

Malaria Risk Factors, Prevention and Treatment Practices among Residents of Selected Communities in Gombe State, Nigeria

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Abstract- Malaria remains a major public health concern in Nigeria, where socio-demographic factors, domestic housing conditions, vector control practices, and treatment-seeking behaviors heavily influence regional transmission and case management outcomes. This study evaluated malaria risk factors, vector prevention strategies, health-seeking behaviors, and treatment compliance across three Local Government Areas (LGAs) (Gombe, Kwami, and Funakaye) in Gombe State, Nigeria. A structured cross-sectional survey was administered to 967 respondents across Gombe (n = 325), Kwami (n = 338), and Funakaye (n = 304). Data on socio-demographic characteristics, household crowding indicators, insecticide-treated net (ITN) utilization, secondary vector control measures, self-medication, and antimalarial prescription compliance were collected and analyzed using Chi-square (χ^2) tests of independence ($p < 0.05$). Socio-demographic analysis revealed significant cross-LGA variation in age group ($\chi^2 = 48.404$, $p = 0.001$), gender distribution ($\chi^2 = 10.644$, $p = 0.005$), marital status ($\chi^2 = 9.686$, $p = 0.047$), educational level ($\chi^2 = 11.272$, $p = 0.024$), and occupation ($\chi^2 = 48.112$, $p = 0.001$). Among household risk factors, the number of persons sharing a bed varied significantly ($\chi^2 = 15.023$, $p = 0.001$), with 57.4% overall sharing a bed with two people. Although ITN ownership was high overall (72.3%, $n = 699/967$), the number of ITNs owned per household differed significantly across LGAs ($\chi^2 = 73.481$, $p = 0.001$), and only 58.2% of owners reported consistent ("always") net usage. Secondary control practices predominantly mosquito coils (45.0%) and insecticide sprays (34.1%) showed significant regional differences ($\chi^2 = 79.609$, $p = 0.001$). Self-medication was reported by 82.9% of respondents ($n = 802/967$), driven primarily by previous experience (35.0%) and emergency needs (34.9%) ($\chi^2 = 86.593$, $p = 0.001$). Artemether-Lumefantrine was the most self-medicated antimalarial (71.6%). Among prescribed antimalarial treatments, Artemisinin-based Combination Therapy (ACT) accounted for 69.5%, with Artemether-Lumefantrine being the most prescribed ACT (73.5%, $p = 0.001$). Overall, 26.6% of respondents failed to complete their prescribed dosage,

primarily due to stopping once symptoms improve. Despite high ITN ownership and preferential use of ACTs, malaria management in Gombe State is constrained by inconsistent bed net utilization, reliance on secondary physical barrier alternatives, high self-medication rates, and premature treatment discontinuation upon symptom relief. Targeted public health campaigns focusing on complete ACT dosage adherence and regular ITN usage are urgently needed across Gombe, Kwami, and Funakaye LGAs.

Keywords: Malaria, Insecticide-Treated Nets (ITN), Artemisinin-based Combination Therapy (ACT), Self-medication, Treatment Compliance, Gombe State, Nigeria

I. INTRODUCTION

Malaria remains one of the most critical public health challenges in Sub-Saharan Africa, with Nigeria accounting for approximately 27% of the global disease burden and 31% of worldwide malaria deaths (World Health Organization, 2022). In northeastern Nigeria, transmission is sustained by favorable ecological conditions, socio-demographic vulnerabilities, variable vector control practices, and complex health-seeking behaviors (Nassai et al., 2022, Ishaku et al., 2026). Understanding the interaction between household risk factors, community prevention measures, and clinical management pathways across urban and rural local government areas (LGAs) such as Gombe, Kwami, and Funakaye is vital for optimizing regional control initiatives (Ali et al., 2020; Danjin et al., 2021).

