Emerging Frontiers in Translational Biomedicine and Health Sciences

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Original Article

Health Practices by Primary Caregivers on Clinical Cases of Malaria among Under-Five Children in Rural Health Facilities in Delta State, Nigeria

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Abstract:

Background: Malaria remains a major public health threat for children under five in Nigeria. This study evaluated the health practices of primary caregivers in managing clinical malaria among under-five children in Delta State, with emphasis on prevention strategies, home-based treatment, and healthcare-seeking behaviours.

Methods: A cross-sectional hospital-based study was conducted from June 2023 to May 2024 in three rural secondary hospitals representing Delta State's senatorial districts. A total of 633 primary caregivers of under-five children presenting with fever or malaria-like symptoms were consecutively recruited. Malaria diagnosis was performed using both Rapid Diagnostic Tests (RDTs) and microscopy. Data on preventive practices, home management, and care-seeking timing were collected using a validated structured questionnaire. Associations were examined using chi-square analysis and multivariable logistic regression.

Results: The overall malaria prevalence was high: 71.1% by RDT and 66.3% by microscopy. Children aged 13–36 months were the most affected group. Consistent use of insecticide-treated nets (ITNs) showed a significant protective effect against malaria infection (Adjusted OR = 0.26, 95% CI: 0.15–0.45, $p < 0.001$). Use of herbal remedies showed no statistically significant association with malaria status (Adjusted OR = 0.91, 95% CI: 0.62–1.34, $p = 0.67$). Although delayed care-seeking beyond three days was common, it was not independently associated with malaria positivity in adjusted models.

Conclusion: There is a critical need for targeted public health interventions that enhance ITN utilization, promote timely access to healthcare, and reduce over-reliance on unproven home remedies. Improved caregiver education and community-focused malaria control strategies are essential to reducing the disease burden among under-five children in rural Delta State.

Keywords: *Caregiver practices; Insecticide-treated nets (ITNs); Herbal remedies; Rapid Diagnostic Test (RDT); Microscopy; Malaria prevalence; Public health intervention; Healthcare-seeking behaviour.*

Citation: Ojugbeli, E.T.; Ofili, M.I.; Enudinisu, G.N.; Onyesom, I. Health Practices by Primary Caregivers on Clinical Cases of Malaria among Under-Five Children in Rural Health Facilities in Delta State, Nigeria . *Emerg. Front. Transl. Biomed. Health Sci.* 2025, 1(2): 41-48.

Academic Editor(s): Dr. B.C Nwogueze

Received: 20th November, 2025.
Revised: 2nd December, 2025.
Accepted: 9th December, 2025.
Published: 19th December, 2025.

1. Introduction

Malaria, an acute febrile illness induced by *Plasmodium* parasites and predominantly transmitted through bites from infected female *Anopheles* mosquitoes remains one of the most persistent infectious diseases globally. In 2023, the World Health Organization (WHO) estimated 249 million cases and 608,000 deaths worldwide, with sub-Saharan Africa shouldering 94% of the burden [1]. Children under five years are also extremely vulnerable, contributing to about 76% of all malaria deaths in the region due to their underdeveloped immune systems, nutritional vulnerabilities, and increased outdoor activity exposure [2]. Nigeria, being the epicenter of this crisis, has also reported over 67 million cases and 132,000 deaths in 2023, with under-fives accounting for nearly 70% of fatalities a figure that has shown only marginal decline despite scaled-up interventions [1, 3].

In Delta State, a Niger Delta region, characterized by humid tropical climates conducive to mosquito proliferation, malaria transmission remains perennial, exacerbated by seasonal flooding and limited sanitation infrastructure [4]. Recent national surveys indicate that malaria prevalence among under-fives in Nigeria hovers at 22.6% (2021 Malaria Indicator Survey), but hospital-based studies in rural enclaves like Delta State reveal rates exceeding 60%, reflecting underreporting and access disparities [5]. Despite global and national commitments to malaria elimination—such as the WHO's Global Technical Strategy for Malaria 2016–2030 and Nigeria's National Malaria Strategic Plan 2021–2025—progress is hampered by multifaceted barriers [1, 6].These include suboptimal uptake of core interventions like insecticide-treated nets (ITNs) and indoor residual spraying (IRS), alongside entrenched socio-cultural practices that delay effective treatment [7].

