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Analysis of Five-Year Malaria Prevalence at the Federal Teaching Hospital, Ido-Ekiti, Nigeria

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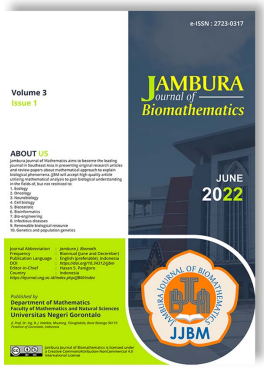

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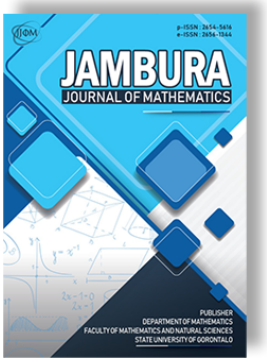

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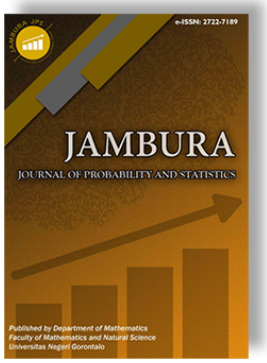

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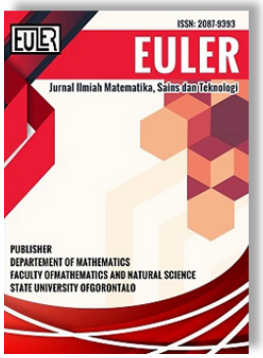

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Research Article

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Analysis of Five-Year Malaria Prevalence at the Federal Teaching Hospital, Ido-Ekiti, Nigeria

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ABSTRACT. *Malaria remains a major public health problem globally, with Nigeria accounting for approximately 27% of the global burden. Chronological analysis of malaria data is vital for evaluating the performance of malaria prevention programmes in Nigeria. Therefore, the objective of this study is to determine the malaria prevalence rate at the Federal Teaching Hospital, Ido-Ekiti (FETHI), over a five-year period. Data from 484 suspected malaria patients who visited the hospital between 2019 and 2023 were collected and analysed. Logistic regression was used to evaluate the relationship between positive blood film results and potential associated factors. Among all presumptive cases, 307 (63.4%) were female. The annual malaria prevalence ranged from 30.4% to 54.2%, with an overall prevalence of 42.32% (95% CI: 34.3%–54.4%). Two Plasmodium species were detected: Plasmodium falciparum (98 cases, 47.3%) and Plasmodium vivax (83 cases, 40.1%). A higher proportion of cases were recorded in December, January, and May (50%, 51.2%, and 51.4%, respectively). Patients who visited the hospital in January were twice as likely to be infected compared to those in April [OR: 2.29; 95% CI: 0.88–6.18; $p = 0.037$]. Males were half as likely to be infected as females [OR: 0.47; 95% CI: 0.30–0.72; $p = 0.00066$]. Malaria remains a significant concern in the studied location. Therefore, malaria control programmes need to be strengthened to reduce its impact.*

