Afghanistan Journal of Infectious Diseases
AJID
https://ajid.ghalib.edu.af/index.php/ajid

2025 July 3(2): 127-133

Prevalence of Malaria Based on Blood Smear Examination: A Retrospective Study at FCVMLT Clinic, Vom, Plateau State, Nigeria

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ARTICLE INFO

Type: Original Article
Received: 11/04/2025
Accepted: 17/06/2025

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To cite this article: Kinjir H, Onah IE. Prevalence of Malaria Based on Blood Smear Examination: A Retrospective Study at FCVMLT Clinic, Vom, Plateau State, Nigeria. Afghanistan Journal of Infectious Diseases. 2025 July 3(2): 127-133.
https://doi.org/10.60141/ajid.106

ABSTRACT

Background: Malaria is a significant public health issue in Nigeria, contributing to high morbidity and mortality rates, particularly in sub-Saharan Africa. The disease remains a persistent burden, occurring year-round and continuously exposing the population to the risk of infection.

Materials: A preliminary retrospective study was conducted at the clinic of the Federal College of Veterinary and Medical Laboratory Technology (FCVMLT), Vom, from Sep to Oct 2020. Four years of malaria data (2016–2020) were collected from laboratory registration books after obtaining permission from the head of the laboratory. Overall, 2020 patients were screened during this period.

Results: The slide positivity rate for malaria remained relatively stable throughout the four-year period, with only minor fluctuations. Malaria prevalence was consistently high, with seasonal peaks during the rainy season. Among the infected individuals, 827 (75.46%) were males and 269 (24.54%) were females. In 2018, the highest infection rate among adults (above 17 yr) was recorded at 578, while the lowest adult infection rate was in 2016, with 29 cases. For children (<17 yr), the highest infection rate was 639, and the lowest was 91, also in 2016.

Conclusion: The study demonstrates the persistent prevalence of malaria in the area, with notable seasonal variations. It is recommended that greater efforts be made to control the disease through public education on its dangers and the implementation of preventive measures.

Keywords: Malaria, FCVMLT, Retrospective study, Prevalence, Nigeria

Introduction

Malaria remains one of the foremost public health challenges globally, with significant attention drawn to its high morbidity and mortality rates, particularly within sub-Saharan Africa. According to the WHO, approximately 247 million cases of malaria were reported worldwide in 2022, resulting in an estimated 619,000 deaths. The vast majority of these deaths, approximately 95%, occurred in sub-Saharan Africa, with children under five years old disproportionately affected. Malaria is endemic in 85 countries, and approximately 3.2 billion individuals globally are considered at risk of infection (1).

The burden of malaria revealed 241 million clinical cases worldwide in 2020, with deaths remaining persistently high,

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predominantly in the WHO African Region (2). Nigeria continues to bear a significant proportion of the global malaria burden, with an estimated 27% of global cases occurring in the country (2). Approximately 30% of Nigerians reside in areas with high malaria transmission rates, 67% live in regions with moderate transmission, and 3% are in low to very low transmission areas (3). Additionally, around half of Nigerian adults experience at least one malaria attack per year, while children under five experience two to four episodes annually (4).

Malaria is an infectious disease transmitted by mosquitoes, caused by protozoan parasites from the *Plasmodium* genus. The infection is initiated when an infected female *Anopheles* mosquito transfers the parasite into the bloodstream through its saliva. Once in the bloodstream, the parasites move to the liver, where they mature and multiply (1).

Malaria, characterized by symptoms such as fever and headaches, can progress to severe complications, including coma or death, if not promptly treated. The disease is endemic in tropical and subtropical regions near the equator, particularly in sub-Saharan Africa, Asia, and the Americas. Historically, malaria was prevalent in Europe and North America, but these regions are no longer considered endemic. However, imported cases continue to be reported, underscoring the global nature of the disease (1).

This study is crucial due to the high malaria burden in Nigeria, particularly in rural areas where local data is scarce. It provides insights into malaria trends, assesses control measures, and supports targeted interventions to reduce morbidity and mortality (2,3). The study aimed to evaluate a four-year retrospective dataset on malaria prevalence at the Federal College of Veterinary and Medical Laboratory Technology (FCVMLT), Vom, in Jos South Local Government Area, Plateau State, Nigeria. This research analyzed four years of clinic records, which are valuable sources of malaria data due to their accessibility and minimal cost. The findings of the study will provide baseline information, offering key indicators on the status of malaria testing at the facility, and will be useful for policymakers, particularly the head of the institution. This data is essential for assessing the impact of national malaria control initiatives on malaria prevalence in the region. If effectively utilized, the information will prompt timely action from decision-makers to enhance the efficiency and effectiveness of malaria control interventions.