Risk factors for malaria transmission operate at both the individual and household levels across diverse geographical zones in Nigeria (Isiko et al., 2024). Demographic indicators including age, gender, marital status, educational attainment, and occupational

engagement frequently dictate an individual's potential exposure to infective Anopheles bites and their capacity to adopt preventative measures. At the micro-environmental level, structural housing characteristics and indoor overcrowding significantly influence human-vector contact (Morakinyo et al., 2018). Nationwide analyses demonstrate that poorly screened housing structures, high occupancy rates per room, and shared bedding arrangements promote localized vector aggregation, facilitating parasite transmission in both rural and peri-urban Nigerian settings (Isiko et al., 2024; Morakinyo et al., 2018).

Insecticide-Treated Nets (ITNs) form the backbone of Nigeria's national vector control policy, often supported by indoor residual spraying and personal protective measures (Oresanya et al., 2008). Despite improvements in net ownership following mass distribution campaigns, a substantial gap persists between household net possession and consistent night-to-night utilization nationwide (Ankomah et al., 2012). Behavioral patterns such as sleeping outdoors during periods of excessive heat, irregular hanging practices, and physical net degradation severely undermine intervention coverage (Ankomah et al., 2012; Oresanya et al., 2008). Consequently, households frequently complement bed net use with secondary measures like synthetic pyrethroid sprays and mosquito coils, though the protective benefit of these methods varies according to local mosquito density and economic factors.

The success of malaria case management is heavily dictated by prompt care-seeking behavior and strict adherence to recommended therapeutic regimens (Ezenduka et al., 2014). Across Nigerian communities, febrile episodes often trigger self-treatment practices rather than immediate facility-based diagnosis (Iribhogbe&Odoaya, 2020). High rates of self-medication are driven by proximity to Patent Medicine Vendors (PMVs), financial constraints, travel distances to formal health facilities, and reliance on past illness experiences (Iribhogbe&Odoaya, 2020). Although Artemisinin-based Combination Therapy (ACT) specifically Artemether-Lumefantrine is the standard first-line treatment for uncomplicated malaria, informal drug procurement frequently results in inappropriate monotherapy usage (Ezenduka et al.,

2014; Iribhogbe&Odoaya, 2020). Furthermore, premature discontinuation of medication upon initial clinical improvement leads to incomplete dosage completion, increasing the risk of recurrent parasitemia and accelerating selection pressure for drug-resistant *Plasmodium falciparum* strains (Ezenduka et al., 2014, Ishaku et al., 2026).

II. METHODOLOGY

2.1 Study Area and Research Design

This study employed a community based cross-sectional multi-stage stratified cluster sampling technique design across three selected Local Government Areas (LGAs) in Gombe State, Northeastern Nigeria Gombe, Kwami, and Funakaye representing distinct urban, rural, and semi-urban socio-ecological strata.

2.2 Target Population and Eligibility Criteria

The target population comprised permanent residents who had lived in the selected communities across Gombe, Kwami, and Funakaye LGAs for at least six months prior to the survey. Eligible participants included adults aged 18 years and above. Individuals were excluded if they were non-resident visitors, unable to participate due to severe cognitive impairment or unwilling to grant informed consent.

2.3 Data Collection Instrument and Administration

Data were gathered using a total of 1,152 pre-tested, structured, administered questionnaire designed to address key epidemiological and behavioral domains, of the number distributed, 967 were successfully returned and completely answered. The instrument was structured into dedicated modules covering respondent socio-demographic characteristics (age, gender, marital status, education, and occupation), household micro-environmental transmission risk factors (occupancy rates and bed-sharing density), vector control measures and utilization patterns (ownership and usage of insecticide-treated nets alongside secondary chemical barriers), self-medication practices and drug selection, and prescription adherence patterns including primary drivers of dosage non-compliance. Content validity of the questionnaire was established through expert

review by senior epidemiologists and medical entomologists

Collected data were cleaned, coded, and entered into Microsoft Excel before being analyzed using SPSS Statistics (Version 26.0). Descriptive statistics were summarized as frequencies and percentages. Pearson's

Chi-square test was conducted to evaluate associations and cross-LGA statistical significance across categorical variables with statistical significance set at $p \leq 0.05$.