1. Introduction

Malaria is one of the major public health challenges globally. It continues to have a devastating impact on people's well-being, despite being both preventable and curable. It remains a leading cause of death in many developing countries, including Nigeria, where children under the age of five and pregnant women are the most affected groups [1–3]. According to a recent report, approximately half of the world's population lives in areas susceptible to malaria transmission, spanning about 85 countries and territories [2–5]. In 2022 alone, there were 249 million clinical cases and 680,000 deaths due to malaria, with about 90% of the global burden occurring As Africa's most populous country, Nigeria bears the highest burden of malaria, accounting for 27.4% of global cases and 31% of global deaths [6]. In 2022, Nigeria was estimated to have recorded 68 million cases and 194,000 deaths. However, due to inadequate record-keeping, data on malaria infections and deaths remain uncertain. Nevertheless, millions of infections and thousands of deaths occur annually, and morbidity and mortality rates increase significantly during epidemics [3, 7–11]. Plasmodium falciparum is the deadliest malaria parasite and the most prevalent species in Nigeria and other African countries [2]. It is found in all malaria-endemic areas of Nigeria and is responsible for approximately 80–95% of all clinical cases, although its incidence varies across different regions. Plasmodium malariae and Plasmodium ovale are less common, contributing 9.8% and less than 1%, respectively, of all confirmed malaria cases. Malaria distribution in Nigeria is not uniform but seasonal, with incidence patterns influenced by temperature, rainfall, and relative humidity. There is year-round transmission in the southern regions, while in the north, transmission typically lasts for about three months or less each year [12]. Nigeria has not achieved significant success in combating malaria over the past decade. According to a report indicating that Nigeria accounts for 50% of global malaria deaths [13], the country organized a week-long "data deep-dive" involving both internal and external stakeholders to assess national progress in using strategic information to drive impact against malaria [14]. Due to the lack of comprehensive data on malaria cases in Nigeria, hospital-based prevalence studies—such as this one—are essential to enhance understanding of malaria incidence and trends over time [15]. The findings from this study will assist policymakers in evaluating the status and progress of malaria prevention programmes in the study area. Therefore, the objective of this study is to determine the malaria prevalence rate at the Federal Teaching Hospital, Ido-Ekiti

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(FETHI), Ekiti State, over a five-year period.

2. Methods

Data Collection: Details of 484 clinically suspected malaria patients who underwent blood film (BF) testing were collected and analyzed. The study was conducted at the Federal Teaching Hospital, Ido-Ekiti (FETHI). Ido-Ekiti is a town in the Ido-Osi Local Government Area of Ekiti State, Nigeria, located 35.9 km northwest of Ado-Ekiti, the state capital [13]. The town had an estimated population of 239,600 in 2022. It experiences distinct wet and dry seasons, with annual temperatures ranging from 21°C to 28°C, high humidity, and an elevation of 553 meters above sea level [16]. All malaria-suspected patients who visited the hospital between January 2019 and December 2023 were included in the analysis. The following data were retrieved from hospital records: blood film results (positive or negative), sex, type of malaria parasite identified (Plasmodium vivax, Plasmodium falciparum, or mixed), age, month, and year of visit. Patients were presumed to have malaria if they presented with fever and other related clinical indicators. "Mixed" infections refer to positive BF results showing the presence of both P. falciparum and P. vivax parasites.

The data were cleaned using Microsoft Excel 2013, and statistical analysis was performed using R software (version 4.1.3). Descriptive statistics, including mean, median, and percentages, were presented. Logistic regression analysis was conducted to evaluate the relationship between malaria infection and potential predictor variables. A p-value of less than 0.05 was considered statistically significant.

3. Results

Demographic profile of the study sample: The blood film microscopy results of 484 clinically suspected malaria patients, obtained from medical records at the Federal Teaching Hospital, Ido-Ekiti, over a five-year period, were analyzed. Among the patients, 307 (63.4%) were female and 177 (36.6%) were male. The mean age was 24.81 years, and the median age was 23 years, with ages ranging from 1 month to 88 years. Malaria prevalence and its trend: The 484 patients that visited FETHI during the period under study with malaria symptoms were compared. It was observed that 92(19)% came in 2019 while 118(24.4)% came in 2023 (Figure 1a).

