

Prevalence of *Plasmodium Falciparum* Parasite among Outpatients Attending Muhammad Abdullahi Wase Teaching Hospital in Kano state, Nigeria.

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Abstract

Plasmodium falciparum, which is the most dangerous and widespread malaria parasite in Nigeria, Annually, malaria contributes to a global estimate of 124 to 283 million cases, leading to 367,000 to 755,000 deaths. This study aimed to assess the prevalence of *Plasmodium falciparum* among outpatients attending Muhammad Abdullahi Wase Teaching Hospital in Kano State, Nigeria. Three hundred blood samples were collected and examined using both thick and thin Giemsa-stained blood smears. The overall malaria infection prevalence was found to be 34%. A questionnaire was employed to gather demographic information from outpatients attending the hospital. Regarding gender distribution, females 20% patient exhibited a higher malaria infection compared to males 14%, although statistical analysis revealed no significant differences. The prevalence of malaria varied across age groups, with those aged 21-30 experiencing the highest infection rate at 16%, while those above 60 had the lowest 2%. Educational status did not show statistical significance in relation to malaria infection, as patients with non-formal education had a higher prevalence of 13.7% compared to those with tertiary education. Concerning residence, rural areas showed a higher prevalence at 42.2% compared to urban areas at 23.8%, and this difference was statistically significant ($p < 0.05$). Occupation status also played a role, with farmers having a higher malaria infection rate of 12.7% compared to civil servants at 5.7%. The

use of preventive methods showed a significant impact, where patients employing insect-treated nets recorded a higher prevalence at 14.7% compared to those using bushes and gutters at 6.0%. Malaria remains prevalent among outpatients attending Muhammad Abdullahi Wase teaching in Kano State, Nigeria, emphasizing the importance of targeted interventions, especially in rural areas, to mitigate the impact of *Plasmodium falciparum* infections.

Keywords: Prevalence; Outpatients; Malaria infection; *Plasmodium falciparum*; Hospital; Kano State

INTRODUCTION

The higher prevalence of *Plasmodium falciparum* malaria infection, coupled with its profound economic repercussions, pose a severe threat to human well being in endemic areas, including Nigeria. This disease, caused by a protozoan parasite belonging to the Plasmodium genus, resides within red blood cells and is transmitted through bites from female infected Anopheles mosquitoes. Given its significant health challenges, malaria has garnered international attention and is recognized as a paramount parasitic ailment (Onolade, 2003).

Malaria stands out as the most widespread tropical disease, characterized by high morbidity and mortality rates, along with substantial economic and social consequences (WHO, 2010). The majority of malaria-related deaths, exceeding 90%, are concentrated in sub-Saharan Africa, with approximately 85% affecting children under the age of 5 (WHO, 2010). Pregnant women face high malaria risks due to natural immune suppression during pregnancy (Fievet *et al.*, 2007). Nigeria bears a significant burden, accounting for around 25% of all estimated malaria cases in the World Health Organization African Region (WHO, 2010).

Malaria infection during pregnancy emerges as a major public health concern globally, particularly in tropical and subtropical regions (WHO, 2010). *Plasmodium falciparum*, the predominant malaria species in Africa, is the primary cause of malaria during pregnancy (WHO, 2010). In malarious areas of Africa, where stable transmission prevails, over 3 million pregnancies occur annually, exposing women to varying levels of malaria intensity (Brabin, 2000). The symptoms and complications during pregnancy depend on the transmission intensity and the acquired immunity of the pregnant woman (Perlmann and Troye-Blomberg, 2000).

Pregnant women and their unborn children face heightened vulnerability, experiencing prenatal mortality, low birth weight, and maternal anemia as major consequences of malaria (Greenwood *et al.*, 2007). The impact extends beyond this demographic, affecting the entire population of Nigeria. Every individual in the country faces a 100% risk of malaria, with at least 50% experiencing at least one malaria episode annually (WHO, 2010). Notably, 51% of malaria cases and deaths in Nigeria are concentrated in rural villages, where access to effective diagnostic and treatment facilities is limited (WHO, 2010). The country has witnessed an increase in malaria cases and deaths, attributed to the imprudent use of antimalarial drugs, delayed healthcare seeking, and reliance on clinical judgment without laboratory confirmation in many peripheral health facilities (Vander *et al.*, 2015).

