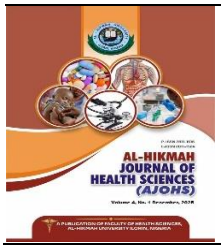
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Original Article

Availability and Utilisation Of Insecticide-Treated Nets Among Community Members in Ilorin Metropolis, Kwara State

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ABSTRACT

Background: Insecticide-treated nets (ITNs) remain a cornerstone of malaria prevention. This study assessed the availability and level of utilisation of insecticide-treated nets (ITNs) among community members in Ilorin Metropolis, Kwara State, Nigeria.

Methodology: A descriptive cross-sectional survey design was adopted among adult residents of Ilorin East, Ilorin West and Ilorin South Local Government Areas. A multistage sampling technique involving random selection of wards and communities and systematic sampling of households was used to select 400 respondents. Data were analysed using descriptive statistics and the Chi-square at 0.05 alpha level.

Results: Most respondents owned at least one ITN, mainly from government/NGO campaigns, but only 53.0% had enough nets for all sleeping members and 67.8% had nets in usable condition. ITN utilisation was moderate, highest for correct net hanging and use by children under five, lowest for net inspection and household-wide use. ITNs were significantly available, $\chi^2(1) = 388.267$, $p < .001$, and ownership was significantly related to household size, $\chi^2(2) = 14.382$, $p = .001$, rising from 67.9% in small to 87.8% in large households.

Conclusion: ITN ownership is high in Ilorin Metropolis but utilisation remains moderate rather than optimal, with gaps in net sufficiency, household-wide use and routine net inspection.

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Introduction

Malaria remains one of the most significant public health challenges in sub-Saharan Africa, particularly in Nigeria, where it is a leading cause of morbidity and mortality and disproportionately affects children under five years and pregnant women (Okonofua et al., 2020; World Health Organization [WHO], 2023). Globally, an estimated 263 million malaria cases and 597,000 malaria deaths occurred in 2023, with the WHO African Region carrying a disproportionately high share of the burden (WHO, 2024). Nigeria alone accounts for about 27% of global malaria cases and 31% of global malaria deaths (WHO, 2023). Within the country, the Federal Ministry of Health (FMOH, 2022) reported that malaria accounts for about 60% of outpatient visits, 30% of hospital admissions and 11% of maternal mortality.

Insecticide-treated nets (ITNs) remain a cornerstone of malaria prevention. They protect through a dual mechanism: a physical barrier that prevents mosquito bites during sleep, and insecticide that repels or kills mosquitoes on contact. The WHO recommends ITNs

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as a first-line defence for vulnerable groups, especially children under five years and pregnant women (WHO, 2022). A landmark Cochrane review found that ITNs reduce malaria incidence by about 50% when used consistently (Lengeler, 2004). These benefits, however, depend on nets being used, not merely owned.

Nigeria has invested heavily in ITN mass distribution campaigns supported by the National Malaria Elimination Programme and partners, and household ownership has improved (National Population Commission [NPC] *et al.*, 2021). Yet ownership does not translate automatically into use: the National Malaria Strategic Plan stresses that the effectiveness of ITNs depends on correct, consistent and equitable use, particularly in households with children under five years and pregnant women (FMOH, 2022). Reported reasons for not using a net when one is available include discomfort, lack of space or fixtures to hang nets, and poor net condition (Pulford et al., 2011; Balogun & Adeyemi, 2023), and misuse of nets for purposes such as fishing, gardening or covering food has also been reported in several Nigerian states (UNICEF, 2021). Socio-demographic factors such as age, education and household income are further associated with utilisation, with lower use reported among adult males and lower-income households (Ezeh *et al.*, 2023).

Ilorin Metropolis, a rapidly growing urban area in Kwara State, experiences high malaria transmission, especially in the rainy season, and government and non-governmental organisations have distributed ITNs there as part of malaria control programmes. However, there is limited empirical evidence on how many households actually have nets and how consistently and correctly those nets are used in this urban setting. The general objective of this study was to assess the availability and utilisation of ITNs among community members in Ilorin Metropolis, with the following specific objectives: to assess the availability of ITNs among community members in Ilorin Metropolis; and to determine the level of utilisation of ITNs among community members in Ilorin Metropolis.