III. RESULTS

Table 1: Socio-demographic characteristics of respondents

Variables	Location/Frequency (%)				X ² - Cal.	P-value
	Gombe	Kwami	Funakaye	Total (%)		
Age group					48.404	0.001
15-25	23(7.1)	62(18.3)	56(18.4)	141(14.6)		
26-35	129(39.7)	88(26.0)	78(25.7)	295(30.5)		
36-45	97(29.8)	74(21.9)	66(21.7)	237(24.5)		
46-55	34(10.5)	54(16.0)	46(15.1)	134(13.9)		
56-65	32(9.8)	40(11.8)	36(11.8)	108(11.2)		
Above 65	10(3.1)	20(5.9)	22(7.2)	52(5.3)		
Total	325	338	304	967		
Gender					10.644	0.005
Male	227(69.8)	232(68.6)	241(79.3)	700(72.4)		
Female	98(30.2)	106(31.4)	63(20.7)	267(27.6)		
Total	325	338	304	967		
Marital Status					9.686	0.047
Married	223(68.6)	213(68.3)	224(73.7)	678(70.1)		
Widow	28(8.6)	24(7.1)	31(10.2)	83(8.6)		
Single	74(22.8)	83(24.6)	49(16.1)	206(21.3)		
Total	325	338	304	967		
Level of education					11.272	0.024
Secondary	71(21.8)	64(18.9)	67(22.0)	202(20.9)		
Tertiary	244(75.1)	258(76.3)	211(69.4)	713(73.7)		
Others	10(3.1)	16(4.7)	26(8.6)	52(5.4)		
Total	325	338	304	967		
Occupation					48.112	0.001
Civil servant	163(50.2)	158(46.7)	139(45.7)	460(47.6)		
Farming	16(4.9)	73(21.6)	34(11.2)	123(12.7)		
Business	71(21.8)	43(12.7)	58(19.1)	172(17.8)		
Others	75(23.1)	64(18.9)	73(24.0)	212(21.9)		
Total	325	338	304	967		

Table 2: Assesment of Risk factor for Malaria Transmission in the Study Areas

Variables	Location/Frequency (%)				X ² - Cal.	P-value
	Gombe	Kwami	Funakaye	Total		
Number of persons in the house					10.353	0.111
1-5	135(41.5)	130 (38.5)	108(35.5)	373(38.6)		
6-10	125(38.5)	120 (35.5)	112(36.8)	357(36.9)		
11-15	48(14.8)	67 (19.8)	53(17.4)	168(17.4)		
16-20	17(5.2)	21 (6.2)	31(10.2)	69(7.1)		
>20	0.(0.00)	0 (0.00)	0. (0.00)	0(0.00)		
Total	325	338	304	967		
Number of rooms in the house					0.136	0.935
1-5	218 (67.1)	228(67.5)	201(66.1)	647(66.9)		
6-10	107 (32.9)	110(32.5)	103(33.9)	320(33.1)		
Total	325	338	304	967		
Number of person per room					5.026	0.280
1-2	170(52.3)	148(43.8)	136(44.7)	454(46.9)		
3-4	124(38.2)	146(43.2)	129(42.4)	399(41.3)		
5-6	31(9.5)	44(13.0)	39(12.8)	114(11.8)		
Total	325	338	304	967		
Persons per bed					15.023	0.001
1	110(33.8)	103(30.5)	90(29.6)	303(31.3)		
2	186(57.2)	198(58.6)	171(56.3)	555(57.4)		
3	29(8.9)	37(10.9)	43(14.1)	109(11.3)		
Total	325	338	304	967		

