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Socio-Demographic Evaluation of Ownership Levels and Utilization Rates of LLINs against Malaria Vectors within Urban Settlements of Osogbo District, Osun State, Nigeria

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Abstract

Globally, malaria is one of the major endemic diseases of public health importance caused by *Plasmodium spp*. and transmitted by Anopheles mosquitoes. Efforts to eradicate malaria disease are on the decline despite appreciable progress recorded in the past. This warranted holistic review of malaria interventions which include among others, the assessment of Long Lasting Insecticidal Treated Nets (LLINs). Adopted questionnaires from Roll Back Malaria (RBM), World Health Organization (WHO) and United Nations Children's Fund (UNICEF) were administered to evaluate ownership levels and utilization rates of LLINs against malaria vectors in urban settlements of Osogbo district, Osun state, Nigeria. Out of 1,500 households surveyed, 78.9% of the households had at least one LLIN, while 78.3% households had the LLINs hanging in their homes, but 60.8% of the households frequently used the LLINs. There were statistically significant differences between the ownership levels of LLINs, usage of LLINs by hanging and the utilization rates of LLINs in the studied population comparatively ($p < 0.05$). Although the percentage of LLINs possession is high, the rate of utilization of the LLINs varies and is not encouraging which negates the WHO recommended utility procedures. Therefore, acceptability of LLINs usage and sustainable positive attitudinal changes are needed to achieve the target goals of WHO on elimination of the endemic disease.

Keywords: Malaria; Households; LLINs Usage; Acceptability; Nigeria.

Introduction

Malaria is caused by *Plasmodium spp.* (*P. falciparum, P. knowlesi, P. malariae, P. ovale* and *P. vivax*) (WHO 2012) mainly transmitted by female Anopheles mosquitoes. This often results to severe illness and probably death if not handled carefully by proper diagnoses with appropriate therapy. *Plasmodium falciparum* Welch (1897) was identified to be the most prevalent malaria parasite in sub-Saharan Africa which accounted for 99% of estimated malaria cases in 2016, while *P. vivax* was reported to be the predominant parasite in WHO Regions

representing 64% of malaria cases (WHO 2017). The most vulnerable groups to malaria include pregnant women and children less than 5 years old (WHO 2017). High mortality and morbidity among these vulnerable groups caused by malaria could translate to high loss of economic and human resources in endemic regions in Africa including sub-Saharan Africa (Kamau 2006, WHO 2008).

Malaria was categorized as one of the major endemic diseases of public health interests which has drawn global attentions and support for holistic solutions monetarily, including donations of materials and other resources to curtail or eradicate the endemic disease. The World Health Organization (WHO 2012) reported that almost half of the World's population is at risk and the malaria disease affected not less than 200,000,000 people annually, despite series of preventable and treatable measures taken. In 2010, about 219 million cases of malaria were estimated, of which 660,000 deaths were reported in the World Malaria Report 2011 (WHO 2012). Eighty percent of the estimated malaria death related cases were reported to occur in about 14 countries including Nigeria and Democratic Republic of Congo (WHO 2012).

According to the WHO report (WHO 2017), it was observed in the year 2016 that there was reasonable reduction overtime in malaria cases globally from 237 million cases in 2010 to 211 million cases in 2015. The global incidence rate of malaria cases was estimated to have decreased by 18%, from 76 to 63 cases per 1000 population at risk, between 2010 and 2016 (WHO 2017) in WHO African Region by 90%. In 2016, out of 91 countries which reported malaria cases, 15 countries (in sub-Saharan Africa, with exception of India) carried 80% of the global malaria burden (WHO 2017). Between 2014 and 2016, WHO South-East Asia Region recorded the largest decline of malaria cases (48%) followed by the WHO Region of the Americas (22%) and the WHO African Region (20%). Despite the appreciable reduction reported between 2014 and 2016, substantial increase in malaria incidence occurred in the WHO America Region, and marginally in the WHO South-East Asia, Western Pacific, and African regions, respectively (WHO 2017) which calls for attention.

