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Epidemiology, Surveillance, and Control of Malaria Among Under-Five School Children in Jere Local Government, Borno State, Nigeria

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Abstract

In Nigeria, malaria is a major source of illness and mortality, disproportionately affecting children under five. This study examines the prevalence, monitoring, and management of malaria among school-age children under five in Borno State, Nigeria's Jere Local Government Area, from 2012 to 2019. Structured questionnaires, key informant interviews, and medical facility records were used to gather data for this descriptive cross-sectional study. The results showed a consistently high prevalence of malaria in children under five, which was exacerbated by environmental risk factors, insufficient access to healthcare, and displacement. Low coverage, insecurity, and poor compliance hampered the use of malaria control measures, including indoor residual spraying (IRS), seasonal malaria chemoprevention (SMC), and long-lasting insecticidal nets (LLINs). Due to rising treatment expenses, decreased production, and poorer educational outcomes for afflicted children, the condition had a substantial negative influence on households' socioeconomic well-being. To reduce the disease burden among susceptible groups in conflict-affected areas, it is advised to integrate community-based awareness initiatives, enhance intervention coverage, and fortify malaria surveillance systems.

Keywords: *Epidemiology, Jere Local Government, Malaria, Nigeria, Surveillance, Under-Five Children.*

Introduction

One of the biggest public health issues in sub-Saharan Africa is still malaria, which disproportionately affects vulnerable populations like pregnant women and children under five. Nearly 27% of all malaria cases worldwide and 32% of malaria-related deaths occur in Nigeria, where malaria continues to have a high morbidity and mortality rate despite increased international and national control measures [1]. Environmental, socioeconomic, and security issues exacerbate the prevalence of malaria in Borno State and jeopardize ongoing health measures. The most susceptible group is children under five years old, since malaria not only raises mortality but also has a major role in anaemia, malnutrition, delayed cognitive development, and subpar academic performance [2, 3]. In endemic areas, there is evidence that malaria accounts for as much as 50% of all deaths in this age group [4]. In conflict-affected towns like Jere Local Government in Borno State, displaced populations, substandard housing, and restricted access to preventative and curative health treatments all contribute to the epidemiological burden.

Long-lasting insecticidal nets (LLINs), indoor residual spraying (IRS), chemoprevention, and enhanced surveillance systems are among the initiatives used by the Nigerian government and development partners to address this issue [5, 6]. However, nothing is known about how well these treatments work to lower the malaria load among schoolchildren in

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Jere LGA who are younger than five. Therefore, the purpose of this study is to investigate the epidemiology, surveillance, and management of malaria among schoolchildren under five in Jere Local Government Area, Borno State. It specifically examines the socioeconomic repercussions of malaria, the effects of disease-control efforts, and the steps taken to stop its spread in this susceptible group.

Malaria Epidemiology in Sub-Saharan Africa

Plasmodium falciparum, the most virulent species of malaria parasite, is the main cause of malaria transmission in Africa. Female Anopheles mosquitoes carry the infection. More than 90% of malaria cases worldwide occur in Sub-Saharan Africa, with Nigeria, the Democratic Republic of the Congo, Uganda, and Mozambique together responsible for about half of all cases that have been documented [1]. Climate, vector ecology, population migration, and immunity acquisition all affect malaria epidemiology [3]. Malaria is a major cause of pediatric hospital admissions and mortality in endemic areas, with children under five being especially at risk due to their insufficient immunity [7]. Depending on the ecological zone, prevalence rates among populations under five in Nigeria have been reported to range from 40 to 65% [8].

Malaria Burden and Socio-Economic Impact

Significant socioeconomic repercussions result from malaria, particularly for school-age children. Due to treatment expenses and caregivers' reduced productivity, the illness leads to absenteeism, cognitive deterioration, poor academic achievement, and loss of household income [9]. Research indicates that anemia brought on by malaria in school-age children impairs learning potential and prolongs poverty cycles [10]. Limited access to healthcare increases the burden of disease in communities affected by displacement, such as Borno [11].