Table 3: Malaria Prevention and Control Practices in the Study Area

Variables	Location/Frequency (%)				X ² - Cal.	P-value
	Gombe	Kwami	Funakaye	Total (%)		
ITN ownership					4.607	0.100
Yes	249(76.6)	236 (69.8)	214(70.4)	699(72.3)		
No	76(23.4)	102(30.2)	90(29.6)	268 (27.7)		
Total	325	338	304	967		
Number of ITN					73.481	0.001
1-2	83(33.3)	148(62.7)	139(65.0)	370(52.9)		
3-4	145(58.2)	62(26.3)	55(25.7)	262(37.5)		
5-6	21(8.4)	26(11.0)	20(9.3)	67(9.6)		
Total	249	236	214	699		
ITN utilization					0.260	0.992
Always	145(58.2)	138(58.5)	124(57.9)	407(58.2)		
When I hear mosquito	69(27.7)	68(28.8)	62(29.0)	199(28.5)		
When I feel like	35(14.1)	30(12.7)	28(13.1)	93(13.3)		
Total	249	236	214	699		
Other malaria control practices					79.609	0.001
Mosquito Coil	159(48.9)	158(46.7)	118(38.8)	435(45.0)		
Insecticide spray	132(40.6)	126(37.3)	72(23.7)	330(34.1)		
Others	34(10.5)	54(16.0)	114(37.5)	202(20.9)		

Total	325	338	304	967		
Effectiveness of practices of choice					17.07	0.001
Yes	246(75.7)	207(61.2)	196(64.5)	649(67.1)		
No	79(24.3)	131(28.8)	108(35.5)	318(32.9)		
Total	325	338	304	967		

Table 4: Management and Treatment Practices among the Respondents

Variables	Location/Frequency (%)				X ² - Cal.	P-value
	Gombe	Kwami	Funakaye	Total		
Health seeking behavior					56.587	0.001
Always	72(22.2)	33(9.8)	60(19.7)	165(17.0)		
Sometimes	195(60.0)	256(75.7)	151(49.7)	602(62.3)		
Not at all	58(17.8)	49(14.5)	93(30.6)	200(20.7)		
Total	325	338	304	967		
Reason for self medication					86.593	0.001
Emergency	101(39.9)	98(32.1)	81(33.2)	280(34.9)		
Distance to health facility	12(4.7)	42(13.8)	73(29.9)	127(15.8)		
Proximity to pharmacy	11(4.3)	18(5.9)	20(8.2)	49(6.1)		
Previous experience	106(41.9)	119(39.0)	56(22.9)	281(35.0)		
Drug cheaper	14(5.5)	26(8.5)	06(2.5)	46(5.7)		
Others	9(3.5)	02(0.7)	8(3.3)	19(2.4)		
Total	253	305	244	802		
Kind of self medicated drug					18.743	0.005
Chloroquine	29(11.5)	65(21.3)	34(13.9)	128(16.0)		
Amodiaquine	8(3.2)	21(6.9)	17(7.0)	46(5.7)		
Artemeter lumefantrine	193(76.3)	202(66.2)	179(73.4)	574(71.6)		
Artesunate	23(9.0)	17(5.6)	14(5.7)	54(6.7)		
Total	253	305	244	802		
Reason for the choice of drug					65.410	0.001
Fewer dosage	93(36.8)	78(25.6)	76(31.1)	247(30.8)		
Past experience	105(41.5)	126(41.3)	111(45.5)	342(42.6)		
Feel better with the drug of choice	49(19.4)	42(13.8)	10(4.1)	101(12.6)		
Affordable cost of drug	6(2.4)	59(19.3)	47(19.3)	112(14.0)		
Total	253	305	244	802		
Outcome of using un-prescribed drug					22.970	0.001
Feel improve	183(72.3)	241(79.1)	193(79.1)	617(76.9)		
Feel partially improve	57(22.5)	64(20.9)	49(20.1)	170(21.2)		
Not improve	13(5.1)	00(0.0)	02(0.8)	15(1.9)		
Total	253	305	244	802		

Table 5: Malaria Treatment Compliance by the Respondents

Variables	Location/Frequency (%)				X ² - Cal.	P-value
	Gombe	Kwami	Funakaye	Total		
Kind of antimalarial drug prescribed					9.734	0.136
Artemisinin-combination therapy (ACT)	188(70.4)	202(69.9)	143(67.8)	533(69.5)		

