table 3: Risk factors associated with malaria infection

Risk factors	No. tested	Microscopy No. positive (%)	RDT No. positive (%)	$\chi 2$	P-value
Residence					
Rural	153	89 (52.2)	44 (28.8)	23.534	<0.001
Urban	97	43 (46.2)	11 (11.3)		
Total	**250**	**132 (52.8)**	**55 (22.00)**		
$\chi 2$					
P-value					
Use of Mosquito net					
Yes	67	25 (37.3)	-	16.691	<0.001
No	183	107 (58.5)	55 (30.1)		
Total	**250**	**132 (52.8)**	**55 (22.00)**		
$\chi 2$					
P-value					

Key:
χ^2 = chi square,
T-test = A statistical test that compares the means of two samples
p = level of significance
% = Percentage
RDT = Rapid Diagnostic Test Kits

Therefore, there was a significant difference in the prevalence of malaria among patients that use mosquito net and those that did not (P<0.05). According to Tesfaye & Teshome (2022), the main reason for rejection of the ITNs by individuals, is as a result misconceptions about its toxicity. Ofori, *et al.,* (2019) stated that residence area could influence high prevalence of malaria infection. Enyi *et al.,* (2023) also stated that occupation and level of education respectively may contribute to high malaria infection. This study shows that malaria prevalence is linked to two factors which include level of education and residence (settlement patterns). This is in line with the findings of Benjamin *et al.*, (2019) who studied demographic factors associated with malaria in Zaria, Kaduna State Nigeria, and found out that the highest prevalence was detected among individuals who are not educated. Also, in their study of the prevalence, trends, and associated factors of malaria in the Shai-Osudoku District Hospital, Ghana, Tatteh *et al.,* (2023) recorded higher rate of malaria infection among the uneducated and rural dwellers compared to the educated and urban dwellers.

4.0 Conclusion

This study provides information on the prevalence of malaria in symptomatic patients attending Federal Medical Center Keffi and shows that malaria remains a major public health challenge

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despite realistic efforts made to manage it. Risk and demographic factors such as place of residence, use of mosquito nets, age, sex and level of education have been revealed to impact malaria transmission. Therefore, malaria control efforts should be intensified, taking into cognizance, the role of risk and demographic factors in transmission of infection.

The adoption of malaria control measures by the government should be encouraged, these includes campaigns promoting the use of mosquito treated nets, maintenance of good personal and environment hygiene. It is also recommend that individuals should sleep under an insecticide treated bed net and stay in an air conditioned or well screened area.

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Conflict of Interest

The authors declare no competing interest.

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