



Long-Lasting Insecticide-Treated Nets and Malaria Prevention: A Study of Women in Asa Local Government Area, Kwara State, Nigeria

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Received: 25.03.2026 | Accepted: 10.04.2026 | Published: 13.04.2026

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DOI: [10.5281/zenodo.19557857](https://doi.org/10.5281/zenodo.19557857)

Abstract

Review Article

Background: Malaria remains a significant public health challenge in Africa, imposing substantial burdens on both health and economic productivity. Women of reproductive age are particularly susceptible to malaria infection due to immunological changes during pregnancy, which increase the risk of severe malaria, maternal anemia, and mortality.

Objective: To assess the knowledge, attitude, and utilization of long-lasting insecticide-treated bed-nets (LLINs) among women of reproductive age in selected communities in Asa Local Government Area, Kwara State, Nigeria.

Methods: This study utilized a descriptive cross-sectional design to assess knowledge, attitude, and utilization of LLINs among women of reproductive age in selected communities within Asa Local Government Area, Kwara State. A multistage sampling technique was applied to select 360 women of reproductive age, and data were collected using a pretested, structured, interviewer-administered questionnaire. Analysis was performed with SPSS version 26.0. Descriptive statistics were used to summarize frequencies and percentages, while Chi-square tests examined associations between variables at a significance level of $p < 0.05$.

Results: The results showed that most respondents knew LLINs prevent malaria (84.7%), kill mosquitoes (80.3%), and require nightly use (72.5%). There was a positive attitude towards LLINs as the majority (81.7%) agreed to their importance for family health. A good utilization was also noted as 70.8% used LLINs nightly and 61.9% for children. Age, education, occupation, and number of children influenced knowledge and utilization ($p < 0.05$).

Conclusions: While awareness of LLINs is widespread in Asa LGA, actual usage is still influenced by a combination of personal, economic, and infrastructural factors. Gaps in utilization and seasonal use attitude highlight the need for targeted interventions to improve LLIN use and malaria prevention in the study area. There is a need for sustained health education and enhanced distribution of insecticide-treated bed-nets to overcome usage barriers.

Keywords: Long-Lasting Insecticide-treated Bed-Nets, Women of Reproductive Age, Knowledge, Asa LGA, Kwara State, Nigeria.

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Introduction

Malaria remains a major public health challenge, especially in Africa, because the disease affects both public health and economic development (WHO,2023). In 80 countries globally in 2024, there were an estimated 282 million cases of malaria with 610 000 deaths (WHO,2025). Africa bears the disproportionate brunt of global malaria, with 95% of cases (265 million) and 95% (579,000) deaths from malaria in 2024 alone. More than half of all malaria deaths in Africa occurred in just three countries: Nigeria (31.9%), the Democratic Republic of the Congo (11.7%), and Niger (6.1%) (WHO,2025). The disease has a greater impact on vulnerable groups, including children under 5 years of age, pregnant women or women of reproductive age, people living in areas with high malaria transmission, people with weakened immune systems, refugees and displaced persons, and travelers to malaria-endemic areas (WHO,2023).

Women of reproductive age are especially susceptible to malaria infection because immunological changes during pregnancy increase their risk of severe malaria, maternal anemia, low birth weight, stillbirth, and maternal and neonatal mortality (Desai et al., 2018; Rogerson et al., 2018). The Nigerian government, through the Federal Ministry of Health, has established malaria prevention strategies that specifically target this population because it constitutes the main focus of malaria control programmes in areas where the disease is common. One of the most widely endorsed and cost-effective malaria prevention tools is the long-lasting insecticidal net (LLIN), which are specialized bed nets that use insecticide treatment to protect against malaria because they execute lethal force against both mosquitoes and all other insects that transmit the disease (Lengeler, 2000; WHO,2021). The use of LLINs with proper procedures has been reported to result in a 50 percent decrease in malaria cases and a 20 percent decrease in all child deaths (Bhatt et al., 2015). The National Malaria Control Programme requires 80 percent of the population to use ITNs and pregnant women to receive intermittent preventive treatment (IPTp) for

the programme to achieve its goal of 50 percent malaria burden reduction (NMEP, 2021; Chukwuanukwu et al., 2025).