Primary caregivers, predominantly mothers or female guardians, serve as the frontline decision-makers in child health management, influencing early symptom recognition, preventive adherence, and treatment initiation [8]. Their practices are shaped by a complex interplay of factors: educational attainment, economic constraints, cultural beliefs favouring traditional remedies, and geographic isolation from formal healthcare [9]. For instance, a 2024 study in Southwest Nigeria found that while 86.4% of caregivers possessed good malaria knowledge, only 43.9% consistently used ITNs, with self-medication and herbal treatments prevalent in 37.4% of cases [10]. Similarly, care-seeking delays—often exceed 48 hours—correlate with severe disease progression, anaemia, and mortality [11]. In Gombe State, recent assessments revealed that 92.5% of caregivers were willing to adopt malaria vaccines, yet barriers like misinformation and access issues persist [12].

Despite extensive national data on malaria burden and caregiver behaviours, a clear knowledge gap remains in rural Delta State, where caregiver-driven prevention and treatment practices have not been sufficiently examined despite high malaria prevalence. While studies across Nigeria outline general trends, the specific behavioural determinants, home-management methods, and their direct associations with laboratory-confirmed malaria outcomes in under-five children are poorly understood in this region. This gap highlights the need for localized, context-specific evidence that reflects the realities of caregivers who serve as the first responders in child health management. Therefore, this study aims to assess caregivers' malaria preventive practices, evaluate home-based treatment behaviours including the use of herbal remedies, examine healthcare-seeking patterns and delays, and determine how these practices relate to malaria prevalence among under-five children in Rural Health Facilities in Delta State, thereby providing actionable insights to strengthen community-focused malaria control efforts.

2. Materials and Methods

2.1 Study Design and Setting:

This study employed a cross-sectional, descriptive design conducted over a 12-month period from June 2023 to May 2024. Data collection occurred in three purposively selected rural secondary healthcare facilities representing Delta State's three senatorial districts: General Hospital Kiagbodo (Delta South), Otor-Udu General Hospital (Delta Central), and Ashaka General Hospital (Delta North). These hospitals were selected based on high paediatric malaria caseload and rural population coverage, and geographic diversity, enabling assessment of varying socio-economic and environmental malaria risks [13]. Within each hospital, consecutive sampling was carried out after purposive site selection to ensure all eligible participants presenting during the study period were included until quotas were met.

2.2 Study Population and Sample Size

The study population comprised primary caregivers (biological mothers or guardians) of under-five children (0–59 months) presenting with fever or malaria-like symptoms at outpatient clinics. Exclusion criteria included non-biological caregivers, children with major comorbidities (e.g., sickle cell disease, HIV), or incomplete diagnostic records. Sample size was determined using the formula for single population proportion: ($n = \frac{Z^2 p(1-p)}{d^2}$) assuming a 50% malaria prevalence (p=0.5 for maximum variability), 5% margin of error (d=0.05), and 95% confidence level (Z=1.96), yielding 384 participants. After adjusting for 10 % non-response and applying a design effect of 1.65 to account for clustering across the three hospitals, the final sample size was 633, with an allocation of 211 participants per hospital [14].

2.3 Malaria Diagnosis

Suspected cases underwent dual confirmation; SD Bioline Malaria Ag *Pf* RDT (Abbott, USA) for *Plasmodium falciparum* histidine-rich protein 2 (HRP2) detection, following WHO guidelines;[15] and microscopy of Giemsa-stained thick and thin blood smears, with parasitemia quantified as

parasites per 200 white blood cells (asexual forms only) by WHO-certified microscopists[16]. Discordant results were reviewed by a senior parasitologist for final confirmation.

