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Full-Length Research

Assessment of malaria prevalence and associated risk factors in Warri South Local Government Area, Delta State, Nigeria

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ABSTRACT: Malaria remains a significant public health burden in Nigeria; however, localised, community-level epidemiological data required to inform targeted interventions remain limited. This study assessed the prevalence of malaria and identified associated risk factors among adult residents of Warri South Local Government Area (LGA), Delta State, Nigeria, including the coverage and utilisation of insecticide-treated nets (ITNs). A cross-sectional study was conducted between November and December 2025 among 300 participants selected through multistage stratified random sampling. Data were collected using a structured questionnaire, while malaria infection was confirmed using HRP-II-based rapid diagnostic tests (RDTs). Statistical analyses, including descriptive statistics, Chi-square tests, and Fisher's exact tests, were performed to examine associations between malaria prevalence and selected sociodemographic, environmental, and behavioural factors. The findings revealed an overall malaria prevalence of 3.33%. Among the sociodemographic variables, only occupation was significantly associated with malaria infection ($p < 0.001$), with farmers exhibiting the highest prevalence (66.7%). Housing type was the only environmental factor significantly associated with infection ($p = 0.017$); individuals residing in unscreened cement houses had a prevalence of 14.3%, compared to 2.3% among those living in houses with screened windows and doors. None of the behavioural variables showed statistically significant associations, although notable trends were observed for delayed healthcare-seeking and poor treatment adherence. ITN ownership was 70.0%, while utilisation was considerably lower at 45.7%, indicating a 24.3% gap between ownership and use. These findings suggest that malaria risk in Warri South is primarily associated with occupational exposure and housing conditions rather than traditional environmental proximity factors. Therefore, effective malaria control strategies in this area should integrate housing improvements, occupational risk reduction, and targeted behavioural change interventions.

Keywords: Delta State, insecticide-treated nets, malaria prevalence, Nigeria, occupational risk, sociodemographic factors.

INTRODUCTION

Malaria is a life-threatening disease caused by Plasmodium parasites and transmitted through the bites of infected female Anopheles mosquitoes (World Health Organisation [WHO], 2024). Despite decades of control efforts, it remains a major global public health challenge, with approximately 236 million cases and 597,000 deaths reported worldwide in 2023, the majority occurring in the WHO African Region (WHO Regional Office for Africa, 2023; Talapko *et al.*, 2019). Sub-Saharan Africa bears a disproportionate share of this burden, accounting for about 94% of global cases and 95% of deaths, with children under five representing the majority of fatalities (WHO, 2023). The predominance of *Plasmodium falciparum,* the most virulent malaria parasite, further intensifies disease

severity in the region (Chavan *et al.,* 2023).

Nigeria carries the highest malaria burden globally, accounting for nearly 27% of total cases, with an estimated 68 million cases and 194,000 deaths in 2021 (WHO Regional Office for Africa, 2023). Transmission occurs year-round, particularly in southern regions where climatic conditions such as high temperature, humidity, and rainfall favour mosquito breeding and parasite development (NMEP *et al.*, 2022; CDC, 2024b). Although the Nigerian government, in collaboration with international partners, has implemented key control strategies, including insecticide-treated nets (ITNs), indoor residual spraying (IRS), chemoprevention, and public health education, progress remains uneven due to regional variations in transmission and intervention uptake (WHO, 2022; Ozodiegwu *et al.*, 2023).

Delta State, located in the South-South geopolitical zone, continues to experience sustained malaria transmission, with cases increasing from 1.4 million to 1.6 million between 2018 and 2021 (WHO, 2022). This trend is driven by environmental factors such as tropical climate, heavy rainfall, and stagnant water bodies, as well as socioeconomic challenges including poor sanitation and inadequate health infrastructure (NMEP, 2020).

