







ORIGINAL RESEARCH ARTICLE

Epidemiology of Malaria in Bauchi North, Bauchi State Nigeria: Prevalence and Determinants of the Infection

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ABSTRACT

Malaria remains a leading public health concern globally, particularly in sub-Saharan Africa, with Nigeria bearing a significant burden of the disease. This cross-sectional study aimed to assess malaria prevalence and associated risk factors among patients attending healthcare facilities in Bauchi North, Bauchi State, Nigeria. A total of 300 patients suspected of having malaria were enrolled, and blood samples were analyzed using microscopy of thick blood film stained with Giemsa's stain. The presence of gametocytes, trophozoites, or schizonts, which stained dark blue, indicated positive results. Structured questionnaires were administered to collect demographic and risk factor data. The overall prevalence of malaria was 40%, with higher prevalence rates among females (27%) compared to males (13%) and among adults aged 25–64 years (24%). Rural residents (29.67%), individuals from low-income families (20.67%), and those exposed to poor housing and environmental conditions exhibited higher prevalence rates. The key risk factors assessed included residence of the patients, use of a net, and socioeconomic status, among which a history of fever within two weeks prior to the study ($p = 0.006$) was the only statistically significant risk factor associated with malaria at $p < 0.05$. Logistic regression analysis confirmed fever history as the primary predictor of malaria (COR = 0.438, 95% CI = 0.242–0.792). These findings highlighted the need for targeted malaria control interventions focusing on high-risk groups and environmental management. Strengthened public health campaigns are essential to improve awareness of the danger of malaria, its modes of transmission, infection agents, and preventive measures in underserved areas.

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INTRODUCTION

Malaria remains a significant global public health challenge, resulting from infection with protozoan parasites from the genus *Plasmodium*, which are transmitted through the bites of infected female Anopheles mosquitoes (Mohammed *et al.*, 2020; Balcha *et al.*, 2023). Numerous efforts in recent years have been made towards malaria control, leading to notable reductions in morbidity and mortality (WHO, 2023).

Malaria remains a global public health challenge, with an estimated 263 million cases and approximately 600,000 deaths reported in 2023 (WHO, 2023). The incidence of malaria is disproportionately high in Africa, which accounts for 94% of the global malaria cases and deaths (WHO, 2023). Nigeria bears the highest malaria burden globally, contributing to about 31% of global malaria-

related deaths (The Guardian, 2024). Within Nigeria, the prevalence of malaria varies significantly by region, with the Northeast, including Bauchi state, experiencing high transmission rates due to climatic conditions that favor mosquito breeding, poor access to healthcare, and limited malaria control interventions (Reuters, 2024).

In Nigeria, there were about 68 million cases of malaria and 194,000 deaths due to the disease in 2021 (WHO, 2022). Globally, Nigeria had the peak burden of malaria, resulting in about 27% of the global malaria load. The infection's transmission risk exists across the country throughout the year (WHO, 2022). These successes have been attributed to increased funding and the implementation of intervention strategies such as long-lasting insecticidal nets, intermittent preventive treatment

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for pregnant women, and vector control measures (WHO, 2023). Despite these advances, Africa continues to bear the highest global malaria burden, with Nigeria experiencing the largest number of cases and deaths. Malaria accounts for 30% of under-five mortality and 25% of infant mortality in the country (WHO, 2022).

In line with global progress, Nigeria has made significant strides in malaria control through integrated vector management and effective case management (Sale *et al.*, 2020). However, 97% of the Nigerian population remains at risk of malaria (WHO, 2023). Several factors contribute to malaria vulnerability, including environmental, socioeconomic, and interventional elements (Magaji and Mahmud, 2025). High malaria prevalence has been reported among febrile children under five years old (WHO, 2022), although recent data indicate a decline in prevalence among this group, with an increasing incidence among older children (Simon-Oke and Akinbote, 2020). This shift has been linked to targeted intervention programs focusing on children under five, leading to reduced parasite transmission in this age group. However, this decline in exposure may have resulted in a loss of acquired functional immunity, leaving older children more susceptible to malaria (Reuters, 2024).

