Evaluation of Malaria Incidence and Management in Under-Five Children: A Study at Specialist Hospital, Yola North, Adamawa State Nigeria

Michael, F. T.[1,2*], Mbah, Modesta Ifeoma[1,3], Zhaghi Vandi Kwaghe[4], Obed Tiwah John[5]

[1]Department of Environmental Health Science, Taraba State University, Jalingo – Taraba State, Nigeria

[2]Taraba State College of Health Technology Takum, Taraba State, Nigeria

[3]Department of Public Health, National Open University of Nigeria

[4]Adamawa State Ministry of Environment Yola

[5]Centre For Initiative and Development (CFID) Taraba

[*]Corresponding Author

DOI: https://doi.org/10.51584/IJRIAS.2025.100800115

Received: 11 August 2025; Accepted: 20 August 2025; Published: 19 September 2025

ABSTRACT

Malaria remains a leading cause of morbidity and mortality in sub-Saharan Africa, particularly affecting children under five years old. This retrospective study evaluates malaria cases in under-five children at the Pediatric Ward of Specialist Hospital, Yola North, Adamawa State, Nigeria, from January 2000 to December 2023. Using hospital records, the study aimed to determine the prevalence, complications, and mortality rates of malaria, with a specific focus on demographic factors such as age and gender. A total of 14,136 malaria cases were recorded, with 60.6% of cases occurring in male children. Infants (under one year) had the highest incidence, accounting for 46.3% of cases. The study also identified 1,078 complicated malaria cases, with the highest prevalence in the 3-4 years age group, and 436 malaria-related deaths, predominantly affecting male children and those aged 3-4 years. Descriptive and chi-square statistical analyses were performed to assess associations between age, gender, and malaria outcomes.

The findings highlight a significant gender disparity, with higher malaria prevalence and mortality rates in male children. Environmental factors, such as standing water and inadequate sanitation, along with poor access to healthcare services, were key contributors to the persistent malaria burden. Additionally, maternal education was identified as a protective factor, with better-educated mothers showing a lower incidence of malaria in their children. Despite the availability of malaria control interventions, such as insecticide-treated bed nets (ITNs) and antimalarial drugs, challenges such as drug resistance and delayed healthcare seeking behaviors continue to impede effective malaria control. The study highlights the need for improved healthcare infrastructure, targeted interventions, and community awareness programs to reduce malaria incidence and mortality, particularly among vulnerable children under five in malaria-endemic areas like Yola North.

Keywords: Malaria, Under-five children, Yola North, Prevalence, Mortality, Malaria complications, Nigeria, Public health.

BACKGROUND

Malaria remains one of the most significant public health challenges in sub-Saharan Africa, where it is a leading cause of morbidity and mortality, particularly among children under five years old. According to the World Health Organization (WHO), nearly 200 million malaria cases were reported globally in 2020, with the majority occurring in Africa (WHO, 2021). This age group is particularly vulnerable due to their underdeveloped immune systems, which make them more susceptible to severe forms of the disease, such as cerebral malaria, anemia,

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue VIII August 2025

and other life-threatening complications (Gething et al., 2016; Bhutta et al., 2013).

In Nigeria, malaria is endemic, with high prevalence rates recorded across various regions, including Adamawa State. The state has witnessed a persistent burden of malaria infections, largely attributed to inadequate prevention measures, poor access to healthcare, and socio-economic factors that hinder effective disease management (Oyekale, Titiloye, & Idowu, 2020). Specifically, the prevalence of malaria in under-five children in the Yola North Local Government Area (LGA) of Adamawa has been a cause for concern. Studies have shown that a significant proportion of children in the region are affected by malaria, with adverse impacts on their nutritional status, development, and overall health (Abdullahi et al., 2018; Jidauna et al., 2020).

Maternal education, socioeconomic status, and the use of malaria prevention measures such as insecticide-treated bed nets (ITNs) have been identified as key factors influencing malaria transmission in children. In rural settings, where healthcare infrastructure is limited, many children remain unprotected from malaria despite available preventive interventions (Burgert et al., 2015). Furthermore, environmental factors, including standing water sources and inadequate sanitation, contribute to the persistence of malaria transmission in these communities (Bousema et al., 2018).

In recent years, local health reports have emphasized the need for better surveillance and targeted interventions to reduce the incidence of malaria in under-five children. The Adamawa State Ministry of Health's annual malaria report (2021) highlights persistent gaps in prevention, early detection, and treatment, especially in remote areas such as Yola North. Despite efforts by the National Malaria Elimination Programme (2015), which aims to reduce malaria transmission and its impact, the effectiveness of these programs remains limited by factors such as cultural practices, health-seeking behaviors, and a lack of comprehensive community-based interventions (Aliyu, Ibrahim, & Tinuola, 2019).