Research Methodology

Research Design

A descriptive cross-sectional survey design was adopted for the study. The design allows data to be collected from a population at a specific point in time, enabling patterns and relationships between variables to be identified without manipulating the natural setting, and it is widely used in malaria-related behavioural research.

Study Area and Population of the Study

The study was conducted in Ilorin Metropolis, the capital of Kwara State in the North-Central region of Nigeria, which comprises Ilorin East, Ilorin West and Ilorin South Local Government Areas (LGAs). The metropolis is the administrative, commercial and educational hub of the state and has a tropical climate with a rainy season from April to October, which favours mosquito breeding. The projected population of the three LGAs in 2022 was approximately 1,155,215, based on the 2006 census and an annual growth rate of 2.6%. The population of the study comprised adult residents aged 18 years and above who had lived in the community for at least six months, with emphasis on household heads or decision-makers responsible for health-related practices in the family. Visitors, persons who were seriously ill or mentally incapacitated, and those who declined consent were excluded.

Sample Size Determination and Sampling Techniques

The sample size was determined using the formula for proportions in a large population, $n = Z^2pq/d^2$, as presented by Fisher et al. (1998) and consistent with the standard formula for cross-sectional surveys attributed to Cochran (1977), with $Z = 1.96$ (approximated to 2) at the 95% confidence level, $p = 0.5$ because no prior proportion was available, and a margin of error of 0.05, giving a sample size of 400. A multistage sampling technique was used. In the first stage, three wards were selected by simple random sampling (ballot method) from each of the three LGAs, out of 35 wards in total across the three LGAs (12 in Ilorin West, 12 in Ilorin East and 11 in Ilorin South), giving nine wards selected overall. In the second stage, questionnaires were allocated proportionately to the LGAs based on their relative number of wards (a 12:12:11 ratio for Ilorin West: Ilorin East: Ilorin South) rather than an equal split, giving 137 respondents each for Ilorin West and Ilorin East and 126 for Ilorin South. In the third stage, communities were randomly selected within the wards, and in the fourth stage, households were selected at intervals by systematic sampling, with one eligible respondent per household.

Research Instrument

Data were collected using a structured, close-ended questionnaire with sections on socio-demographic characteristics, availability and ownership of ITNs, and utilisation patterns and practices. Availability items were answered Yes or No, while utilisation items were measured on a four-point frequency scale of Always (4), Often (3), Rarely (2) and Never (1).

P-ISSN: 2811-1516
E-ISSN: 2811-1524

Validity and Reliability of the Instrument

The questionnaire was reviewed by specialists in public health and malaria control for content accuracy, relevance and alignment with the study objectives. A pre-test was conducted with 10% of the sample size (40 respondents) in Share, Ifelodun Local Government Area, Kwara State, to identify ambiguities and improve clarity. Reliability was tested using Cronbach's alpha, which yielded a coefficient of 0.82, indicating a high level of internal consistency.

Method of Data Collection

The questionnaire was administered face to face by trained research assistants who visited the selected households and obtained informed consent before administration. For respondents who could not read, the questions were read aloud in the local language and their responses recorded.

Method of Data Analysis

Data were coded and entered into the Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics of frequency, percentage, mean and standard deviation were used to answer the research questions. The chi-square goodness-of-fit test and the chi-square test of independence were used to test the hypotheses at 0.05 alpha level. For Table 4, the pooled chi-square statistic combines responses across the six availability/ownership items (total N = 2,400) into a single test of overall departure from an even 50/50 split; because the same 400 respondents answered all six items, this pooled statistic should be interpreted as indicating a consistent directional pattern of affirmative responses across items, rather than as an independent-samples test, and is reported alongside, rather than in place of, the item-level frequencies in Table 2 (see also Limitations).

Ethical Consideration

Ethical approval was obtained from the State Ministry of Health Ethical Review Committee (Approval Number: ERC/MOH/2026/07/808) prior to data collection. The study upheld the ethical principles governing research involving human subjects. Respondents were informed of the purpose of the study, participation was voluntary, informed consent was obtained, and respondents were assured of confidentiality, of no harm arising from participation and of fair treatment. Data were used solely for academic research and not disclosed to unauthorised persons.