The Bauchi North sub-region of Bauchi state remains particularly vulnerable due to its rural nature, inadequate health infrastructure, and persistent poverty. Despite the efforts of both governmental and non-governmental organizations to control and prevent malaria, the incidence of malaria among low-income groups in the rural areas of Bauchi State has increased. This study aimed to assess malaria's incidence and associated risk factors among patients attending healthcare facilities in Bauchi North, Bauchi State, Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in the selected healthcare facility in the Katagum zone (Bauchi North), one of the three senatorial districts of Bauchi State of Nigeria, with headquarters in Azare. It consists of seven local governments, including Katagum, Shira, Giade, Zaki, Itas-Gadau, Gamawa, and Jama'are. It is located at 11°40'27"N 10°11'28E coordinates: 11°40'27"N 10°11'28E. Local governments in the region include Misau and Dambam (Bauchi Central), Gwaram, Kiyawa, Buji, and Hadejia (Jigawa State).

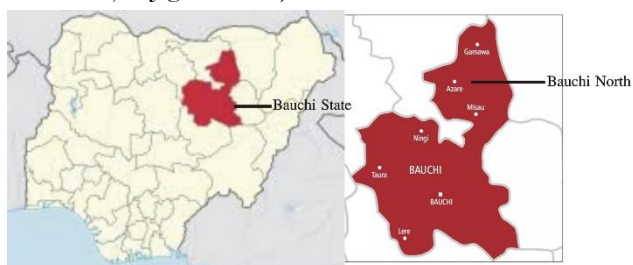


Figure 1: Map of Nigeria Showing the Study Area

Study Population and Design

A cross-sectional study was conducted among Extreme Hospital Azare, Bauchi State, Nigeria patients.

The study population included patients of all ages and sexes with suspected cases of malaria. All patients without symptoms and signs of the infection or those unwilling to participate in the study were excluded.

Ethical Consideration

Ethical approval with reference number EHA/11/07/24/02 was obtained from the research and ethics committee of Extreme Hospital Azare. Before the data collection, all the participants received an informed consent form detailing the study's objectives, procedures, potential risks, and benefits. Participants were assured of the confidentiality of their responses and their rights to withdraw from the study at any time without consequences. Only those who voluntarily signed the consent form were included in the study.

Sample Size Determination

The sample size for this study was calculated using Cochran's formula for cross-sectional as indicated below:

$$n = z^2 p q / d^2$$

“n” represents the minimum sample size,

“z” = 1.96 for the 95% confidence level,

“q” = 1-p

“p” represents the prevalence of malaria in the study area (23.3%) from the previous report by Nwaneli *et al.*, (2020).

“d” represents precision, and 5% was taken for this study.

Hence, 300 patients suspected to have malaria at Extreme Hospital Azare were enrolled for the study.

Development, Validation, and Administration of the Questionnaire

A structured questionnaire was developed to obtain information on the patients' demography and the associated risk factors among the study participants. The questionnaire was developed based on a thorough review of relevant literature that aligned with the study's objectives. It consisted of sections covering demographic characteristics, health-seeking behavior, environmental and socioeconomic risk factors, and history of malaria infection. To ensure the content validity and reliability, the instrument was reviewed by experts in epidemiology, public health, and infectious disease. A pilot study was conducted among a small subset of participants outside the study area, and necessary revisions were made based on the feedback to improve clarity and consistency. Three hundred (300) of the questionnaires were administered during sample collection through face-to-face interviews to minimize potential misinterpretations and ensure comprehensive data collection. Responses were carefully recorded, and the completed questionnaires were checked for accuracy and completeness before data analysis.

Sample Collection and Detection of the Malaria Parasite

For the current study, 300 samples of blood were collected from the patients enrolled in the study.

A sample of blood was dropped on the center of clean glass slides and then spread to form thick blood smears. These were then allowed to air-dry and stained with 10% Giemsa stain. The smear was then allowed to stay for about ten minutes before washing, air drying, and

examining under the microscope using x40 and x100 magnifications. The presence of gametocytes, trophozoites, or schizonts, which stained dark blue, indicated positive results (Iwuafor *et al.*, 2016).