Warri South LGA reflects these conditions, with additional risk factors such as poor drainage, rapid urbanisation, and overcrowding contributing to persistent transmission (WHO, 2023; Okunlola and Oyeyemi, 2019). Local studies report high malaria parasitaemia levels, indicating sustained disease burden within the area (Jemikalajah *et al.,* 2021; Kelechi and Omuemu, 2022).

Despite ongoing interventions, malaria remains endemic, highlighting the limitations of generalised control strategies. Moreover, most national and state-level surveys do not provide LGA-specific data, and existing studies largely focus on high-risk groups such as pregnant women and children under five, with limited attention to adults who may serve as asymptomatic reservoirs of infection (Nkumama *et al.,* 2017). This gap in localised, adult-focused evidence limits the effectiveness of targeted interventions.

This study therefore aims to determine the prevalence of malaria among adults in Warri South, identify associated risk factors, and assess ITN coverage and utilisation. The study provides localised evidence to inform targeted malaria control strategies and contributes to the broader literature on malaria in Nigeria and sub-Saharan Africa, supporting policy development and program implementation.

MATERIALS AND METHODS

Study area

The study was conducted in Warri South LGA, Delta State. This area experiences a tropical monsoon climate with a mean daily temperature of 26.7°C and annual rainfall of approximately 2,770 mm (Ndakara and Eyefia, 2024). The population's livelihoods are centred on oil and gas, agriculture (notably fish farming), and civil service (Oxford Business Group, 2024; Okpeke and Akarue, 2015; Delta State Government, 2024). The area is characterised by urbanisation, poor drainage infrastructure, and proximity to the Warri River, conditions that collectively sustain year-round malaria transmission (Okunlola and Oyeyemi, 2019).

Study design

A descriptive cross-sectional design was adopted to assess malaria prevalence and its associated risk factors between November and December 2025. This design is widely used for assessing malaria prevalence and associated risk factors (Wang and Cheng, 2020).

Study population

The study population comprised adults aged ≥18 years who had resided in Warri South LGA for at least two years and provided informed consent to participate in the study.

Sample size determination

The sample size was calculated using Cochran’s formula based on a malaria prevalence of 23.0% (Lemy *et al.,* 2022), a 95% confidence level, and a 5% margin of error. The calculated sample size was 273 participants. To account for a 10% non-response rate, the sample size was adjusted to 300 participants.

Sampling technique

A multistage stratified random sampling technique was employed. The study population was first stratified into the two dominant ethnic groups in Warri South LGA, namely Itsekiri and Urhobo, to ensure adequate representation of both groups. Within each stratum, communities were randomly selected, after which households were selected using simple random sampling. Finally, one eligible adult was randomly selected from each sampled household to participate in the study.

Reliability and validity of instruments

Reliability of the data collection instruments was assessed through internal consistency (Cronbach’s alpha ≥ 0.70), test-retest reliability using Pearson’s correlation coefficient (≥0.70), and inter-observer reliability for RDT interpretation

using Cohen's kappa to ensure consistency between health workers. The validity of the questionnaire was established through face and content validity, with expert reviews ensuring that the instrument was relevant, comprehensive, and aligned with the study objectives.

Data collection instruments and procedures

Data were collected using a structured questionnaire and HRP-II-based rapid diagnostic test (RDT) kits. The questionnaire captured sociodemographic, environmental, and behavioural variables and was administered through interviewer-guided sessions. Malaria testing was conducted by trained health personnel using WHO-recommended procedures. Participants who tested positive were referred for treatment.

Data analysis

Data were analysed using SPSS version 25.0. Descriptive statistics (frequencies and proportions) summarised participant characteristics and malaria prevalence. Associations between independent variables and malaria status were assessed using Chi-square or Fisher's exact tests, with statistical significance set at $p<0.05$ and a 95% confidence interval.

Ethical approval

Ethical approval was obtained from the Delta State Ministry of Health Ethics Committee (Approval No. CHW/ECCVOL.1/157). Participation was voluntary, informed consent was obtained, and all data were anonymized and securely stored.