Despite global attention and support, including donations of materials (Long Lasting Insecticidal Nets – LLINs) and other resources to eradicate malaria totally, the World Malaria report (WHO 2018), highlighted that after an unprecedented period of success in global malaria control, progress has stalled. Data on national household surveys from 87 countries including Nigeria showed no significant progressive reduction in global malaria cases between 2015 and 2017 (WHO 2018). According to the WHO (2014), Africa bears over 80 percent of the global malaria burdens of which Nigeria across all endemic states, including Osogbo (Osun State) accounts for about 29 percent. Democratic Republic of Congo and Nigeria contribute up to 40 percent of the global burdens (WHO 2014). Generally, the disease stressed the already-weakened health system and exerts economic and social burdens on the nation, retarding the GDP (gross domestic product) annually by 40 percent, costing approximately 480 billion naira in out-of pocket treatments, prevention costs, and loss of man hours (FMoH and NMEP 2015, FMoH, NMEP and RBM 2014). Hence, the need to evaluate ownership levels and degrees of utilization of LLINs for malaria vector control within Osogbo district, Osun State, Nigeria, to provide basic data for informed decision being an endemic area.

Long lasting insecticidal net (LLIN) is one of the combination tools and methods to combat malaria through the malaria vector control programme. Other methods include artemisinin-based combination therapy (ACT), indoor residual spraying of insecticide (IRS) and intermittent preventive treatment in pregnancy (IPT). In 2006, despite substantial supply of LLINs in Africa,

the number available in 2006 was far below the need in almost all endemic countries (Biadgilign et al. 2012) for malaria control in compliment to the procurement of antimalarial medicines through increased public health services. Indoor residual spraying of insecticide (IRS) presents a new opportunity for large-scale malaria control and prevention. Selective systematic combination of vector control with long-lasting insecticidal nets and indoor residual household spraying (IRS) played key role in malaria control and prevention (WHO 2008) to achieve United Nations Millennium Development Goals (MDGs) (WHO 2012).

Long-lasting insecticidal nets (LLINs) are treated net fibres impregnated with specific insecticides such as permethrin at factory level, designed to maintain biological efficacy against malaria vectors for minimum of 3 years as recommended (WHO and UNICEF 2005). Permethrin or deltamethrin or alphacypermethrin treated LLINs provide physical barriers against mosquitoes (malaria vectors) to prevent malaria disease transmission. According to WHO (2005), LLINs proved to be important tools of malaria vectors' control and other vector borne diseases confirmed by several studies in malaria endemic countries in reducing man-vector contact from malaria (Lengeler 2004, Greenwood et al. 2005, Eisele et al. 2006, Thwing et al. 2008). Although, currently the efficacy of pyrethroid insecticides treated LLINs is in doubt due to resistance development by Anopheles mosquites as recently reported in several publications (Protopopoff et al. 2013, Yadouleton et al. 2010).

Several studies on usage of LLINs in different parts of Nigeria have shown variations in ownership and usage (Ahmed and Zerihun 2010, Ordinioha 2012, Aderibigbe et al. 2014). Moreover, recent studies in Nigeria showed that expanding the uses of LLINs to people in target areas will enhance coverage and protection of both the vulnerable and non-vulnerable (parasite reservoir) groups while protecting everyone (Oresanya et al. 2008, Aderibigbe et al. 2014, Dawaki et al. 2016). The mass distribution of LLINs was carried out in Osogbo Metropolis in 2017 by non-governmental organization and religious houses. This study was, therefore, carried out to evaluate levels of ownership and rates of utilization of LLINs against malaria vectors by selected households after six months of mass distribution of the nets in Osogbo, Osun state, Nigeria.

Materials and Methods

Study setting and participants

Osogbo is the capital of Osun State, Nigeria 7.7827°N and 4.5418°E (Figure 1). It shares boundary with Ede, Egbedore, Ikirun, Ilesa, and Iragbiji. The city has a population of about 649,600 people according to 2006 Nigeria population census. The study covers the assessment of levels of ownership and rates of utilization of LLINs as a preventive intervention tools against malaria vector using an adopted cross-sectional descriptive survey. The studied human population comprises of selected settlements in the study area. Three settlements with the highest number of population and two settlements with low number of populations were selected (five settlements per ward) and a total of three wards were selected for visitation and interviewed. One hundred questionnaires were administered per settlement for three wards in Osogbo Local Government District, Osun State, Nigeria. Respondents for the studies were household heads: either male or female. The female respondents were those of reproductive age, who were mothers or guardians of children under five years of age.