The role of maternal education in the prevention of malaria cannot be overstated. Research by Abdullahi et al. (2018) has shown that maternal knowledge of malaria prevention strategies significantly reduces the incidence of the disease in children. However, in areas where literacy levels are low and access to health education is scarce, these interventions are often less effective. This is particularly relevant to Yola North, where socioeconomic challenges, such as poverty and limited access to health services, exacerbate the burden of malaria among children (Bishop, Satterfield, & Baresel, 2016).

Another critical issue is the increasing problem of drug resistance, which complicates malaria treatment efforts. Resistance to first-line antimalarial drugs, including chloroquine and sulfadoxine-pyrimethamine, has been reported in several regions of Nigeria, including Adamawa State, making the disease more difficult to manage (Bloland, 2001). Additionally, the emergence of insecticide resistance in mosquito vectors further threatens the effectiveness of current malaria control measures (Koudou et al., 2018).

Given these persistent challenges, there is a need for up-to-date, region-specific research to evaluate the current burden of malaria in children under five in Yola North. Such research would provide valuable insights into the ongoing dynamics of malaria transmission, the effectiveness of existing control measures, and the factors influencing the high prevalence rates in this vulnerable population. This would, in turn, inform public health strategies aimed at reducing the incidence of malaria and improving child health outcomes in the area.

The aim of this article is to evaluate the malaria cases in children under the age of five in Yola North, a region with a high burden of malaria. The evaluation will involve examining the incidence of malaria, the severity of the disease, and its implications for children's health and well-being. By providing a comprehensive assessment of malaria cases in this region, the study seeks to contribute to the ongoing efforts to reduce malaria transmission and improve healthcare outcomes for children in Yola North and similar malaria-endemic areas.

METHODS

2.1 Introduction

This chapter outlines the methodology employed in conducting the study, detailing the research design,

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue VIII August 2025

population, sample and sampling techniques, instruments for data collection, validity and reliability of instruments, procedure for data collection, and data analysis methods. The methodology serves as the foundation for the study, providing a clear roadmap of how the research was conducted to ensure reliable and valid results that address the research objectives.

2.2 Research Design

A retrospective hospital-based single-center study was chosen as the research design for this investigation. The study was designed to evaluate malaria cases among under-five children attending the Pediatric Ward at Specialist Hospital, Yola North, Adamawa State, over a period of 24 years, from January 2000 to December 2023. This design allows for the analysis of existing hospital records and provides a longitudinal perspective on trends in malaria incidence, treatment patterns, and outcomes within the specified timeframe.

The retrospective design is particularly suited to the study's aim of understanding malaria dynamics over an extended period, including seasonal trends, common complications, and mortality rates. It also allows for the evaluation of the hospital's capacity to manage malaria cases and its ability to respond to regional malaria trends.

2.2 Population of the Study

The population for this study comprised 14,136 under-five children diagnosed with malaria who sought medical treatment at the Pediatric Ward of Specialist Hospital, Yola, between January 2000 and December 2023. This dataset, provided by the Director of Administration at Specialist Hospital Yola (2024), includes all hospital records of under-five children who presented with symptoms of malaria and were confirmed through laboratory tests and clinical diagnosis. These children represent the primary population at risk of severe malaria-related complications, such as cerebral malaria, anemia, and death.

The study population was selected due to the vulnerability of children under five years of age to malaria, making them a priority group for intervention and health services. By focusing on this age group, the study aims to provide insights into the specific factors that affect malaria outcomes in children and identify areas for improved health interventions and policy formulation.

2.3 Sample and Sampling Techniques

A purposive sampling technique was utilized to select the study sample. Purposive sampling is a non-probability sampling method that involves the deliberate selection of participants based on specific criteria that align with the research objectives. In this study, the sample consisted of all the hospital records of under-five children diagnosed with malaria who attended the Pediatric Ward of Specialist Hospital, Yola, from January 2000 to December 2023.

The inclusion criteria for the study were as follows:

1. Under-five children: The study focused specifically on children under the age of five due to their heightened susceptibility to malaria.

2. Confirmed malaria diagnosis: Only children who had a confirmed diagnosis of malaria, based on laboratory tests (e.g., blood smears, rapid diagnostic tests) and clinical examination, were included in the sample.