The yearly prevalence of confirmed malaria cases was 13.5%, 21.7%, 19.4%, 14.5%, and 30.9% for the years 2019, 2020, 2021, 2022, and 2023, respectively (Figure 1b). Overall, the total malaria prevalence among suspected cases over the five-year period was 42.8% [207/484; 95% CI: 38.2%–47.2%]. Higher proportions of confirmed malaria cases were recorded in the months of December (50.0%), January (51.2%), and May (51.4%) (Figure 1c). The major malaria parasites detected were Plasmodium falciparum [98 cases; 47.3%, 95% CI: 43.5%–51.1%] and Plasmodium vivax [83 cases; 40.1%, 95% CI: 37.6%–42.6%]. Mixed infections involving both P. falciparum and P. vivax were also observed in 28 cases (13.6%, 95% CI: 12.2%–15.0%) (Table 1). Factors linked to Blood Film confirmed malaria cases: From the logistic regression model, males were found to be significantly less likely to test positive for malaria compared to females [OR: 0.498, 95% CI: 0.299–0.721, $p < 0.001$]. Similarly, individuals aged over 15 years were 0.84 times less likely to test positive for malaria compared to children under five years of age [OR: 0.835, 95% CI: 0.498–1.402], although this finding was not statistically significant. Patients who visited the Federal Teaching Hospital in 2023 were 3.66 times more likely to be infected with malaria than those who visited in 2019 [OR: 3.660, 95% CI: 1.983–6.896, $p < 0.001$]. There were also statistically significant differences in annual malaria distribution in the years 2020 and 2022 ($p < 0.05$) (Table 2). In terms of seasonal variation, individuals who visited the hospital in August were 2.46 times more likely to be diagnosed with malaria compared to those who visited in April [OR: 2.462, 95% CI: 0.896–6.990, $p = 0.039$].

Table 1. Demographic attributes of the study sample and malaria distribution at FETHI, 2019–2023

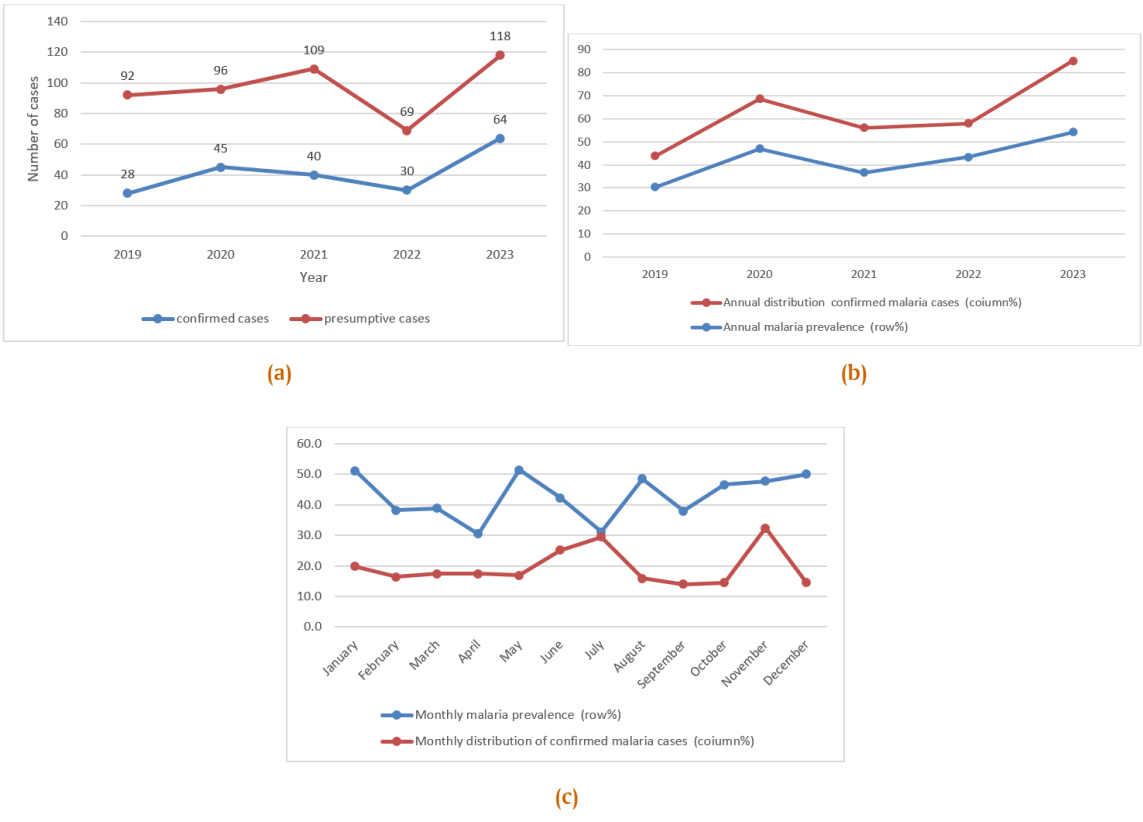
Variable	n (%)
Gender	
Male	177 (36.6)
Female	307 (63.4)
Total	484 (100)
Age category	
< 5	106 (21.9)
5–15	88 (18.2)
> 15	290 (59.9)
Mean age	24.81 years
SD	20.72 years
Median age	23.0 years
BF results	
Positive	207 (42.8)
Negative	277 (57.2)
Malaria parasites identified	
P. falciparum	98 (47.3)
P. vivax	83 (40.1)
Mixed	28 (13.6)
Month	
January	41 (8.5)
February	34 (7.0)
March	36 (7.4)
April	36 (7.4)
May	35 (7.2)
June	52 (10.7)
July	61 (12.6)
August	33 (6.8)
September	29 (6.0)
October	30 (6.2)
November	67 (13.9)
December	30 (6.3)
Year	
2019	92 (19.0)
2020	96 (19.8)
2021	109 (22.5)
2022	69 (14.3)
2023	118 (24.4)

