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Research Article

Prevalence of Malaria Among Febrile Patients in Oluyoro Hospital, Ibadan, Oyo State

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ABSTRACT

Malaria remains a major public health burden in sub-Saharan Africa, with Nigeria accounting for a significant proportion of global cases. This cross-sectional study was conducted at Oluyoro Catholic Hospital, Ibadan, between November 2023 and June 2024, to determine the prevalence of malaria and its distribution across age and gender groups. A total of 350 febrile patients with clinical symptoms of malaria were recruited. Blood samples were collected and analysed using microscopy and rapid diagnostic tests (RDTs). Of the participants, 173 (49.4%) tested positive for malaria. Prevalence was significantly higher among females (53.7%) compared with males (41.3%) (χ^2 = 4.24; p = 0.039). Children under 15 years carried the greatest burden (63.2%), followed by young adults aged 16–30 years (54.2%). Prevalence declined with age, falling to 25.8% among those aged 31–45 years and 15.9% in individuals above 46 years ($p < 0.0001$). These trends suggest greater vulnerability among younger individuals due to underdeveloped immunity and increased exposure. Microscopy served as the gold standard for parasite detection. The findings emphasise the importance of targeted malaria control strategies, particularly among children and women. Strengthening diagnostic capacity, expanding access to molecular testing, and implementing routine surveillance are crucial to addressing both *Plasmodium falciparum* and emerging non-falciparum species. Tailored interventions are needed to reduce malaria morbidity and guide effective treatment approaches.

Keywords: Age distribution; Malaria; Mixed infections; Oluyoro; *Plasmodium* species; Prevalence

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INTRODUCTION

Malaria remains a significant public health concern, particularly in sub-Saharan Africa, where it is a leading cause of morbidity and mortality (Kolawole *et al.,* 2023). The disease is caused by protozoan parasites of the genus *Plasmodium*, with *Plasmodium falciparum* being the most virulent and prevalent species in Nigeria (Elom *et al*., 2021). However, other non-*Plasmodium falciparum* species, including *P. vivax*, *P. ovale*, and *P. malariae*, also contribute to the disease burden but are often underdiagnosed due to limitations in conventional microscopy and rapid diagnostic tests (RDTs) (Lalremruata, 2020). Molecular techniques, such as polymerase chain reaction (PCR), have emerged as superior diagnostic tools for malaria, enabling precise identification of *Plasmodium* species (Gimenez *et al.,* 2021).

Malaria is still a significant worldwide health issue. In 2022, there were 249 million cases of malaria in 85 countries where the disease is endemic, making it a serious global health concern. This was up from 233 million in 2021, and the WHO African Region countries accounted for the majority of this growth (Impouma *et al*., 2021).

Five Plasmodium species can cause malaria, but *Plasmodium falciparum* is responsible for the majority of cases and illness. In Africa, rapid diagnostic tests (RDTs) are the primary method used to diagnose malaria. *P. falciparum* histidine-rich protein 2 (HRP2), which is specific to falciparum malaria, is the main antigen that RDTs detect (Apinjoh *et al.,* 2024). They frequently have a second, less sensitive band for pan-species lactate dehydrogenase (LDH). However,

diagnostic tests frequently fail to detect low-density falciparum infections and species other than falciparum malaria, which results in a reservoir of non-falciparum and asymptomatic malaria that contributes to ongoing transmission.

There is growing evidence that *P. ovale spp*. and *P. malariae* malaria becomes more common in Africa as *P. falciparum* is controlled and prevalence decreases. In addition, *P. vivax* is being reported more frequently due to wider implementation of molecular diagnostics (Nkemngo *et al.,* 2023; Nyarko *et al*., 2021; Yimam *et al*., 2021). In contrast with falciparum infection, *vivax* and *ovale* contribute to malaria by causing relapse through the persistence of hypnozoites (dormant liver stage parasites) (Lalremruata, 2020). Hypnozoites do not respond to blood-stage treatment, like artemisinin-combination therapies (ACTs), the primary treatment for severe malaria in most countries, and require radical cure. Thus, their presence may require national malaria control programs to alter therapeutic options in the country. The devastating effect of malaria on vulnerable populations in disease-endemic countries is still overwhelming **(**Tartour *et al*., 2024).