The distribution of LLINs through international and domestic funding has failed to provide complete protection to women of reproductive age who need access to the nets and proper usage methods (NMEP,2021; Ugwu et al., 2024). The Nigeria Malaria Indicator Survey 2021 reported that although 61% of households owned at least one LLIN, actual use among women of reproductive age remains low, at around 41.5% (NMEP,2021; Ugwu et al., 2024). The combination of language barriers, insufficient training for community health workers, and resource limitations together with gender norms creates problems for healthcare delivery in communities (Omo-Imafidon et al., 2022; Yaya et al., 2018) The public health need to decrease malaria cases through existing preventive methods which people accept and which continue beyond their current use serves as the foundation for this research. This study will produce area-specific information about how women of reproductive age in Asa LGA understand and use LLINs, which serves as the basis for developing solutions that will tackle the actual barriers that stop people from using LLINs. Public health interventions often fail when they do not take into account the local context in which health behaviors are practiced. The specific beliefs and attitudes that people in rural Asa LGA hold, together with their actual health practices, will help create better community engagement techniques for outreach work. The study will determine how different factors related to malaria prevention behavior operate because it will identify existing knowledge gaps and common misconceptions, and the factors that stop people from using health services. The evidence-based public health interventions that will be developed from the findings include health education programmes and behavior change communication strategies, which will enhance LLIN effectiveness.

Additionally, the study will deliver essential insights that will help policymakers and malaria control programmes to achieve their goals of malaria

elimination in Nigeria. The study will establish a foundation that future studies on malaria prevention and vector control research in rural areas can use. This study is therefore aimed at assessing the knowledge, attitude, and utilization of long-lasting insecticidal nets (LLINs) among women of reproductive age in Asa Local Government Area, Kwara State, Nigeria.

Review of Literature

Level of Knowledge of Women of Reproductive Age on Insecticide-Treated Bed Nets.

Insecticide-treated bed nets represent one of the most effective malaria control methods that scientists have developed for global use, especially in sub-Saharan Africa, where the disease remains highly prevalent (WHO, 2017). Women who fall within reproductive age, defined as 15 to 49 years, must understand these nets according to complete knowledge requirements. People who know things about health matters tend to seek medical treatment and prevent diseases while helping public health programs to maintain their operations (Okonkwo & Adeoye, 2017). Health promotion programs collapse when they attempt to operate without essential knowledge components, which become especially vital in communities that lack resources (Okonkwo & Adeoye, 2017). The Nigerian nationwide survey showed that 81% of women had heard about ITNs, while only 45% could explain their proper usage and re-treatment methods (Afolabi et al., 2019). The gap between general knowledge and definite understanding exists because people still lack correct information about the topic. In Ogun State Nigeria, a study found that 82% of women had heard about ITNs yet only 47% understood that ITNs need re-treatment after a certain time period (Afolabi et al., 2019). The research showed that people who know about something do not understand everything about that topic or know how to use it correctly. Abiodun and Olu-Abiodun conducted a study in Ogun State, Nigeria, which found that 78% of women had heard about ITNs, while only 39% understood their correct usage. The study found that women held common misconceptions about insecticide use because they

believed it could lead to infertility and miscarriages (Abiodun & Olu-Abiodun, 2019).

Attitude of Women of Reproductive Age towards the Use of Insecticide-Treated Bed Nets

Health programmes depend on people's attitudes to determine whether they will use the programme and how effectively it will function. Malaria prevention requires both knowledge and a positive attitude because knowledge provides the foundation for changing actual behavior (Bosnjak et al., 2020). Reproductive-age women who reside in malaria-endemic areas of Nigeria represent a highly vulnerable population whose insecticide-treated bed net usage decision represents a vital factor that determines their households' adherence to bed net usage and their children's health outcomes (Adebayo et al., 2015; Ujuju et al., 2018). A study conducted in Ogun State discovered that 78% of women possessed at least one ITN, but only 42% of them used their ITNs because they believed the bed nets would make them feel hot and suffocated (Adebayo et al., 2017). People knew the information, but their attitude created an obstacle that prevented them from working. The study showed that only women who attended antenatal clinics used ITNs consistently because their negative view of the product and discomfort with it prevented them from using it. A study conducted in Tanzania showed that although more than 85% of participants recognized the protective value of ITNs, only 60% of them stated that they used the product on a regular basis. Women reported that the net's smell, chemical content, and perceived negative effect on fertility or pregnancy were major concerns affecting attitude and subsequent usage (Mushi et al., 2011)

Utilization of Insecticide-Treated Bed Nets among Women of Reproductive Age

The distribution of ITNs between 2010 and 2020 brought major improvements to malaria control efforts across the world, with sub-Saharan Africa receiving the most funding. According to the World Malaria Report, 73 percent of households in areas

with malaria transmission own at least one ITN, but only 51 percent of people in those households used the net for sleeping the night before (UNICEF, 2020). However, the actual usage pattern among reproductive-age women shows greater disparity. This is because their needs depend on three factors: gender roles, socioeconomic constraints, and household decision-making patterns. For example, the National Malaria Elimination Programme (NMEP) in Nigeria reports high ITN coverage rates, yet women capable of conceiving still show irregular bed net use. Additionally, the Nigeria Demographic and Health Survey and other recent surveys found that 60 percent of women own a net, but only 37 percent use it regularly (NPC, 2019).