4. Discussion

Malaria remains one of the major public health challenges globally. The African continent bears the greatest burden due to its wide diversity of mosquito vectors, malaria parasites, and vulnerable human populations. In Nigeria, seasonal rainfall patterns and diverse topography significantly contribute to malaria transmission. The study location, situated in a tropical climate zone, is considered a malaria-prone area [17]. At the Federal Teaching Hospital Ido-Ekiti (FETHI), the number of suspected malaria cases during the study period ranged from 69 (14.3%) in 2022 to 118 (24.4%) in 2023. Similarly, the annual prevalence of confirmed

Table 2. Logistic regression analysis of factors linked to Blood Film confirmed and suspected malaria cases in FETHI, 2019–2023 (Significance codes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, . $p < 0.1$, ns: not significant)

Variable	Odds Ratio	95% CI LB	UB	P value
Intercept	0.38281	0.14495	0.9571	0.0449988*
Age				
>15	0.83531	0.49765	1.4023	0.4950415
5 to 15	0.57058	0.30347	1.0628	0.0786688.
SexM	0.46685	0.29945	0.7205	0.0006597***
Month				
August	2.46207	0.89635	6.9904	0.03857.
December	2.12633	0.75573	6.1677	0.1566959
February	1.35996	0.48777	3.8422	0.5568469
January	2.29063	0.8809	6.1812	0.036935.
July	0.80402	0.32028	2.0654	0.6443272
June	1.67765	0.6684	4.3563	0.2765576
March	1.3195	0.48058	3.6851	0.5914656
May	2.03582	0.74938	5.7166	0.1680189
November	1.7187	0.71146	4.3172	0.2363185
October	1.89049	0.67044	5.4882	0.2325168
September	1.76441	0.60225	5.2207	0.2995681
Year				
2020	2.24089	1.18500	4.2963	0.0138520*
2021	1.49788	0.80493	2.8150	0.2047436
2022	2.33470	1.16612	4.7264	0.0172713*
2023	3.66004	1.98263	6.8956	0.0000434***



(a) (b)

(c)

Figure 1. (a) Number of Blood Film malaria presumptive cases and confirmed cases at FETHI, 2019 – 2023. (b) Annual malaria prevalence at FETHI, from 2019 to 2023. (c) Monthly malaria distribution at FETHI, from 2019 to 2023.