Materials and Methods

Study Area

The study was conducted at the clinic of the (FCVMLT) in Vom, Plateau State, Nigeria. Established to provide high-quality training in veterinary science and medical laboratory technology, the college plays a key role in educating professionals who contribute to the fields of healthcare and animal management. It is located in Vom, a scenic, rocky village situated 1,285 meters above sea level, which contributes to its notably cool climate, especially during Dec and Jan when nights can be particularly cold. Vom is located 24 kilometers to the north of Bukuru and 24 kilometers to the east of Jos, with geographical coordinates of 9.7294°N latitude and 8.7885°E longitude. The region's climate is characterized by consistent winds, further enhancing its cool atmosphere. The wet season spans from late Apr to mid-Oct. The college's clinic serves as both a practical training facility for students and a vital health service provider to the local community. The institution’s academic and healthcare services are an integral part of the community, contributing to public health and veterinary care in the region.

Study Design

A retrospective study was conducted to assess the slide positivity rate of malaria

over a four-year period by reviewing blood film malaria reports at the clinic of the (FCVMLT), Vom. We aimed to analyze historical malaria data, providing valuable insights into the prevalence of malaria in the community served by the college's clinic. The data was drawn from patients (those screened for malaria) at the clinic. Data were obtained from the laboratory records. The records were retrieved and scrutinized carefully and entered into tables on the basis of patients demographic profiles (age and sex), and clinical finding investigations (positive or negative). Thick and thin blood smears were prepared, stained with Giemsa, and examined under a light microscope by trained laboratory scientists. Quality control was ensured by rechecking 10% of slides by a second independent microscopist.

Ethical Clearance

Ethical clearance for the study was obtained from the Medical Laboratory Science Department of the FCVMLT, Vom, Plateau State, Nigeria. After explaining the study's objectives, written permission was secured from the Parasitology Department before initiating data collection. All data collected from laboratory register were anonymized to ensure confidentiality.

Inclusion and Exclusion criteria

Inclusion criteria included all patients who presented with clinical symptoms suggestive of malaria (e.g., fever, chills, headache) and were screened using blood smear microscopy. Exclusion criteria included patients already on antimalarial treatment or with incomplete records.

Data Analysis

Data entry and analysis were performed using SPSS ver. 20 software (IBM Corp., Armonk, NY, USA). The Chi-square test was applied to compare proportions, and a *P*-value of $\leq$ 0.05 was regarded as statistically significant.

Results

Overall, 2,020 patients suspected of having malaria provided blood films for diagnosis during the study period at the FCVMLT, Vom clinic. 1,750 (86.6%) study subjects tested positive for malaria and 270(13.4%) were negative. The highest prevalence (96.7%, n=702) was recorded in 2018, while the lowest was recorded the following year; 2019 (74.5%, n=306). The variation in malaria prevalence across the years was statistically significant (χ^2_{cal} =121.6, χ^2_{tab} =7.815, P<0.05) (Table 1). With respect to season, across the years, rainy season recorded a higher prevalence (94.9%, n=924) compared to dry season (79.0%, n = 826). Although the number of females positive (923) for malaria was higher than males (827), Males recorded a higher prevalence (89.2%) compared to females (84.4%). The difference in malaria prevalence between genders was statistically significant (χ^2_{cal} = 9.843, χ^2_{tab} =3.841, P<0.05) (Table 2).

With respect to age group, a total of 1,421 adults (>18 yr) screened were positive for malaria, with a prevalence of 87.1%. Adults screened during the rainy season recorded a higher prevalence (95.1%, n=764), compared to adults in dry season who recorded a lower prevalence of (79.3%, n=657). The difference in malaria prevalence between the rainy and dry seasons was statistically significant (χ^2_{cal} = 110.1, χ^2_{tab} = 3.841, P<0.05). The same trend was observed for children (<18yr) screened for malaria; those screened in the rainy season also recorded a higher prevalence (93.6%, n=160) compared to those screened in the dry season (77.9%, n=169). Children (n=389) recorded an overall prevalence of 84.8%. The difference in malaria prevalence between the children and adults was not statistically significant (χ^2_{cal} = 1.426, χ^2_{tab} = 3.841, P>0.05) (Table 3).