Factors Influencing the Use of Insecticide-Treated Bed Nets among Women of Reproductive Age

Effective malaria prevention requires increased usage of insecticide-treated bed nets, which depends on identifying the factors that influence their adoption. Pregnant women are at higher risk of malaria due to physiological changes during pregnancy and a developing immune system. Additionally, their caregiver and household management roles make their ongoing use of preventive methods critical for community health (Okafor et al., 2020). Insecticide-treated bed net usage among women of reproductive age is shaped by age, education level, marital status, and household size. Health services nationwide struggle because adolescent and unmarried women need more health education but often rely on others for medical decisions (Ekezie et al., 2020). Mothers who reach marriage age tend to use insecticide-treated bed nets as they access health information through antenatal and child welfare programmes (Baume et al., 2009).

Methodology

Study design and setting

The study was conducted as a descriptive cross-sectional study, which took place across eight different communities within Asa LGA of Kwara

State from February 2026 to March 2026. The area of Asa LGA stretches across central Kwara State in Nigeria, covering an area of 1,286 square kilometers, which supports a population of 126,435 according to the 2006 census, and an annual growth rate of 2.8%. The area experiences a tropical wet and dry weather pattern, with healthcare services that are accessible but which people in the area do not fully use. The population includes a significant number of women of reproductive age, making it suitable for this study.

Participant Selection and Sample Size Determination:

The study included all women of reproductive age who lived in the selected communities. The sample included women who were present during the survey and who provided informed consent to participate in the study. The minimum sample size (n=318) was calculated using Fisher's formula:

$$n = (z^2 pq) / d^2$$

where $z=1.96$, $p= 0.708$ (prevalence of LLIN utilization from a previous study), $q=1- p=0.292$, $d=0.05$. This calculated sample size was adjusted to 360 to increase the study's power, considering a 90% response rate. Multi-stage sampling methods were used to recruit the study participants. Simple random sampling method was used to select 8 communities from the 12 political wards in the LGA. The first house of each community was selected using the grid method, while simple random sampling was used to choose 10 households from each community. The eligible respondents received selection through systematic random sampling methods, which selected one respondent per household when multiple eligible respondents existed.

Instrument and methods of data collection:

A validated, pretested, interviewer-administered questionnaire was employed to gather data about participants' socio-demographic characteristics, their knowledge of LLINs, their attitudes toward LLIN usage, their patterns of usage, the reasons that prevented them from using LLINs, and the factors that determined their LLIN usage. Knowledge was

scored to categorize respondents' understanding into poor or good levels. Attitude responses were evaluated to determine whether participants held positive or negative attitudes toward the evaluated content, while utilization was measured through the frequency and regularity of LLIN usage in different situations. Data collection for the study was conducted by eight trained field assistants who spoke both English and the local dialect of Yoruba throughout 4 weeks by conducting face-to-face interviews, which achieved complete data collection with clear results.

Analysis of data

The researchers assigned codes to all collected data, which they subsequently analyzed through Statistical Package for Social Sciences Software (SPSS v26). The respondent characteristics, LLIN knowledge and attitudes, and LLIN usage were displayed through descriptive statistics, which included tables and figures. Chi-square test was used to examine associations between categorical variables at a 95% confidence level.

Ethical Considerations

The Ethical Review Committee of the Kwara State Ministry of Health granted approval for this study through permission number ERC/MOH/2026/02/596. The research team obtained informed consent from participants who received assurances about their identity protection and their right to withdraw at any time without facing negative consequences. The study ensured anonymity by avoiding the collection of names or any identifiable data from the participants.

Results

Socio-Demographic Characteristics of Respondents

Close to half of the respondents (168, 46.7%) were aged 18-25 years, single (151, 41.9%), and had tertiary education (157, 43.6%). Most were traders (136, 37.8%) with a monthly income of N50,000 and above (97, 26.9%) as shown in Table 1.