RESULTS

Sociodemographic characteristics

All 300 sampled participants completed both the questionnaire and the RDT, achieving a 100% response rate. The sample was nearly balanced by gender (females 50.3%, males 49.7%), with the largest age range in the 39-48 years bracket (32.0%). The majority of respondents had attained at least secondary education (86.3%), and public servants constituted the largest occupational group (54.7%). 45.0% of the respondents lived in peri-urban areas, 27.4% in urban areas, and 27.6% in rural areas (Table 1).

Malaria prevalence

The overall malaria prevalence, as determined by RDT, was 3.33% (n=10 of 300). The remaining 96.67% (n=290) tested negative (Figure 1).

Table 1. Sociodemographic characteristics of the respondents.

Variables	Frequency (n=300)	Percentage (%)
Age (Years)		
18 -28	31	10.3
29-38	57	19.0
39-48	96	32.0
49-58	73	24.3
59 and above	43	14.3
Gender		
Female	151	50.3
Male	149	49.7
Level of Education		
No formal Education	11	3.7
Primary School	30	10.0
Secondary School	138	46.0
Tertiary	121	40.3
Occupation		
Civil Servants	16	5.3
Farmers	3	1.0
Public Servants	164	54.7
Traders/Entrepreneurs	101	33.7
Unemployed	16	5.3
Place of Residence		
Peri-urban	135	45.0
Rural	84	28.0
Urban	81	27.0

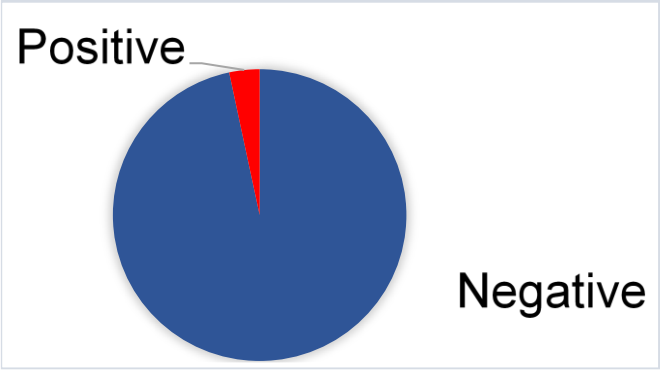

Figure 1. Distribution of Malaria RDT results in Warri South.

Sociodemographic factors associated with malaria prevalence

Bivariate analysis showed no significant association between malaria infection and gender ($p = 0.540$), age (p

Table 2. Association between sociodemographic characteristics and malaria infection in Warri South

Variables	RDT Test Results			Test Statistics	p-value
	Negative (n = 290)	Positive (n = 10)	Total		
	n (%)	n (%)	(N)		
Gender of Participants					
Female	147 (97.4)	4 (2.6)	151	†	0.540
Male	143 (96.0)	6 (4.0)	149		
Age of Participants					
18 - 28	31 (100.0)	0 (0.0)	31		
29 - 38	54 (94.7)	3 (5.3)	57		
39 - 48	95 (99.0)	1 (1.0)	96	† = 4.455	0.281
49 - 58	69 (94.5)	4 (5.5)	73		
59 and above	41 (95.3)	2 (4.7)	43		
Educational Level					
No formal	11 (100.0)	0 (0.0)	11		
Primary	28 (93.3)	2 (6.7)	30	† = 1.502	0.668
Secondary	134 (97.1)	4 (2.9)	138		
Tertiary	117 (96.7)	4 (3.3)	121		
Occupation					
Civil Servant	16 (100.0)	0 (0.0)	16		
Farmer	1 (33.3)	2 (66.7)	3	† = 19.670	
Public Servant	158 (96.3)	6 (3.7)	164	df = 4	< 0.001*
Trader	101 (100.0)	0 (0.0)	101		
Unemployed	14 (87.5)	2 (12.5)	16		
Place of residence					
Peri-urban	128 (94.8)	7 (5.2)	135		
Rural	82 (97.6)	2 (2.4)	84	† = 2.322	0.323
Urban	80 (98.8)	1 (1.2)	81		

*Statistical significant, X²Pearson Chi-square, †Fisher's Exact.

