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A Cross Sectional Study of Malaria Burden among Febrile Patients Attending a Healthcare Facility in Nassarawa State, Nigeria

Hajara Zakari[1*], Samuel Bawa Ijimbili[1], Sabina Chioma Eze[1], Suleiman Zakari[2,3], Celestine O Ogbu[2], Blessing Ogbene Andy[1], Naomi Ilehi Acham[1], Agwara Bright Chiaka[4], Akuki Moses[4] and Oludare Agboola[1]

[1]Department of Biological Sciences, Faculty of Sciences, Federal University of Health Sciences, Otukpo, Benue State, Nigeria

[2]Department of Biochemistry, College of Medicine, Federal University of Health Sciences, Otukpo, Benue State, Nigeria

[3]Covenant Applied Informatics and Communication-Africa Centre of Excellence (CAPIC-ACE), Covenant University, Ota, Ogun State, Nigeria

[4]College of Strategic Learning and Health Technology, Kuchikau, Nasarawa State, Nigeria

[*]**Corresponding author:** Hajara Zakari, Department of Biological Sciences, Federal University of Health Sciences, Benue State, Nigeria; Email: Hajara.zakari@fuhso.edu.ng

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Abstract

Malaria is one of the world most prevalent and common parasitic disease in Nigeria and most developing countries, which contributes to high infants and maternal mortality. The study ascertained malaria burden among febrile patients attending a healthcare facility in Nasarawa state, Nigeria and present epidemiological data on malaria. Purposive sampling of patients with febrile conditions who sought treatment were adopted for the study and rapid diagnostic test kits specific for *Plasmodium falciparum* were used for malaria testing. Eight thousand seven hundred and eighty four participants (8784) were enrolled from January to December, 2022 for the study. Out of 8784 subjects examined, 5211 (59.3%) were females while 3558 (40.5%) were males, 5939 (67.6%) were positive for malaria infection and 2845 (32.4%) were negative. Out of 5939 positive patients, 2545 were males and 3394 were females. An overall prevalence rates of 67.6% were observed with higher rates among females (38.6%) than males (29.0%), among children (≤ 20: 12.1%) and young adults (≤ 40: 46.6%) with least infection rates among the elderly (41-above 61: 1.1%). Higher rate were recorded in the month of August, followed by September, October, November and December. There is significant difference ($P \leq 0.05$) and association in malaria prevalence rates with gender and age categories of patients. In conclusion, the study established a relatively high prevalence rate (67.6%) of malaria and vulnerability of children, young adults and females to malaria infection within the study location.

Keywords: Malaria burden; Prevalence; Karu LGA; Nasarawa state; Nigeria

Introduction

The main purpose of primary healthcare is to serve as the initial access point for the general population to the healthcare system, with the goal of delivering effective and efficient medical services. It is crucial to ensure proper prescription of medications, particularly for malaria, as it continues to be a significant public health concern [1,2]. Malaria puts a significant socioeconomic burden on humanity and it accounts for 85% of global infectious disease burden [3]. Malaria is one of the major health problems caused by a vector-borne eukaryotic protist of the genus *Plasmodium*. *Plasmodium* is a parasite which is transmitted naturally by the bite of a female mosquito anopheles called malarial vectors [4]. The disease is characterized by symptoms and resemble the flu, including fever, headache, vomiting and among others [5,6]. The disease's effects on populations include both direct health repercussions, where people afflicted suffer physical and psychological pain, potentially leading to illness or death and indirect health consequences, where those affected suffer physically and psychologically, which may lead to illness or death. There is also an economic consequence because patients and caregivers may experience decreased productivity or income loss, resulting in large decreases in overall outputs [7-9].