Table 1: Socio-demographic characteristics of respondents N= 360

Variables	Category	Frequency	Percentage
Age	18-25 years	168	46.7
	26-39 years	99	27.5
	40-60 years	73	20.3
	60 years and above	20	5.6
Marital status	Single	151	41.9
	Married	150	41.7
	Widowed	38	10.6
	Divorced	13	3.6
	Separated	8	2.2
Level of education	No formal education	67	18.6
	Primary	53	14.7
	Secondary	83	23.1
	Tertiary	157	43.6
Occupation	Farmer	56	15.6
	Trader	136	37.8
	Civil servant	59	16.4

Monthly Income	Artisan	17	4.7
	Unemployed	92	25.6
	Less than N10,000	80	22.2
	N10,000-N29,999	90	25.0
	N30,000-N49,999	93	25.8
Religion	N50,000 and above	97	26.9
	Christianity	142	39.4
	Islam	200	55.6
	Traditional	17	4.7
Number of children	Others	1	0.3
	None	150	41.7
	1-2	85	23.6
	3-4	76	21.1
	5 and above	49	13.6

Knowledge of Long-Lasting Insecticide-Treated Bed Nets

Most respondents knew that insecticide-treated bed nets can prevent malaria effectively (305, 84.7%),

are treated with chemicals that kill mosquitoes (289, 80.3%), and should be re-treated or replaced after a certain period (279, 77.5%). However, 27.5% (99) did not agree that sleeping under the nets every night is necessary for protection as shown in Table 2.

Table 2: Knowledge of Long-Lasting Insecticide-Treated Bed Nets N= 360

Variables	Category	Frequency	Percentage
Insecticide-treated bed nets can prevent malaria effectively	No	55	15.3
	Yes	305	84.7
Insecticide-treated bed nets are treated with chemicals that kill mosquitoes	No	71	19.7
	Yes	289	80.3
Bed nets should be re-treated or replaced after a certain period	No	81	22.5
	Yes	279	77.5

Sleeping under insecticide-treated nets every night is necessary for protection	No	99	27.5
	Yes	261	72.5
I know where and how to get insecticide-treated bed nets in my community	No	147	40.8
	Yes	213	59.2

Attitude towards the Use of Insecticide-Treated Bed Nets

Respondents had a positive attitude towards using bed nets, with 81.7% (294) agreeing that it's

important for family health and 74.2% (267) believing it makes sleeping more comfortable and safer. However, 36.1% (130) did not agree that it's necessary to use bed nets even during dry seasons as shown in Table 3.

Table 3: Attitude towards the Use of Insecticide-Treated Bed Nets

Variables	Category	Frequency	Percentage
Using a bed net every night is important for my family's health	Strongly Agree	153	42.5
	Agree	141	39.2
	Neutral	38	10.6
	Disagree	26	7.2
	Strongly Disagree	2	0.6
I believe bed nets make sleeping more comfortable and safer	Strongly Agree	126	35.0
	Agree	141	39.2
	Neutral	44	12.2
I encourage others in my household to use insecticide-treated bed nets	Disagree	41	11.4
	Strongly Disagree	8	2.2
	Strongly Agree	119	33.1
	Agree	134	37.2
I feel confident using insecticide-treated bed nets correctly	Neutral	58	16.1
	Disagree	45	12.5
	Strongly Disagree	4	1.1
	Strongly Agree	133	36.9
	Agree	134	37.2
	Neutral	53	14.7
	Disagree	34	9.4

	Strongly Disagree	6	1.7
It is necessary to use bed nets even during dry seasons	Strongly Agree	114	31.7
	Agree	116	32.2
	Neutral	68	18.9
	Disagree	52	14.4
	Strongly Disagree	10	2.8

Utilization of Insecticide-Treated Bed Nets

About 70.8% (255) of respondents used insecticide-treated bed nets every night, while 61.9% (223) ensured their children slept under bed nets regularly.

Most respondents received bed nets from health facilities or campaigns (277, 76.9%) and followed instructions on how to use them (273, 75.8%) as shown in Table 4 and Figure 1.