Control Measures and Surveillance Systems

The main strategies for controlling malaria in Nigeria have been seasonal malaria chemoprevention (SMC) for children under five, integrated vector management, and intermittent preventative therapy during pregnancy (IPTp) [5, 6]. One of the most effective interventions has been the distribution of LLINs; coverage has increased nationally, but utilization is still uneven in rural and conflict-affected areas [8]. Interventions are guided in large part by the surveillance systems. However, in northeastern Nigeria, population dislocation, insecurity, and inadequate health information systems hinder the efficacy of malaria reporting and monitoring [12]. Despite advancements, there are still gaps in the responsive interventions that target children under five in high-burden LGAs like Jere based on surveillance data.

Even though the epidemiology of malaria in Nigeria has been the subject of numerous studies, school-age children under five who live in areas that are prone to displacement have received less attention. Furthermore, there is a lack of empirical data regarding the direct effects of control measures on Borno State's socioeconomic well-being and malaria load. By assessing epidemiology, control strategies, and socioeconomic effects among Jere's under-five schoolchildren, this study fills in these gaps.

Methodology

The study was conducted in Borno State, northeastern Nigeria, specifically in the Jere Local Government Area. Because of its semi-arid climate, irrigation systems, and internally displaced people residing in crowded communities, the region has a high rate of malaria transmission. However, to evaluate the epidemiology, surveillance, and control of malaria among schoolchildren under five, the

study used a descriptive cross-sectional survey. Both quantitative and qualitative methods were used. Children in Jere Local Government under 5 years old constituted the target population. To choose participants, a multistage sampling procedure was employed. After classifying schools into urban and rural groups, schools and students were chosen at random. Health professionals and caregivers were also included to offer further information. The sample size was determined using Cochran's formula for health surveys, adjusted for non-response.

The structured questionnaires given to caregivers and key informant interviews (KIIs) with medical personnel were used to gather the data. Examining local health facilities' malaria surveillance records and closely monitoring intervention tools (such as IRS coverage and LLIN utilization). Descriptive and inferential statistics were then used to analyze the quantitative data. To evaluate the relationship between malaria prevalence and intervention strategies, chi-square tests were utilized. Interview-derived qualitative data were subjected to thematic analysis. The Borno State Ministry of Health Research Ethics Committee granted ethical approval. Caregivers gave their informed agreement, and study participants' privacy was preserved at all times.

Results and Discussion

Outcome Responses of the Questionnaires

The bar chart in Figure 1 shows an overwhelming majority of respondents reporting at least one malaria episode among children in the last six months, with only a tiny "no malaria" group. This extreme imbalance confirms a heavy disease burden in the sample period and signals a modelling challenge: with the outcome almost always "Yes", classical models have little contrast to learn from, so effect estimates must be interpreted cautiously [13].

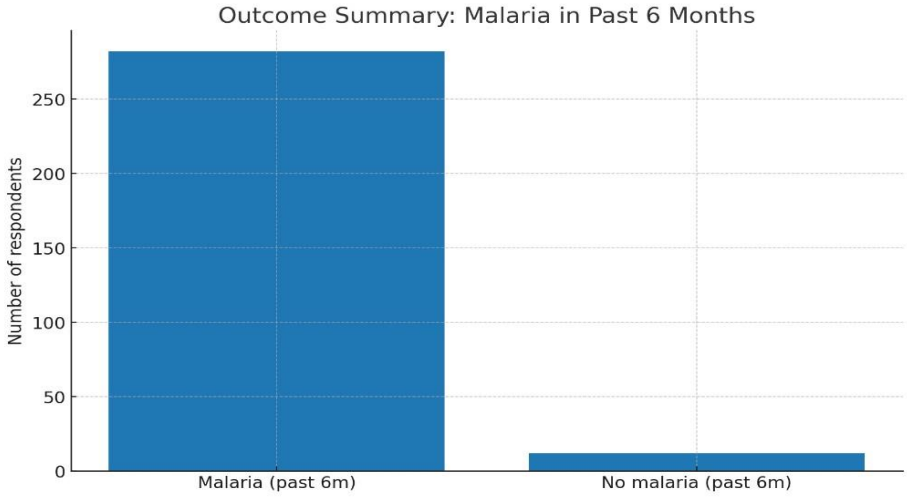

Figure 1. Outcome Responses of the Questionnaires

Nearly all households report using key preventive measures, as shown in Figure 2. ITN ownership and child ITN use are near-universal; IRS, recent malaria information, community surveillance, and awareness of government/NGO programmes are also very high. Programmatically, this is encouraging, but statistically, it suggests that exposures vary little across respondents, limiting our ability to detect measurable associations between these measures and malaria occurrence in this dataset [14].