RESULTS

Validation Results

The pilot study included a total of 30 respondents, representing 10% of the total sample size. The study revealed that the majority of respondents (33.33%) were aged 30–39 years, followed by 20–29 years (26.67%), 40 years and above (16.67%), 10–19 years (13.33%), and 0–9 years (10%). More females (56.67%) participated in the study compared to males (43.33%). Most respondents were married (63.33%), while 33.33% were single, and 3.33% were widowed. No divorced participants were recorded. Also, the respondents were predominantly from towns (43.33%), followed by cities (30%) and villages (26.67%). More than half of the respondents (56.67%) belonged to the low-income category, while 30% were in the middle-income group and 13.33% in the high-income group (Table 1).

According to the risk factors of the infection, over half of the respondents (56.67%) reported experiencing fever in the two weeks prior to the study. 56.67% reported regular use of ITNs, whereas 43.33% did not use them. About 40% had traveled outside Bauchi State two weeks before the study, while 60% had not. Furthermore, malaria cases were reported in 63.33% of the respondents' households. More than half of the respondents (53.33%) had visited a healthcare facility for treatment in the last two weeks. Also, 70% of respondents resided in areas near stagnant water bodies or bushy environments. Only 36.67% lived in houses with proper window and door screens, while 63.33% did not. Only 10% of respondents practiced regular indoor insecticide spraying, while 90% did not spray their homes (Table 1).

Prevalence of Malaria in the Study Area

The current study revealed that the overall prevalence of malaria in Bauchi North, Bauchi State, Nigeria, is 40%. The prevalence on the basis of the gender of the patients was found to be 27.00% and 13.00% among females and males, respectively. On the age basis, the study revealed a prevalence of 4.00% among children aged 0–9 years, 4.67% among adolescents aged 10–19 years, 6.33% among young adults aged 20–24 years, 24.00% among adults aged 25–64 years, and 1.00% among elderly individuals aged 65 years and above (Figure 2).

Prevalence of Malaria Based on Risk Factors

Based on the risk factors of the infection, the study indicated that, a higher prevalence (29.67%) of malaria was noticed in rural than the urban areas (10.33%). The prevalence of 20.67%, 14.33%, and 5.00% were seen among patients from Low, Middle, and High-income families, respectively. A high prevalence of the infection (29.67%) was also seen among the patients who had a fever two weeks prior to the enrolment in the study, while a low prevalence of 10.33% was recorded among those who had not experienced a fever two weeks before the study. Furthermore, the study revealed a higher prevalence (25.00%) among those using net and 15.00% among those not. A prevalence of 14.67% was seen

among patients who had a traveling history out of Bauchi state two weeks before the study and 25.33% among those who had not. Also, the infection's prevalence among those with a patient in their household and those without were 26.00% and 14.00%, respectively. The study also showed a high prevalence (21.00%) among patients who visited healthcare facilities for fever medication 2 weeks before the study, 19.00% among those who did not. The prevalence was higher (30.00%) among those living in bushy areas with stagnant water than those without (10.00%). Low prevalence (14.33%) was seen among individuals sleeping in rooms with good door and window screens, while those without access to rooms with good doors and windows exhibited high prevalence (25.67%). Furthermore, a low prevalence (5.00%) was seen among those who were regularly spraying their homes with insecticides and a high prevalence (35.00%) among those who were not (Table 2). Statistically, the risk factors assessed do not reach a significance level associated with the high prevalence of malaria, except in having fever 2 weeks prior to the study (p -value = 0.006) (Table 2).

Furthermore, the logistics regression analysis revealed that, none of the variables assessed was statistically associated with likelihood of developing the infection except “having fever two weeks before the study” (COR(95%CI): 0.438(0.242-0.792)) (Table 3).

DISCUSSION

The pilot study findings provided insights into the prevalence of malaria risk factors in Bauchi North. The high proportion of respondents from low-income backgrounds (56.67%) aligns with previous studies suggesting that malaria disproportionately affects economically disadvantaged populations due to limited access to preventive measures and healthcare services.