Table 4: Utilization of Insecticide-Treated Bed Nets

Variables	Category	Frequency	Percentage
I use an insecticide-treated bed net every night	Strongly Agree	134	37.2
	Agree	121	33.6
	Neutral	43	11.9
	Disagree	57	15.8
	Strongly Disagree	5	1.4
All my children sleep under bed nets regularly	Strongly Agree	107	29.7
	Agree	116	32.2
	Neutral	81	22.5
	Disagree	46	12.8
	Strongly Disagree	10	2.8
I received an insecticide-treated bed net from a health facility or campaign	Strongly Agree	126	35.0
	Agree	151	41.9
	Neutral	42	11.7
	Disagree	39	10.8
	Strongly Disagree	2	0.6
I follow instructions on how to use the insecticide-treated bed net properly	Strongly Agree	113	31.4
	Agree	160	44.4
	Neutral	43	11.9
	Disagree	39	10.8
	Strongly Disagree	5	1.4
	Strongly Agree	123	34.2

I have maintained and replaced old bed nets as needed	Agree	137	38.1
	Neutral	44	12.2
	Disagree	44	12.2
	Strongly Disagree	12	3.3

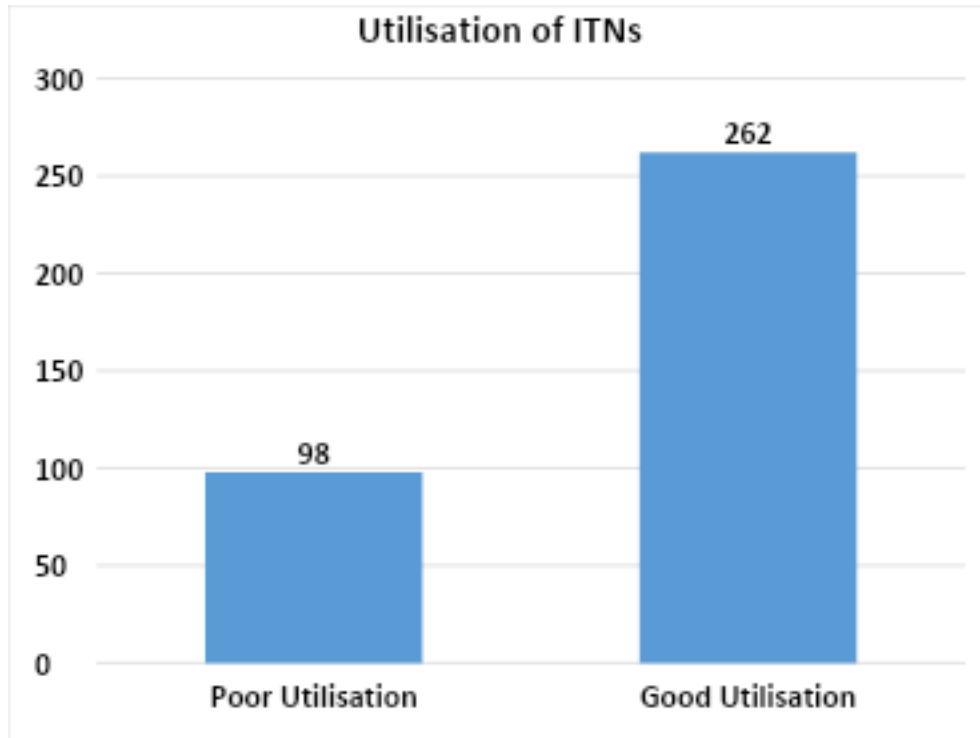


Figure 1: Showing women's utilization of ITNs

Factors Influencing the Utilization of Insecticide-Treated Bed Nets

Education (261, 72.5%), health education programs (274, 76.1%), and economic accessibility (277,

76.9%) were significant determinants of bed net usage. However, lack of space or facilities to hang bed nets was a notable barrier (223, 61.9%) as shown in Table 5.

Table 5: Factors Influencing the Utilization of Insecticide-Treated Bed Nets

Variables	Category	Frequency	Percentage
	Strongly Agree	128	35.6
	Agree	133	36.9



The level of my education affects my decision to consistently use insecticide-treated bed nets	Neutral	35	9.7
	Disagree	53	14.7
	Strongly Disagree	11	3.1
	Strongly Agree	107	29.7
Health education programs in my community influence my decision to use insecticide-treated bed nets.	Agree	167	46.4
	Neutral	48	13.3
	Disagree	34	9.4
	Strongly Disagree	4	1.1
I am more likely to use insecticide-treated bed nets when they are made available at no or low cost	Strongly Agree	117	32.5
	Agree	160	44.4
	Neutral	44	12.2
	Disagree	35	9.7
Lack of space or facilities to hang bed nets makes it hard to use them	Strongly Disagree	4	1.1
	Strongly Agree	88	24.4
	Agree	135	37.5
	Neutral	45	12.5
	Disagree	66	18.3
	Strongly Disagree	26	7.2

Association between Socio-Demographic Characteristics and Knowledge of Insecticide-Treated Bed Nets

There was a statistically significant association between age ($p=0.035$) and educational level ($p=0.034$) with knowledge of insecticide-treated bed nets as shown in Table 6.