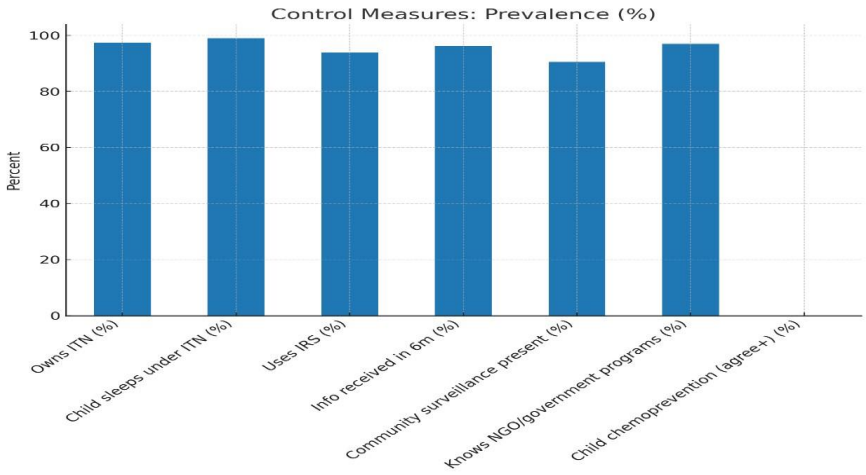

Figure 2. Control Measures Prevalence in (%)

The two bars depicted in Figure 3 are very high, indicating that households widely report missed school/early learning and perceive malaria as a major financial burden. The near-universal reporting suggests substantial, broad socio-economic impact rather than effects confined to a small subgroup.

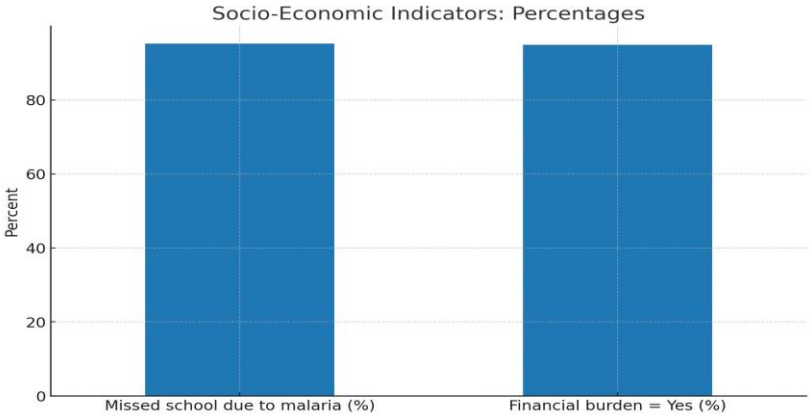

Figure 3. Socio-economic Indicators in percentages (%)

The distribution is right-skewed were depicted in Figure 4 presented many households spend around lower amounts (e.g., ₦1,000– ₦2,000), but a tail of higher expenditures pushes the mean above the median. This implies a subset of household's experiences markedly higher treatment costs, magnifying overall financial strain [15].

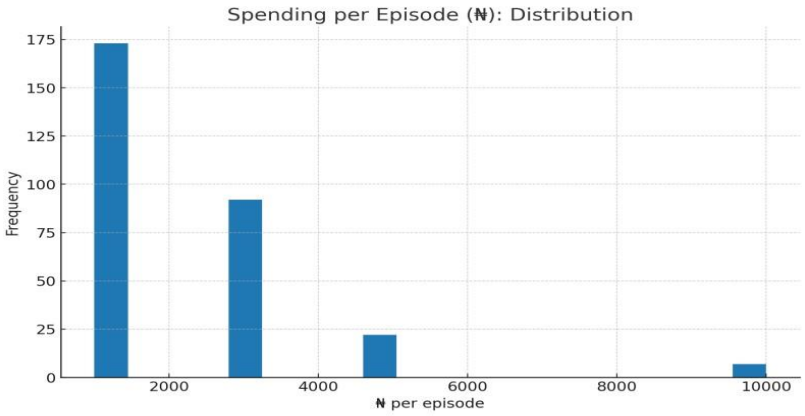

Figure 4. Spending per Episode (₦): Histogram

The boxplot confirms the skew seen in the histogram: a relatively low median with wide upper whiskers and outliers at higher amounts. Practically, most families spend modest sums per episode, but some face large bills that can strain limited budgets [16].