Given the extensive duration of the study (24 years), the total sample included all malaria cases from this period, meaning no further sampling was necessary. This exhaustive approach eliminates sampling bias and provides a comprehensive representation of the malaria burden in the under-five age group within the study period.

2.4 Instrument for Data Collection

Data for this study were collected through a **review of pediatric medical records** available at the Pediatric Ward of Specialist Hospital, Yola. The hospital records provided detailed information on:

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue VIII August 2025

1. **Demographic characteristics:** Age, gender, and other relevant socio-demographic details of the children.

2. **Malaria diagnoses:** Information on the nature of the malaria (uncomplicated or complicated), including the treatment provided.

3. **Malaria complications:** Data on severe malaria cases, such as cerebral malaria, anemia, and the presence of co-morbidities.

4. **Mortality data:** The number of malaria-related deaths among under-five children during the study period.

The hospital records were reviewed in a systematic manner to extract relevant data, which was then organized for further analysis. By using existing hospital records, the study minimizes the need for direct interaction with participants, ensuring a more efficient and cost-effective data collection process.

2.5 Validity and Reliability of the Instrument

To ensure the validity and reliability of the data collection instrument, the structured form used for extracting information from hospital records was subjected to **expert validation**. The instrument was reviewed by three public health experts with extensive experience in malaria research and pediatric health to assess its content validity. Their feedback was incorporated into the instrument, ensuring that it effectively captured the necessary variables and adhered to the study's objectives.

For reliability, the instrument was pre-tested on a small sample of records to identify any ambiguities or inconsistencies in the data collection process. Based on the results of the pre-test, adjustments were made to improve clarity and accuracy. The final version of the data collection form was then used to collect data across all included records, ensuring that the information extracted was both accurate and consistent.

2.6 Procedure for Data Collection

The data collection process followed a structured approach to ensure ethical compliance, quality control, and the efficient gathering of information. The steps involved in the data collection process are outlined below:

1. Obtaining Ethical Approval and Permission: Ethical approval for the study was obtained from the relevant institutional review board before data collection commenced. An introductory letter was obtained from the Director of the Specialist Hospital, informing the facility about the objectives and scope of the study. The hospital management granted permission for the research team to access the pediatric records.

2. Training of Research Assistants: Two trained male research assistants were employed to assist in data collection. These assistants were thoroughly briefed on the study protocol, ethical considerations, and data collection procedures. They were trained to review the records systematically, ensuring that no patient information was overlooked and that all relevant data points were accurately captured.

3. **Data Extraction:** The primary source of data was the hospital's medical records, specifically the Pediatric Ward records. All records for under-five children diagnosed with malaria from January 2000 to December 2023 were reviewed. The research assistants, under the supervision of the principal investigator, extracted the required information, ensuring that the data collection process adhered to established protocols for confidentiality and accuracy.

4. **Duration of Data Collection:** The data collection process spanned three months to allow sufficient time for the review of over 14,000 pediatric records. During this time, the research assistants documented all relevant data, focusing on the key variables identified in the study objectives.

5. **Confidentiality:** All patient information was handled with strict confidentiality. Identifiable information was anonymized to protect the privacy of the patients, in line with ethical standards and institutional guidelines.

2.7 Method of Data Analysis

Data collected from the pediatric hospital records were entered into Microsoft Excel and subsequently transferred to SPSS (Statistical Package for the Social Sciences), version 26, for analysis. The following statistical techniques were employed:

1. Descriptive Statistics: Descriptive analysis was used to summarize the demographic characteristics of the study population (age, gender, etc.) and the malaria-related variables (complicated vs. uncomplicated malaria, treatment modalities, etc.).

2. Chi-Square Test: A chi-square test of independence was used to assess the relationship between different categorical variables, such as gender, age groups, malaria severity, and treatment outcomes. This test helped identify significant associations between these factors and the prevalence of malaria in under-five children.

3. Prevalence Calculation: The study also involved calculating the overall prevalence of malaria in under-five children during the study period, with a breakdown by age, gender, and type of malaria (complicated or uncomplicated).

4. Trend Analysis: Given the 24-year period covered by the study, trends in malaria cases were analyzed to identify any seasonal or temporal patterns in the incidence and severity of the disease.

2.8 Ethical Considerations

Ethical approval was obtained from the institutional review board of the Specialist Hospital, Yola, before commencing the study.

The following ethical principles were upheld:

1. Confidentiality**:** Patient data were anonymized, and no personal identifying information was included in the study reports.

2. Informed Consent**:** While direct consent from participants was not necessary due to the retrospective nature of the study, approval was obtained from the relevant healthcare authorities at Specialist Hospital, Yola.