= 0.281), educational level (p = 0.668), or place of residence (p = 0.323). However, a statistically significant association was observed between occupation and malaria infection (Fisher's Exact = 19.670; p < 0.001), with farmers recording the highest group-specific prevalence at 66.7%, and no infections were detected among civil servants or traders, as shown in Table 2.

Environmental factors associated with malaria infection

Among the environmental variables examined, housing type was the only factor significantly associated with malaria infection (Fisher's Exact = 7.747; p = 0.017), with residents of cement houses with unscreened windows and doors recording a prevalence of 14.3%. Other environmental factors, including proximity to stagnant water, swamps, and waste disposal methods and environmental sanitation practices, were similarly non-significant (Table 3).

Behavioural factors and ITN coverage

No behavioural variable reached statistical significance in the bivariate analysis. However, clinically meaningful trends were evident. Respondents who reported not seeking care at all had a malaria prevalence of 11.5%, more than five times the 2.1% recorded among those who sought care within 24 hours, approaching but not reaching significance (p = 0.081). Similarly, those who never completed antimalarial dosage had a prevalence of 9.5%, compared to 3.3% among consistent adherers (p = 0.215). Frequent outdoor sleepers had a prevalence of 6.2% versus 1.5% among those who never slept outdoors (p = 0.182). ITN usage, both general frequency and previous-night use, showed no significant association with infection status (p = 0.841 and p = 1.000, respectively) (Table 4).

Table 3. Association between environmental characteristics and malaria infection in Warri South (RDT test results).

Variables	RDT Test Results			Test statistics	p-value
	Negative (n = 29 n (%)	Positive (n =10) n (%)	Total N		
Proximity to Stagnant Water					
No	146 (98.0)	3 (2.0)	149	†	0.336
Yes	144 (95.4)	7 (4.6)	151		
Proximity to Swamps					
No	250 (96.5)	9 (3.5)	259	†	1.000
Yes	40 (97.6)	1 (2.4)	41		
Proximity to Bushes					
No	145 (96.7)	5 (3.3)	150	$x^2 = 0.000$ df = 1	1.000
Yes	145 (96.7)	5 (3.3)	150		
Housing Type					
Cement House with Screened Windows	253 (97.7)	6 (2.3)	259		
Cement walls with no screening	24 (85.7)	4 (14.3)	28	† = 7.747	0.017*
Thatched Roof/Mud House	13 (100.0)	0 (0.0)	13		
Waste Disposal Method					
Burned	29 (96.7)	1 (3.3)	30		
Collected by Authorities	139 (95.9)	6 (4.1)	145	† = 0.762	0.643
Dumped in the Open/River	122 (97.6)	3 (2.4)	125		
Environmental Sanitation Practices					
Monthly	146 (96.1)	6 (3.9)	152		
Never	12 (100.0)	0 (0.0)	12	† = 2.698	0.334
Rarely	24 (92.3)	2 (7.7)	26		
Weekly	108 (98.2)	2 (1.8)	110		

*Statistical significant, X^2Pearson Chi-square, †Fisher's Exact

ITN coverage and utilization

70.0% of respondents reported owning at least one ITN, while actual utilisation (measured as sleeping under a net on the night preceding the survey) was 45.7%. This represents a 24.3% ownership-utilisation gap (Figure 2).

DISCUSSION

The malaria prevalence of 3.33% observed in this study is substantially lower than previously reported rates in Warri South and across Delta State, where RDT prevalence has ranged from 18.9% to over 60% in high-risk groups (WHO Regional Office for Africa, 2023; Kelechi and Omuemu, 2022; Kehinde *et al.,* 2022). This lower prevalence is likely attributable to the focus on the general adult population, who possess greater acquired immunity, the predominantly urban-peri-urban setting of participants, and the timing of data collection. Comparable low prevalence rates have been reported among adult populations in Ethiopia and India, reinforcing the pattern of reduced malaria burden in urban adult cohorts (Yhdego *et al.,* 2022; Hawadak *et al.,* 2026).

