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Analysis on Pervasiveness of Malaria Infection among Children in Katsina Local Government Area of Katsina State, Nigeria.

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ABSTRACT

Malaria remains a formidable public health challenge in Nigeria, particularly affecting children under the age of five. Katsina Local Government Area (LGA) in Katsina State grapples with a persistent high prevalence of malaria among its children, impacting their health, development and overall well-being. This research comprehensively analyze the factors contributing to the pervasiveness of malaria infection among children in Katsina LGA, shedding light on key dimensions of the problem. The study adopts a cross-sectional design, incorporating a multi-faceted approach to data collection. A retrospective approach was adopted in collection of data of children under five years and laboratory tests has already been made by technician before accessing the data. Geographic Information System (GIS) mapping was employed to visualize the spatial distribution of malaria cases, providing intuitions into high-risk zones in the local government and environmental influences. The research objectives include determining the prevalence of malaria, identifying contributing factors, assessing caregiver knowledge and practices and evaluating healthcare infrastructure. The analysis explored the demographic, and socio-economic offering a holistic understanding.

Keywords: Pervasiveness, Malaria and Children

1.0 Introduction

Malaria continues to be a major public health concern globally, particularly in sub-Saharan Africa, where the burden is most pronounced. Among the vulnerable populations, children are disproportionately affected by this infectious disease. In the Katsina Local Government Area (LGA) of Katsina State, Nigeria, malaria poses a significant threat to the well-being of children. This study aims to conduct a thorough analysis of the pervasiveness of malaria infection among children in this region, shedding light on the key factors contributing to its prevalence. Nigeria bears a substantial burden of malaria, with a high prevalence rate throughout the country. Malaria is a leading cause of morbidity and mortality, especially among children under the age of five. The socioeconomic impact of malaria is substantial, affecting not only the health sector but also the productivity and development of communities. Katsina LGA, situated in Katsina State, Nigeria, faces unique challenges concerning healthcare delivery. Factors such as climate, socioeconomic conditions, and healthcare infrastructure can influence the prevalence and impact of malaria in this region. Malaria, a life-threatening parasitic disease transmitted by female Anopheles mosquitoes, poses a serious health risk globally. It is caused by Plasmodium parasites and manifests as an acute feverish illness. Of the five parasite species causing malaria in humans, P. falciparum and P. vivax are particularly threatening, with P. falciparum being the deadliest, prevalent in sub-Saharan Africa, and P. vivax dominating in regions outside this area. The initial symptoms of malaria, including fever, headache, and chills, typically appear 10–15 days after an infective mosquito bite. These symptoms can be mild and challenging to recognize as indicators of malaria. If left untreated, P. falciparum malaria can progress rapidly to severe illness, potentially leading to death within 24 hours. As of 2020, approximately half of the world's population was at risk of malaria. Certain groups, such as infants, children under 5 years of age, pregnant women, individuals with HIV/AIDS, and those with compromised immunity (e.g., migrant workers, mobile populations, and travelers), face a significantly higher risk of contracting malaria and developing severe complications. In Nigeria, malaria has emerged as a major public health challenge, predominantly caused by protozoan parasites of the genus Plasmodium, prevalent in tropical and sub-tropical regions. According to Jasminka et al. (2019), global estimates in 2018 recorded around 228 million malaria cases, resulting in approximately 405,000 deaths. The WHO African Region accounted for a substantial portion, with 93% of all cases, and six countries, including Nigeria, contributing significantly to the burden. Nigeria alone represented 25% of reported cases, emphasizing the urgent need for targeted interventions and sustained efforts to mitigate the impact of malaria in the country**.**