The high percentage (70%) of participants residing near stagnant water bodies or bushy areas is a notable concern, as such environments provide breeding grounds for *Anopheles* mosquitoes, the primary malaria vectors. This finding underscores the importance of environmental management in malaria control efforts.

Although more than half (56.67%) of respondents reported using insecticide-treated nets, the persistence of fever episodes and household malaria cases suggests that net usage alone may be insufficient. Additional interventions, such as proper house screening and insecticide spraying, remain underutilized, with only 36.67% having protective window and door screens and a mere 10% regularly spraying their homes.

Travel history was also identified as a possible factor influencing malaria transmission, as 40% of respondents had traveled outside Bauchi State in the past two weeks. Travel to endemic regions could contribute to malaria importation and spread.

Based on feedback from the pilot study, some modifications were made to improve the final questionnaire. The age categorization was adjusted to align with WHO's standardized age groups. Similarly, marital status was removed due to respondents' reluctance to disclose this information. Also, residence classification was changed from “village, town, and city” to a simpler

“urban vs. rural” classification, as some respondents found it difficult to differentiate between town and city categories.

These refinements enhanced the clarity and accuracy of the main study questionnaire, ensuring better data collection for assessing malaria prevalence and its determinants in Bauchi North.

Table 1: Validation Results Obtained From the Pilot Study

Variable	Responses	Percentage (%)
Age:		
0-9 years	3	10
10-19years	4	13.33
20-29years	8	26.67
30-39years	10	33.33
40years and above	5	16.67
Gender		
Males	13	43.33
Females	17	56.67
Marital status:		
Single	10	33.33
Married	19	63.33
Divorced	0	0
Widowed	1	3.33
In which residential area are you living?		
Village	8	26.67
Town	13	43.33
City	9	30
Which category of socioeconomic groups do you belong to?		
Low income	17	56.67
Middle income	9	30
High income	4	13.33
Have you experienced fever in the past 2 weeks?		
Yes	17	56.67
No	13	43.33
Are you using insecticide treated net regularly?		
Yes	17	56.67
No	13	43.33
Have you travelled out of Bauchi state in the past 2 weeks?		
Yes	12	40
No	18	60
Are there malaria patients in your household?		
Yes	19	63.33
No	11	36.67
Have you visited healthcare facilities for medication in the past 2 weeks?		
Yes	16	53.33
No	14	46.67
Do you live in bushy areas or near stagnant water bodies (e.g., ponds, ditches)?		
Yes	21	70
No	9	30
Does your house have proper window and door screens?		
Yes	11	36.67
No	19	63.33
Is your house regularly sprayed with insecticides?		
Yes	3	10
No	27	90

The present study provided valuable insights into malaria's prevalence and risk factors in Bauchi North, Bauchi State, Nigeria. With an overall prevalence of 40%, this finding underscored the ongoing malaria burden in the region, which aligns with the World Health Organization's (WHO) 2022 report highlighting the northeast region of Nigeria as a global hotspot for malaria transmission (WHO, 2022). Nigeria contributes significantly to the

global malaria burden, accounting for 27% of malaria cases worldwide and 28% of cases in the WHO African Region (WHO, 2022). This high prevalence poses a considerable public health challenge, particularly in rural areas where access to effective malaria control interventions is limited.

The current study aligns with studies conducted in Ekiti state by Simon-Oke *et al.* (2019) and Kogi state by Okolo

et al. (2023), in which prevalence rates of 40.2% and 40% were recorded, respectively. The findings of this study contrast with the findings of other studies conducted in other regions of Nigeria, including Osun state by Bolaji *et al.* (2023), Abuja by Ohalete *et al.* (2020), Imo state by Onyemaechi & Malann (2020), and Gombe state in Nigeria by Yusuf *et al.* (2023) who reported higher prevalence rates of 53.9%, 80.9%, 70.5%, and 74%,

respectively among pregnant women. Also, the findings of the current study disagree with the findings of Lawal *et al.* (2023), who reported a lower prevalence of 24.25% in Katsina state, and Kwala *et al.* (2021) in Adamawa state, who recorded a prevalence of 36.74% in the state. The variations in the reported findings could be attributed to differences in study populations, climatic conditions, seasons, or regions.