Despite evidence demonstrating the cost effectiveness of enhancing access to treatment and ensuring compliance (Goodman and Mill, 1999), a significant number of malaria fatalities still occur due to the absence of healthcare facilities near individuals' residences or the failure of health workers to diagnose their condition (WHO, 2000). Early and effective treatment of

malaria illness has long been emphasized in malaria control efforts (Vander *et al.*, 2015). Relying solely on symptom based diagnosis presents inherent challenges (Vander *et al.*, 2015), although some success has been observed with volunteer health workers in rural areas practicing it (Pagnoni *et al.*, 1997).

Achieving a reduction in morbidity and breaking the cycle of parasite transmission through community based antimalarial treatment necessitates an accurate, rapid, and practical diagnostic approach. The delivery of treatment in rural Nigerian areas faces complications due to the centralized nature of microscopy services (Alaba and Alaba, 2008). In recent years, advancements in rapid field diagnostic techniques, based on detecting parasite antigens, have introduced new possibilities for enhanced rural malaria diagnosis that is not reliant on centralized diagnostic services (Benjamin *et al.*, 2009).

In Nigeria, the federal ministry of health, in collaboration with the then millennium development goals (MDG), had initially aimed to reduce the mortality and morbidity rates associated with malaria by half by the year 2013 (FMOH, 2010). Given the failure to meet this targeted goal by the end of the project's specified date, it becomes imperative to conduct comprehensive malaria surveys across communities. These surveys serve as a means to monitor the impact and effectiveness of malaria control measures and programmes at various levels. The data collected from such studies will contribute to defining the current malaria burden and help formulate appropriate intervention measures. This study aimed to determine the prevalence of malaria infection among outpatients attending the Muhammad Abdullahi Teaching Hospital in Kano State, Nigeria.

MATERIALS AND METHODS

Study area

Kano State is located at the north western region of Nigeria laid between latitude 10°33' N and 12°23' E and longitude 7°45' N and 9°29' E with total land area of 21,276.872 kilometers with 1,754,200 hectares for agricultural activities and 75,000 hectares forest vegetation and grazing land (Abaje, 2014). The state occupied a central position of the northern part of Nigeria. Kano State falls mostly within Sudan savanna zones. Kano State is the most largest and dense populated cities in Nigeria. It significantly contributes to agriculture, commerce, and functions as a hub for business activities. The weather is hot and sunny with temperature between 35 to 40°C which drops with the beginning of rainy season (mid May- September). The area has two distinct seasons. The dry season begins from late October to May with a spell of harmattan period from November to February and the rainy season is usually short and commence in late May to September (Abaje *et al.*, 2014).

The study is carried out in the laboratory of Muhammad Abdullahi Wase Teaching Hospital Kano State, Nigeria. The hospital is located in Nassarawa local government area of Kano state. The local government is in Kano state metropolis is bordered by Fagge, Dala, Ungogo, Tarauni and Kumbotso local government. The hospital is usually attended by low and moderate socioeconomic groups and therefore, the hospital is affordable and accessible to most dwellers of Kano state.

Ethical Approval

The study protocol was approved by the Ethical Review Committee of Muhammad Abdullahi Wase teaching Hospital Kano. Before the commencement of the study, consent was sought

from patients or parent/legal guardian after details of study was explained to them in English and Hausa language for those who could not understand English language.

Inclusion and Exclusion Criteria

The inclusion criteria comprised outpatients aged 1 to 60 and above who presented with febrile illness (with an axillary temperature 37.5°C) and exhibited a recent history of fever within the past 48 hours, along with additional clinical symptoms of malaria such as headache, dizziness, joint pain, anorexia, and malaise. Exclusion criteria encompassed individuals who were critically ill and required immediate attention, those with mental illness, and individuals undergoing malaria treatment or having completed antimalarial treatment within two weeks prior to the study.

Sample Size Determination

The sample size was determined using the standard epidemiological formula (Fisher's formula for cross-sectional descriptive study) for calculation of minimum sample size (Jaykaran and Tamoghna, 2013).

$$n = \frac{Z^2 p(1 - p)}{d^2}$$

Where,

n is the Sample size

Z is the standard normal distribution at 95% confidence level = 1.96

P is the prevalence or proportion of value to be estimated from previous studies.

d is the precision, tolerance limit, the minimum is 0.05.

(= 1 - p) is the Proportion of failure

Study population

The research took place from June 2019 to December 2019 and was conducted within a hospital setting. It specifically focused on outpatient individuals referred to the Laboratory department for medical diagnosis. The study encompassed a population of 300 subjects, comprising both children and adults, who underwent screening for *Plasmodium falciparum* infection. Epidemiological information about the patients was collected through the use of questionnaires.