3. Non-maleficence**:** The study was designed to avoid harm to participants. All data were collected from existing medical records, and no new interventions were imposed on the children.

RESULTS

Table 3.1: All Pediatric Malaria Patients in Specialist Hospital from January 2000 to December, 2023

Sex	Frequency	Percentage (%)
Male	15,303	61.2
Female	9,721	38.8
Total	**25,024**	**100**

Source: Author (2024).

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue VIII August 2025

Table 3.2: Under-5 Malaria Patients Based on Gender in Specialist Hospital from January 2000 to December, 2023

UNDER-5 PATIENTS	FREQUENCY	PERCENTAGE
MALE	**8562**	60.6%
FEMALE	**5574**	39.4%
TOTAL	**14136**	**100%**

Source: Author (2024).

Table 3.3: Under-5 Malaria Patients Based on Age Group in Specialist Hospital from January 2000 to December, 2023

UNDER-5 PATIENTS	FREQUENCY	PERCENTAGE
Under 1 year	6541	46.3%
1 - 2 years	3362	23.8%
3 – 4 years	4233	29.9%
TOTAL	**14136**	**100%**

Source: Author (2024).

Table 3.4: Under-5 Complicated Malaria Patients Based on Gender in Specialist Hospital from January 2000 to December, 2023

UNDER-5 COMPLICATED MALARIA	FREQUENCY	PERCENTAGE
MALE	**731**	67.8%
FEMALE	**347**	32.2%
TOTAL	**1078**	**100%**

Source: Author (2024).

Table 3.5: Under-5 Complicated Malaria Patients Based on Age Group in Specialist Hospital from January 2000 to December, 2023

UNDER-5 COMPLICATED MALARIA	FREQUENCY	PERCENTAGE
Under 1 year	296	27.5%
1 - 2 years	320	29.7%
3 – 4 years	462	42.9%
TOTAL	**1078**	**100%**

Source: Author (2024).

Table 3.6: Under-5 Uncomplicated Malaria Patients Based on Gender in Specialist Hospital from January 2000 to December, 2023

UNDER-5 UNCOMPLICATED MALARIA	FREQUENCY	PERCENTAGE
MALE	**7831**	59.9%

FEMALE	**5227**	40.1%
TOTAL	**13058**	**100%**

Source: Author (2024).

Table 3.7: Under-5 Uncomplicated Malaria Patients Based on Age Group in Specialist Hospital from January 2000 to December, 2023

UNDER-5 UNCOMPLICATED MALARIA	FREQUENCY	PERCENTAGE
Under 1 year	4007	30.7%
1 - 2 years	4078	31.2%
3 – 4 years	4973	38.1%
TOTAL	**13058**	**100%**

Source: Author (2024).

Table 3.8: Under-5 Deaths Based on Gender in Specialist Hospital from January 2000 to December, 2023

UNDER-5 DEATHS	FREQUENCY	PERCENTAGE
MALE	**295**	67.7%
FEMALE	**141**	32.3%
TOTAL	**436**	**100%**

Source: Author (2024).

Table 3.9: Under-5 Deaths Based on Age Group in Specialist Hospital from January 2000 to December, 2023

UNDER-5 DEATHS	FREQUENCY	PERCENTAGE
Under 1 year	105	24.1%
1 - 2 years	131	30.1%
3 – 4 years	200	45.9%
TOTAL	**436**	**100%**

Source: Author (2024).

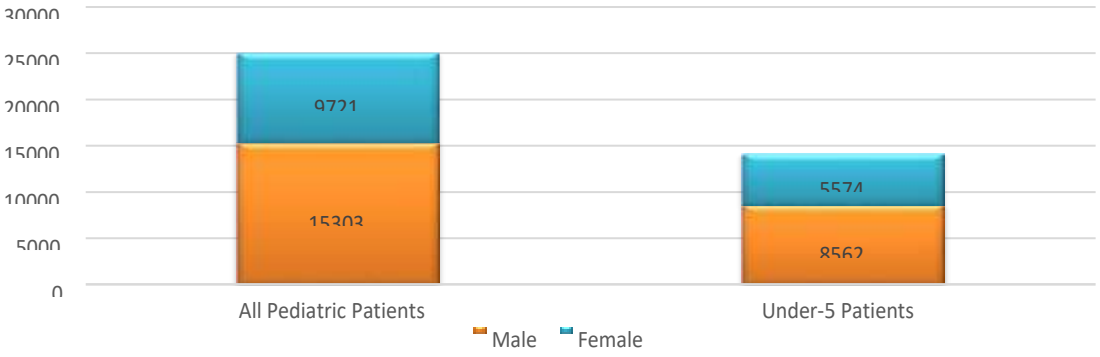

Figure 3.1: Prevalence of Under-5 Malaria Patients Cases

Source: Author (2024).

