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Coverage and usage of insecticidal treated bed-nets for preventing malaria in four peri-urban communities of Ijebu-North, Southwest Nigeria

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ABSTRACT

Sleeping under insecticidal treated bed-nets has been proven as an effective tool towards preventing mosquito bites and malaria but the burden of malaria cases seems to be on the increase. This study therefore assessed the limiting factors associated with ownership and usage of Long-Lasting Insecticidal Nets (LLINs) in four peri-urban communities in Ogun State, Nigeria. A total of 499 residents above age 15, were recruited and interviewed at the healthcare facilities in the selected communities using a well-structured questionnaire. Data obtained were analyzed using SPSS 25.0 version for descriptive and chi-square statistics, with significance set at 95%. Of the 499 residents, 72.1% (360/499) owned at least one LLIN, while only 56.7% (204/360) affirmed to sleeping under the bed net. Heat was a major reason for non-usage, 70/135 (51.9%) followed by harboring dust 40/135 (29.6%), skin irritation 16/135 (11.9%) and problem of hanging nets 2/135 (1.5%). There were significance differences between the challenges in the use of LLIN by the respondents and the peri-urban communities (p= 0.000). Majority of the respondents also reported LLIN abuse; 59/93 (63.4%) used them as window or door nets, 13/93 (13.9%) and 13/93 (13.9%) used them as fishing nets and as sieves and sponges respectively. Other uses included using it as a means of protection against rodents on the farm and as football goal nets. There was no significance difference between the abuse of LLINs by the respondents and the peri-urban communities (p= 0.209). The non-usage and abuse of LLIN will dampen the efforts targeted at controlling malaria in the southwestern region of Nigeria. It is therefore important that malaria control programmes incorporate health awareness campaigns targeted at promoting usage and disapproving the abuse of LLINs.

Keywords: Challenges, Long-Lasting Insecticide Nets, Malaria, Ogun State, Prevalence.

INTRODUCTION

Malaria is the leading and most important parasitic disease in Africa, with high mortality among children under age five and pregnant women. In Africa, over 215 million cases and 386,000 deaths have been attributed to this disease (WHO, 2020), with Nigeria sharing more than one-fifth of this burden (WHO, 2019). Beyond the negative consequences on human health, malaria heavily impact on financial capability of individuals via huge out-of-pocket expenses, and has been a promoter of poverty (White *et al.*, 2011).

Majority of malaria cases are established through bites of infected female Anopheles mosquitoes and sleeping under insecticide treated bed nets have been adopted as one of the

primary transmission prevention and control measures in endemic countries (WHO, 2020). One of such bed-nets is the Long-Lasting Insecticide Nets (LLINs). These nets are impregnated with insecticide pyrethroid designed to repel and kill mosquitoes (and other insects) over a period of 4 years (Tokponnon *et al.,* 2014; Edogun *et al.,* 2012). The ownership and proper utilization of these nets have thus been adopted by Roll Back Malaria (RBM) partners in Nigeria to stem the high incidence of malaria (Isreal *et al.,* 2018). Residents of malaria endemic countries are therefore expected to sleep every day during the night hours under these nets. To ensure a physical barrier is set between the mosquitoes and users of the bed nets, the nets must be without damage and must be properly hanged and tucked under the sleeping materials (Ajegena and Oti, 2020).

In the past years, the RBM strategy has focused on provision of LLINs to women and children under age five as a priority class (Kedebe *et al.,* 2021; Taremwa *et al.,* 2022). This strategy has marginalized households without members who belong to the priority class, hence creating a pool of non-LLIN owners in endemic communities. An improvement over this practice is the recent shift in approach to an inclusive coverage of all populations regardless of age or gender (Teh *et al.,* 2021). Several studies in sub-Saharan Africa have demonstrated community-wide benefits of universal LLINs coverage on malaria related morbidity and mortality, yet LLINs usage remain below universal coverage (Kanyangarara *et al.,* 2018).