Occupation emerged as the only significant sociodemographic predictor ($p<0.001$), with farmers recording the highest prevalence (66.7%), highlighting outdoor agricultural activity as a key exposure pathway. This aligns with existing evidence linking increased malaria risk to farming activities during peak mosquito biting periods (Degarege *et al.,* 2019; Hussaini *et al.,* 2025). In contrast, the absence of infection among traders and civil servants likely reflects lower exposure due to indoor work environments and better access to preventive measures, while the moderate prevalence among the unemployed may be associated with socioeconomic disadvantage.

The lack of significant associations with age, gender, place of residence and education may be explained by the low number of positive cases, which limited the statistical

Table 4. Association between behavioural factors and malaria infection in Warri South.

Variables	RDT Test Results			Test statistics	p-value
	Negative (n=290)	Positive (n =10)	Total		
	n (%)	n (%)	N		
Place of Treatment Obtained					
Health Facility	104 (94.5)	6 (5.5)	110		
Chemist	172 (98.3)	3 (1.7)	175	† = 4.132	0.121
Traditional Healer	14 (93.3)	1 (6.7)	15		
Duration Before Seeking Care					
Within 24 hours	93 (97.9)	2 (2.1)	95		
After 24 hours	174 (97.2)	5 (2.8)	179	† = 4.742	0.081
Do not seek care	23 (88.5)	3 (11.5)	26		
Outdoor Sleeping Frequency					
Frequently	61 (93.8)	4 (6.2)	65		
Occasionally	97 (96.0)	4 (4.0)	101	† = 3.289	0.182
Never	132 (98.5)	2 (1.5)	134		
Treatment Adherence					
Always	203 (96.7)	7 (3.3)	210		
Sometimes	68 (98.6)	1 (1.4)	69	† = 3.067	0.215
Never	19 (90.5)	2 (9.5)	21		
ITN Usage (General)					
Always	121 (96.0)	5 (4.0)	126		
Sometimes	59 (98.3)	1 (1.7)	60	† = 0.552	0.841
Never	110 (97.5)	4 (3.5)	114		
Slept Under ITN the previous Night					
No	158 (96.9)	5 (3.1)	163	†	1.000
Yes	132 (96.4)	5 (3.6)	137		

*Statistical significant, †Fisher's Exact.

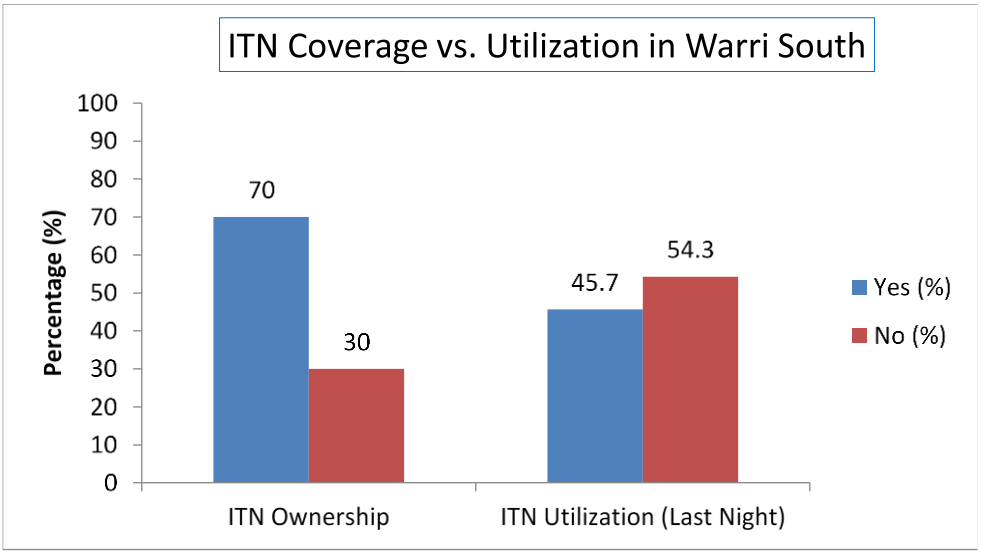

Figure 2. ITN Ownership vs. Utilization in Warri South.

power to detect differences across subgroups. This should be considered when interpreting these findings.