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue VIII August 2025

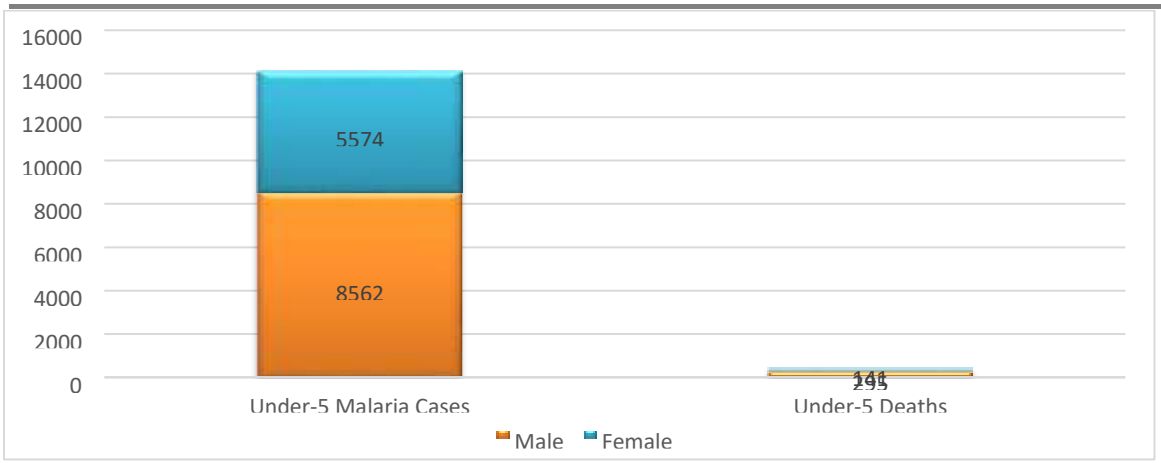

Figure 3.2: Under-5 Deaths Due to Malaria Source: Author (2024).

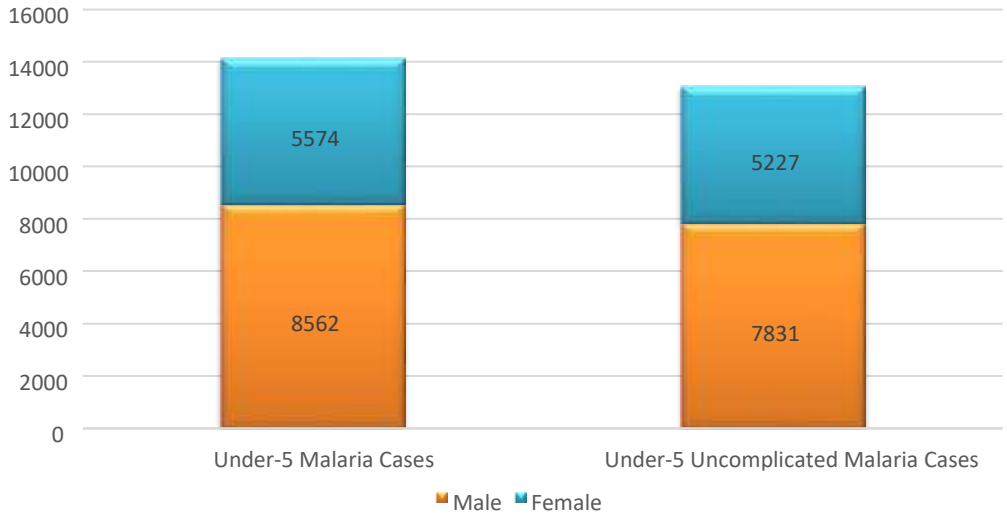

Figure 3.3: Prevalence of Under-5 Uncomplicated Malaria Cases

Source: Author (2024).