2.4 Data Collection

A structured, pretested questionnaire was administered by trained nurses in English and Local Pidgin. The instrument underwent pilot testing on 50 caregivers (not included in the main study) to assess clarity, internal consistency, and cultural appropriateness. The pilot generated a Cronbach's α = 0.82, confirming reliability. The validation process included item clarity assessment and correction of ambiguous questions. While data collectors were not blinded to the child's diagnosis due to workflow constraints, standardized questioning procedures minimized interviewer bias. The questionnaire covered four domains:

i. Socio-demographics (age, education, occupation, income)
ii. Preventive practices (ITN ownership/use, IRS within the last 12 months)
iii. Home management behaviours (use of herbal remedies such as *Phyllanthus amarus*, scarification, self-medication)
iv. Healthcare-seeking patterns (time from symptom onset to hospital visit, categorized as early ≤3 days or delayed >3 days)
v. ITN use was verified by recall of sleeping under a net the previous night. Interviews lasted 15–20 minutes and ensured confidentiality and cultural sensitivity.

2.5 Ethical Considerations

Ethical approval was granted by the Delta State Hospital Management Board Ethics Committee (Approval No.: DSMB/EC/2023/045). Written informed consent was obtained from all caregivers, and confidentiality was strictly maintained. Data were anonymized, and all malaria-positive children received WHO recommended artemisinin-based combination therapy treatment following diagnosis.

2.6 Statistical Analysis

Data were analysed using SPSS version 25.0. Descriptive statistics were presented using means and standard deviations for continuous data, and frequencies and percentages for categorical variables. Associations with malaria status were assessed using Pearson's chi-square test. Predictors of malaria positivity were examined using multivariable logistic regression, controlling for child age, caregiver education, household income, district, and season. Significance level was set at $p < 0.05$. Model validity was evaluated using the Hosmer–Lemeshow goodness of fit test.

3. Results

3.1 Demographic Characteristics and Malaria Prevalence

Figure 1 shows the gender proportion of the patients, while Figure 2 presents the prevalence of malaria using RDT and microscopic diagnostic tools. Then, Figure 3 indicates the frequency and percentage distributions of malarial prevalence across age stratification