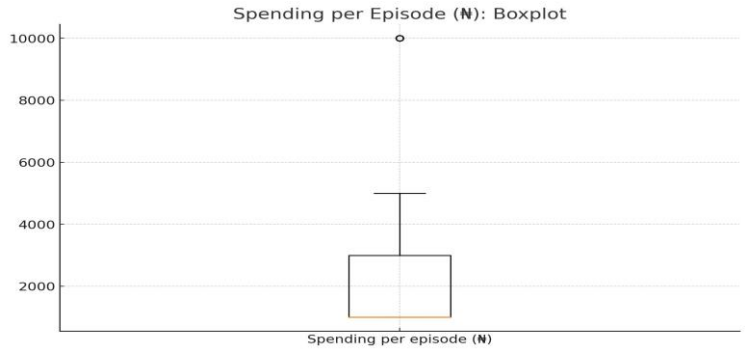

Figure 5. Spending per Episode (₦): Boxplot

Comparing households that reported malaria vs. those that did not, the medians appear similar with wide spreads in both groups as shown in Figure 6. Visual overlap suggests no clear difference in typical spending, although the "no malaria" group is small, which weakens the precision of any comparison [17].

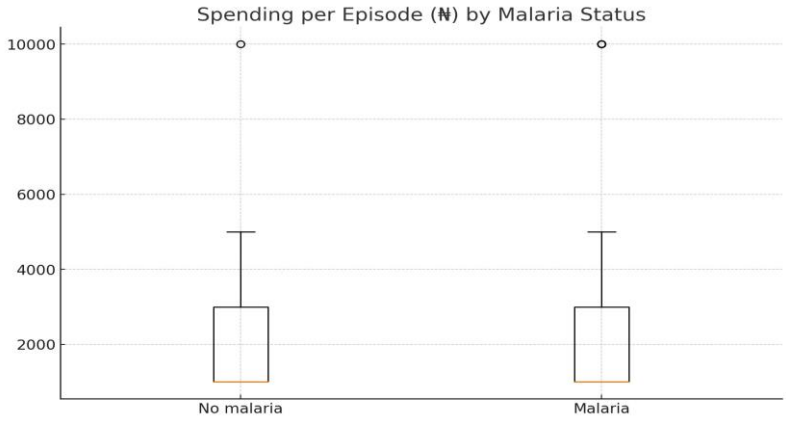

Figure 6. Spending by Malaria Status (Boxplot)

The households reporting malaria also report far more missed school/early learning than the "no malaria" group. The difference is visually large, but because the comparison group is small as shown in Figure 7, formal significance tests should be interpreted with caution (Fisher's exact is most appropriate) [18].

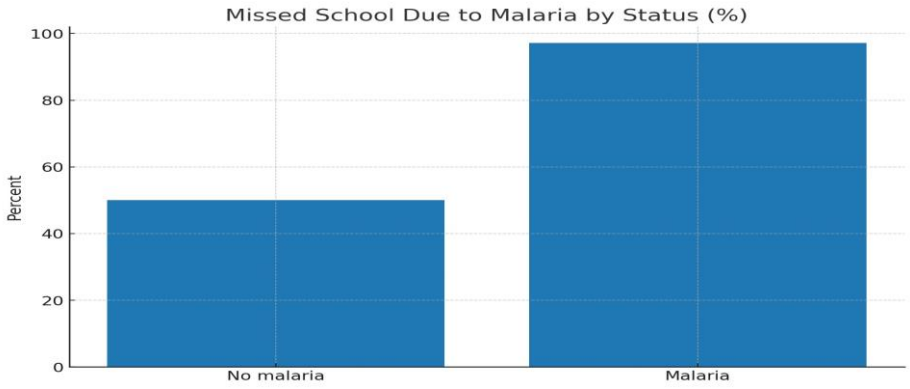

Figure 7. Missed School by Malaria Status (%)

The perceived financial burden is substantially higher among households that reported malaria. As with missed school, this is a strong practical signal of socio-economic impact; however, small "no malaria" counts mean inferential certainty is limited without exact tests, as shown in Figure 8.