Table 1: Overall slide positive rate of malaria in relation to sex at FCVMLT, Vom Clinic from 2016-2020

Year	*MALE*		*FEMALE*		*TOTAL*	
	No. screened	No. positive (%)	No. screened	No. positive (%)	No. screened	No. positive (%)
2016	119	107(89.9)	130	105(80.8)	249	212(85.1)
2017	274	257(93.8)	360	273(75.8)	634	530(83.6)
2018	349	337(96.6)	377	365(96.8)	726	702(96.7)
2019	185	126(68.1)	226	180(79.6)	411	306(74.5)
Total	927	827(89.2)	1,093	923(84.4)	2,020	1,750(86.6)

(χ^2_{cal} = 121.6, χ^2_{tab} = 7.815, P<0.05)

Table 2: Overall slide positive rate of malaria in relation to season at FCVMLT, Vom Clinic from 2016-2020

Year	*Season*	*MALE*		*FEMALE*		*TOTAL*	
		No. screened	No. positive (%)	No screened	No. positive (%)	No. screened	No. positive (%)
2016	Dry	86	77(89.5)	84	62(73.8)	170	139(81.8)
	Rainy	33	30(90.9)	46	43(94.5)	79	73(92.4)
2017	Dry	108	104(96.3)	185	104(56.2)	293	208(71.0)
	Rainy	166	153(92.2)	175	169(96.6)	341	322(94.4)
2018	Dry	137	136(99.3)	114	114(100.0)	251	250(99.6)
	Rainy	212	201(94.8)	263	251(95.4)	475	452(95.2)
2019	Dry	139	81(58.3)	193	148(76.7)	332	229(69.0)
	Rainy	46	45(97.8)	33	32(97.0)	79	77(97.5)
Total	Dry	470	398(84.7)	576	428(74.3)	1,046	826(79.0)
	Rainy	457	429(93.9)	517	495(95.7)	974	924(94.9)
Grand Total		927	827(89.2)	1,093	923(84.4)	2,020	1,750(86.6)

(χ^2_{cal} = 9.843, χ^2_{tab} = 3.841, P<0.05)

Table 3: Overall slide positive rate of malaria in relation to age at FCVMLT, Vom Clinic from 2016-2020

Year	*Season*	*Adult (>18 years)*		*Children (<18 years)*		*Total*	
		Number Screened	Number Positive (%)	Number screened	Number positive (%)	Number screened	Number positive (%)
2016	Dry	53	38(71.7)	117	101(86.3)	170	139(81.8)
	Rainy	13	12(92.3)	66	61(92.4)	79	73(92.4)
2017	Dry	234	179(76.5)	59	29(49.2)	293	208(71.0)
	Rainy	336	318(94.6)	6	4(66.7)	341	322(94.4)
2018	Dry	216	216(100.0)	35	34(97.1)	251	250(99.6)
	Rainy	394	374(94.9)	81	78(96.3)	475	452(95.2)
2019	Dry	326	224(68.7)	6	5(83.3)	332	229(69.0)
	Rainy	60	60(100.0)	19	17(89.5)	79	77(97.5)
Total	Dry	829	657(79.3)	217	169(77.9)	1,046	826(79.0)
	Rainy	803	764(95.1)	171	160(93.6)	974	924(94.9)
Grand Total		1,632	1,421(87.1)	388	329(84.8)	2,020	1,750(86.6)

(χ^2_{cal} = 1.426, χ^2_{tab} = 3.841, P>0.05)

Discussion

Malaria remains endemic in Vom, Plateau State, based on a four-year review of clinic records. Environmental factors such as stagnant water bodies, poor drainage, and inadequate housing conditions contribute significantly to transmission. The occurrence of malaria is influenced by factors such as adequate rainfall and temperature. In regions with a temperate climate, malaria transmission is typically restricted to months when the average temperature exceeds the minimum threshold required for sporogony. Several factors contribute to seasonal variations, including ecological and environmental conditions, characteristics of the host and vector, social and economic determinants like changes in healthcare infrastructure, biological factors, population immunity, government policies, availability of healthcare facilities, and drug resistance.

Vom is characterized by poorly planned and inadequately constructed residential accommodations for students of the FCVMLT, as well as other nearby colleges. The community suffers from a poor urban planning system, leading to overcrowding and the creation of multiple mosquito breeding sites. The housing conditions in many neighbourhoods are substandard, with inadequate ventilation in some hostels, which discourages the use of insecticide-treated mosquito nets. These factors likely contribute to the high incidence of malaria, even during the dry season. This observation is consistent with findings from several previous studies (5-7).