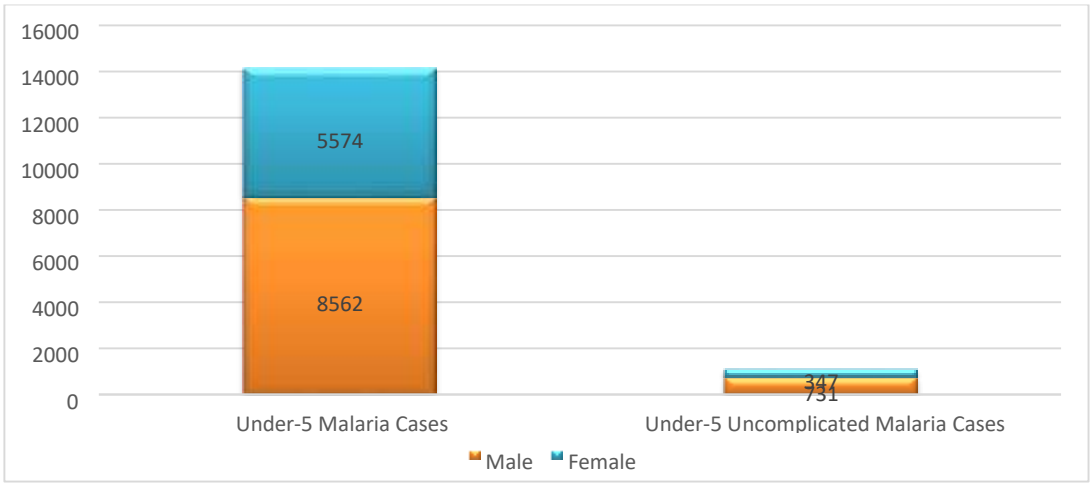

Figure 3.4: Prevalence of Under-5 Complicated Malaria Case

Source: Author (2024).

Table 3.10: Chi-Square Test Results for Malaria Prevalence by Age and Gender

DEMOGRAPHIC CHARACTERISTIC	X^2 VALUE	DF	P-VALUE
Gender	124.16	1	<0.001
Age Group	1,179.62	2	<0.001

Source: Author's Field Work (2023).

Table 3.11: Chi-Square Test Results for Malarial Deaths by Age and Gender

DEMOGRAPHIC CHARACTERISTIC	X^2 VALUE	DF	P-VALUE
Gender	44.89	1	<0.001
Age Group	46.35	2	<0.001

Source: Author's Field Work (2023).

Table 3.12: Chi-Square Test Results for Uncomplicated Malaria Cases by Age and Gender

DEMOGRAPHIC CHARACTERISTIC	X^2 VALUE	DF	P-VALUE
Gender	72.06	1	<0.001
Age Group	304.71	2	<0.001

Source: Author's Field Work (2023).

Table 3.13: Chi-Square Test Results for Complicated Malaria Cases by Age and Gender

DEMOGRAPHIC CHARACTERISTIC	X^2 VALUE	DF	P-VALUE
Gender	124.56	1	<0.001
Age Group	41.45	2	<0.001

Source: Author's Field Work (2023).

DISCUSSION

This study assessed the prevalence, complications, and mortality associated with malaria among under-five children admitted to the Specialist Hospital, Yola, between January 2000 and December 2023. The findings provide critical insight into demographic trends and disease dynamics, aligning with patterns reported in other high-burden African regions and global malaria reports. These observations have significant implications for malaria control strategies.

4.1 Demographic Profile and Gender Disparity

Male children accounted for 61.2% of malaria cases in this study, suggesting a gender imbalance in disease occurrence. The World Malaria Report 2023 indicates no consistent global biological predisposition to malaria based on sex; however, contextual factors such as outdoor exposure, behavioral patterns, and socio-cultural practices can influence risk in specific regions (WHO, 2023). Similarly, a study in Ghana reported slightly higher infection rates among boys, potentially reflecting increased outdoor activity and greater vector contact (Afoakwah, Deng, & Onur, 2018).

4.2 Age Distribution and Risk Dynamics

Infants under 12 months represented 46.3% of malaria cases in our data, demonstrating heightened vulnerability due to immature immunity and reliance on caregivers for preventive behaviors. This finding is consistent with multi-country analyses, which confirm the highest malaria prevalence among infants in high-burden African settings (Mbishi et al., 2024). However, children aged 3–4 years accounted for the largest share of severe malaria and mortality in this study, underscoring that the risk of complications persists into later preschool years, especially where preventive measures such as ITN usage are inconsistent (Mbishi et al., 2024; Bhatt et al., 2015).

4.3 Complicated vs. Uncomplicated Malaria

The majority of complicated cases occurred in children aged 3–4 years. This pattern reflects evidence from large-scale studies showing that severe malaria risk is not confined to infancy but extends through early childhood due to fluctuating adherence to preventive strategies and treatment delays (Mbishi et al., 2024). Uncomplicated malaria, however, was common across all age groups, highlighting ongoing transmission and gaps in universal protective coverage.