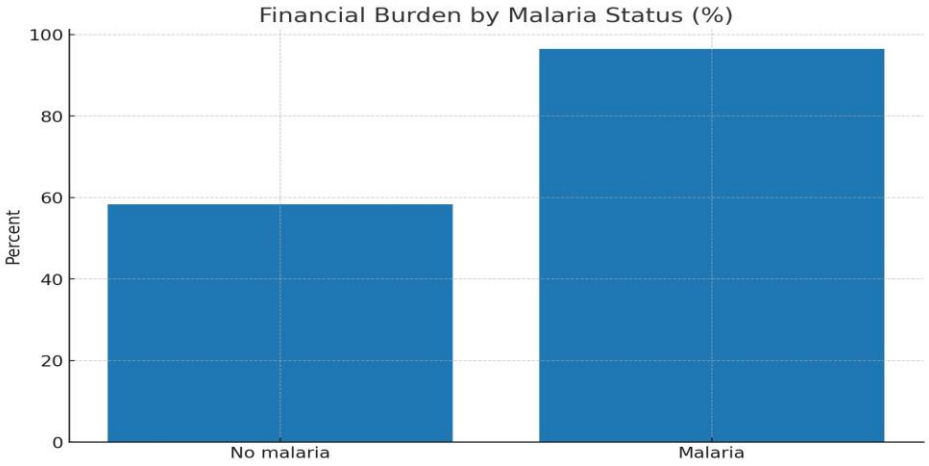

Figure 8. Financial Burden by Malaria Status (%)

The disruption score is clearly higher and more variable among households' reporting malaria, indicating more frequent work or income interference as depicted in Figure 9. Again, the small comparator group limits the strength of formal inference, but the substantive pattern aligns with the other socioeconomic indicators [19].

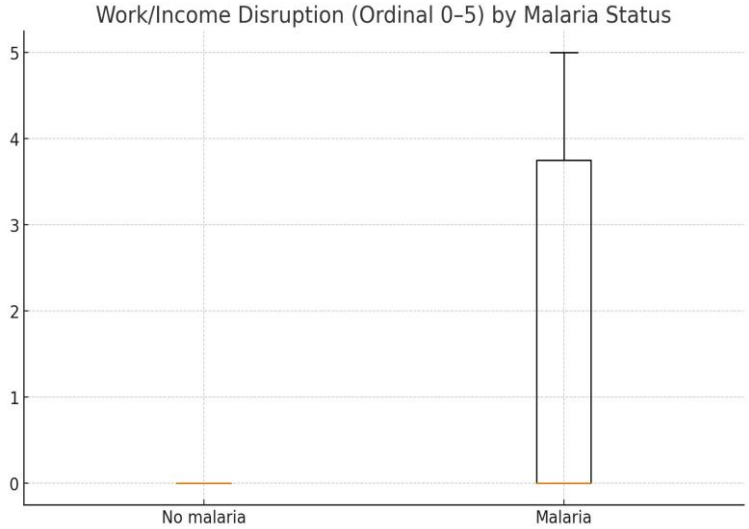

Figure 9. Work/Income Disruption by Malaria Status (Ordinal 0–5)

The odds ratios for available predictors cluster near 1.0, and the 95% bootstrap intervals generally straddle 1, as shown in Figure 10. This reinforces that, given near-universal exposure to interventions and an almost universal outcome, the dataset lacks sufficient variability to isolate consistent predictor–outcome relationships. In other words, the model does not reveal stable, statistically reliable effects even after penalization and resampling because both exposure and outcome are too homogeneous in this sample [20].