Sample Size

A total of 300 blood samples were collected from out-patients attending Muhammad Abdullahi Wase teaching hospital with varying age ranging from 1 to 60, and above 61years, in the study area.

Sample Collection

Patients attending the hospital, who were febrile or with a history of fever in the past 24 hours were screened for malaria, Blood samples were collected by pricking a finger with a sharp sterile needle (Lancet). After accurate cleaning of the finger with the spirit-moister cotton and then following drops of blood, obtained by gentle squeezing of the finger were then collected on a glass slide.

Staining Thin Blood Film with Giemsa stain

The prepared slide was dipped into methanol for fixing after which it was covered with diluted and filtered Giemsa for 30 minutes. The stain was poured off and washed quickly with

buffered distilled water to remove the excess stain. The slide was drained, dried and examined for the presence of parasite using oil immersion objective of microscope Cheesbrough (2005).

Staining Thick Blood Film with Giemsa stain

The slide was covered with diluted Giemsa without fixing, and was allowed to stain for 30 minutes. The stain was poured off and washed quickly with buffered distilled water pH 7.2 to remove excess stain. The slide was drained, dried and examined for the presence of parasite using oil immersion objective microscope Cheesbrough (2005).

Questionnaire administration

A structured questionnaire was used to collect data on the gender, age, and educational status occupation and malaria preventive measures.

Statistical Analysis

Simple percentage and Chi-squared test were used for data presentation. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software (version 16.0, SPSS Inc., Chicago, IL., USA). Chi-squared test was used to compare prevalence of malaria infection between age, sex, occupation, educational status and preventive methods of the subjects. The significance level was considered at $P \leq 0.05$.

RESULTS

A total of 300 blood samples were gathered from patients attending Abdullahi Wase Teaching Hospital in Kano State, and these samples were subjected to screening for the presence of the *Plasmodium* parasite. The findings presented in Table 1 indicated that cases of malaria infection were more prevalent among female patients, with a positivity rate of 20.0% for *Plasmodium falciparum*, while male patients recorded a 14.0% positivity rate for the same parasite.

Table 2, shows the distribution of age categories among male and female patients revealed that individuals aged 21-30 had a higher incidence of malaria parasites. Specifically, 12 cases were observed in males, while females in the same age range recorded 16 cases.

Table 3 shows the distribution of *Plasmodium falciparum* based on the education status of the patients. Secondary students exhibited a higher occurrence of *Plasmodium falciparum* infection, accounting for 13.7%, whereas patients with tertiary education had the lowest prevalence at 5.3%.

Table 4 depicts the prevalence of *Plasmodium falciparum* infection among patients in relation to their residence. Rural residents exhibited a higher infection rate at 20.0%, compared to urban residents who recorded a 14.0% infection rate Table 4 presents the prevalence of *Plasmodium falciparum* infection among patients in relation to their residence. Rural residents exhibited a higher infection rate at 20.0%, compared to urban residents who recorded a 14.0% infection rate. Table 5 illustrates the incidence of *Plasmodium falciparum* infection in relation to various occupations. Farmers exhibit a higher rate of infection at 12.7%, whereas Civil servants experience the lowest rate at 3.7%. However, statistically, there is no significant difference observed in malaria infection across different occupations. Tables 6 reveal the prevalence of *Plasmodium falciparum* infection concerning preventive methods. Individuals utilizing Insecticide Treated Nets (ITN) at 14.7% are more protected compared to those employing alternative preventive measures. Notably, individuals relying on Bushes and Gutter as preventive methods face a higher exposure to malaria infection at 6.0%. Statistical

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analysis indicates significant differences in the prevalence rate of *Plasmodium falciparum* infection concerning the use of preventive methods.