malaria cases ranged from 28 (30.4%) in 2019 to 64 (54.2%) in 2023, with an overall prevalence of 42.32% [95% CI: 34.3%–54.4%]. According to Patel et al. [3], the number of presumptive and confirmed malaria cases reported in public health facilities in Nigeria increased from 89% in 2010 to 108% in 2021. Furthermore, the prevalence rate of confirmed cases among presumptive cases has varied widely, from 14% to as high as 90%, with the highest rate reported in 2022 (90%). The results of this study align broadly with national estimates, although slight discrepancies were observed. These differences may be attributed to variations in sample size, geographic location, and seasonal factors. For instance, according to [6], the estimated malaria prevalence in Nigeria is approximately 86%, which is slightly higher than the 42.32% found in this study. Two species of malaria parasites were identified

in this study: Plasmodium falciparum (98 cases, 47.3%) and Plasmodium vivax (83 cases, 40.1%). Additionally, 28 cases (13.6%) were mixed infections involving both species. This finding contrasts with earlier national prevalence studies that reported an absence of P. vivax in Nigeria due to the high prevalence of the Duffy-negative gene in the population [2] However, recent reports have confirmed the presence of P. vivax in Edo and Lagos States, in southern Nigeria [15], with evidence suggesting its occurrence in Duffy-negative individuals [18–26]. Seasonally, December, January, and May recorded the highest number of confirmed malaria cases—50.0%, 51.2%, and 51.4% respectively. Individuals who visited the Federal Teaching Hospital in January were twice as likely to be infected as those who visited in April [OR: 2.29, 95% CI: 0.88–6.18, p = 0.037]. This result is consistent with [27], which reported that harmattan dust and biomass burning may facilitate malaria transmission. Statistically significant differences in yearly malaria distribution were observed in 2020, 2022, and 2023, with p-values of 0.014, 0.017, and <0.001 respectively. Furthermore, males were found to be significantly less likely to test positive for malaria than females [OR: 0.467, 95% CI: 0.299–0.721, p < 0.001]. This may be due to relatively higher immunity levels among males, as supported by the World Malaria Report [28]. Additionally, individuals aged 5 to 15 years were found to be 0.5 times less likely to contract malaria compared to children under five years [OR: 0.571, 95% CI: 0.303–1.063, p = 0.079]. The findings of this study provide valuable insights into the prevalence and burden of malaria in the study area and can support evidence-based malaria control strategies.

5. Conclusion

Despite ongoing efforts to control malaria, it remains a significant public health concern in the study area. The two predominant Plasmodium species identified were P. falciparum and P. vivax, with children under five years of age being the most affected group. The detection of P. vivax in 40.1% of cases, though limited to Ekiti State in Southwestern Nigeria, suggests that the presence and impact of this species in Nigeria and across sub-Saharan Africa may be underestimated. This finding highlights the urgent need for nationwide surveillance to assess the presence of P. vivax in other geopolitical zones and to implement appropriate control strategies. Consequently, stakeholders must intensify efforts toward sustainable and targeted malaria prevention measures to effectively reduce its burden

Ethical Approval and Consent

Permission to use the data for research purposes was obtained from the hospital administration. Patient identifiers such as names and addresses were not used, and confidentiality was strictly maintained.

Author Contributions. **Mmaduakor, C.**: conceptualization, methodology, software, validation, formal analysis. **Ngwu, B.**: methodology, software, validation, formal analysis. **Ojo-Lawal, S.**: original draft preparation, writing—review and editing, visualization. **Oluwafemi, G.**: conceptualization, methodology, software, validation, formal analysis. **Peter, O. J.**: formal analysis, investigation, resources, data curation, writing—original draft preparation, writing—review and editing, visualization. **Raso, M.**: original draft preparation, writing—review and editing, visualization.

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