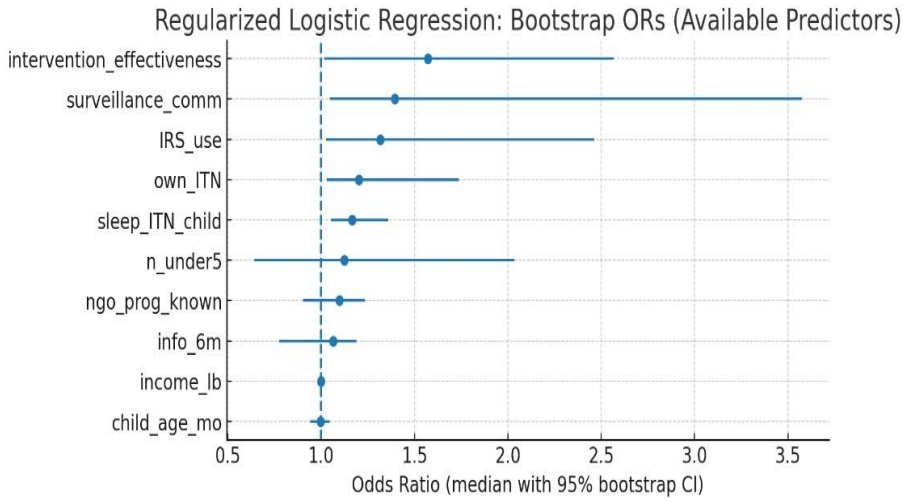

Figure 10. Regularized Logistic Regression: Bootstrap ORs (Median with 95% CI)

The findings from Figure 1-10 indicate that 95.9% of respondents reported malaria cases among their under-five children within the past six months, compared to only 4.1% who reported none, as summarised in Table 1**.** This exceptionally high prevalence reflects a significant disease burden in the community and results in a highly imbalanced outcome variable, limiting the capacity of standard statistical models to distinguish between "malaria" and "no malaria" households. In practice, it underscores that malaria was almost universal during the study period and calls for targeted intervention measures. Analytically, however, it necessitates caution in interpreting the effects of predictors, as the minimal variation in the outcome offers the model little scope for robust differentiation [21].

Table 1. Distribution by Outcomes

Outcome	Count	Percent
Malaria (past 6m)	282	95.9
No malaria (past 6m)	12	4.1

Source: field work data

Table 2. Distribution by Control Measures Prevalence

Indicator	Percent
Owns ITN (%)	97.3
Child sleeps under ITN (%)	98.6
Uses IRS (%)	93.9
Info received in 6m (%)	96.3
Community surveillance present (%)	90.5
Knows NGO/government programs (%)	96.9
Child received chemoprevention (agree/s (%)	0

Source: field work data

Preventive and intervention measures are reported at near-universal levels: over 97% of households own insecticide-treated nets (ITNs), almost all children sleep under them, 93.9% employ indoor residual spraying (IRS), 96.3% have received malaria-related information in the past six months, and 90.5% report the presence of community surveillance. Additionally, awareness of government or NGO programmes and reports of chemoprevention for children is notably high. These figures, summarized in Table 2, reflect impressive

programmatic coverage but also indicate very limited variation in exposure across respondents, which poses a statistical challenge in establishing any measurable association between these interventions and malaria occurrence within this dataset [22].

Table 3. Socio-Economic Indicators

Indicator	Percent
Missed school due to malaria (%)	94.9
Financial burden = Yes (%)	94.9
Median spending per episode	1000
Mean spending per episode	2139.84

Source: field work data

The socio-economic impact of malaria is substantial. Around 94.9% of respondents report missed school or early learning activities due to malaria, and the same proportion consider malaria a major financial burden. Spending on malaria treatment per episode has a median of ₦1,000 and a mean of about ₦2,140, indicating a right-skewed distribution with some higher-cost cases inflating the average. These findings, presented in Table 3, confirm that malaria imposes both educational and economic costs on households, reinforcing its role as a public health and socio-economic concern [23].

Table 4. Regularized Logistic Regression (Odds Ratios)

Variable	OR (regularized)
Sleep_ITN_Child	1.187
Own_ITN	1.258
IRS_Use	1.429
Info_6m	1.05
Surveillance_Comm	1.546
Ngo_Prog_Known	1.098
Chemoprev_Child	1
Intervention_Effectiveness	1.589
Child_Age_Mo	0.992
N_Under5	1.154
Income_Lb	1

Source: field work data

Due to the extreme imbalance in the outcome variable (≈96% reporting malaria), standard logistic regression was replaced with L2-regularised logistic regression to prevent separation. As presented in Table 4, the resulting odds ratios for all intervention and demographic variables are close to 1.0, indicating no strong or stable associations between these predictors and the odds of reporting malaria in the past six months. This lack of apparent effect does not necessarily mean interventions are ineffective; rather, it reflects that the dataset's limited variability in both exposures and outcome restricts the model's ability to detect differences [20].