According to the latest World malaria report, there were about difference 245 million cases. The estimated number of malaria deaths stood at 625,000 in 2020. The WHO African region carries a disproportionately high share of the global malaria burden. In 2021, the African region accounted for 96% malaria case and death [10]. Several factors have contributed to the prevalence of malaria in endemic countries. These predominant factors can be grouped into three: Medical condition (malaria co-infection with typhoid, HIV-AIDS anaemia), environmental factors and human status (age, gender, pregnancy, blood group and rhesus factors) [11]. Age is an important factor as a determinant of malaria prevalence.

Bassey and Nwakaku, reported low prevalence among children of 1-3 years, Ndubuisi, et al. reported high prevalence among the elderly, Houmsou, et al., among children and young adults under forty of age. Gender either male or female is another important determining factor of malaria infection rates as some studies had reported a higher prevalence among males while others females [12].

Malaria burden estimation is difficult, especially in low-income countries with inadequate data collection and reporting quality. Incomplete and discontinuous data from a single health facility may affect the final worldwide malaria prevalence estimate. Malaria cases are frequently misdiagnosed in malaria-endemic regions, where moderate signs of chronic malaria may lead to a misdiagnosis. On the contrary, over-diagnosis is possible. In fact, not all malaria cases reported are verified by microscopy or other assays, such as Rapid Diagnostic Tests (RDTs) [13-15]. Furthermore, in malaria-endemic locations, febrile diseases of other origins may be misinterpreted as malaria. In any event, WHO recommendations urge that all malaria cases be confirmed by microscopy or RDTs [16].

Nigeria is made up of hundreds of communities and settlements, each having its own indigenous people, microclimate, topography, population density, cultural customs and general way of life. These criteria have a significant impact on the disease's transmission intensity and control. The Nigerian ministry of health had a strategic plan to reduce malaria burden to pre-elimination levels and bring malaria-related mortality to zero but have so far been unable to achieve this [17-19]. Data on malaria epidemiology and transmission dynamics, risk factors associated with infection and the efficacy of available antimalarials are required for effective interventions, planning strategies and implementation of control measures tailored to the needs of individual communities or settings [20-22].

This study aims to provide valuable insights into the malaria situation in the study area. It will contribute to the existing knowledge of malaria epidemiology, inform local healthcare practices and guide policymakers in implementing targeted interventions. The findings from this study have the potential to enhance our understanding of the burden of malaria in the selected endemic setting and aid in the development of evidence-based strategies for malaria control and prevention. Ultimately, the goal is to reduce the impact of malaria on the local population, improve healthcare delivery and contribute to the global effort to combat this preventable and treatable disease [23].

Materials and Methods

Study design and setting

A facility based cross sectional study was conducted at a primary healthcare facility located at Karu local government area of Nasarawa state, North central, Nigeria from January to December 2022. Karu local government area is located within the Guinea savannah belt of north central Nigeria, coordinates of 9°0N, 7°40'E and elevation of 448 (1,470 ft). The hospital is a primary healthcare facility serving several communities and neighbouring towns such as Mararaba, Ado, New Nyanya, new Karu and Kurunduma. Karu is a highly populated area with lots of economic and farming activities on going within the area. Due to its low altitude, more farming and irrigation activities, malaria cases are usually an issue within the area.

Study population

The study population comprised of febrile patients who consists of children, pregnant women and generally adults who attends the facility and agreed to participate in the study from January to December, 2022. A total of 8,784 participants were sampled for the study.

Inclusion and exclusion criteria

Patients with a history of fever or body temperature of >37.5 in both adults and children who agreed to participate in the study at the healthcare centre were included while those who had received treatment of malaria three weeks before study or those on antimalarial treatment were excluded from the study.

Sample collection

Blood sample was collected from each participant by venipuncture following the protocol of Kalu, et al.

Laboratory analysis

A total of 8784 patients attending the hospital, who were febrile or with a history of fever in the past 48 hours were screened for malaria. All patients were classified into four age groups with slight modification: Those under the age of 20, those between the ages of 21 and 40, those between the ages of 41 and 60 and those over the age of 61 [24]. Rapid diagnosis of malaria parasite was carried out using rapid diagnostic tests (CareStart™ RDT) to detect HRP2-specific to *Plasmodium falciparum* following the manufacturer's instruction.