Table 6: Association between the Socio-demographic Characteristics and Knowledge of Insecticide-Treated Bed Nets among Women of Reproductive Age

Variables	Category	Insecticide-treated bed nets can prevent malaria effectively		X ² (p value)
		No	Yes	
Age	18-25 years	27(16.1%)	141(83.9%)	8.635(0.035)
	26-39 years	11(11.1%)	88(88.9%)	
	40-60 years	17(23.3%)	56(76.7%)	
	60 years and above	0(0.0%)	20(100.0%)	
Marital status	Single	26(17.2%)	125(82.8%)	3.651(0.455)
	Married	19(12.7%)	131(87.3%)	
	Widowed	8(21.1%)	30(78.9%)	
	Divorced	2(15.4%)	11(84.6%)	
	Separated	0(0.0%)	8(100.0%)	
Level of education	No formal education	4(6.0%)	63(94.0%)	8.698(0.034)
	Primary	13(24.5%)	40(75.5%)	
	Secondary	11(13.3%)	72(86.7%)	

Occupation	Tertiary	27(17.2%)	130(82.8%)	2.743(0.602)
	Farmer	5(8.9%)	51(91.1%)	
	Trader	21(15.4%)	115(84.6%)	
	Civil servant	11(18.6%)	48(81.4%)	
	Artisan	2(11.8%)	15(88.2%)	
Monthly Income	Unemployed	16(17.4%)	76(82.6%)	0.462(0.927)
	Less than N10,000	11(13.8%)	69(86.3%)	
	N10,000-N29,999	13(14.4%)	77(85.6%)	
	N30,000-N49,999	16(17.2%)	77(82.8%)	
	N50,000 and above	15(15.5%)	82(84.5%)	
Religion	Christianity	24(16.9%)	118(83.1%)	6.397(0.094)
	Islam	27(13.5%)	173(86.5%)	
	Traditional	3(17.6%)	14(82.4%)	
	Others	1(100.0%)	0(0.0%)	
	None	23(15.3%)	127(84.7%)	
Number of children	1-2	15(17.6%)	70(82.4%)	1.359(0.715)
	3-4	12(15.8%)	64(84.2%)	
	5 and above	5(10.2%)	44(89.8%)	

Association between Socio-Demographic Characteristics and Utilization of Insecticide-Treated Bed Nets

The association between socio-demographic characteristics and utilization of insecticide-treated

bed nets was statistically significant with age (p=0.031), number of children (p=0.013), and occupation (p<0.001) of respondents as shown in Table 7.

Table 7: Association between the Socio-demographic Characteristics and Utilization of Insecticide-Treated Bed Nets among Women of Reproductive Age

Variables	Category	Utilization of Insecticide-Treated Bed Nets		X ² (p value)
		Good Utilisation	Poor Utilisation	
Age	18-25 years	111(66.1%)	57(33.9%)	8.855(0.031)
	26-39 years	78(78.8%)	21(21.2%)	
	40-60 years	55(75.3%)	18(24.7%)	
	60 years and above	18(90.0%)	2(10.0%)	
Marital status	Single	99(65.6%)	52(34.4%)	7.574(0.109)
	Married	116(77.3%)	34(22.7%)	

	widowed	29(76.3%)	9(23.7%)	
	Divorced	11(84.6%)	2(15.4%)	
	separated	7(87.5%)	1(12.5%)	
Level of education	No formal education	49(73.1%)	18(26.9%)	5.032(0.169)
	Primary	36(67.9%)	17(32.1%)	
	Secondary	68(81.9%)	15(18.1%)	
	Tertiary	109(69.4%)	48(30.6%)	
Occupation	Farmer	38(67.9%)	18(32.1%)	22.776(<0.001)
	Trader	117(86.0%)	19(14.0%)	
	Civil servant	42(71.2%)	17(28.8%)	
	Artisan	9(52.9%)	8(47.1%)	
	Unemployed	56(60.9%)	36(39.1%)	
Monthly Income	Less than N10,000	57(71.3%)	23(28.7%)	6.344(0.096)
	N10,000-N29,999	73(81.1%)	17(18.9%)	
	N30,000-N49,999	69(74.2%)	24(25.8%)	
	N50,000 and above	63(64.9%)	34(35.1%)	
Religion	Christianity	99(69.7%)	43(30.3%)	4.134(0.247)
	Islam	151(75.5%)	49(24.5%)	
	Traditional	12(70.6%)	5(29.4%)	
	Others	0(0.0%)	1(100.0%)	
Number of children	None	97(64.7%)	53(35.3%)	10.720(0.013)
	1-2	67(78.8%)	18(21.2%)	
	3-4	56(73.7%)	20(26.3%)	
	5 and above	42(85.7%)	7(14.3%)	