MATERIALS AND METHODS

The Study Area

This study was conducted at Oluyoro Catholic Hospital, Oke-Ofa, Ibadan. It is a prominent faith-based healthcare institution in Ibadan, Oyo State, Nigeria. It is owned and operated by the Catholic Archdiocese of Ibadan. It is located in Ibadan South-West**.** (Apata is a major locality within this LGA), Ibadan metropolis is located at Longitude 7.3960° N and Latitude 3.8830° E.. The hospital is well-known for providing a wide range of medical services to the community, including general outpatient care, maternity and obstetrics, paediatrics, surgery, and specialised care for infectious diseases like HIV/AIDS and tuberculosis. It is considered a major healthcare provider in the region, often participating in public health initiatives and research studies.

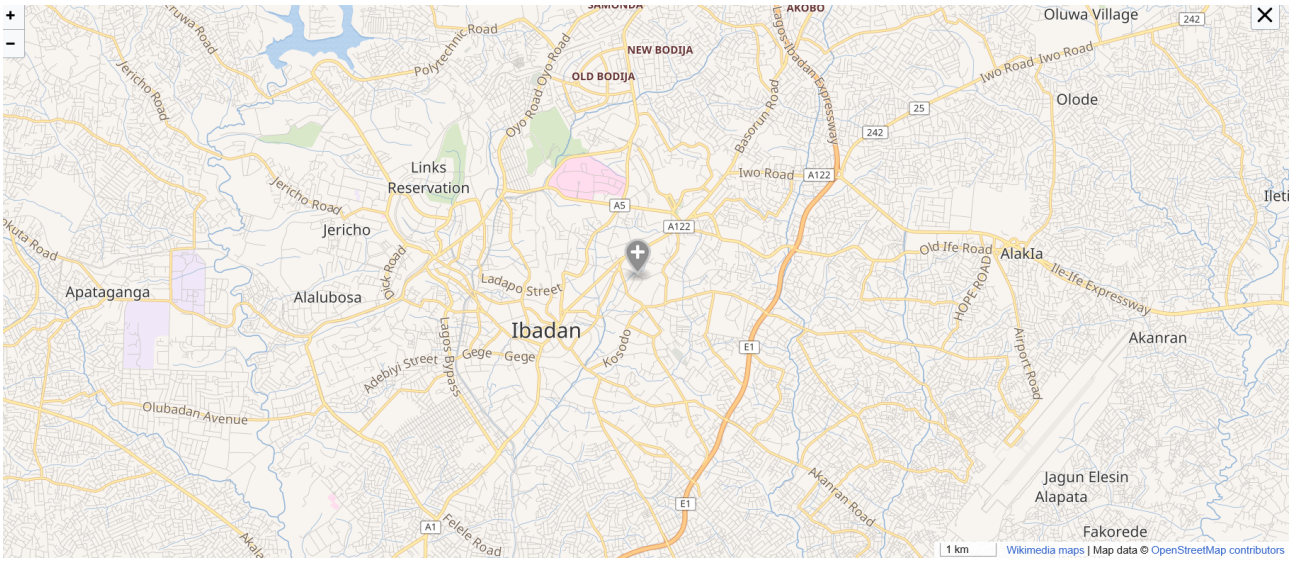

Figure 1: A map showing the study area (Oluyoro Catholic Hospital)

Study Population

The study population consists of patients presenting with clinical symptoms of malaria at Oluyoro Hospital. During November 2023 to June 2024, 350 febrile patients, adults, children, and pregnant women who visited the facility consented to be included in the study, comprising the study population. Using Swinscow and Campbell 1's formula, the average sample size was calculated. **$n = (Z^2 * p * q) / d^2$**

Where:

n = required minimum sample size, **Z** = the Z-score corresponding to the desired confidence level (e.g., 1.96 for 95% confidence), **p** = the estimated prevalence (proportion) of the condition in the population and d = the desired margin of error (precision) around the prevalence estimate, expressed as a decimal (e.g., 0.05 for ±5%).

Study Design

This is a cross-sectional study involving the collection and molecular analysis of blood samples to determine the prevalence of *P. falciparum* and non-*P. falciparum* species.

Inclusion and Exclusion Criteria

Inclusion Criteria:

i. Patients with clinical signs of malaria.
ii. Patients who give informed consent.

Exclusion Criteria:

i. Patients on anti-malarial drugs within the last two weeks.
ii. Patients with other febrile illnesses not suspected to be malaria.