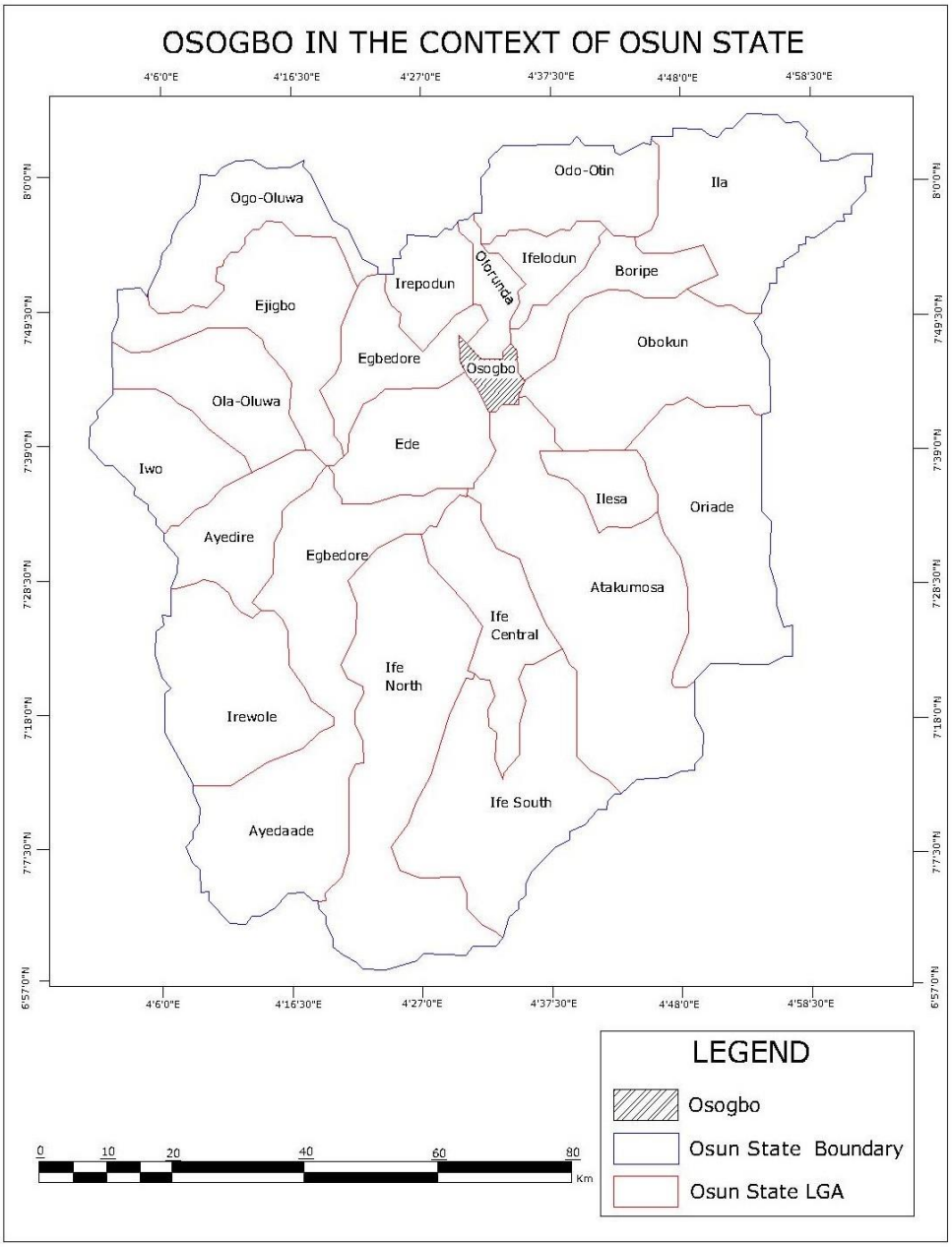

Figure 1: Osogbo District within the context of Osun State (Osun State Ministry of Land, Housing and Survey, Osogbo, Osun State, 2018).

Ethical issues

Ethical clearance approved by Research Ethics Review Committee was obtained from Ministry of Health, Osun State, Nigeria, prior to the commencement of data collection. Based upon low literacy rate in the

population surveyed, verbal informed consent was obtained from all households' participants prior to administering the questionnaires. Interviewers explained the general purpose, benefits, and any risks of the survey to each respondent in his or her local language (Yoruba), and the respondents had the right to refuse participation in the survey at any point. But verbal consent was obtained from individual respondents.