In summary, the study found good knowledge, attitude, and utilization of Long-Lasting Insecticide-Treated Bed Nets (LLINs) among women of reproductive age in Asa LGA, Kwara State. Most respondents knew LLINs prevent malaria (84.7%), had a positive attitude towards using them (81.7%), and used them every night (70.8%). However, gaps in utilization and attitude towards seasonal use were noted. Factors influencing utilization included education, health education programs, and economic accessibility. Age, education, occupation, and number of children were significantly associated with knowledge and utilization of LLINs.

Discussion

The sociodemographic variables of the respondents in this study showed a mainly young population, with the close to half (46.7%) been aged 18-25 years. This is in agreement with the demographic profile of Nigeria, where the youth population is significant (NPC, 2018). However, this finding is in contrast to the findings of a study in Ethiopia, where the majority of respondents were aged 26-35 years (Getaneh et al., 2020). This difference in age distribution may be due to variations in the study population and setting, as the Ethiopian study was

conducted in a rural setting, whereas this study was conducted in a semi-urban area. In addition, the Nigerian population has a higher proportion of young people, which may contribute to the observed difference (NPC, 2018).

Recent studies have shown that sociodemographic factors significantly determine LLIN utilization. A study conducted in Osun State, Nigeria, found that older parents /caregivers who are between age 50 and 59 years, and those with post-secondary education were more likely to use LLINs for under-five children (Mbalu et al., 2024). Another study conducted in 13 Nigerian States with hyper endemic malaria found that LLIN utilization was higher in rural areas (55.7%) than urban areas (48.8%) (Uhomobhi et al., 2022). The respondents in this study were fairly educated, with 43.6% having tertiary education, which is higher than the national average (NBS, 2020). This is different from a study in rural Uganda, where the majority of respondents had primary education (Katureebe et al., 2016). The higher level of education in this study may be due to the semi-urban area involved, where access to education is generally better than in rural areas (Adebayo et al., 2018).

Majority of the respondents in this study had good knowledge of LLINs, with 84.7% knowing that they prevent malaria. This is similar to the findings of some previous studies that reported high knowledge of LLINs among pregnant women in Nigeria (Oresanya et al., 2018; Singh et al., 2019). However, a study conducted in Kenya, East Africa, found that only 56.7% of respondents knew that LLINs prevent malaria (Njelekela et al., 2019). This difference in knowledge levels may result from variations in health education and awareness campaigns, as well as access to healthcare services (Aikins et al., 2018). A 2021 study in Ondo State, South west Nigeria, reported that age, level of education, and healthcare center were significantly associated with knowledge, attitudes, and perceptions of malaria in pregnancy among pregnant women (Adeyemi, 2021). Another study in Jigawa State conducted in 2024 also found that educational level, marital status, and occupation were significantly associated with knowledge of LLIN use (Sabo, et al., 2024).

A positive attitude towards LLINs was found among respondents in this study, with 81.7% agreeing that using a bed net every night is crucial for family health. This is in agreement with previous studies that reported positive attitudes towards LLINs among pregnant women in Nigeria (Adebayo et al., 2018; Oresanya et al., 2018). However, a Ghanaian study showed that only 56.2% of respondents had a positive attitude towards LLINs (Aikins et al., 2018). The difference in attitude may be due to variations in cultural beliefs and practices among the respondents, as well as access to healthcare services (Mathenge et al., 2018).

This study found that 70.8% of the respondents used LLINs every night, which is lower than the national average of 78.6% reported in the 2018 Nigeria Demographic and Health Survey (NDHS). However, this is supported with findings from previous studies that showed varying levels of LLIN use among pregnant women in Nigeria (Oresanya et al., 2018; Singh et al., 2019). A study in Uganda revealed that only 38.1% of respondents used LLINs every night (Katureebe et al., 2016). The difference in utilization levels may be as a result of variations in access to LLINs, as well as cultural beliefs and practices of the respondents (Adebayo et al., 2018). A 2022 study conducted in 13 Nigerian States with hyper endemic malaria found that LLIN utilization was higher in rural areas (55.7%) than urban areas (48.8%) (Uhomobhi et al., 2022). Factors that were posited has been associated with LLIN use included obtaining nets from ANC or immunization clinics and campaigns.