Table 1: Distribution of *Plasmodium falciparum* in relation to gender of respondents

Gender	Number Examined	Number Infected
Male	126	42(14%)
Female	174	60(20%)
Overall	300	102(34%)

P>0.05 =0.08

Table 2: Distribution of *Plasmodium falciparum* in relation to Age of respondents

Age/Year	Number Examined	Male		Female	
		positive	Negative	Positive	Negative
1-10	35	7	12	8	15
11-20	55	10	18	14	20
21-30	58	12	21	16	28
31-40	49	5	11	10	19
41-50	47	3	9	6	13
51-60	32	2	6	4	10
Above 61	24	3	7	2	9
Total	300	42	84	60	114
Percentage (%)		14.0	28	20	38

P =0.03

Table 3: Distribution of *Plasmodium falciparum* infection among patients with respect to educational status

Educational Status	Number Examined	Number Infected (%)	Number Negative (%)
Non informal	90	41(13.7)	49(16.3)
Primary	86	24(8.0)	62(20.7)
Secondary	70	21(7.0)	49(16.3)
Tertiary	54	16(5.3)	38(12.7)
Total	300	102(34.0)	198(66.0)

p = 0.07

Table 4: Prevalence of *Plasmodium falciparum* infection among patients with respect to Residence

Residents	Number Examined	Number infected (%)	Number negative (%)
Rural	180	60(20.0)	120(40)
Urban	120	42(14.0)	78(26)
Total	300	102(34)	198(66)

P = 0.83

Table 5: Prevalence of *Plasmodium falciparum* infection among patients with respect to Occupation

Occupation	Number examined	Number infected (%)	Number negative (%)
Unemployed	85	26(8.7)	59(19.7)
Farmers	92	38(12.7)	54(18.0)
Traders	70	21(7.0)	49(16.3)
Civil servant	53	17(5.7)	36(12.0)
Total	300	102(34.0)	198(66)

P = 0.672

Table 6: Prevalence of *Plasmodium falciparum* infection among patients with respect to Preventive measures.

Preventive measure	Number Examined	Number infected (%)	Number negative (%)
ITNs	110	44(14.7)	66(22)
Insecticide spray	70	40(13.3)	30(10)
Bushes and gutters	120	18(6.0)	102(34)
Total	300	102(34)	198(66)

P = 0.37

DISCUSSION

The overall prevalence of *Plasmodium falciparum* infection among patients observed in this study was 34%, which falls within the range of moderate prevalence. This figure is notably lower when compared to the overall malaria prevalence rates reported in other studies: 62% in Uli, Anambra State (Onyido *et al.*, 2010); 79.1% in Ebonyi State (Opara *et al.*, 2011); 80.4% in Abia State (Kalu *et al.*, 2012); and 64.9% in Kano State (Oladele *et al.*, 2018). The variance in prevalence rates could likely stem from the timing of our study, which was conducted during the dry season when the population of Anopheline malaria vectors, and consequently malaria transmission in the area, had significantly reduced (Yakasai *et al.*, 2017).

The prevalence observed in this study aligns with the overall malaria prevalence rates reported in other regions, such as 34% in Ogun State (Adenola *et al.*, 2016), 32.4% in Enugu State (Umeanaeto *et al.*, 2019), and 34.8% in Benue State (Adulugba *et al.*, 2020). Notably, the prevalence in our study area is significantly higher than the rates reported in specific areas, including 23.0% in Kura, 21.6% in Bebeji, 17.6% in Gwarzo, 18.0% in Shanono, and 19.9% in Minjibir rural areas of Kano State. Additionally, our findings surpass the prevalence rates of 17.0% in Eastern Nigeria (Anumudu *et al.*, 2006) and 27.3% in Sokoto State (Abdullahi *et al.*, 2009). The heightened prevalence could be attributed to issues related to sanitation, such as the absence of proper drainage and sewage disposal systems, as well as stagnant water bodies that serve as conducive breeding habitats for malaria vectors (Nasir *et al.*, 2015). This variability in malaria prevalence across different parts of Nigeria may be influenced by various factors, including environmental and climatic conditions, mosquito vector behaviors, vector competency, and the absence of preventive measures (Audu & Abdulsalam, 2015).

Regarding gender and age, females exhibited a higher infection rate of 20%, compared to males with a 14% infection rate in the study area, although the difference is not statistically significant. This disparity might be attributed to variations in physiological processes among women, potentially contributing to lower immunity. Additionally, the nature of women's activities, exposing them to more mosquito bites, and the fact that females, especially pregnant women, may experience a reduction in resistance during pregnancy could be contributing factors. This contrasts with the findings of Adulugba *et al.* (2020), who reported higher infections in females than males. Yohanna *et al.* (2019) observed that gender did not impact the prevalence of malaria among patients, while Nwaorgu and Orajaka (2011) found contradictory results, suggesting that males might be more susceptible to the disease than females.