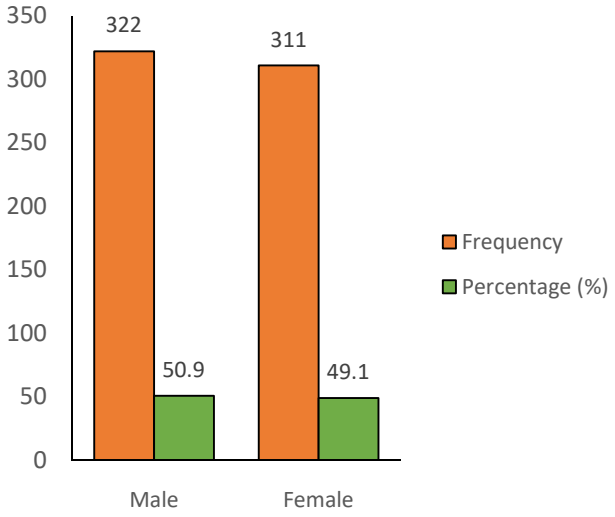

Figure 1: Proportions of patients' gender

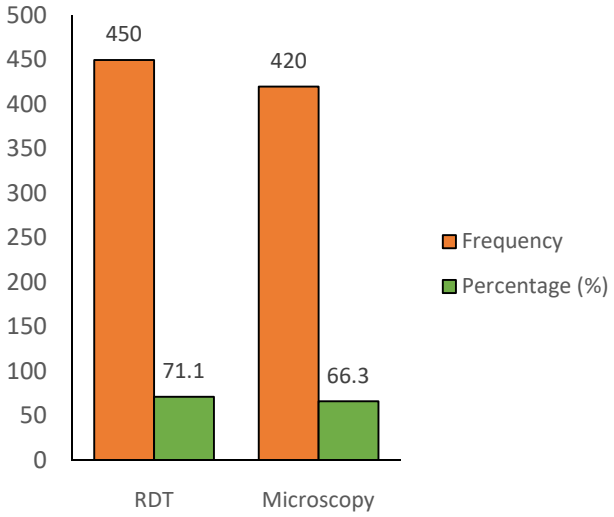

Figure 2: Comparison of malaria prevalence by RDT and microscopic examinations

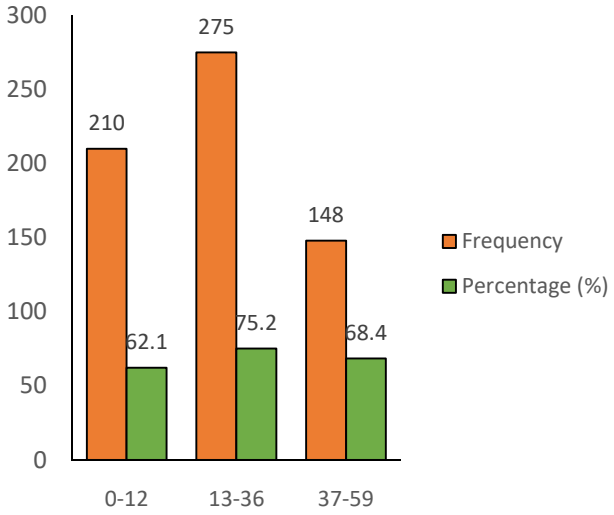

Figure 3: Distribution of malaria prevalence across age groups.

The study cohort comprised 633 caregiver-child dyads, with near-equal gender distribution: 322 (50.9%) males and 311 (49.1%) females (Figure 1). Mean child age was 24.6 ± 14.2 months, with 43.4% (n=275) in the 13–36-month bracket—the peak vulnerability window (Figure 3). Caregivers were primarily mothers (92.3%), aged 25–34 years (58.1%), with secondary education or below (71.4%) and low household income (<₦50,000/month; 64.8%). Malaria prevalence was elevated, with 450 children (71.1%) RDT-positive and 420 (66.3%) microscopy-confirmed (κ=0.82 for agreement; Figure 2). Age-stratified prevalence peaked at 75.2% for 13–36 months (Figure 3), declining to 62.1% in 0–12 months (maternal immunity effect) and 68.4% in 37–59 months. District variations showed highest rates in Delta South (74.5%), linked to mangrove ecosystems favouring *Anopheles* breeding.

Table 1. Practices of caregivers and relationship with malaria status of children under care

Practice / Category	*Malaria positive*	*Malaria negative*	*Total*
Overall	450	183	633
Used ITN	220 (48.9%)	150 (82.0%)	370 (58.5%)
Did not use ITN	200 (51.1%)	33 (18.0%)*	233 (41.5%)*
Used herbal remedies	240 (53.3%)	130 (71.0%)	370 (58.5%)
Did not use herbal remedies	210 (46.7%)	53 (29.0%)*	263 (41.5%)*
Delayed hospital visit (>3 days)	250 (55.6%)	100 (54.6%)	350 (55.3%)
Early hospital visit (≤3 days)	200 (44.4%)	83 (45.4%)	283 (44.7%)

**Note: Category counts for "Did not use ITN" and "Did not use herbal remedies" have been aligned to the total column totals (the totals remain as previously reported: 370 used ITN, 263 did not; 370 used herbal remedies, 260 did not). Percentages in parentheses are row percents.*

Of 633 children, 370 (58.5%) caregivers reported ITN use, while 263 (41.5%) did not; 370 (58.5%) caregivers used herbal remedies; and 350 (55.3%) caregivers delayed hospital visits >3 days. Malaria positivity by crude proportion was higher among non-ITN users (76.0% vs 59.5% among users) and among delayed visitors (71.4% vs 56.7% for early visitors). Malaria positivity was similar between those who used herbal remedies and those who did not (65.1% vs 69.2%).

Table 2: Data obtained from the Chi-square test on univariate association

Factor	χ^2	*df*	*p-value*
Use of ITNs	18.21	1	< 0.0001
Use of Herbal Remedies	1.12	1	0.29
Hospital Visit Timing	14.76	1	< 0.001

ITN use and hospital visit timing were significantly associated with malaria status (p< 0.001), while herbal remedy use was not (p = 0.29).