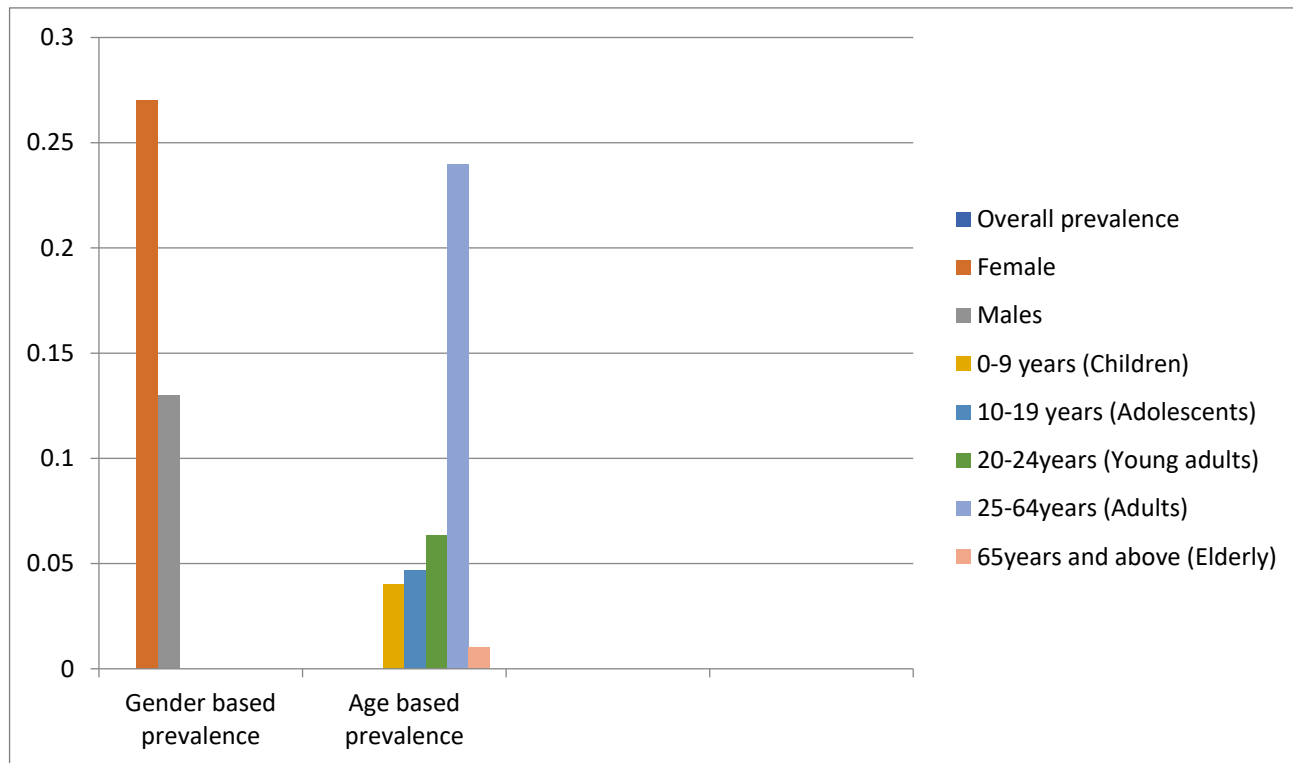


Figure 2 Prevalence of Malaria on the basis of gender and age of the patients

In this study, the gender-based prevalence of malaria was disproportionately higher among females (27%) than males (13%). This finding is consistent with previous studies, which have noted gender differences in malaria prevalence, often attributed to factors such as differential exposure, health-seeking behaviors, and household responsibilities (Elechi *et al.*, 2015; Ceesay *et al.*, 2008).