Results

Table 1: Demographic Characteristics of Respondents

S/N	Characteristics	Frequency	Percentage (%)
1.	**Age Range**		
	18-23 years	75	18.8
	24-30 years	122	30.5
	31-40 years	131	32.8
	Above 40 years	72	18.0
	Total	**400**	**100.0**
2.	**Sex**		
	Male	189	47.3
	Female	211	52.8
	Total	**400**	**100.0**
3.	**Highest Level of Education**		
	No formal education	32	8.0
	Primary education	61	15.3
	Secondary education	163	40.8
	Tertiary education	144	36.0
	Total	**400**	**100.0**
4.	**Marital Status**		
	Single	118	29.5
	Married	236	59.0
	Widowed	28	7.0
	Divorced/Separated	18	4.5
	Total	**400**	**100.0**
5.	**Occupation**		
	Student	74	18.5
	Employed (Government/Private)	108	27.0
	Self-employed/Trader	158	39.5
	Unemployed	60	15.0
	Total	**400**	**100.0**

P-ISSN: 2811-1516
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Table 1 shows the demographic characteristics of the 400 respondents. The largest proportion, 131 (32.8%), were aged 31-40 years, followed by those aged 24-30 years, 122 (30.5%), indicating a predominantly young to middle-aged sample. Females, 211 (52.8%), were slightly more numerous than males, 189 (47.3%). Most respondents had attained secondary education, 163 (40.8%), or tertiary education, 144 (36.0%), while 32 (8.0%) had no formal education. Over half of the respondents, 236 (59.0%), were married, and self-employed persons/traders formed the largest occupational group, 158 (39.5%).

Research Question One: Are insecticide-treated nets (ITNs) available among community members in Ilorin Metropolis?

Table 2: Descriptive Statistics on Availability and Ownership of ITNs

Item	Yes	No	Mean	SD
1. Does your household currently own at least one ITN?	328 (82.0%)	72 (18.0%)	0.82	0.39
2. Was the ITN(s) obtained free of charge from government or NGO campaign?	296 (74.0%)	104 (26.0%)	0.74	0.44
3. Have you received any ITN from a health facility during ANC or immunisation visits?	218 (54.5%)	182 (45.5%)	0.55	0.50
4. Is the ITN(s) in your household currently in usable (non-torn/non-damaged) condition?	271 (67.8%)	129 (32.3%)	0.68	0.47
5. Are you aware of any ITN distribution programme currently ongoing in your community?	306 (76.5%)	94 (23.5%)	0.77	0.42
6. Do you have enough ITNs in your household to cover all sleeping members?	212 (53.0%)	188 (47.0%)	0.53	0.50
Grand Mean			**0.68**	

Table 2 shows that 328 (82.0%) of the respondents owned at least one ITN, 296 (74.0%) obtained their nets free of charge from government or NGO campaigns, and 306 (76.5%) were aware of an ongoing ITN distribution programme in their community. Fewer respondents, 218 (54.5%), had received an ITN from a health facility during antenatal or immunisation visits, and 271 (67.8%) reported that their nets were in usable condition. Only 212 (53.0%) had enough ITNs to cover all sleeping members of the household. The grand mean of 0.68 is reported here as a composite availability index (the mean proportion of affirmative responses across the six binary items) rather than as a mean of a continuous variable; it indicates that about 68% of responses were affirmative, showing that ITN ownership and awareness are relatively high in Ilorin Metropolis, but that important gaps remain in the adequacy and condition of nets.

Research Question Two: What is the level of utilisation of ITNs among community members in Ilorin Metropolis?

Table 3: Descriptive Statistics on Utilisation of ITNs

Item	Always	Often	Rarely	Never	Mean	SD
1. How often do you sleep under an ITN at night?	142 (35.5%)	118 (29.5%)	96 (24.0%)	44 (11.0%)	2.89	1.02
2. How often do all members of your household use the ITN when sleeping?	108 (27.0%)	124 (31.0%)	112 (28.0%)	56 (14.0%)	2.71	1.01
3. How often do children under five years sleep under an ITN?	156 (39.0%)	128 (32.0%)	78 (19.5%)	38 (9.5%)	3.01	0.98
4. How often do pregnant women in your household sleep under an ITN?	138 (34.5%)	112 (28.0%)	94 (23.5%)	56 (14.0%)	2.83	1.04
5. How often do you hang the ITN correctly over your sleeping area before going to bed?	162 (40.5%)	134 (33.5%)	74 (18.5%)	30 (7.5%)	3.07	0.94
6. How often do you inspect your ITN for holes or damage before use?	96 (24.0%)	108 (27.0%)	126 (31.5%)	70 (17.5%)	2.58	1.04
Grand Mean					**2.85**	

Note. Always = 4; Often = 3; Rarely = 2; Never = 1. Criterion mean = 2.50.