The college, established in 1956, has long been an influential center for students. Its activities make the college a potential hotspot for malaria transmission, as they facilitate the regular movement of large numbers of people into and out of the community. This movement could contribute to the persistent incidence of malaria throughout the year. Human mobility has been increasingly recognized as a key driver of sustained malaria transmission, particularly in endemic regions. Population movement can introduce malaria parasites into low-transmission or previously cleared areas, undermining control efforts and contributing to year-round transmission, especially in regions with emerging drug resistance (8).

An annual fluctuation in malaria incidence was observed during the study period, with a peak in 2018 and a decline in 2019. While the exact reasons for this decrease are not entirely clear, it is likely influenced by intervention measures implemented in the area, such as the mass distribution of insecticide-treated nets (ITNs), the increased availability of the new, more effective antimalarial drug (ACT), indoor residual spraying, and regular larviciding activities. Given the high prevalence rates, particularly among males and during the rainy season, targeted interventions should include the distribution of ITNs to males working outdoors during peak mosquito activity. Additionally, improving urban planning to reduce mosquito breeding sites could help lower transmission rates.

While some studies indicate that heavy rainfall can eliminate mosquito breeding sites and wash away larvae, leading to a decrease in mosquito population and lower disease transmission (8-10), this study found no such effect. Malaria prevalence was higher during the rainy season than in the dry season throughout the years analyzed.

In this study, males recorded a significantly higher prevalence of malaria (89.2%) compared to females (84.4%), a trend that has been observed in other malaria-endemic regions. This disparity may be attributed to several factors. Males are more likely to engage in outdoor activities, such as farming and fishing, which increase their exposure to *Anopheles* mosquitoes, particularly during peak biting times (11). Furthermore, cultural practices and resistance to adopting preventive measures, such as the use of insecticide-treated bed nets, may contribute to the higher infection

rate observed among males (12). Additionally, biological and immunological differences, with some studies suggesting that females may develop stronger protective immunity due to hormonal influences (13), could help explain the gender disparity. Occupational hazards, such as outdoor work at night, which are more prevalent among males, may also play a role in the increased infection rate. These findings highlight the need for targeted malaria prevention strategies that take into account the specific behaviors and vulnerabilities of males in endemic regions (14).

Adults (> 18 yr) recorded an overall higher prevalence (87.1%, n=1,421) compared to the children (84.8%, n=329). This may due to the fact that the laboratory where data was retrieved from is located in a college where most of the population around are above 18yr. Most of the students expose themselves to mosquito bites while reading at night.

Recommendations

We recommend that the government increase funding for malaria control in rural areas, ensuring broader access to insecticide-treated nets, affordable antimalarial drugs, and mobile health units for remote communities. Public health education campaigns should focus on prevention, early treatment, and environmental management. Strengthening malaria surveillance systems is crucial for targeted interventions, and the government should invest in research to develop new prevention strategies. Additionally, integrated vector control programs, including indoor residual spraying and environmental sanitation, must be prioritized to reduce mosquito populations and combat malaria transmission effectively.

Limitations

This study had several limitations. Firstly, malaria transmission intensity was not measured, even though the disease is highly endemic in the region. Secondly, the study relied on data from a four-year period (2016-2019), which may not fully represent the long-term temporal trends of malaria in the area. However, this time frame was chosen as it was the only period with comprehensive and reliable clinical data available at the facility. Thirdly, the exclusion of self-treated cases and incomplete data from private clinics limits the generalizability of the findings to the broader population of Vom. Despite these limitations, the study provided valuable insights into the malaria situation among individuals screened at the facility. Fourthly, the reliance on a single data source and one diagnostic method (blood smear) limits the external validity of these findings.

Conclusion

Malaria remains a persistent health burden in Vom, with elevated risks during the wet season when transmission peaks. The findings further indicate a higher density of malaria cases during the wet season compared to the dry season. The study provides valuable insights into the temporal patterns of malaria transmission. Additionally, the high slide positivity rate of malaria was found to be statistically significant with respect to both sex and age. Consequently, it is imperative for health planners and administrators to intensify health education efforts for the community and daily laborers in Vom, focusing on malaria control and prevention strategies.

Conflict of interest

The authors assert that there are no conflicts of interest.

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