Questionnaires and data collection

Data were gathered using pre-tested structured questionnaires prepared in English language (official language) which was translated into indigenous language (Yoruba) on the field for better understanding of the project. The questionnaire was adopted from instruments developed by the Roll Back Malaria (RBM) partnership monitoring and evaluation reference group by WHO and UNICEF. The questionnaire included variables related to socio-demographic characteristics, number of household members, net possession, and net utilization. The questionnaires were administered between July and September 2018 from household to household. Information was primarily collected from the heads of the households (male or female). Household with a minimum number of children and pregnant women reported to have slept under LLIN(s) in the night prior to the survey interview were considered as users.

Statistical analysis

Data were checked for completeness and consistency. The data were coded and entered, cleaned, and analysed using 2016 excel sheet, immediately after the administration of all the questionnaires on the field. Descriptive summaries (frequencies and proportions) were calculated. Correlation and Chi-square analyses and one-way analysis of variance were used for determining levels of LLINs ownership, usage of LLINs by hanging and rate of utilization of LLINs by sleeping underneath the LLINs a night before the survey as the main outcome variables and to examine the strength of association. P-values of less or equal to 0.05 were considered significant. All statistical analyses were performed using SPSS version 17.0.

Results

Socio-demographic characteristics of the studied population

Socio-demographic characteristics of the studied population involved a total of 1,500 households who participated in the survey. Twenty-one-point one percent (21.1%) (316) of the respondents were males, while the remaining 1184 (78.9%) were females. The percentage of females' respondents favoured the study because females and children below age 5 years were targets of the usage of LLINs with respect to maternal roles. The ages of major respondents were well above 10 years. Nine hundred and thirty-eight thousand (938) (62.5%) of the respondents were married. Almost all the households surveyed had at least one household membership, while between 390 (26.0%) and 523 (34.9%) households had three or more membership. Fifty-seven-point four (57.4%) (861) of the total respondents were Muslims (Islam), while 39.7% (595) were Christians and the remaining respondents were between the categories of traditionalists 40 (2.7%) and other religions 4(0.3%). Eight-point three percent (8.3%) of the respondents were farmers, 6.9% (104) were students, 18.7% (281) were full housewives, 11.3% (170) were government employees, 25.2% (378) were merchants, while 29.5% (442) were unclassified. Thirty-seven-point one percent (37.1%) (557) and 23.7% (356) of the respondents had secondary and primary school education, respectively, while 19.3% (289) attained tertiary education. Twelve-point seven percent (12.7%) (191) of the respondents had no formal education and 7.1% (107) were literate (Table 1).

Table 1: Socio-demographic characteristics of respondents in selected zones, Osogbo district, Osun State, Nigeria

Variables	Frequency	Percentage (%)
Sex		
Male	316	21.1
Female	1184	78.9
Age ranges of heads of households		
10–15 yrs	6	0.4
16–20 yrs	79	5.3
21–25 yrs	213	14.2
26–30 yrs	405	27.0
31 yrs and above	797	53.1
Marital status of heads of households		
Single	167	11.3
Married	938	62.5
Widowed	224	14.9
Divorced	80	5.3
Separated	89	5.9
Unclassified	2	0.1
Membership of each household		
One	51	3.4
Two	152	10.1
Three	390	26.0
Four	523	34.9
Five or more	384	25.6
Religion of the heads of households		
Christianity	595	39.7
Islam	861	57.4
Traditional	40	2.7
Others	4	0.3
Occupation of the respondents		
Farmers	125	8.3
Students	104	6.9
Full housewives	281	18.7
Government employees	170	11.3
Merchants	378	25.2
Unclassified	442	29.5
Education level of the respondents		
No formal education	191	12.7
Read and write only	107	7.1
Primary education	356	23.7
Secondary education	557	37.1
Tertiary	289	19.3