P-ISSN: 2811-1516
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Table 3 shows that correct hanging of the ITN before going to bed had the highest mean (3.07, 95% CI [2.98, 3.16]), followed by use by children under five years (mean = 3.01, 95% CI [2.91, 3.11]) and sleeping under an ITN at night (mean = 2.89, 95% CI [2.79, 2.99]). Use by pregnant women (mean = 2.83, 95% CI [2.73, 2.93]) and use by all household members (mean = 2.71, 95% CI [2.61, 2.81]) were lower, and inspection of the net for holes or damage before use recorded the lowest mean (2.58, 95% CI [2.48, 2.68]). The grand mean of 2.85 out of 4.00 indicates a moderate level of ITN utilisation, with gaps in household-wide use and net maintenance practices.

Hypotheses Testing

H_{01}: There is no significant availability of insecticide-treated nets (ITNs) among community members in Ilorin Metropolis.

Table 4: Chi-Square Goodness-of-Fit Test for Availability and Ownership of ITNs

Item	Yes n (%)	No n (%)	Total	χ^2
Household owns at least one ITN	328 (82.0%)	72 (18.0%)	400	
ITN obtained free of charge	296 (74.0%)	104 (26.0%)	400	
Received ITN from health facility	218 (54.5%)	182 (45.5%)	400	
ITN in usable condition	271 (67.8%)	129 (32.3%)	400	
Aware of ongoing ITN distribution programme	306 (76.5%)	94 (23.5%)	400	
Enough ITNs to cover all sleeping members	212 (53.0%)	188 (47.0%)	400	
Pooled Total	**1,631 (68.0%)**	**769 (32.0%)**	**2,400**	**388.267**

Note. Expected frequency = 50% Yes / 50% No. $p < .001$. Critical value $\chi^2(1) = 3.841$ at $p = .05$.

The chi-square goodness-of-fit test was statistically significant for the pooled total, $\chi^2(1) = 388.267$, $p < .001$, far exceeding the critical value of 3.841 at $\alpha = .05$. The null hypothesis is therefore rejected. As this pooled statistic combines non-independent, repeated-measures responses from the same 400 respondents across six items, it should be interpreted as showing that affirmative responses regarding ITN availability departed significantly, and consistently across items, from an even split, rather than as a single independent-samples test; this is corroborated by the item-level proportions in Table 2, all of which exceeded 50% affirmative responses. This implies that ITNs are widely and consistently reported as available among community members in Ilorin Metropolis, although gaps in net adequacy and condition qualify this finding.

H_{02}: There is no significant relationship between household size and ownership of ITNs among community members in Ilorin Metropolis.

Table 5: Chi-Square Test of Independence for Household Size and ITN Ownership

Household Size	Own ITN n (%)	No ITN n (%)	Total	χ^2	p-value
Small (1-2 members)	38 (67.9%)	18 (32.1%)	56		
Medium (3-5 members)	182 (82.0%)	40 (18.0%)	222		
Large (6+ members)	108 (87.8%)	15 (12.2%)	123		
Total	**328 (82.0%)**	**72 (18.0%)**	**400**	**$\chi^2(2) = 14.382$**	**p = .001**

Note. Household size was categorised as small (1-2 members), medium (3-5 members) and large (6+ members). df = 2. Critical value $\chi^2(2) = 5.991$ at $p = .05$.

The chi-square test of independence was statistically significant, $\chi^2(2) = 14.382$, $p = .001$. ITN ownership increased with household size: small households (67.9%), medium households (82.0%) and large households (87.8%). The null hypothesis is therefore rejected. This implies that there is a statistically significant positive relationship between household size and ITN ownership in the study area.