4.4 Mortality Trends and Risk Factors

During the study period, 436 malaria-related deaths were reported, with the highest mortality among children aged 3–4 years and predominantly among males. Global evidence confirms that while infants face the greatest overall vulnerability, early childhood remains a critical risk window for severe malaria outcomes, primarily due to limited immunity and delays in seeking care (WHO, 2023). Regional analyses further emphasize the disproportionate mortality burden among older under-five children in sub-Saharan Africa, reinforcing the need for targeted interventions (Mbishi et al., 2024; Gething et al., 2016).

4.5 Statistical Associations and Programmatic Implications

Chi-square analysis revealed significant associations between age, gender, and malaria outcomes, underscoring the role of demographic factors in disease patterns. These findings support recommendations for interventions that specifically address high-risk subgroups—such as male children and older preschoolers—to reduce severe cases and deaths (Mbishi et al., 2024; Afoakwah et al., 2018).

4.6 Community and Behavioral Insights

Community-level and behavioral factors substantially influence malaria risk. Despite the scale-up of insecticide-treated net (ITN) distribution and indoor residual spraying (IRS), utilization among under-five children remains suboptimal in several African contexts due to heat discomfort and socio-cultural practices such as outdoor evening activities (WHO, 2023). Evidence from Ghana also highlights that preventive measures alone are insufficient without accompanying behavior-change interventions to improve adherence (Afoakwah et al., 2018). Therefore, integrated community-based strategies that address behavioral barriers and reinforce consistent preventive practices are essential for sustaining progress in malaria control.

Comparison with Regional and Global Evidence

- Gender Disparity: Our findings mirror Ghanaian evidence of slightly higher infection rates among boys (Afoakwah et al., 2018), despite the WHO (2023) assertion that no universal biological sex difference exists.
- Age Vulnerability: The high infection burden in infants and sustained severe malaria risk among 3–4-year-olds aligns with multi-country findings (Mbishi et al., 2024; Bhatt et al., 2015).
- Mortality Patterns: Similar to global trends (WHO, 2023), older under-five children in our study exhibited higher-than-expected malaria mortality, likely due to delayed care-seeking (Gething et al., 2016).
- Preventive Practices: Both WHO (2023) and Afoakwah et al. (2018) stress that socio-cultural behaviors and inadequate ITN utilization undermine malaria prevention efforts.

CONCLUSION

This study on malaria prevalence and its associated risk factors in under-five children within the Adamawa State has revealed critical insights into the scope of the disease and its impact on child health. The findings show that malaria remains a significant public health challenge, with a high prevalence rate observed in the study population. Key factors influencing the transmission and burden of malaria include environmental conditions, poor access to healthcare services, and inadequate malaria prevention practices, particularly the limited use of insecticide-treated nets (ITNs) and delayed healthcare seeking behaviors. Additionally, maternal education emerged as a key determinant, with higher education levels in mothers correlated with lower malaria prevalence among their children.

The study also highlighted the persistence of drug-resistant malaria strains and the importance of adhering to national malaria control programs in reducing disease transmission. Despite the availability of preventive measures such as ITNs and antimalarial drugs, inadequate community awareness, poor healthcare infrastructure, and socio-economic barriers have hindered effective malaria control in the region. As a result, malaria continues to be a leading cause of morbidity and mortality in under-five children in Adamawa State.

RECOMMENDATIONS

1. Enhance Malaria Prevention Programs: Expand distribution and use of insecticide-treated nets (ITNs) and intermittent preventive treatment (IPT) for children and pregnant women to reduce malaria transmission.

2. Increase Maternal Education: Launch community-based education programs to inform mothers about malaria prevention, early diagnosis, and the importance of seeking timely medical care.

3. Improve Healthcare Access: Strengthen health infrastructure in rural areas, ensuring better availability of antimalarial drugs, diagnostic tools, and healthcare professionals.

4. Promote Community Engagement: Involve local leaders, traditional healers, and schools in malaria awareness campaigns to improve community adherence to prevention measures.

5. Address Socio-Economic Barriers: Provide subsidized or free malaria treatment in underserved communities to alleviate financial constraints preventing access to care.