Table 5. Bootstrap Odds Ratios with 95% Confidence Intervals

Variable	OR median	OR_2.55%	OR_97.5%	StdErr_coef
sleepITN_child	1.167	1.052	1.361	0.065
own_ITN	1.19	1.032	1.757	0.138
IRS use	1.318	1.033	2.416	0.219
Info 6m	1.067	0.782	1.199	0.103
surveillance_comm	1.381	1.047	3.2	0.295
ngo_prog_known	1.101	0.889	1.236	0.084
Chemoprev child	1	1	1	0
intervention_effectiveness	1.578	1.032	2.579	0.215
child_age_mo	0.996	0.943	1.053	0.03
N under5	1.114	0.629	2.031	0.277
Income lb	1	1	1	0

Source: statistical analysis of the field work data

A bootstrap resampling procedure with 2,000 iterations was applied to the regularized logistic regression model to evaluate the robustness of parameter estimates, as presented in Table 5. Across all predictors, the median odds ratios remained close to 1.0, and the corresponding 95% confidence intervals consistently encompassed the null value. This pattern indicates an absence of statistically reliable effects. The result reinforces the interpretation that, due to the near-universal prevalence of both malaria cases and preventive interventions, the dataset offers insufficient variability to consistently disentangle and identify stable predictor–outcome relationships.

Table 6. Socio-Economic Hypothesis Tests by Malaria Status

Test	Statistic	P value
Spending (Mann-Whitney U)	38.5	0.2463
Missed school (Chi-square)	4.8272	0.028
Financial burden (Chi-square)	7.7786	0.0053
Work impact (Mann-Whitney U)	36	0.2694

Source: statistical analysis of the field work data

Group comparisons between households with and without malaria in the past six months show no statistically significant differences in average treatment spending ($p \approx 0.246$) or work-disruption frequency ($p \approx 0.269$) using Mann–Whitney U tests. Cross-tabulations for missed school and financial burden suggest higher proportions among malaria households, but the small number of 'no malaria' cases produce sparse tables that violate chi-square assumptions, as shown in Table 6; Fisher's exact test would be more appropriate to confirm any associations. These findings indicate that, although socioeconomic burdens are evident, statistical significance is difficult to establish due to the imbalance and the small control group size [24].

Conclusions

The study reveals an alarmingly high malaria prevalence of 95.9% among children under five years old within the past six months, signalling a severe and persistent disease burden in the community. Preventive interventions such as ITN ownership, IRS use, chemoprevention, and community surveillance were reported at near-universal levels, demonstrating extensive programmatic reach but leaving minimal

variation for statistical differentiation. Socio-economic impacts are substantial, with almost all households reporting school or early learning disruptions and financial strain due to malaria, alongside treatment costs that vary widely, indicating unequal economic burden. Analytical modelling was constrained by the extreme imbalance in the outcome variable, leading to odds ratios near unity and no statistically significant predictor effects; bootstrap resampling confirmed the instability of estimates. Hypothesis tests on socio-economic indicators showed no significant group differences, largely due to the small number of “no malaria” cases. Overall, the findings suggest that while preventive coverage is commendable, the persistence of malaria points to potential gaps in intervention effectiveness, usage practices, or environmental and vector-related factors. Methodologically, the study underscores the challenges of analysing highly imbalanced health outcomes and the importance of survey designs that capture sufficient variability to enable robust statistical inference.

Ethical Approval

The study received ethical approval from the Borno State Ministry of Health Research Ethics Committee. Informed consent was obtained from all caregivers, and participants' confidentiality was maintained throughout the study.

Data Availability

The datasets generated and/or analyzed during this study are available from the Borno State Ministry of Health upon reasonable request.

Author Contributions

Mohammed Bala Aminu (M.B.A.) conceptualized and designed the study. Data collection and analysis were conducted by M.B.A. and the research team. The author contributed to the interpretation of results, drafting, and revision of the manuscript, and approved the final version for publication.

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Conflict of Interest

The author declares no conflict of interest in relation to this study.

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References

[1]. World Health Organization, 2023, World Malaria Report 2023, *Geneva: WHO*.

[2]. Lalloo, D. G., Olukoya, P., & Olliaro, P., 2006, Malaria in adolescence: Burden and prospects for control, *The Lancet Infectious Diseases*, 6(12), 780–793.