Discussion

Availability and Ownership of ITNs

The finding that 82.0% of respondents own at least one ITN indicates a high level of household ownership, consistent with the substantial investment by the National Malaria Elimination Programme and its partners in mass distribution in Kwara State. It is above the national ownership of approximately 73% reported in the 2021 Nigeria Malaria Indicator Survey (NPC et al., 2021), suggesting that ownership in Ilorin Metropolis may be slightly higher, possibly because of the concentration of distribution campaigns in urban areas. Ogidan et al. (2025) similarly reported that ITN ownership among women of reproductive age in Nigeria varies by geopolitical zone and socio-economic factors, with urban areas generally recording better ownership than rural areas.

However, only 53.0% of households had enough ITNs for all sleeping members, and 67.8% had nets in usable condition, so high ownership overstates the protection actually available. This gap is consistent with the WHO (2023) report that although 73% of Nigerian households owned at least one ITN, only 42% of

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household members slept under one. Andrada *et al.* (2019) found that subnational differences in ITN ownership and use are shaped by household demographics and geographic access, and Solanke *et al.* (2023) identified household net sufficiency as the strongest structural predictor of consistent use among childbearing women in Northern Nigeria. The results therefore point to the need for household-level needs assessments to complement population-level distribution campaigns.

Level of ITN Utilisation

The grand mean of 2.85, above the midpoint of 2.50 but below the "Often" threshold of 3.00, indicates moderate ITN utilisation and shows that a substantial proportion of owners do not use their nets consistently. This agrees with the FMOH (2022) observation that while ownership continues to improve, actual use remains suboptimal. Ezeh et al. (2023) also documented that age, educational attainment and household income are significantly associated with utilisation in Nigeria, with lower use among adult males and lower-income households.

Use by children under five years recorded one of the highest means (3.01), which is encouraging and aligns with the priority given to this group in distribution programmes. It should be interpreted carefully, however: high use among children may reflect parental concern for child health rather than household-wide protection, and use by all household members was lower (mean = 2.71). Okonofua et al. (2020) noted that in Nigerian households ITN use is often prioritised for children but inconsistently extended to adults, which limits the community-level benefit of nets in reducing transmission. Inspection of nets for holes or damage before use recorded the lowest mean (2.58), which is a concern because damaged nets give little protection while creating a false sense of security. Taken together with the finding that only two-thirds of households had nets in usable condition, this points to routine net maintenance and timely replacement as important gaps.

Availability of ITNs and Relationship with Household Size

The rejection of H_{01} confirms that ITNs are significantly available among community members in Ilorin Metropolis, although the shortfalls in net adequacy and condition qualify this finding. The rejection of H_{02} shows that ownership increased with household size, from 67.9% in small households to 82.0% in medium and 87.8% in large households. This suggests that larger households are more likely to own ITNs, possibly because they are more visible and are targeted during mass distribution campaigns, and because their perceived need is greater. It is in line with evidence that household demographics influence ITN ownership (Andrada *et al.*, 2019; Ogidan *et al.*, 2025). Since ownership alone does not guarantee use, larger households in particular need attention to ensure that the number of nets matches the number of sleeping spaces.

Conclusion

The study has shown that ITN ownership is high in Ilorin Metropolis, reflecting the investment made in mass distribution campaigns, and that ITNs are significantly available among community members. However, only about half of households have enough nets for all sleeping members, and about one-third do not have nets in usable condition. ITN utilisation is moderate rather than optimal, with children under five years and correct hanging of nets receiving the highest scores, while household-wide use and routine inspection of nets for damage remain the main behavioural gaps. Ownership is significantly related to household size, with larger households more likely to own ITNs.

Recommendations

Based on the study's findings, the following recommendations are suggested:

1. The National Malaria Elimination Programme, the Kwara State Ministry of Health and partner organisations should move from mass-coverage metrics to household-level sleeping-space coverage assessments in Ilorin Metropolis, so that every sleeping space is covered by a functional ITN, with particular attention to larger households.
2. A structured ITN replacement programme should be implemented for households with old or damaged nets, and community health workers and primary health care centres should conduct periodic household net condition assessments and facilitate timely replacement.
3. The National Malaria Elimination Programme and the Kwara State Primary Health Care Development Agency should enforce and monitor the provision of free ITNs at every antenatal care visit and childhood immunisation contact, with supply chain improvements to prevent stock-outs at facility level.
4. Community health extension workers and village health workers should be trained and deployed to provide household-level education on ITN use, demonstrations of correct hanging, and support for net inspection and maintenance as part of routine outreach.