Data analysis

Data obtained were coded, entered and analysed using Statistical Package for Social Science software version 20 (SPSS). Descriptive statistics such as frequency, percentage and mean were used to explain the study participants and malaria prevalence in the area. *Chi-square* statistical test was used to determine differences and values obtained were considered statistically significant at $P \leq 0.05$.

Results

Out of 8784 subjects examined, 5939 were positive for malaria infection and 2845 were negative. Out of 5939 positive patients, 2545 were males and 3394 were females.

The malaria prevalence in relation to patient's gender was: Male 29.0% (2545/8784) and female 38.6% (3394/8784). Statistically, there is a significant difference ($P \leq 0.05$) between malaria prevalence and gender (Table 1 and Figure 1).

Table 1: Gender related distribution of malaria infection rates.

Gender	Malaria result			
	Negative	**Positive**	**No. examined**	**Prevalence (%)**
Male	1018	2545	3563	29
Female	1827	3394	5221	38.6
Total	2845	5939	8784	67.6
Note: *P value=0.000, df=1, X^2=157.215[a]				

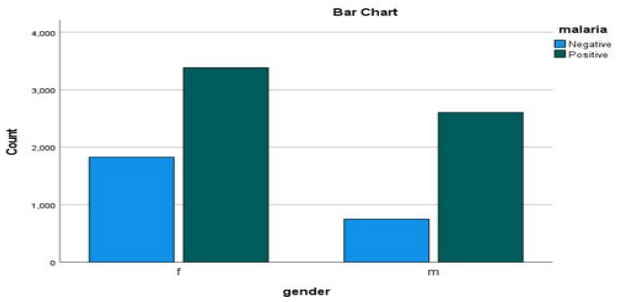

Figure 1: Malaria infection rates according to gender.

Malaria infection rate according to age categories are: 0-20: 12.1% (1061/8784), 21-40: 46.6% (4094/8784), 41-60: 7.8% (684/8784) and 61 and above: 1.1% (100/8784). The highest infection rate was observed among patients of 21-40 age categories, followed by 0-20 age category. The least infection rate was recorded among patients of age category 61 and above. Malaria infection rate were significantly different statistically ($P \leq 0.05$) with age categories of patients (Table 2).

Table 2: Malaria occurrence across age categories of febrile patients.

Age	Malaria result			
	Negative	**Positive**	**No. examined**	**Prevalence (%)**
0-20	1189	1061	2250	12.1
21-40	1171	4094	5265	46.6
41-60	423	684	1107	7.8
61 and above	62	100	162	1.1
Total	2845	5939	8784	67.6
Note: *P value=0.000, df=3, X^2=618.643				

Malaria infection rates across twelve months of the year, January to December is presented in Table 3 and Figure 2. High infection rates were observed to occur in August 15.4% (1353), November 13.03% (1145), September 13.25% (1164), December 8.9% (782), October 7.66% (673), arranged in descending order. Much lower infection were recorded in June 0.65% (57), January 1.45% (127), April 2.15% (189), May 2.53% (222), March 2.58% (227), arranged in ascending order. The least and highest infection rates were observed in June 0.65% (57) and August 15.4% (1353) respectively. No sampling activity was carried out in the month of February and July.

Table 3: Monthly distribution of malaria infection rates of febrile patients.