Housing type was significantly associated with malaria infection ($p = 0.017$), with a higher prevalence observed in unscreened houses. This supports existing evidence that improved housing is associated with reduced malaria transmission by limiting mosquito entry (Fox *et al.,* 2022; Tusting *et al.,* 2017). The absence of significant associations with environmental proximity factors may reflect the urban-peri-urban context, where exposure is more likely linked to occupational activities than residential location.

The observed gap between ITN ownership (70.0%) and utilisation (45.7%) highlights persistent behavioural barriers to effective malaria prevention. Although utilisation appears higher than state averages, inconsistent use reduces protective benefits. Additionally, ITNs offer limited protection against outdoor exposure, particularly among farmers, indicating the need for complementary interventions.

Although not statistically significant, trends in healthcare-seeking behaviour and treatment adherence suggest that delayed care and incomplete treatment may contribute to sustained transmission. These findings are consistent with existing evidence emphasising the importance of prompt diagnosis and adherence to treatment in reducing the malaria burden (WHO, 2022).

Conclusion

This study demonstrates that malaria prevalence among adults in Warri South LGA is relatively low at 3.33%, reflecting measurable progress in malaria control efforts in the area. However, the data reveal that specific, modifiable risk factors continue to sustain transmission. Occupation, particularly farming, and housing quality, specifically the absence of window screening, are the two most actionable risk factors identified. The significant ownership-utilisation gap in ITN use, combined with troubling trends in healthcare-seeking delays and treatment non-adherence, underscores that commodity availability alone does not translate into protection.

Limitation of the study

The cross-sectional approach used only captured malaria insight at one point in time, limiting insight into long-term trends or the significant seasonal variations inherent in malaria transmission patterns. Also, the relatively low overall prevalence detected (3.33%) may have limited the statistical power required to identify significant associations across certain environmental and behavioural variables.

Recommendations

Based on these findings, the following recommendations are made to the Delta State Ministry of Health, the State Malaria Elimination Programme, and relevant implementing partners:

1. Targeted Protection for Occupational Risk Groups: Given the high prevalence among farmers, the State Malaria Elimination Programme should distribute topical repellents or insecticide-treated clothing to outdoor workers and integrate malaria education into agricultural extension programs.
2. Strengthening Social and Behavioural Change Communication (SBCC): To bridge the 24.3% ownership-utilisation gap, public health campaigns must shift focus from net ownership to promoting consistent and correct usage by addressing barriers like heat discomfort and risk misconceptions.
3. Promotion of Housing Improvements: Given the significant association of malaria infection with housing, local authorities should encourage affordable structural mosquito-proofing, such as the installation of window and door screens, to prevent vector entry into domestic spaces.
4. Promotion of Early Healthcare-Seeking Behaviour: Interventions should emphasise prompt professional diagnosis and treatment while discouraging self-medication and incomplete antimalarial regimens.
5. Strengthening Environmental Vector Control: Health authorities should enhance Larval Source Management (LSM) through improved drainage, regular sanitation, and targeted larviciding of stagnant water bodies.

Suggestions for further study

Future research should include larger sample sizes to improve statistical power for detecting associations among specific demographic subgroups, incorporate longitudinal designs to capture seasonal variation in transmission, and explore community-level qualitative dimensions of care-seeking behaviour and ITN use in the Niger Delta context.

CONFLICT OF INTEREST

The author declares no conflicts of interest. No external funding was received for this study.

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