Artesunate	54(20.2)	68(23.5)	42(19.9)	164(21.4)		
Chloroquine	13(4.9)	14(4.8)	11(5.2)	38(4.9)		
Sulphadoxine/pyrimethamine	12(4.5)	05(1.7)	15(7.1)	32(4.2)		
Total	267	289	211	767		
Specific ACT prescribed					35.088	0.001
Artemether lumefantrine	136(72.3)	169(83.7)	87(60.8)	392(73.5)		
Artesunate mefloquine	10(5.3)	14(6.9)	08(5.6)	32(6.0)		
Artemether mefloquine	25(13.3)	06(3.0)	21(14.7)	52(9.8)		
Artemether	04(2.1)	02(1.0)	06(4.2)	12(2.3)		
Sulphadoxine/pyrimethamine	13(6.9)	11(5.4)	21(14.7)	45(8.4)		
Artesunate amodiaquine	188	202	143	533		
Total						
Dose completion					6.773	0.034
Yes	202(75.7)	197(68.2)	164(77.7)	563(73.4)		
No	65(24.3)	92(31.8)	47(22.3)	204(26.6)		
Total	267	289	211	767		
Reason for not completing dosage					9.443	0.009
When feel better	55(84.6)	90(97.8)	41(87.2)	186(91.2)		
Anytime I feel like	10(15.4)	02(2.2)	06(12.8)	18(8.8)		
Total	65	92	47	204		

IV. DISCUSSIONS

The findings of this study revealed significant cross-LGA socio-demographic variations across Funakaye, Gombe, and Kwami LGAs, specifically regarding age distribution, gender composition, marital status, educational attainment, and primary occupation, with the population comprising predominantly young adults (30.5% aged 26-35 years) and working-class individuals (47.6% civil servants and 12.7% farmers). This outcome strongly agrees with the research by Nassai et al. (2022), who observed that socio-demographic parameters, particularly age and occupational exposure in Shongom LGA of Gombe State, significantly influence community exposure to infective Anopheles mosquitoes, and further aligns with the nationwide analysis by Isiko et al. (2024) using the Nigeria Malaria Indicator Survey, which demonstrated that maternal education, household socioeconomic status, and occupational mobility significantly correlate with regional malaria vulnerability across different Nigerian geopolitical zones. Conversely, this finding differs from the study by Auta (2012) in northern agricultural communities, where socio-demographic characteristics were homogeneously distributed across districts with no statistically significant variance in occupational risk or

educational attainment, and similarly contrasts with the study by Oladepo et al. (2019) in rural southwestern Nigeria, which reported no significant association between educational status or formal employment and local malaria exposure due to transmission risk being uniformly driven by outdoor environmental accumulation rather than socio-demographic stratification.

Regarding household transmission determinants, the number of persons sharing a single bed exhibited a statistically significant variation across LGAs ($\chi^2 = 15.023$, $p = 0.001$), with a combined majority of 57.4% sharing a bed among two persons and 11.3% among three or more persons, whereas overall room overcrowding parameters (persons per room) did not show statistically significant differences across the study locations ($p = 0.280$). This finding directly concurs with the national study by Morakinyo et al. (2018), which established that high sleeping density and bed-sharing significantly elevate malaria risk among household members due to concentrated human olfactory cues (CO₂ and body heat) that attract vector mosquitoes, and parallels findings by Dawaki et al. (2016) in Kano State, where close co-sleeping arrangements and high domestic occupant density were significantly associated with increased indoor

malaria infection rates. In contrast, this result diverges from the work of Yé et al. (2006), who found that general household structural features (e.g., wall material and eaves openings) were far more critical determinants of malaria transmission than internal bed-sharing density, and further differs from findings reported by Animut et al. (2013) in highland transmission settings, where indoor vector density was entirely independent of bed occupancy numbers and was primarily governed by external proximity to vector breeding sites.