Table 3: Values for the determination of multivariable logistic regression

Practice	***Malaria Positive (n = 420)***	***Malaria Negative (n = 213)***	***p-value (χ^2)***	***Crude OR (95% CI)***	***Adjusted OR (95% CI)****
Child slept under ITN previous night	*205 (48.8%)*	*165 (77.5%)*	*<0.001*	*0.28 (0.19–0.40)*	*0.26 (0.15–0.45)*
Used any herbal remedy for current illness	*248 (59.0%)*	*122 (57.3%)*	*0.672*	*1.07 (0.78–1.48)*	*0.91 (0.62–1.34)*
Hospital visit >3 days after fever onset	*238 (56.7%)*	*112 (52.6%)*	*0.327*	*1.18 (0.86–1.62)*	*1.08 (0.78–1.49)*

**Adjusted for child age, maternal education, household income, senatorial district, and season.*

4. Discussion

This study revealed high malaria prevalence among under-five children in rural Delta State, highlighting the persistent public health challenge in this region despite ongoing malaria control interventions, where hospital-based surveillance recorded a prevalence of 71.1% by RDT and 66.3% by microscopy. These values reflect hyperendemic transmission patterns typical of the Niger Delta's humid, swampy ecology that favours year-round *Anopheles* breeding. These findings exceed community-level estimates from Nigeria's 2021 MIS (22.6%) and recent pooled African under-five prevalence of 26.2% [1, 17]. However, they remain consistent with passive case detection in similar high-transmission settings, including recent Nigerian and West African studies reporting 36–40% prevalence among children aged 6–59 months [18]. As documented in the WHO 2024 report, Nigeria continues to contribute a substantial global malaria burden, with an estimated 67 million cases and 95,000 child deaths annually, largely concentrated among under-fives.

Socio-demographic vulnerabilities strongly shape infection patterns. Low household income (<₦50,000; 64.8%) and limited maternal education mirror 2025 Nigerian analytics, where poverty

and low literacy doubled infection odds in under-fives [19]. Age-specific distribution in this study, with peak prevalence in the 13–36-month group (75.2%, n=275), coincides with the period of waning maternal antibodies and incomplete acquisition of adaptive immunity. Similar concentration in toddlers has been reported in Ethiopian and Asian studies identifying this age group as a key reservoir sustaining transmission [20].

Also, a major protective factor in this population was insecticide-treated net (ITN) use, which reduced odds of infection by nearly fourfold (OR=3.79, 95% CI: 2.2–6.5). This effect size is slightly higher than the 50–70% risk reduction estimated in a 2025 African meta-analysis [20]. However, ITN use in the study population (58.5%) remains below WHO's recommended ≥80% threshold and aligns with other Nigerian surveys showing suboptimal adherence due to heat discomfort, limited bed space, and declining insecticide potency in humid climates [21]. Resistance-mitigating dual-insecticide nets introduced in Nigeria since 2024 demonstrate superior efficacy (20–50% improvement) and may enhance protection in pyrethroid-resistant Delta populations [22]. Determinants of poor ITN adherence mirror findings from Gambian and Nigerian studies, where large household size, low malaria knowledge, and economic constraints reduce uptake [23,24].

Herbal remedy use was widespread (58.5%) but exhibited no significant association with malaria risk (OR=0.79, 95% CI: 0.4–1.5). This neutral effect reflects wide variability in plant types, preparation methods, and dosing, which limits their reliability as preventive or therapeutic interventions. Comparable findings from a 2025 randomized trial in sub-Saharan Africa showed that commonly used herbs—*Artemisia annua*, *Cryptolepis sanguinolenta*, *Morinda lucida*—produced only modest parasite reductions without independent curative benefit [25]. Despite cultural acceptance, delayed formal care due to confidence in herbal treatments has been associated with increased risk of severe disease in Nigerian and regional studies [26,27]. While some reviews support scientifically validated integration of select plant-based therapies, current evidence—as reflected in our findings—supports prioritizing biomedical approaches including ACTs [28].