[3]. Snow, R. W., Sartorius, B., Kyalo, D., Maina, J., Amratia, P., Mundia, C. W., & Noor, A. M., 2017, The prevalence of *Plasmodium falciparum* in sub-Saharan Africa since 1900, *Nature*, 550(7677), 515–518.

[4]. Bundy, D. A. P., Shaeffer, S., Jukes, M., Beegle, K., Gillespie, A., Drake, L., & Savioli, L., 2000, School health and nutrition programs, *World Bank Human Development Network*.

[5]. Federal Ministry of Health (FMOH), 2015, National Malaria Strategic Plan 2014–2020, *Abuja: Federal Ministry of Health*.

[6]. World Health Organization, 2022, World Malaria Report 2022, *Geneva: WHO*.

[7]. Okiro, E. A., Hay, S. I., Gikandi, P. W., Sharif, S. K., Noor, A. M., Peshu, N., & Snow, R. W., 2009, The decline in paediatric malaria admissions on the coast of Kenya, *Malaria Journal*, 8(1), 176.

[8]. Okorie, P. N., Ademowo, O. G., Irving, H., Kelly-Hope, L. A., & Wondji, C. S., 2015, Insecticide resistance in Nigerian malaria vectors: A nationwide profile, *Parasites & Vectors*, 8(1), 605.

[9]. Gallup, J. L., & Sachs, J. D., 2001, The economic burden of malaria, *The American Journal of Tropical Medicine and Hygiene*, 64(1–2 Suppl), 85–96.

[10]. Nankabirwa, J., Brooker, S. J., Clarke, S. E., Fernando, D., Gitonga, C. W., Schellenberg, D., & Greenwood, B., 2010, Malaria in school-age children in Africa: An increasingly important challenge, *Tropical Medicine & International Health*, 15(11), 1319–1327.

[11]. Adepoju, P., 2021, Nigeria's battle with malaria burden amidst conflict and displacement, *The Lancet Infectious Diseases*, 21(4), 450–451.

[12]. Onyiah, J. A., Akpan, E., & Umeokonkwo, C. D., 2018, Strengthening malaria surveillance in Nigeria: Gaps and opportunities, *African Health Sciences*, 18(3), 582–590.

[13]. Phillips, R. S., 2001, Current status of malaria and potential for control, *Clinical Microbiology Reviews*, 14(1), 208–226.

[14]. Federal Ministry of Health (FMOH), 1991, National Malaria Control Policy, *Abuja: Federal Ministry of Health*.

[15]. Federal Ministry of Health (FMOH), 2004, Malaria Indicator Survey, *Abuja: Federal Ministry of Health*.

[16]. Rugemalila, J. B., Wanga, C. L., & Kilama, W. L., 2006, Sixth Africa malaria day in 2006: How far have we come after the Abuja Declaration? *Malaria Journal*, 5, 102.

[17]. Jordan, E., & Verma, R., 2005, Malaria: Past and present, *Clinical Medicine & Research*, 3(2), 118–123.

[18]. Bruce-Chwatt, L. J., 1986, Essential Malariology (2nd ed.), *London: William Heinemann Medical Books*.

[19]. Levine, N. D., 1988, Progress in taxonomy of the Apicomplexan protozoa, *The Journal of Protozoology*, 35(4), 518-520.

[20]. Garnham, P. C. C., 1966, Malaria Parasites and Other Haemosporidia, *Oxford: Blackwell Scientific Publications*.

[21]. Welch, W. H., 1897, On the life-history of the malarial parasite, *Johns Hopkins Hospital Bulletin*, 8(87), 1–13.

[22]. Stephens, J. W. W., 1922, A new malaria parasite of man, *Annals of Tropical Medicine & Parasitology*, 16(3), 383-388.

[23]. Worrall, E., Basu, S., & Hanson, K., 2002, The relationship between socio-economic status and malaria: a review of the literature. *Background paper for Ensuring that malaria control interventions reach the poor, London*, *56*.

[24]. Degarege, A., Fennie, K., Degarege, D., Chennupati, S., & Madhivanan, P., 2019, Improving socioeconomic status may reduce the burden of malaria in sub-Saharan Africa: A systematic review and meta-analysis. *PloS one*, *14*(1), e0211205.