This study indicates the highest prevalence of malaria among patients in the age groups 21-30, with 12% for males and 16% for females. Conversely, the lowest prevalence was observed in the age group of 51-60 and above 60, respectively. These findings align with the results reported by Oladele *et al.* (2018) and Idris *et al.* (2023), who also observed a high prevalence in the age group of 21-30 and a low prevalence in the age group of 51-60 and above 60. The

reduced prevalence in the older age groups 51-60 and above 60 may be attributed to the development of immunity against malaria parasites as individuals age, consistent with the established concept that higher prevalence at younger ages gives way to lower prevalence as individuals acquire natural immunity to infectious diseases, including malaria, with increasing age (Golassa *et al.*, 2013).

In this study, the prevalence of malaria in rural areas was notably higher at 42.2% compared to the urban areas, which recorded a prevalence of 23.8%. This difference could be attributed to various factors, including environmental conditions in rural areas and the behavioral patterns of the residents towards preventive measures, or it might be due to a lower awareness of mosquito density. These findings contrast with the research conducted by Oladele *et al.* (2018), where a higher prevalence was reported in urban areas compared to rural areas in Kano State. Similarly, Adulugba *et al.* (2020) also found higher prevalence in urban areas compared to rural areas among patients attending a general hospital in Benue State. However, the difference in malaria parasite prevalence between rural and urban areas in this study aligns with the observations of the National Malaria Control Programme (NMCP, 2010), which reported an average prevalence of 23% in urban areas and 48% in rural areas in Nigeria. The prevalence of *Plasmodium falciparum* infections varies among occupational groups, with farmers exhibiting the highest infection rates in the study areas. Statistical analysis indicates significant differences among these occupational groups ($p < 0.05$). This heightened susceptibility among farmers may be attributed to various factors such as poverty, low income, lack of awareness, inadequate environmental sanitation, and the presence of numerous mosquito-breeding sites in the region, coupled with insufficient mosquito preventive measures. These findings align with previous research by Oladele *et al.* (2018), who similarly observed a high prevalence of malaria among farmers. Additionally, Amuta *et al.* (2014) highlighted the influence of socioeconomic conditions, population mobility, housing, occupation, human habits, and immunity on the spread of the disease.

The prevalence of malaria varies among different educational groups, with the highest rates observed among individuals with non-formal education. Statistical analysis indicates a significant difference in malaria prevalence across various educational levels ($p < 0.05$). This pattern aligns with the findings of Umeanaeto *et al.* (2019) and Adulugba *et al.* (2020), who also reported elevated malaria prevalence among those with non-formal education in Alulu-Nike community, Enugu State, and among patients attending general hospitals in Benue State, Nigeria. Conversely, individuals with higher levels of education exhibited lower infection rates. The correlation between education and malaria prevalence could be attributed to increased awareness, as those with tertiary education may possess better knowledge and practices for protecting themselves against mosquito bites and malaria transmission. Furthermore, this association may be linked to economic status, enabling individuals with higher education to afford antimalarial drugs for effective malaria treatment.

Some participants showed the least inclination towards using bushes and gutters as methods for mosquito control. Proximity of bushes and gutters to the participants' dwellings was evaluated, revealing the highest incidence of infection among those residing in close proximity to these areas. Participants living at least 1 kilometer away from bushes and gutters were found to be at a lower risk. The increased frequency of infections in the high-risk groups, particularly those close to gutters and bushes, can be attributed to heightened exposure to mosquito bites. These areas serve as conducive breeding grounds for mosquitoes around their

homes, a trend observed in various studies conducted in Nigeria, Africa, and other developing countries (Nahum *et al.*, 2010; Sohail *et al.*, 2015; Belete *et al.*, 2016; Amusan *et al.*, 2017).

CONCLUSION AND RECOMMENDATION

In conclusion, this study revealed a moderate prevalence of *Plasmodium falciparum* infection among outpatients, with notable demographic and environmental factors influencing malaria transmission. The findings emphasize the significance of targeted interventions, improved awareness, education, and mosquito control measures, particularly in rural areas, among specific age groups, and occupational categories, to effectively reduce malaria prevalence in the region.

The recommendations highlight the significance of regular community wide malaria surveys for targeted interventions, comprehensive public health awareness campaigns focusing on specific demographic groups, promoting proper environmental sanitation, developing occupational health programs for high-risk groups, integrating malaria education into school curricula, improving access to healthcare services, especially in rural areas, and implementing targeted interventions for pregnant women to address their heightened vulnerability to malaria.

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