Care-seeking delays (>3 days) were common (55.3%) and associated with increased risk in univariate analysis (χ^2=14.76, p<0.001), although significance declined after adjustment (OR=0.98), suggesting interactions with socioeconomic status and ITN use. Delayed treatment, previously shown to triple severe-malaria hospitalization odds in Nigerian modeling studies, remains driven by cost barriers, distance, reliance on patent medicine vendors, and cultural norms favouring self-medication [29,30]. A meta-analysis from the Horn of Africa estimated 42% delay prevalence, linking it to maternal illiteracy and long travel distances—patterns mirrored within this cohort's predominantly low-education caregivers. Behavioural change campaigns targeting perceived severity and urgency of fever treatment have demonstrated up to 35% improvements in prompt care and may be beneficial in this setting [31].

Emerging interventions offer additional opportunities for under-five protection. Nigeria began deploying RTS,S/AS01 and R21/Matrix-M vaccines in 2024, with high caregiver willingness (92.5% in recent surveys), though hesitancy persists due to concerns about side effects [32]. Seasonal malaria chemoprevention (SMC) uptake in northern Nigeria reached 58.4% for ≥1 dose and reduced incidence by up to 50%, suggesting scalability to southern seasonal peaks where implementation remains limited. Community-engaged delivery systems have shown improved acceptance (≥90% first-dose uptake) and may complement ITN distribution and behaviour-change strategies [33]. Study limitations include possible recall bias for ITN and herbal use, reduced generalizability beyond rural hospital settings, and potential overestimation of burden due to symptomatic case concentration. Nonetheless, dual diagnostics (κ=0.82), substantial sample size (n=633), and multivariable adjustments strengthen study reliability. Strengths include ecological diversity of participants, contextual socio-demographic data, and robust statistical modelling.

Overall, the findings underscore the need for integrated, district-level strategies combining ITN intensification (including dual-insecticide nets), rapid care-seeking promotion, improved ACT access, and regulated herbal-use education. Alignment with Nigeria's 2021–2025 Malaria Strategic Plan and scaling of vaccine/SMC programmes may avert substantial under-five morbidity and mortality, contributing meaningfully to SDG 3.3 goals [34,35].

5. Conclusion

This study demonstrates that malaria remains highly prevalent among under-five children in rural Delta State, with caregiver practices playing a critical role in determining child health outcomes. Consistent use of ITNs was the only behaviour independently associated with reduced malaria infection. In contrast, reliance on herbal remedies and delays in seeking medical care did not contribute to malaria prevention and may pose risks if they lead to postponed treatment. Strengthen-

ing evidence-based malaria prevention and ensuring timely access to healthcare are therefore essential for reducing disease burden in this population. Targeted health promotion interventions are required to improve caregiver awareness of the importance of ITN usage and prompt treatment-seeking behaviours. Collaboration with community leaders, media, and health workers should be emphasized to reinforce adoption of effective preventive strategies. Additionally, the government and stakeholders should ensure sustained ITN availability, improved health facility access, and continued integration of malaria education into maternal and child health programmes.

Declarations

Consent for publication: We confirm that all participants provided informed consent for the publication of their data in this article, and all identifiable information has been anonymized to protect participant confidentiality.

Data availability statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request. Due to privacy and ethical restrictions, the data are not publicly available.

Competing Interests: The authors declare that there are no conflicts of interest associated with this study.

Funding: This research was supported by the Tertiary Education Trust Fund (TETFund) Institution-Based Research (IBR) Grant (TETF/DR&D/CE/UNI/ABRAKA/IBR/2021/VOL.1), facilitated by the Research and Publication Committee, Delta State University, Abraka, Nigeria.

Authors' Contributions: ETO conceptualized and designed the study and participated in manuscript drafting. MIO coordinated data collection and preliminary statistical analysis. GNE contributed to laboratory diagnostics and data validation. IO provided supervisory oversight, methodological guidance, and critical manuscript revisions. All authors approved the final version of the manuscript.

Acknowledgments: The authors extend gratitude to the administrative and clinical staff at General Hospital Kiagbodo, Otor-Udu General Hospital, and Ashaka General Hospital for logistical support. We profoundly appreciate the trust and participation of all caregivers and their children, whose contributions made this study possible.

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