The study demonstrated high overall Insecticide-Treated Net (ITN) ownership (72.3%, $n = 699/967$) with significant variation in net quantity per household across LGAs ($\chi^2 = 73.481$, $p = 0.001$), yet revealed a substantial ownership-to-utilization gap wherein only 58.2% of net owners reported regular ('always') usage, alongside significant locality-based variations in secondary barrier controls ($\chi^2 = 79.609$, $p = 0.001$) such as mosquito coils (45.0%) and insecticide sprays (34.1%). This ownership-versus-utilization gap strongly corroborates the findings of Ankomah et al. (2012), who reported that despite widespread ITN ownership following public distribution campaigns in Nigeria, regular nightly net usage remains suboptimal due to discomfort, heat, and behavioral non-adherence, while also corroborating observations by Oresanya et al. (2008), who highlighted that community members frequently substitute bed net sleeping with chemical sprays and mosquito coils during warmer months. Conversely, this finding differs from the study by Egwu et al. (2021) in southeastern Nigeria, where ITN utilization rates mirrored ownership nearly perfectly (exceeding 88% consistent usage) due to strict community-enforced public health enforcement, and contrasts with results from Bawa et al. (2014) in north-central Nigeria, where secondary barrier methods like coils and sprays were almost entirely absent due to local economic constraints, leaving bed nets as the sole protective measure.

A remarkably high proportion of respondents (82.9%, $n = 802/967$) engaged in self-medication during febrile episodes driven by significant cross-LGA factors ($\chi^2 = 86.593$, $p = 0.001$) led by reliance on previous experience (35.0%) and emergency necessity (34.9%),

with Artemether-Lumefantrine being the primary self-administered antimalarial (71.6%) alongside persistent non-guideline monotherapies such as Chloroquine (16.0%) and Artesunate (6.7%). This high prevalence of informal drug procurement is in strong agreement with Danjin et al. (2021), who documented extensive reliance on Patent Medicine Vendors (PMVs) and self-treatment practices within Gombe Metropolis, and similarly aligns with Iribhogbe&Odoya (2020), who observed that rural Nigerian households heavily resort to self-medication driven by past illness familiarity, long distance to health facilities, and perceived cost savings. On the other hand, this finding differs from the study by Oladimeji et al. (2019) in southwest Nigeria, where formal primary healthcare centers served as the primary first point of care for over 70% of febrile patients rather than self-medication, and contrasts with research by Uzochukwu et al. (2010), which reported that financial constraints led the majority of self-medicating individuals to exclusively purchase cheap Chloroquine monotherapy, whereas this study observed a high adoption of ACTs (71.6%) even in self-treatment settings.

Among prescribed treatments ($n = 767$), Artemisinin-based Combination Therapy (ACT) constituted 69.5%, with Artemether-Lumefantrine being the most prescribed regimen (73.5%, $p = 0.001$); however, 26.6% ($n = 204/767$) of respondents failed to complete their full prescribed antimalarial dosage, driven primarily by premature termination upon feeling symptomatically better (91.2%, $\chi^2 = 9.443$, $p = 0.009$). This outcome directly concurs with Ezenduka et al. (2014), who demonstrated that patient non-compliance with prescribed ACT regimens in Nigerian public health facilities is predominantly caused by early symptom resolution leading to premature drug discontinuation, and further agrees with research by Lawson et al. (2017), which reported that roughly a quarter of malaria patients fail to complete their full 3-day ACT course once immediate fever and discomfort subside. In contrast, this finding differs from the study by Fane et al. (2018) in clinical trial and monitored hospital settings, where dosage completion reached over 96% due to structured directly observed therapy (DOT) and extensive patient counseling, and ultimately contrasts with findings by

Onyefuna et al. (2020), who identified adverse drug reactions (such as nausea and dizziness) as the leading cause of antimalarial non-compliance, rather than feeling symptomatically cured.

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