Health Organization (WHO, 2020), malaria is a tropical and lethal disease caused by Plasmodium spp., transmitted through the bite of infected female Anopheles mosquitoes. In Ghana, malaria is both pervasive and perennial, with notable seasonal variations, particularly in the savanna and northern regions (Gogue et al., 2020). Malaria transmission dynamics in Ghana vary across geographical regions, with fewer transmissions during the dry seasons (Gogue et al., 2020). The four main species of Plasmodium protozoa causing malaria include Plasmodium vivax, Plasmodium malaria, Plasmodium falciparum, and Plasmodium ovale (Broni, 2017). In Ghana, almost all malaria cases are attributed to Plasmodium falciparum, transmitted through the bite of female Anopheles mosquitoes. Notably, over the last decade, at least 35% of patients admitted to health facilities were due to malaria (Manso et al., 2014). The 2018 World Malaria Report (WMR) reported 220 million malaria cases globally, with 49% occurring in children under the age of five. Severe malaria manifestations, such as severe anemia, hypoglycemia, and cerebral malaria, are more frequently observed in children than in adults (Tsegaye et al., 2021). Persistent malaria infections in children elevate the risk of additional diseases, including diarrhea, fever, and other illnesses. Approximately 2% of children recovering from cerebral malaria may develop complications such as epilepsy and spasticity, leading to learning difficulties (Tsegaye et al., 2021). Malaria contributes to 25% of mortalities in children under the age of five (Asare et al., 2017).

1.1 Transmission and Symptoms of malaria in children

Malaria is predominantly transmitted through the bites of female Anopheles mosquitoes in most instances. The transmission intensity is influenced by factors related to the parasite, vector, human host, and the environment. Female mosquitoes, seeking a blood meal to nourish their eggs, play a crucial role in this transmission. Malaria epidemics can arise when climate and other conditions suddenly favor transmission in areas where individuals possess little or no immunity to malaria. Additionally, such outbreaks can occur when individuals with low immunity relocate to regions characterized by intense malaria transmission, whether for work purposes or as refugees. Human immunity is a significant factor, particularly among adults in areas with moderate or intense transmission conditions. Although partial immunity develops over years of exposure, it never provides complete protection; however, it does reduce the likelihood that a malaria infection will lead to severe disease. Consequently, the majority of malaria-related deaths in Africa are observed in young children, while in regions with lower transmission and limited immunity, individuals of all age groups are susceptible. Malaria manifests as an acute febrile illness, with symptoms typically appearing seven days or more (usually 15 days) after an individual is bitten by an infected mosquito. Initial symptoms such as "fever, headache, chills, and vomiting" may be mild and challenging to recognize as malaria. If left untreated within 24 hours, P. falciparum malaria can progress to severe illness, often resulting in fatalities. Severe malaria in children commonly presents with symptoms like severe anemia, respiratory distress related to metabolic acidosis, or cerebral malaria. In adults, multi-organ involvement is also frequently observed. In regions where malaria is endemic, partial immunity may lead to asymptomatic infections.

1.2 Diagnosis and management of malaria

Treatment decisions are influenced by several factors, including the infecting Plasmodium species, the geographical location of malaria acquisition, the clinical status of the patient, and their history of antimalarial prophylaxis. The selection of specific drugs is contingent on national policy and local drug availability. While the ideal approach is to commence treatment only after laboratory testing has confirmed the diagnosis of malaria, practical constraints may sometimes necessitate a different course of action. Given the potential rapid progression to severe malaria, it is recommended that all children suspected or diagnosed with falciparum malaria be admitted to the hospital for a minimum of 24 hours. This precautionary measure aims to closely monitor the patient's condition and respond promptly to any signs of deterioration. It is advisable to conduct prompt parasitological confirmation through either microscopy or Rapid Diagnostic Test (RDT) for individuals presenting with suspected malaria before initiating treatment.

1.3 Prevention of malaria among children

Established and scientifically proven preventive interventions encompass the promotion of insecticide-treated mosquito nets (ITNs), with a focus on the distribution and utilization of Long Lasting Insecticidal Nets (LLINs). Additionally, indoor residual spraying (IRS) involves the systematic and timely application of insecticides to the interior walls of homes, effectively eliminating mosquitoes. Another key intervention is intermittent preventive treatment for pregnant women (IPTp), which significantly reduces the impact of malaria on both the expectant mother and her unborn child through the administration of at least two doses of the drugs Sulfadoxine-pyrimethamine (SP). Utilizing antimalarial medicines is also recommended as a preventive measure against malaria. For travelers, chemoprophylaxis serves as an effective strategy, suppressing the blood stage of malaria infections and thus preventing the onset of malaria disease. It is important to note that, as of now, there are no licensed vaccines available against malaria or any other human parasite. Two distinct disease presentations of malaria are outlined: uncomplicated and severe. Uncomplicated malaria manifests with nonspecific symptoms such as fever, chills, headache, myalgias, cough, vomiting and diarrhea, making clinical diagnosis unreliable. Establishing a diagnosis in travelers to endemic areas presenting with fever requires a high index of suspicion, and laboratory testing is crucial for accurate confirmation. Malaria should be considered in any child with a history of travel to a malaria-endemic country within one year after return.