The analysis of malaria prevalence across age groups revealed that the infection is most common among adults aged 25–64 years (24%), while a comparatively lower prevalence was observed in children and the elderly. These findings diverge from the conventional understanding that malaria predominantly affects young children, who are at a higher risk due to their underdeveloped immune systems. However, recent trends have shown a shift in malaria burden, with increasing cases in older age groups, as evidenced by studies in other parts of Sub-Saharan Africa (Ceesay *et al.*, 2008; Mawili-Mboumba *et al.*, 2013; Ogah *et al.*, 2013). This shift may be attributed to several factors, including changing environmental conditions, population dynamics, and variations in immunity over time. Similar trends have been documented in other parts of Africa, where older children and adults have seen increased exposure to malaria transmission (Ceesay *et al.*, 2008; Ogah *et al.*, 2013). The lower prevalence among children in this study may be related to the ongoing implementation of malaria control programs targeting this vulnerable group.

Furthermore, the study revealed that malaria prevalence varied significantly between urban and rural areas, with a higher prevalence (29.67%) observed in rural regions compared to urban areas (10.33%). This trend is consistent with prior studies that have reported higher malaria prevalence in rural settings, often due to factors such as poor access to healthcare, inadequate vector control measures, and greater exposure to breeding sites for *Anopheles* mosquitoes (NMIS, 2016; Umaru and Uyaiabasi, 2015). The higher prevalence in rural areas could also be linked to agricultural practices, which provide suitable habitats for mosquito breeding (Kumar *et al.*, 2014).

Socioeconomic status emerged as another key factor influencing malaria prevalence. Low-income individuals had a higher prevalence (20.67%) compared to middle-income (14.33%) and high-income individuals (5.00%). This finding corroborates the WHO's assertion that malaria disproportionately affects low-income communities, who often lack access to essential preventive measures such as insecticide-treated nets (ITNs) and prompt medical care (WHO, 2022). Studies in similar settings have also highlighted that individuals from lower socioeconomic backgrounds are more vulnerable to malaria due to limited resources for malaria prevention and treatment (Umaru and Uyaiabasi, 2015; Ceesay *et al.*, 2008).

Table 2: Prevalence of Malaria in relation to the risk factors of the infection

Variables	Positive	Negative	Total	Prevalence (%)	χ^2	P value
Residence						
Rural	89	135	224	29.67	0.662	0.416
Urban	31	45	76	10.33		
Socioeconomic status						
Low income	62	81	143	20.67	1.665	0.435
Middle income	43	71	114	14.33		
High income	15	28	43	5.00		
Fever in past 2 weeks						
Yes	89	122	211	29.67	7.697	0.006*
No	31	58	89	10.33		
Use of net						
Yes	75	121	196	25.00	3.671	0.055
No	45	59	104	15.00		
Travelling out of Bauchi in past 2 weeks						
Yes	44	66	110	14.67	0.096	0.756
No	76	114	190	25.33		
Patients in the household						
Yes	78	115	193	26.00	0.440	0.507
No	42	65	107	14.00		
Visit to healthcare facilities in past 2 weeks						
Yes	63	101	164	21.00	1.724	0.189
No	57	79	136	19.00		
Living in bushy areas or near stagnant water						
Yes	90	137	227	30.00	1.191	0.275
No	30	43	73	10.00		
Sleeping in a room with good door and window screens						
Yes	43	61	104	14.33	0.990	0.320
No	77	119	196	25.67		
Spraying home regularly with Insecticides						
Yes	15	44	59	5.00	0.284	0.594
No	105	136	241	35.00		

χ^2 : represents chi=quare

“*” : significance at p<0.05

The study also identified several other risk factors associated with malaria prevalence. Patients who reported having had a fever two weeks before enrollment in the study exhibited a higher malaria prevalence (29.67%) than those who did not (10.33%). This finding aligns with established knowledge that fever is one of the cardinal symptoms of malaria, making it a critical indicator for diagnosis (Mawili-Mboumba *et al.*, 2013). Additionally, individuals who had used bed nets (25.00%) exhibited a higher prevalence of malaria than those who did not (15.00%). This counterintuitive finding might reflect issues such as improper use, maintenance, or coverage of bed nets, as well as the declining efficacy of nets in areas with high malaria transmission (Ugwuibe *et al.*, 2021).