Determination of levels of ownership and rates of utilization of LLINs

Table 2 shows the frequency of malaria knowledge, levels of LLINs ownership, usage of LLINs by hanging and frequency of utilization of LLINs (sleeping underneath LLINs) in the studied population within the selected areas of Osogbo Metropolis, Osun State, Nigeria. The survey showed that only 35.3% (529) of the respondents were diagnosed for malaria in the past one year, while 64.7% (971) of the respondents were not diagnosed. Ninety-two-point eight percent (92.8%) (1392) of the respondents were aware of the LLINs intervention which was statistically significant ($p < 0.05$) from those that were not aware of the nets. Most of the respondents got their information about the nets through unidentified sources (72.5%) (1087). Seventy-six-point one percent (76.1%) (1141) of the households claimed to have acquired the LLINs six months before the study through Osun State Ministry of Health 'malaria intervention programmes' and 'NGOs'. Seventy-eight-point nine percent (78.9%) (1183) of the households owned LLINs of which 68.0% (1021) of the respondents' households acquired the LLINs free from the state health facilities. Seventy-eight-point three (78.3%) (1174) of the households claimed to have the LLINs located in their homes, while 73% (1095) of the households claimed that their LLINs were hanging in their respective households. However, 11.7% (175) of the households surveyed had at least one LLIN per household. Based on the rates of LLINs utilization (sleep underneath the LLINs), about 60.8% (714) of the households frequently used the LLINs and 34.4% (404) occasionally used the LLINs, while the remaining 4.9% (57) of the households sparingly utilized the LLINs by sleeping underneath LLINs. From the Chi-Square test, the level of usage of LLINs by hanging does not equal the ownership level of LLINs in households at 5% level of significance ($X^2_{Cal} = 155.6 > X^2$ (0.05, 2 df) = 5.99). One-way ANOVA analysis showed that there were statistically significant differences ($p < 0.05$) (p-value = 0.003961; $F\text{-}_{val.} = 15.9606$; $F\text{-}_{crit.\ value}$: 5.143253) between the levels of ownership of LLINs, usage of LLINs by hanging and the rate of LLINs utilization (sleeping underneath LLINs a night before the survey) (H_1: $\mu_{ow} \neq \mu_{hg} \neq \mu_{ratout}$). At 95% degree of confidence, the expected relative confidence intervals of level of LLINs ownership, hanging and the rate of LLINs utilization ranged from 989 to 998 households.

This study recorded 48.6% (729) of children under five years old and 19.9% (298) of the pregnant women who slept under the LLINs the night before the survey. The correlation coefficient (r) of level of usage of LLINs a night before the survey between children under ages of five years and pregnant women was –0.24 which indicates inverse correlation between the number of children under ages of 5 years and pregnant women who are major targets of malaria control interventions with respect to the usage of LLINs at nights. Though, there was no significant difference at 95% confidence level ($p = 0.402$, $F_{value} = 1.113$, $F_{crit} = 18.513$) between the number of children under ages of five years and pregnant women who slept under the LLINs a night before the survey, but Chi-square analysis at 5% level of significance ($X^2_{Cal} = 320.44 > X^2_{(0.05,\ 2\ df)} = 5.99$) showed that the number of children of ages under five years who slept under the LLINs a night before the survey does not equal the number of pregnant women who slept under the LLINs at the same period. It was also recorded that 5.7% (85) of the respondents claimed that members of households who were on tour in the last one month before the survey travelled with their LLINs.

Table 2: Malaria knowledge, LLINs ownership and utilization among respondents in Osogbo district, Osun State, Nigeria

Variables	Frequency	Percentage (%)
Malaria diagnoses within one year		
Yes	529	35.3
No	971	64.7
Level of awareness of LLINs		
Yes	1392	92.8
No	98	6.5
Not sure	10	0.7
Source of Information about LLINs		
Health workers	256	17.1
Workshop / seminar	5	0.3
Mass media	47	3.3
District Head	3	0.2
Head of household	0.0	0.0
School	6	0.4
Family	5	0.3
Friends	52	3.4
Neighbourhoods	35	2.3
Posters	4	0.2
Others (Unidentified)	1087	72.5
Level of Ownership of LLINs		
Yes	1183	78.9
No	209	13.9
Not sure	108	7.3
Method of acquisition of LLINs		
Free from state health facilities	1021	68
Purchase at the market, pharmacy store	28	1.8
During mass campaign	53	3.5
Friend	78	5.2
Purchase at the hospital	10	0.6
Others	324	21.6
Location of the LLINs		
In the house	1174	78.3
Not in the house	5	0.3
Not sure	321	21.4
Number of LLINs in the household		
1 Net	175	11.7
2 Nets	547	36.5
3 Nets and More	461	30.7
Not sure	317	21.1
Time of acquisition of LLINs		
<6 months	23	1.5
6 – 12 months	1141	76.1
13 – 24 months	11	0.7
>24 months	8	0.5
Not sure	317	21.1
Usage of LLINs		
Hanging	1095	73.0
Not hanging	88	5.9
Not sure	317	21.1

Table 2 (Ctd):