1.4 The Effects of Maternal Malaria on Infants

Falciparum malaria during pregnancy has been recognized as a significant determinant of low birth weight (LBW) in newborns (Brabin, 2000; Menendez et al., 2000). Primarily marked in primigravidae, LBW, defined as birth weight less than 2.5 kg, can extend to second and third gravidae in regions of low malaria transmission (Brabin, 2000; Nosten et al., 1991). However, many studies investigating the link between malaria during pregnancy and birth weight often overlook potential confounding factors like socioeconomic status, maternal nutrition, and smoking (Menendez et al., 2000). Randomized controlled trials of preventive antimalarial measures during pregnancy have confirmed the causal relationship between malaria and LBW, demonstrating that preventing malaria leads to increased birth weight (Aribodor et al., 2009; Menendez et al., 2000). The primary adverse effect of malaria during pregnancy on the mother is anemia, with the most severe cases occurring in the second trimester following acute malaria infection in the first trimester (Brabin, 2000). While anemia during pregnancy is a global problem, its severity is heightened in malaria-endemic areas.

1.5 Managing Severe Malaria in Children

Severe malaria demands urgent medical attention, given the potential for death within a few hours of hospital admission. Initial management involves assessing respiratory, circulatory, and neurological functions, along with measuring glucose levels, hemoglobin levels, and parasitemia. It is crucial to differentiate cerebral malaria from other causes of coma, such as malaria-associated hypoglycemia and bacterial meningitis. When severe malaria is strongly suspected but laboratory diagnosis is unavailable, collecting blood for later testing is advised, and prompt initiation of antimalarial treatment is essential. Irrespective of the infecting species, the recommended treatment for severe malaria is parenteral artesunate, as supported by Lalloo et al. (2016) and CDCP (2022). All children treated with intravenous artesunate should undergo weekly monitoring for signs of hemolytic anemia.

1.6 Exploration of Malaria Epidemiology and Antioxidant Status on Children

Malaria poses a significant health challenge in developing countries, with approximately 584,000 deaths reported, and 90% of these occurring in sub-Saharan Africa, particularly in children under 5 years of age (WHO, 2015). It is endemic in over 100 nations and territories across Africa, Asia, Latin America, the Middle East, and the South Pacific. The disease is transmitted through the bite of an infected protozoan parasite, primarily the female Anopheles mosquito (Klonis et al., 2013). Among the four human malarial species, Plasmodium falciparum stands out as the deadliest, destroying red blood cells and causing acute anemia. P. falciparum can lead to severe complications, including cerebral malaria, resulting in coma, transient or permanent neurological effects, and death. P. vivax is the most widespread, while P. malariae and P. ovale, though significant, cause fewer cases and less severe forms of the disease (Snow, 2000).

1.7 Objectives of the Study

- Determine the prevalence of malaria infection among children in Katsina LGA.

- Identify the contributing factors to the high prevalence of malaria.

- Assess caregiver knowledge, attitudes, and practices related to malaria prevention and

treatment.

2. RESEARCH METHOD

2.1 Data collection

Data will be collected through structured interviews, and secondary data of laboratory tests to confirm malaria cases.

2.2 Statistical Analysis

Descriptive statistics, including frequencies, percentages and measures of central tendency, will be used to summarize the data. Inferential statistics, such as logistic regression and correlations was employed to explore associations between variables.

3. Result and Discussion

We presented figures as well as tabular results and discussion of an Analysis on Pervasiveness of Malaria Infection among Children in Katsina Local Government Area of Katsina State Using the data obtained from the laboratory and record department of federal teaching hospital Katsina.