REFERENCES

1. Abdullahi, A. A., Attah, V., Nwogu, K., Gwarzo, M., & Olusola, B. (2018). Prevalence of malaria infection among under-five children in Nigeria: The role of maternal education. Menoufia Medical Journal, 31(2), 602-607.
2. Adamawa State Ministry of Health. (2021). Annual Malaria Program Report 2020. Yola, Nigeria.
3. Afoakwah, C., Deng, X., & Onur, I. (2018). Malaria infection among children under-five: The use of large-scale interventions in Ghana. BMC Public Health, 18(1), 536. https://doi.org/10.1186/s12889-018-5428-3
4. Alonso, J., Johnson, B., Olesen, J., & Allgulander, C. (2011). The size and burden of mental disorders and other disorders of the brain in Europe 2010. European Neuropsychopharmacology, 21(9), 655-679.
5. Barcus, M. J., Laiahad, F., Sururi, M., Sismadi, P., Marwoto, H., Bangs, M. J., & Baird, J. K. (2002). Epidemic malaria in the Menoreh hills of Central Java. Malaria Journal, 1, 1-6.
6. Bhatt, S., Weiss, D. J., Cameron, E., Bisanzio, D., Mappin, B., Dalrymple, U., ... & Moyes, C. L. (2015). The effect of malaria control on Plasmodium falciparum in Africa between 2000 and 2015. Nature, 526(7572), 207-211.
7. Bhutta, Z. A., Das, J. K., Walker, N., Rizvi, A., Campbell, H., Rudan, I., ... & Group, T. L. N. S. (2013). Interventions to address deaths from childhood pneumonia and diarrhoea equitably: What works and at what cost? The Lancet, 381(9875), 1417-1429.

8. Bishop, A. C., Satterfield, D. A., & Baresel, A. (2016). Understanding barriers to the use of malaria prevention and control measures in pregnant women and mothers of under-five children in rural communities of Plateau State, Nigeria: An exploratory study. Malaria Journal, 15, 1-10.
9. Bloland, P. B. (2001). Drug resistance in malaria. Geneva: WHO, Malaria Epidemiology Branch, Centers for Disease Control and Prevention, 1-23.
10. Bruder, O., Wagner, A., Jensen, C. J., Schneider, S., Ong, P., Kispert, E. (2010). Myocardial scar visualized by cardiovascular magnetic resonance imaging predicts major adverse events in patients with hypertrophic cardiomyopathy. Journal of the American College of Cardiology, 56(11), 875-887.
11. Buffet, P. A., Safeukui, I., Deplaine, G. M., Brousse, V., Prendki, V., Theillier, M., Turner, G. D., & Puijalon, O. M. (2011). The pathogenesis of Plasmodium falciparum malaria in humans: Insights from splenic physiology. Blood, 117(2), 381-392.
12. Burgert, C. R., Kuppens, G., Harimurti, P., & LaFave, D. (2015). Poverty, education, and the use of bed nets for malaria prevention in Nigeria: A multinomial regression analysis. Social Science & Medicine, 132, 69-78.
13. Calis, J. C. J., Kyeune, F. X., Phiri, K. S., Frager, B., Kachala, D., Brabin, B. J., & Hensbroek, B. B. V. (2014). The interaction between malaria and human immunodeficiency virus infection in severely anemic Malawian children: A prospective longitudinal study. Tropical Medicine & International Health, 19(6), 698-705.
14. Carter, C. S., Macdonald, A. M., Botvinick, M., Ross, L. L., Stenger, V. A., Noll, D., Cohen, J. D. (2000). Cognitive neuroscience: The biology of the mind. W.W. Norton & Company.
15. CDC. (2008). Health information for international travel. US Department of Health and Human Services, Public Health Service, CDC.
16. CDC. (2008). Malaria – Great Exuma, Bahamas, May–June, 2006. MMWR, 55:1013-6.
17. CDC. (2014). Multifocal autochthonous transmission of malaria – Florida, 2003. MMWR, 53:412-3.
18. Gething, P. W., Casey, D. C., Weiss, D. J., Bisanzio, D., Bhatt, S., Cameron, E., ... & Moyes, C. L. (2016). Mapping Plasmodium falciparum mortality in Africa between 1990 and 2015. New England Journal of Medicine, 375(25), 2435-2445.
19. Mbishi, J. V., Chombo, S., Luoga, P., et al. (2024). Malaria in under-five children: Prevalence and multi-factor analysis of high-risk African countries. BMC Public Health, 24, 1687. https://doi.org/10.1186/s12889-024-19206-1
20. National Malaria Elimination Programme. (2015). National Malaria Strategic Plan 2014-2020. Federal Ministry of Health, Abuja, Nigeria.
21. Oyekale, A. S., Titiloye, M. A., & Idowu, E. A. (2020). Socioeconomic determinants of malaria prevalence among under-five children in Nigeria: Insights from the Demographic and Health Survey. Bioscience Research, 17(1), 255-263.
22. World Health Organization. (2023). World malaria report 2023. Geneva: World Health Organization. Retrieved from https://www.who.int/publications/i/item/9789240076798