Variables	Frequency	Percentage (%)
Usage of LLINs by children under five years old		
Sleep under LLINs	729	48.6
Not under LLINs	450	30.0
Not sure	321	21.4
Usage of LLINs by pregnant women		
Sleep under LLINs	298	19.9
Not under LLINs	881	58.7
Not sure	321	21.4
Number of people who slept under the LLINs in the last 24 hours of the survey		
One	110	7.3
Two	223	14.9
Three	378	25.2
Four	313	20.9
>Five	105	7.0
Not sure	371	24.7
Usage of LLIN		
Yes	1175	78
No	71	4.7
Not sure	254	16.9
Rate of LLINs utilization		
Frequently used	714	60.8
Occasionally used	404	34.4
Sparingly used	57	4.9
Usage of LLINs while on tour		
Yes	85	5.7
No	1098	73.2
Not sure	317	21.1

ow: ownership of LLINs; hg: hanging of LLINs; ratout: rate of utilization

Discussion

World Health Organization appreciates the need to control malaria vectors by adopting the use of insecticide impregnated bed nets with the view to eliminate malaria diseases in endemic regions, specifically Africa which bears the brunt of the infections. Our study showed that most of the respondents are aware of LLINs as protection against mosquitoes and malaria transmission. This may be attributed to the high level of literacy of the respondents having formal education, though at various levels. This observation agrees with previous studies that literacy and urbanization usually enhance awareness about LLINs (Kamau 2006, WHO 2008). Osogbo is an urban settlement and the capital of Osun State. Most of the residents are expected to have access to various health information on malaria control and LLINs campaign materials. All these factors are expected to enhance awareness as recorded in the current study.

There are three key elements to the successful LLINs campaign strategies-awareness, ownership, and usage (Kamau 2006). The level of ownership reveals about 78.9% in the study area. Most of the LLINs were sourced freely from the state health facilities by 68% of the households, while 78.9% of the households had at least one LLIN, of which 73% of the households confirmed hanging of the LLINs but only 60.8% households confirmed frequent uses of the LLIN a night before the survey. With high level of awareness recorded among the respondents, it would have been expected that almost all the respondents owned and used the LLINs in their respective households. However, the results showed a great

discrepancy in the levels of awareness, ownership, and usage. The variations observed in these three key elements are in conformity with previous studies wherein high awareness, but low ownership and usage were recorded in different parts of Africa (WHO 2005, WHO 2008, Ndjinga and Minakawa 2010, WHO 2012, Dawaki et al. 2016). Hence, the study predicts, based on the data gathered, that the levels of LLINs ownership and utilization rates are expected to be between the range of 989 to 998 households significantly at 95% confidence interval rather than the utilization rate by 714 households.

Our results also showed that about 19.9% and 48.6% of pregnant women and children under five years old, respectively slept under the LLINs a day before the survey. The low proportion of these vulnerable groups that are utilizing LLINs is of public health concern as they are more at risk of malaria infections with its attendant morbidity and mortality. One of the major goals of LLINs campaign is to use the strategy to reduce the incidence of maternal mortality and neonatal fatality and morbidity (Ndjinga and Minakawa 2010, Dawaki et al. 2016, WHO 2017, WHO 2018). Therefore, there is need to scale up campaigns on the uses of LLNIs among the pregnant women and mothers of children under 5 to reduce the burdens of infections among these groups.

Conclusion

The levels of LLINs possession and the rates of utilization varied which negate the recommended utility procedure. There is need for scaling up campaigns on ownership and utilization of LLINs among the residents of the study area, most especially the vulnerable groups. This can be achieved by door-to-door interactions/campaigns on acceptability/benefits of proper usage to compliment the usual broadcast/jingles to eradicate malaria disease in endemic regions. Research on possibility of adoption and acceptability of insecticide impregnated door and window-curtains and window blinds or nets could be initiated to circumvent the identified challenges of LLINs usage.

Conflict of Interests

The authors declare that they have no conflict of interest. The authors are responsible for the content and writing up of this paper.

Authors' Contributions

K. A. Fasasi conceived and designed the study which was modified by Adeleke M. A. by proofreading the adopted questionnaire. D. H. Familoni applied the questionnaires on the field under the guidance and supervision of K. A. Fasasi and M. A. Rufai. The raw data were coded and entered by D. H. Familoni and cleaned and analysed using 2016 excel sheet and SPSS version 17.0 by K. A. Fasasi. The manuscript was drafted by K. A. Fasasi and critical review was done by M. A. Adeleke and M. A. Rufai.

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