Sample Collection and Processing of Malaria Parasite

Blood samples were collected from patients presenting with symptoms suggestive of malaria, such as fever, chills, and headaches. Venous blood samples (approximately 3-5 mL) were drawn aseptically from each patient using sterile disposable syringes and transferred into Ethylenediaminetetraacetic acid (EDTA) tubes to prevent coagulation. Capillary blood was also obtained from some patients via finger prick using a sterile lancet for rapid diagnostic testing (RDT) and microscopy.

Ethical Approval

This study adhered to the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Oyo State Ministry of Health and Lead City University, Ibadan, Joint Ethical Board before commencement of the study. Informed consent was sought from all participants or their legal guardians, to ensure they understand the study procedures, potential risks and benefits, and their right to withdraw at any time. Confidentiality of participant information was maintained throughout the research process**.**

Sample Transportation and Storage

The collected blood samples were immediately labelled with patient identification codes and transported in cold storage (4–8°C) to the Lead City University, Biological Sciences Laboratory for further processing. Samples were analysed within six hours of collection to maintain the viability of the malaria parasites.

Microscopic Examination of the Malaria Parasite (Gold Standard)

Thin and thick blood smears were prepared on clean, grease-free glass slides. The thick smear was used for parasite detection and quantification, while the thin smear was used for species identification. The smears were air-dried, fixed (thin smear only) with methanol, and stained using 10% Giemsa stain for 10 minutes. The slides were examined under an oil immersion lens (100x magnification) of a light microscope for the presence of Plasmodium species (WHO, 2016)

Staining Procedure

A fixed thin smear was done by dipping it in absolute methanol for 30 seconds and was allowed to air dry. Both smears were diluted with Giemsa stain (1:10 in buffered distilled water) for 10–15 minutes. Then rinse the slides with clean water and allow them to air dry in a vertical position (WHO, 2010).

Microscopic Examination

A drop of immersion oil was dropped on the dried, prepared smear slide and examined under a 100x oil immersion objective lens. It was scanned for malaria parasites, focusing on multiple fields for higher sensitivity. Identification of *Plasmodium* species was based on morphological characteristics in the thin smear. The estimated parasite density was determined by counting parasites against white blood cells multiplied by 8000 (WHO, 2016).

RESULTS

The study revealed key patterns in the prevalence of malaria in the 350 Febrile patients, with significant variations observed across different demographic groups. The overall prevalence of malaria was found to be 49.4%, indicating a high burden of the disease in the area. Statistical analysis identified both gender and age as significant factors associated with malaria infection. A significantly higher prevalence was recorded among female participants compared to males.

Table 1 below assesses the prevalence of malaria among male and female patients in the study area. A total of 350 patients were examined, out of which 173 tested positive for malaria, resulting in an overall prevalence of 49.4%**.** Among the 121 male patients**,** 50 were positive for malaria, yielding a prevalence of 41.3%**.** Conversely, among the 229 female patients**,** 123 tested positives, leading to a higher prevalence of 53.7%**.** The chi-square (X^2) value of 4.24 and the corresponding p-value of 0.039 indicate a statistically significant difference ($p < 0.05$) in malaria prevalence between males and females. This suggests that females had a significantly higher burden of malaria compared to males in the study population. The observed gender disparity in prevalence could be attributed to various factors, including differences in exposure levels, immune responses, healthcare-seeking behaviour, or socio-cultural determinants. Further research may be necessary to investigate the underlying reasons for this variation and to develop targeted intervention strategies.

Table 2 reveals a stark and statistically significant relationship between age and malaria prevalence in the study population ($X^2 = 65.5$, $p < 0.0001$). Children under 15 years recorded the highest prevalence (63.2%). This means nearly two out of every three children in this age group were infected. The 16-30 years group shows a high but reduced prevalence of 54.2%**,** there is a decline in the 31-45 years group **(**25.8%**),** while the lowest prevalence is found in those over 46 years old **(**15.9%**).**

The proportion of malaria cases among study participants was analysed in Table 3 based on age and

gender distribution. In terms of age groups, the majority of participants were below 15 years old**,** accounting for 155 individuals (26.9%) of the study population. Participants aged 16–30 years made up 35 individuals (10.0%)**,** while those in the 31–45 years age group comprised 66 individuals (18.9%)**.** The highest proportion of participants belonged to the >46 years age group**,** representing 94 individuals (44.3%) of the study population.