Travel history and household malaria status were also significant risk factors. A significant proportion of individuals who had traveled out of Bauchi State (14.67%) showed lower malaria prevalence than those who had not (25.33%). This may suggest that the patients might have acquired the infection in their various living places. Similarly, individuals who had a malaria patient in their household were more likely to contract the disease (26.00%), indicating the potential for household

transmission, which is a well-documented risk factor for malaria spread (Umaru and Uyaiabasi, 2015).

In terms of environmental risk factors, individuals living in areas with stagnant water and bushy surroundings had a significantly higher malaria prevalence (30.00%) compared to those in non-bushy areas (10.00%). This finding aligns with the identification of breeding sites for Anopheles mosquitoes in environments with stagnant water, which is common in rural settings (Kumar *et al.*, 2014). Similarly, inadequate housing conditions, such as rooms without proper door and window screens, were associated with higher malaria prevalence, as these conditions facilitate mosquito entry (NMIS, 2016).

Despite the apparent association of these risk factors with malaria prevalence, statistical analysis revealed that only a history of fever two weeks prior to the study was significantly associated with increased malaria risk (p-value = 0.006). This suggests that while certain factors, such as socioeconomic status and environmental conditions, may contribute to higher malaria prevalence, they do not necessarily correlate with the likelihood of developing the infection. This finding is consistent with other studies that have shown that socioeconomic and environmental factors may not always directly predict malaria risk (Ceesay *et al.*, 2008; Umaru and Uyaiabasi, 2015).

Table 3: Logistic regression analysis for the risk factors associated with malaria infection

Variables	Positive	Negative	Total	COR(95% CI)	AOR(95% CI)
In which residential area are you living?					
Rural	89	135	224	1.335(0.664-2.683)	
Urban	31	45	76	1	
Which category of socioeconomic groups do you belong to?					
Low income	62	81	143	0.627(0.269-1.459)	
Middle income	43	71	114	0.599(0.267-1.341)	
High income	15	28	43	1	
Have you experienced fever in the past 2 weeks?					
Yes	89	122	211	0.438(0.242-0.792)*	
No	31	58	89	1	
Are you using insecticide treated net regularly?					
Yes	75	121	196	1.886(0.979-3.633)	
No	45	59	104	1	
Have you Travelled out of Bauchi state in the past 2 weeks?					
Yes	44	66	110	0.909(0.498-1.659)	
No	76	114	190	1	
Are there malaria patients in your household					
Yes	78	115	193	0.819(0.455-1.477)	
No	42	65	107	1	
Have you visited healthcare facilities for medication in the past 2 weeks					
Yes	63	101	164	1.481(0.823-2.665)	
No	57	79	136	1	
Do you live in bushy areas or near stagnant water bodies (e.g., ponds, ditches)?					
Yes	90	137	227	1.488(0.726-3.049)	
No	30	43	73	1	
Does your house have proper window and door screens?					
Yes	43	61	104	0.729(0.391-1.360)	
No	77	119	196	1	
Is your house regularly sprayed with insecticides?					
Yes	15	44	59	0.778(0.30-1.963)	
No	105	136	241	1	

COR: Crude odds ratio

CI: Confidence interval

AOR: Adjusted odds ratio

“*”: significance at $p < 0.05$

Logistic regression analysis further supported these findings, indicating that none of the other risk factors assessed were statistically associated with the likelihood of developing malaria, except for a history of fever two weeks prior to the study (COR(95%CI): 0.438(0.242–0.792)). This reinforces the critical role of fever as a clinical manifestation of malaria and highlights the need for timely diagnosis and intervention.

A combination of seasonal variation, poverty, inadequate public health interventions, and cultural beliefs likely influences the high prevalence of malaria observed in this study. The perception of seasonal fevers, referred to as "Jonte," in the study area may discourage individuals from seeking proper malaria prevention and treatment, further perpetuating the cycle of malaria transmission. This emphasizes the need for targeted public health campaigns to improve community awareness and promote preventive measures.