Age	**Frequency**	**Percentage**
6-10	60	51.7%
11-14	56	48.3%
Total	116	100%
Socio-economic status		
Low	31	26.7%
Middle	78	67.2%
High	7	6.0%

Total	116	100
Result Malaria test		
Negative	60	51.7%
Positive	56	48.3%
Total	116	100
Reside in malaria endemic area		
Yes	81	69.8%
No	35	30.2%
Total	116	100
Use of insect repellent		
Yes	60	51.7%
No	56	48.3%
Total	116	100

Table 1 Demographic profile of the children

Table 1 describe the demographic breakdown provided indicates that the majority of individuals surveyed fall within the age groups of 6-10 and 11-14 years old, with 51.7% and 48.3%, respectively. Regarding socioeconomic status, the distribution shows that a significant portion of the sample belongs to the middle-income bracket (67.2%), followed by the low-income group (26.7%), and a smaller proportion in the high-income category (6.0%). Additionally, the results of the malaria tests reveal a fairly balanced distribution, with 51.7% testing negative and 48.3%

testing positive for malaria. The data also highlights the prevalence of malaria endemic areas, with 69.8% of individuals residing in such regions. Despite this, the use of insect repellent appears evenly split, with 51.7% of individuals reporting its use. These findings suggest a complex interplay of factors influencing malaria prevalence, including age, socioeconomic status, and geographic location. Further analysis could explore correlations between these variables and the incidence of malaria to inform targeted interventions and public health strategies aimed at reducing transmission rates and improving outcomes in affected populations.