Months	Malaria result			
	Negative	**Positive**	**No. examined**	**Prevalence (%)**
January	414	127	541	1.45

February	-	-	-	-
March	193	227	420	2.58
April	117	189	306	2.15
May	443	222	665	2.53
June	11	57	68	0.65
July	-	-	-	-
August	317	1353	1670	15.4
September	281	1164	1445	13.25
October	562	673	1235	7.66
November	65	1145	1210	13.03
December	442	782	1224	8.9
Total	2780	6004	8784	67.6

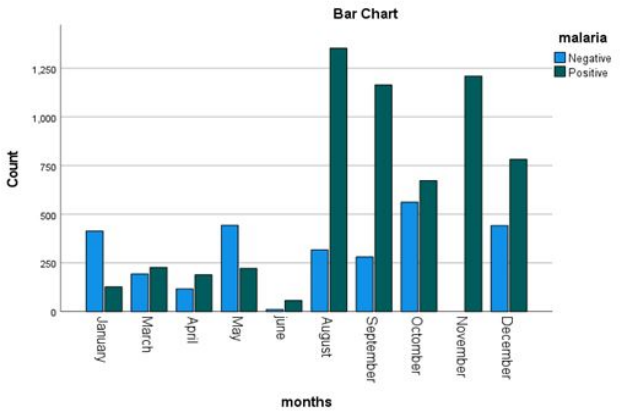

Figure 2: Monthly distribution of malaria infection among febrile patients.

Discussion

An overall prevalence of 67.6% was reported among febrile patients attending the primary healthcare facility in Karu L.G.A, Nasarawa state, north central Nigeria which is in agreement and contrast with several studies within the country and globally. Higher rates than the report of this study have been found in some parts of the country [25-27]. Much lower prevalence rates compared to the findings in this study have been reported in other countries such as 9.8% among students, 25% among adults, 12.3% among pregnant women. A prevalence rate of 64.9% among patients in Kano was reported Oladele, et al., 65.0% among people living with HIV-AIDS in Keffi, 67% among pregnant women in Jos, 69.19% among patients in Niger state, 15% among febrile patients in Jos, 39.5% among patients in Benue state, 31.6% among children in Abeokuta and 38.4% among students in Igbinedion university Okada [28,29]. Differences in prevalence rate comparable to other studies could be due to differences in *Anopheles* species, environmental and climatic conditions of different locations, study period, lifestyle of study population and diagnostic test methodology [30-32]. The relatively high prevalence rate of malaria infection reported in this study might be due to the prevailing environmental conditions that facilitates the breeding of the malaria parasite vector. Due to poor drainage system within the study area and suburbs surrounding it, most communities where patients comes from to the hospital are rural communities without basic facilities, proper sanitary or hygienic measures in place which fosters breeding ground for malaria vectors [33,34]. Also due to poor adherence to preventive measures, low immunity due to poor nutritional status, educational status of parents, social status and lifestyle, lost of some degree of immunity especially in growing children above 5 years of age due to poor living conditions might facilitate exposure to malaria vectors [35]. These all predisposes the people to the bites of mosquitoes and accounts for its high prevalence [36]. There is significant difference statistically ($P \leq 0.05$) between malaria infection rate with age categories and gender of patients and also association between infection rate with age and gender of patients. Therefore age and gender are probably risk factors for the acquisition of the infection within the study area. The parasitic infection was found to be highest among females than males.

The present prevalence of malaria based on gender have been widely reported in literature by authors Okonkwo, et al., Okafor and Oko-Ose, Austin, et al., Kuta, et al., Oladeinde, et al., Tela, et

al., Umaru and Uyaiabasi, Ani, et al., Nmadu, et al., Abah and Temple, Dawaki, et al., Okeke et al., Garba, et al., Bassey and Nwakaku [37,8]. The result of this study contradicts the findings of Houmsou, et al., Oladeinde, et al., Oladele, et al., who all reported higher prevalence rates among males than females and confirmed the result of Okonkwo, et al. and Tela, et al [19]. The higher prevalence of malaria as recorded in this study for females could be due to certain lifestyle, occupation, social status, cultural practices within the communities that might have exposed the females to more infection than males as there are no existing records with scientific evidence or basis of malaria infection to be gender based [38]. Some epidemiological studies on malaria have reported high prevalence of the infection in males but no scientific evidence suggests this could be linked to sex susceptibility. Though there is association between malaria infection with gender and age of patients in this study ($P<0.05$), based on review of literatures malaria infection does not have any significant influence with gender [39].