Regarding gender distribution, there were more female participants (229 individuals, 65.4%) compared to males (121 individuals, 34.6%)**.** The higher representation of females in the study may indicate greater healthcare-seeking behaviour among women or differences in demographic characteristics of the population.

The distribution of age and gender in the study population is essential for understanding malaria prevalence patterns and for tailoring targeted malaria control interventions. The chi-square test ($X^2 = 65.5$, $P < 0.0001$) clearly shows that there are statistically significant differences in the prevalence of malaria across various age categories. Given the P-value (< 0.05), it is highly unlikely that the observed differences are the result of chance. This shows that age is a significant factor in the occurrence of malaria.

Table 1. Prevalence of Malaria According to the Sex of the Patients in the Study Area

Gender	No examined	No positive	Prevalence	X^2	P value
Male	121	**50**	**41.3**	**4.24**	**0.039**
Female	229	123	53.7		
Total	350	173			

Table 2. Prevalence of Malaria Infection among Patients in the Age Groups in the Study

Age (Years)	No examined	No positive	Prevalence	X^2	P value
< 15	155	98	63.2	65.5	0.0001
16-30	35	19	54.2		
31-45	66	17	25.8		
>46	94	15	15.9		

Table 3: The Proportion of Malaria in the Age Groups of Study Participants

Variables	Frequency (n)	Percentage (%)
Age (Years)		
< 15	155	44.3
16-30	35	10.0
31-45	66	18.9
>46	94	26.9
Gender		
Male	121	34.6
Female	229	65.4

DISCUSSION

Our findings highlight existing evidence that malaria continues to exert a heavy burden in sub-Saharan Africa, with *P. falciparum* persisting as the principal cause of severe disease (Kolawole *et al.*, 2023). This study investigated the prevalence of malaria, the distribution of infections across gender and age groups, and the performance of different diagnostic methods in detecting *Plasmodium* species. The results provide valuable insights into the epidemiology of malaria in among the Patients in the study.

The findings indicate that malaria prevalence was higher among females than males, with a statistically significant difference. This result aligns with previous studies that have reported higher malaria prevalence among females (Adenusi *et al.,* 2024). Possible explanations include increased health-seeking behaviour among women, hormonal and physiological factors that may influence susceptibility, and occupational exposure risks. However, some studies have reported higher prevalence in males, attributing it to increased outdoor activities at night, which raises their risk of mosquito bites (Egedegbe *et al.,* 2023). These discrepancies highlight the need for localised malaria control strategies that consider sociocultural and occupational factors.

These findings are consistent with previous epidemiological reports, which indicate that this

disproportionately high prevalence among children reflects their immature immunity and aligns with reports across endemic regions (Makenga, 2023). Older individuals exhibit lower prevalence rates due to acquired immunity from repeated malaria infections over time. This confirms a strong association between malaria prevalence and age, reinforcing the need for targeted interventions such as vaccination, insecticide-treated nets (ITNs), and intermittent preventive treatment (IPT), especially among young children and pregnant women (Egbujor *et al*., 2023).

These proportions align with findings in this study, which indicate that children and younger individuals bear the highest malaria burden in endemic regions.

The declining prevalence with age suggests cumulative immunity from repeated exposure, which reduces susceptibility in adults, consistent with established malaria epidemiology (Abad *et al.*, 2022). The national context is consistent with WHO estimates, which identify Nigeria as carrying the greatest global malaria burden, responsible for nearly 27% of worldwide cases. The pattern observed in this study is consistently reported across numerous Nigerian studies, with some contextual variations.

CONCLUSION

The results show a fundamental principle of malaria epidemiology: in high-transmission areas like Nigeria, acquired immunity develops with age, shifting the disease burden disproportionately onto young children. This underscores the critical importance of sustaining and enhancing control measures focused on paediatric populations, such as LLIN distribution, seasonal malaria chemoprevention (SMC) and the rollout of the RTS, S/AS01 malaria vaccine, which is now being integrated into routine immunisation programs in Nigeria.

Based on the findings of this study, the following recommendations are proposed to improve malaria diagnosis, treatment, and control. Regular surveillance should be conducted to track the prevalence of both *Plasmodium falciparum* and non-*P. falciparum* species to ensure appropriate treatment strategies and reduce misdiagnosis.

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