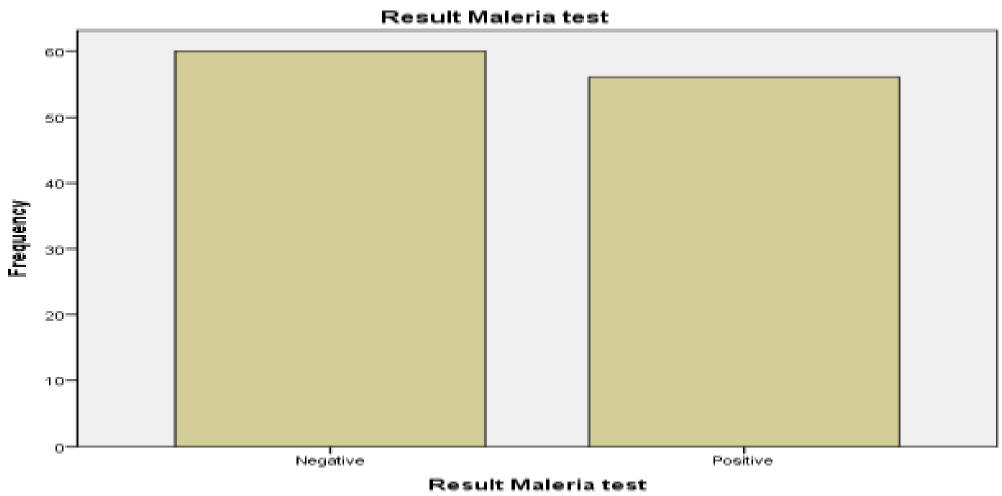

Fig.1. Barchart representing results of malaria test for the children

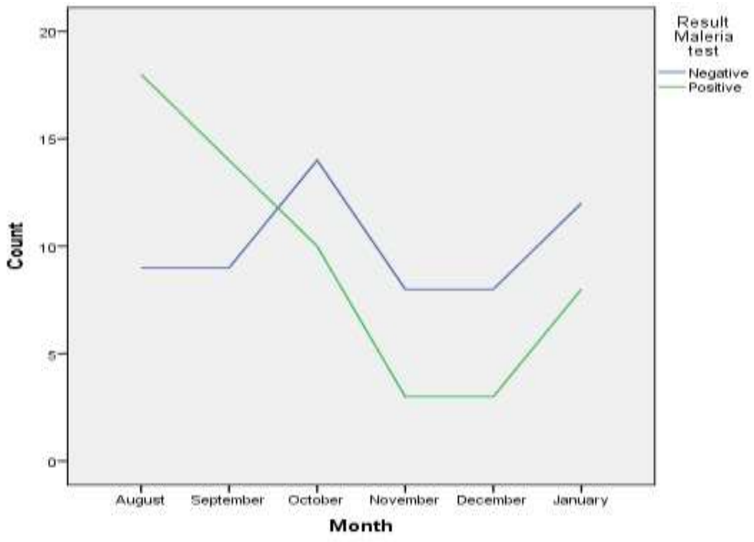

Figure 2. Chart representing trends of malaria for six months

Logistic Regression

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	116	100.0
	Missing Cases	0	.0
	Total	116	100.0
Unselected Cases		0	.0
Total		116	100.0

a. If weight is in effect, see classification table for the total number of cases.

Table 2. logistic regression for case processing summary

Classification Table[a,b]

	Observed		Predicted		
			Result Maleria test		Percentage Correct
			Negative	Positive	
Step 0	Result Maleria test	Negative	60	0	100.0
		Positive	56	0	.0
	Overall Percentage				51.7

a. Constant is included in the model.

b. The cut value is .500

Table 3. classification table for malaria test and overall percentage

Variables in the Equation

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 0	Constant	-.069	.186	.138	1	.710	.933

Table 4. Variables in the Equation

Variables not in the Equation

			Score	Df	Sig.
Step 0	Variables	SOCIO_ECONOMIC_STATUS	3.553	1	.059
		RESIDE_IN_MALARIA_ENDEMIC_AREA	.725	1	.395
		USE_OF_INSECT_REPELLENT	.129	1	.720
		SEASON	5.887	1	.015
		IMMUNE_STATUS	1.031	1	.310
	Overall Statistics		12.922	5	.024

Table 5 Variables not in the Equation

		Chi-square	Df	Sig.
Step 1	Step	13.684	5	.018
	Block	13.684	5	.018
	Model	13.684	5	.018

Table 6 Chi-square for Omnibus Tests of Model Coefficients

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	146.988[a]	.111	.148

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Table 7 Model Summary for the analysis

Variables in the Equation

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1[a]	SOCIO_ECONOMIC_STATUS	-.971	.404	5.781	1	.016	.379
	RESIDE_IN_MALARIA_ENDEMIC_AREA	.652	.460	2.011	1	.156	1.919
	USE_OF_INSECT_REPELLENT	.017	.403	.002	1	.967	1.017
	SEASON	-1.136	.443	6.584	1	.010	.321
	IMMUNE_STATUS	-.436	.650	.450	1	.502	.646
	Constant	3.158	1.831	2.974	1	.085	23.533

Table 8. Socio Economic Status, Reside In Malaria Endemic Area, Use of Insect Repellent, Season, Immune Status.

The logistic regression analysis provides valuable insights into the factors associated with the prevalence of malaria in the research population. The initial (Table 3) includes variables such as socioeconomic status, residence in malaria endemic areas, use of insect repellent, season, and immune status. The overall statistics indicate a significant model (p = 0.024), suggesting that at least one of the predictor variables is associated with the outcome variable, the result of the malaria test. However, when examining the individual variables in this table, none of them are statistically significant predictors of malaria status, as indicated by their respective p-values. Moving to Table 6, where all predictor variables are entered simultaneously using the "Enter" method, the model's performance improves. The omnibus test of model coefficients shows a significant association between the predictor variables and the outcome (p = 0.018), indicating that the model as a whole is predictive of malaria status. Furthermore, the classification table demonstrates an overall percentage of correct classification of 59.5%, suggesting that the model is moderately effective in predicting malaria outcomes based on the included variables.

Upon examining the coefficients for the variables entered in Table 6, it's notable that socioeconomic status, season, and residence in malaria endemic areas show significant associations with malaria status ($p < 0.05$). Specifically, individuals from lower socioeconomic backgrounds and those residing in malaria endemic areas are more likely to test positive for malaria. Additionally, the season also plays a role, with malaria incidence being higher during certain times of the year. These findings have important implications for public health interventions, highlighting the need for targeted efforts to address malaria transmission in vulnerable populations, particularly those in low-income areas and regions with high endemicity. Moreover, the inclusion of variables such as immune status and the use of insect repellent, while not statistically significant in this model, underscores the importance of considering multiple factors in understanding and combating malaria.