There was a statistically significant association between age and knowledge of LLINs ($p=0.035$), with older respondents having better knowledge of LLINs. This is consistent with previous studies that reported older women having better knowledge of LLINs (Adebayo et al., 2018; Oresanya et al., 2018). However, an Ethiopian study revealed that there was no significant association between age and knowledge of LLINs (Getaneh et al., 2020). The differing findings may be due to variations in the study population and study area, as well as access to healthcare services (Aikins et al., 2018).

This study also found a statistically significant association between education level and knowledge of LLINs ($p=0.034$), with respondents with tertiary education having better knowledge of LLINs. This finding is in contrast to a study in Tanzania, which found no significant association between education level and knowledge of LLINs (Mboera et al., 2017). The difference in findings may be as a result of variations in the quality of education and access to healthcare services (Aikins et al., 2018). Furthermore, a statistically significant association was found between occupation and utilization of LLINs ($p<0.001$), with traders having better utilization of LLINs. This is in agreement with findings from previous studies that reported occupation as a significant predictor of LLIN use (Adebayo et al., 2018; Oresanya et al., 2018). However, a study in Uganda found no significant association between occupation and utilization of LLINs (Katureebe et al., 2016). The difference in findings may be as a result of variations in access to LLINs and cultural beliefs and practices of the respondents (Mathenge et al., 2018).

A statistically significant association was also found between age and utilization of LLINs ($p=0.031$) in this study, with older respondents having better utilization of LLINs. This is in contrast to a study in Kenya, which found no significant association between age and utilization of LLINs (Njelekela et al., 2019). The difference in findings may be as a result of variations in access to healthcare services and cultural beliefs and practices of the respondents (Getaneh et al., 2020).

Conclusion and Recommendations

This study assessed the knowledge, attitude, and utilization of Long-Lasting Insecticide-Treated Nets (LLINs) among women of reproductive age in selected communities in Asa LGA, Kwara State, Nigeria. The results showed that the respondents had good knowledge (84.7%) and positive attitude (81.7%) towards LLINs, but utilization was relatively low (70.8%) compared to national average. Significant associations were identified between sociodemographic characteristics (age, education

level, occupation) and knowledge and utilization of LLINs. These findings indicate the need for targeted interventions to improve LLIN utilization and close up the gaps in knowledge and attitude.

To address these gaps, it is recommended that stakeholders intensify health education campaigns to reinforce the importance of LLIN use, targeting women of reproductive age, especially those with low education levels. Widespread and consistent distribution of LLINs through antenatal clinics, immunization centers, and community outreach programs should be ensured, with much focus on rural settings. There is need for further community-based research to identify and address cultural beliefs and practices hindering LLIN use. A strengthened partnership between local governments, NGOs, and community leaders is necessary to promote LLIN use and maintenance. Government need to establish a monitoring system to track LLIN utilization and identify areas for improvement. The implementation of these interventions will increase LLIN utilization and contribute immensely to reducing malaria prevalence among women of reproductive age in Asa LGA, Kwara State and other similar settings in Nigeria.

Limitations of the Study

The outcome of this study had some limitations. The data collected are self-reported, with a risk of recall and social desirability bias, wherein respondents may overstate desirable behaviors. Language barrier and limited literacy levels was a challenge when administering the study instruments to some respondents in the selected communities, and the use of an interpreter to overcome this may have given room for unintended misinterpretations. Lastly, the cross-sectional design nature of the study further restricts the ability to establish causal relationships between variables, as it captured data at a single point in time.

To address these limitations, the recall period was shortened to seven days, and confidentiality of the information was emphasized to reduce social desirability bias. Findings were interpreted as associations due to the cross-sectional design, with

some triangulation for validation. A thorough training of the research assistant, with effective demonstration and repeat demonstration of the use of the study instrument in the local language was ensured before data collection to enable correct and uniform interpretation and content delivery.

Acknowledgements

The authors acknowledge all of the women of reproductive age who gave their consent and responded to the questionnaire. The support and cooperation of the traditional leaders of the eight selected communities in mobilizing their women to participate in this study are well appreciated.

Financial support and sponsorship

The authors declare that the funding for this study is entirely through self-sponsorship.

Competing Interests

No conflicts of interest were reported by the authors of this paper.

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