CONCLUSION

This study underscored the continued high burden of malaria in Bauchi North, Bauchi State, particularly in rural and low-income areas. The overall prevalence of malaria

in the study area was 40%, with higher prevalence rates among females (27%) compared to males (13%) and among adults aged 25–64 years (24%). Rural residents (29.67%), individuals from low-income families (20.67%), and those exposed to poor housing and environmental conditions exhibited higher prevalence rates. The key risk factors assessed include socioeconomic status, use of a net, living in bushy environments or close to stagnant water, presence of malaria patient in the household, and history of fever within two weeks prior to the study ($p = 0.006$), which was the only statistically significant risk factor associated with malaria at $p < 0.05$. Logistic regression analysis confirmed fever history as the primary predictor of malaria (COR = 0.438, 95% CI = 0.242–0.792). The findings highlighted the need for improved malaria control interventions, particularly in underserved areas, and the importance of addressing socioeconomic factors that limit access to prevention and treatment. The study also emphasized the role of fever history in identifying individuals at higher risk of malaria and suggests that further research is needed to better understand the complex interplay of risk factors in malaria transmission dynamics.

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LIST OF APPENDICES

Appendix 1: Validation Questionnaire

VALIDATION QUESTIONNAIRE ON EPIDEMIOLOGY OF MALARIA IN BAUCHI NORTH: PREVALENCE AND DETERMINANTS OF THE INFECTION

Dear Respondent,

We are conducting a study on the Epidemiology of Malaria in Bauchi North, focusing on its prevalence and the factors that contribute to its spread. Your responses will help us better understand malaria patterns in the region and improve prevention and control measures. Participation is voluntary, and all information provided will be kept confidential and used solely for research purposes. Your honest answers are highly valuable in making this study successful.

Thank you for your time and cooperation.

SECTION A: Demographic Information

Please tick on the appropriate option

1. Age:

0-9 years 10-19years 20-29years 30-39years 40years and above

2. Gender: Male Female

3. Marital status: Single Married Divorced Widowed

4. In which residential area are you living?

City Town Village

5. Which category of socioeconomic groups do you belong to?

Low income Middle income High income

SECTION B: Risk factors of malaria infection

1. Have you experienced fever in the past 2 weeks?

Yes No

2. Are you using insecticide treated net regularly?

Yes No

3. Have you travelled out of Bauchi state in the past 2 weeks?

Yes No

4. Are there malaria patients in your household?

Yes No

5. Have you visited healthcare facilities for medication in the past 2 weeks?

Yes No

6. Do you live in bushy areas or near stagnant water bodies (e.g., ponds, ditches)?

Yes No

7. Does your house have proper window and door screens?

Yes No

8. Is your house regularly sprayed with insecticides? Yes No

Appendix 2: Final Questionnaire

EPIDEMIOLOGY OF MALARIA IN BAUCHI NORTH: PREVALENCE AND DETERMINANTS OF THE INFECTION

Dear Respondent,

We are conducting a study on the Epidemiology of Malaria in Bauchi North, focusing on its prevalence and the factors that contribute to its spread. Your responses will help us better understand malaria patterns in the region. Participation is voluntary, and all information provided will be kept confidential and used solely for research purposes. Your honest answers are highly valuable in making this study successful.

Thank you for your time and cooperation.

SECTION A: Demographic Information

Please tick on the appropriate option

1. Age:

0-9 years 10-19years 20-24years 25-64years 65years and above

2. Gender: Male Female

3. In which residential area are you living?

Rural Urban

4. Which category of socioeconomic groups do you belong to?

Low income Middle income High income

SECTION B: Risk factors of malaria infection

5. Have you experienced fever in the past 2 weeks?

Yes No

6. Are you using insecticide treated net regularly?

Yes No

7. Have you travelled out of Bauchi state in the past 2 weeks?

Yes No

8. Are there malaria patients in your household?

Yes No

9. Have you visited healthcare facilities for medication in the past 2 weeks?

Yes No

10. Do you live in bushy areas or near stagnant water bodies (e.g., ponds, ditches)?

Yes No

11. Does your house have proper window and door screens?

Yes No

12. Is your house regularly sprayed with insecticides? Yes No