Limitation of the Study

A descriptive cross-sectional design was used and the study was limited to adult residents of Ilorin Metropolis, so the findings cannot be generalised to

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rural areas of Kwara State or to other regions of Nigeria. In addition, ownership and utilisation were based on respondents' self-reports rather than direct observation of nets in the household, which could lead to recall and social desirability bias. The pooled chi-square goodness-of-fit test reported in Table 4 combines six non-independent items answered by the same 400 respondents; while this is reported alongside the item-level proportions in Table 2 (all of which independently exceeded 50% affirmative responses) as a conservative corroborating check, future analyses should treat each availability item as a separate test, or apply a method such as McNemar's test or generalised estimating equations that properly accounts for the repeated-measures structure of the data. Similarly, the "grand mean" reported for the binary availability/ownership items in Table 2 is a composite availability index rather than a mean of a continuous measure, and should be interpreted accordingly.

References

Andrada, A., Herrera, S., Inyang, U., Mohammed, A. B., Uhomoibhi, P., & Yé, Y. (2019). A subnational profiling analysis reveals regional differences as the main predictor of ITN ownership and use in Nigeria. *Malaria Journal, 18*, 185. https://doi.org/10.1186/s12936-019-2822-4

Balogun, F., & Adeyemi, T. (2023). Structural barriers to insecticide-treated net use in low-income urban housing in Nigeria. *International Journal of Environmental Research and Public Health, 20*(4), 3124. https://doi.org/10.3390/ijerph20043124

Ezeh, C. O., Adedire, E. B., Oladepo, O., & Adeola, O. (2023). Assessment of socio-demographic factors associated with the utilization of insecticide-treated nets among children under-5 years and pregnant women in Nigeria: Secondary analysis of 2021 NMIS data. *medRxiv.* https://doi.org/10.1101/2023.11.30.23299264

Federal Ministry of Health. (2022). *National Malaria Control Programme: Annual report.* Federal Ministry of Health.

Fisher, A. A., Laing, J. E., Stoeckel, J. E., & Townsend, J. W. (1998). *Handbook for family planning operations research design* (2nd ed.). Population Council.

Lengeler, C. (2004). Insecticide-treated bed nets and curtains for preventing malaria. *Cochrane Database of Systematic Reviews, 2004*(2), CD000363. https://doi.org/10.1002/14651858.CD000363.pub2

National Population Commission, National Malaria Elimination Programme, & ICF. (2021). *Nigeria Malaria Indicator Survey (NMIS) 2021.* NPC, NMEP, and ICF. https://dhsprogram.com/pubs/pdf/MIS41/MIS41.pdf

Ogidan, O. C., Nzoputam, C. I., Barrow, A., & Ekholuenetale, M. (2025). Prevalence and determinants of insecticide-treated net ownership among women of reproductive age in Nigeria: A mixed-effect insight from the 2021 malaria indicator survey. *Malaria Journal, 24*, 75. https://doi.org/10.1186/s12936-025-05314-9

Okonofua, F., Ntoimo, L., & Ogu, R. (2020). Prevalence and risk factors for malaria in Nigeria: Implications for control. *African Journal of Reproductive Health, 24*(2), 27-36.

Pulford, J., Hetzel, M. W., Bryant, M., Siba, P. M., & Mueller, I. (2011). Reported reasons for not using a mosquito net when one is available: A review of the published literature. *Malaria Journal, 10*, 83. https://doi.org/10.1186/1475-2875-10-83

Solanke, B. L., Soladoye, D. A., Birsirka, I. A., et al. (2023). Utilization of insecticide-treated nets and associated factors among childbearing women in Northern Nigeria: Insight from the 2021 malaria indicator survey. *Malaria Journal, 22*, 184. https://doi.org/10.1186/s12936-023-04620-4

UNICEF. (2021). *Malaria prevention: Insecticide-treated mosquito nets.* UNICEF. https://www.unicef.org/malaria/prevention

World Health Organization. (2022). *WHO guidelines for malaria, 3 June 2022.* WHO.

World Health Organization. (2023). *World malaria report 2023.* WHO.

World Health Organization. (2024). *World malaria report 2024.* WHO.