The study revealed higher infection rate among less than five children and young adults. Children under twenty and young adults under forty of age were observed to be vulnerable group for the parasitic infection. This could be due to immunity levels, occupational types, certain lifestyle, poor living conditions, educational status of parents, late report of cases by parents, social status, absence or inadequate preventive measures e.g., the use of insecticide treated nets by both parents and adults could be determinant factors responsible for such a high prevalence among these age categories. These findings is consistent with the reports of Houmsou, et al., and Jemimah, et al., who observed a high prevalence rate among participants of this age category but in contrast with reports within the country and globally which indicated a higher prevalence among the elderly rather than the young ones [39,40]. The reports of Oladele, et al., confirmed a high prevalence and vulnerability across all age groups ranging from children, young adults and elderly ones.

Higher prevalence rates were observed in months that fell within the wet season over the dry season. A higher prevalence rate was recorded in August, followed by September, October, November and December. This contradicts the findings of Njila, et al., who reported the highest malaria rate among pregnant women in Jos in the month of September [41]. The differences in the prevalence rate in different locations could be due to the different climatic conditions. With the high amount of rainfall which provides conducive environment for breeding of malaria vectors, environmental components such as high vegetation, humidity, stagnant water collections and water storage during the rainy season within the study area could be responsible for the high prevalence observed. The occurrence of malaria vectors appears higher during the wet season. This could be due to the presence of breeding ground of mosquitoes. Garba, et al., reported higher prevalence during wet season (9.2%) compared to dry season (4.9%) among blood donors [16]. Ukaegbu, et al., attributed its prevalence to rainfall, warm temperatures and stagnant waters which provide ideal habitats for mosquito larvae.

Conclusion

This study reported a relatively high prevalence of malaria infection among the study population, with high occurrence among females, children and young adults. Age and gender of patients showed significance difference and positive correlation statistically with infection rate of malaria among study subjects ($P \leq 0.05$). Therefore efforts should be geared towards improvement of living conditions of the people within the study area. Public health enlightenment or education on the preventive and control measures, personal hygiene and environmental sanitation should be encouraged among the populace.

Limitations

Microscopic determination of malaria parasite was not employed alongside the use of rapid diagnostic tests kits specific for *Plasmodium falciparum*. This has limited this work in its ability to detect malaria cases caused by other species of *Plasmodium*, thereby affecting the true situation of the disease condition within the study area. Therefore microscopy technique in combination with the use of rapid diagnostic test kits and molecular analysis such as Polymerase Chain Reaction (PCR) for identification of specific malaria parasites should be carried out for further studies within the study area or the state at large. These procedures were not carried out due to limited resources and availability of required facilities. Further studies should capture wider, larger population size and more facilities.

Ethical Clearance

Clearance for the study was obtained from the ethical committee on public health research of the facility. Also formal consents were retrieved from adult and pregnant women directly while children below 16 years old, consent were obtained from their parents/guardians using a consent form prior sample collection.

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Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

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The authors declare that no funding was received for conducting this study.

Ethics Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the research ethical committee of the primary healthcare facility in Karu LGA, Nasarawa state (Ethics approval number: PHC: 04580).

Consent to Participate

Informed consent was obtained from all individual participants included in the study.

Consent to Publish

The participants consented to the submission and publication of data analysed and presented in the manuscript.

Data Availability Statement

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

Authors' Contribution

Material preparation, data collection and formal analysis: Suleiman Zakari, Samuel Bawa Ijimbili, Bright Agwara Chiaka and Akuki Moses; review and editing of manuscript: Blessing Ogbene Andy, Celestine O Ogbu, Onma Onaji Maria; methodology and supervision: Oludare Agboola, Sabina Chioma Eze; conceptualization and original draft preparation: Hajara Zakari and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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