Correlations Analysis

		Result Maleria test	Reside in maleria endemic area	Use of insect repellent
Result Maleria test	Pearson Correlation	1	.079	.033
	Sig. (2-tailed)		.399	.722
	N	116	116	116
Reside in maleria endemic area	Pearson Correlation	.079	1	-.071
	Sig. (2-tailed)	.399		.447
	N	116	116	116
Use of insect repellent	Pearson Correlation	.033	-.071	1
	Sig. (2-tailed)	.722	.447	
	N	116	116	116

Table 9. Correlation analysis for the malaria result

The Table 9. Provides understanding into the relationships between different variables in the study, particularly focusing on their associations with the result of the malaria test. The correlation coefficients indicate weak correlations between the result of the malaria test and both residence in malaria endemic areas and the use of insect repellent. Specifically, the Pearson correlation coefficients between the result of the malaria test and residence in malaria endemic areas and the use of insect repellent are 0.079 and 0.033, respectively. These values are close to zero, suggesting a negligible linear relationship between these variables. Additionally, the p-values associated with these correlations are not statistically significant ($p > 0.05$), further indicating weak associations.

Despite the lack of strong correlations, these findings still hold implications for the research. While residence in malaria endemic areas and the use of insect repellent may not show strong linear relationships with the result of the malaria test, they are still important factors to consider in the context of malaria prevention and control efforts. The weak correlations observed may be influenced by other confounding variables not accounted for in this analysis. Therefore, it's crucial for future research to explore additional factors and potential interactions to better understand the complex dynamics underlying malaria transmission and outcomes. Furthermore, these findings highlight the need for multifaceted approaches in malaria control strategies, encompassing not only individual behaviors such as the use of insect repellent but also broader environmental and socioeconomic factors such as residence in endemic areas.

4. Conclusion

In conclusion, the analysis of the pervasiveness of malaria infection among children in Katsina Local Government Area (LGA) of Katsina State, Nigeria, provides valuable understandings into the complex dynamics surrounding the prevalence of malaria in Katsina local government area of Katsina state. The study employed a comprehensive research approach, encompassing demographic analysis and socio-economic assessments to paint a holistic picture of the malaria situation among children in Katsina LGA. The research revealed a concerning prevalence of malaria among children under five in Katsina LGA, emphasizing the urgent need for targeted interventions. And also Identified factors contributing to the high prevalence included socio-economic disparities, environmental influences, and healthcare system challenges. The research underscores the importance of implementing targeted interventions addressing specific factors contributing to malaria prevalence, such as socio-economic disparities and environmental influences.

5. Recommendation

Based on the analysis of the pervasiveness of malaria infection among children in Katsina Local Government Area (LGA) of Katsina State, Nigeria, the following recommendations are proposed to the state government to:

i. Develop and implement targeted malaria control interventions specifically tailored to the needs of children under five in high-prevalence areas within Katsina LGA.

ii. Prioritize the distribution of insecticide-treated bed nets and anti-malarial drugs to vulnerable households.

iii. Launch comprehensive community education programs to enhance awareness and understanding of malaria transmission, prevention, and treatment among caregivers and community members.

iv. Establish or upgrade healthcare facilities, especially in areas with higher concentrations of malaria cases.

v. Encourage active participation of communities in malaria control initiatives to ensure sustainability and community ownership.

The above recommendations aim to provide a comprehensive framework for addressing the pervasiveness of malaria among children in Katsina LGA, fostering a multi-faceted and sustainable approach to malaria control and prevention.

6. Research Contribution

The research contributes to the existing body of knowledge on malaria epidemiology in Nigeria, specifically in the context of Katsina LGA. It serves as a reference point for future studies and research endeavors in similar settings. The research also contributes to the broader goals of improving public health, enhancing healthcare systems, and fostering community resilience against infectious diseases

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