In Nigeria, LLINs have been distributed to different states including Ogun State (Adeneye *et al.,* 2014; Adeniran *et al.,* 2014). Periodic monitoring and evaluation of coverage and conditions of LLINs is therefore a worthy investment in the bid to control and eliminate malaria (Atinga *et al.,* 2019). However, there are paucity of studies reporting the challenges faced by LLIN users in this State. Towards the eastern part of the State, Aina *et al.* (2020) reported LLINs ownership of 86% and non-usage of 66%, which is disturbing. It was imperative to further assess the coverage of LLINs in communities located in this region and also to identify challenges associated with effective utilization of LLINs. Therefore, this study assessed the factors associated with ownership and usage of LLINs in four peri-urban communities of Ijebu in Ogun State, Southwest Nigeria.

METHODOLOGY

Study Area

The study was conducted in Ogun State, South-western Nigeria between July and December 2020. Two Local Government Areas (LGAs); Ijebu-North (6°57′N 4°00′E) and Ijebu–Ode (6°49′15”N 3°55’15”E) were purposively selected as study areas, owing to previously existing report of high non-usage among owners of bed-nets (Aina *et al.,* 2020). The climate is tropical with an average temperature of 27^{0}C and with significant rainfall of 2020 mm. Popularly, the Ijebus are the predominant inhabitants of the study area and they engage in farming and timber businesses.

Ethical approval, consent and sensitization

Ethics approval (OOU/FS/ZOO/16/100) was obtained from the Ethics Review Committee of Faculty of Science, Olabisi Onabanjo University, Ago-Iwoye, Ogun State Nigeria. Consents were sought from the Directors of the Primary Health Centres (PHCs) and Private Hospitals (PHs) within the study area as shown in figure 1. A pre-survey contact/advocacy meeting was made to each selected study community to obtain consent from community leaders and other major stakeholders after explaining the objectives of the research to them. This was followed by mobilization and sensitization using health workers to communicate the objectives of our visit to prospective study participants. Those willing to participate in the study completed written consent forms. Assent forms were completed in cases where the willing member is below 16 years of age. In this case, parents or any legal guardian were asked to accompany minors under age 16 to provide additional consents. The method of consent assertion was through thumbprint on already printed Informed Consent Forms (ICFs).

Study design and selection of communities

This study employed a cross-sectional sampling design involving questionnaire administration in four communities (Ago-Iwoye, Ijebu-Igbo, Ijebu-Ode and Oru-Ijebu). The communities were selected based on (1) previous report of high non-usage of bed-nets by *Aina et al.* (2020) and (2) high population of mixed residents due to the presence of tertiary institutions. Preliminary advocacy visits were made to the primary healthcare facilities closer to the selected communities prior to field survey. The study was conducted between August and September, 2020.

Sample size determination and selection of study participants

A snowball sampling approach was used in recruiting study participants across households in the selected communities. A minimum number of 100 respondents were targeted in each of the community, therefore, a total of 400 persons were estimated to be recruited. However, the recruitment of participants extended beyond the estimated sample size. Only residents who were above age

of 15 years, could provide consent or assent, and had lived within the community in the last 6 months were recruited into the study. Enrollment and interview with participants took place at healthcare facilities in the communities.

Questionnaire administration

Data were collected using well-structured questionnaires. The questionnaire was designed and in English language and pre-tested for suitability. The information obtained through the questionnaires include; demographic data (age, gender, marital status and religion); possession, ownership, usage of LLINs, knowledge of malaria transmission; frequency of sleep patterns and mosquito bites. When necessary, the questions were translated into Ijebu language (the major native language in the study area) for better understanding for the respondents. The questionnaires were duly filled and returned immediately to avoid any loss.

Data analysis

Data collected during interviews were entered into Microsoft Excel sheet 2010 and transported to Statistical Package for Social Science Software (SPSS, Version 24). Descriptive statistics including frequencies and percentages were used to describe the variables, while Chi square statistics was used to estimate association between variables. The level of significance was set at 95% i.e., $p<0.05$.

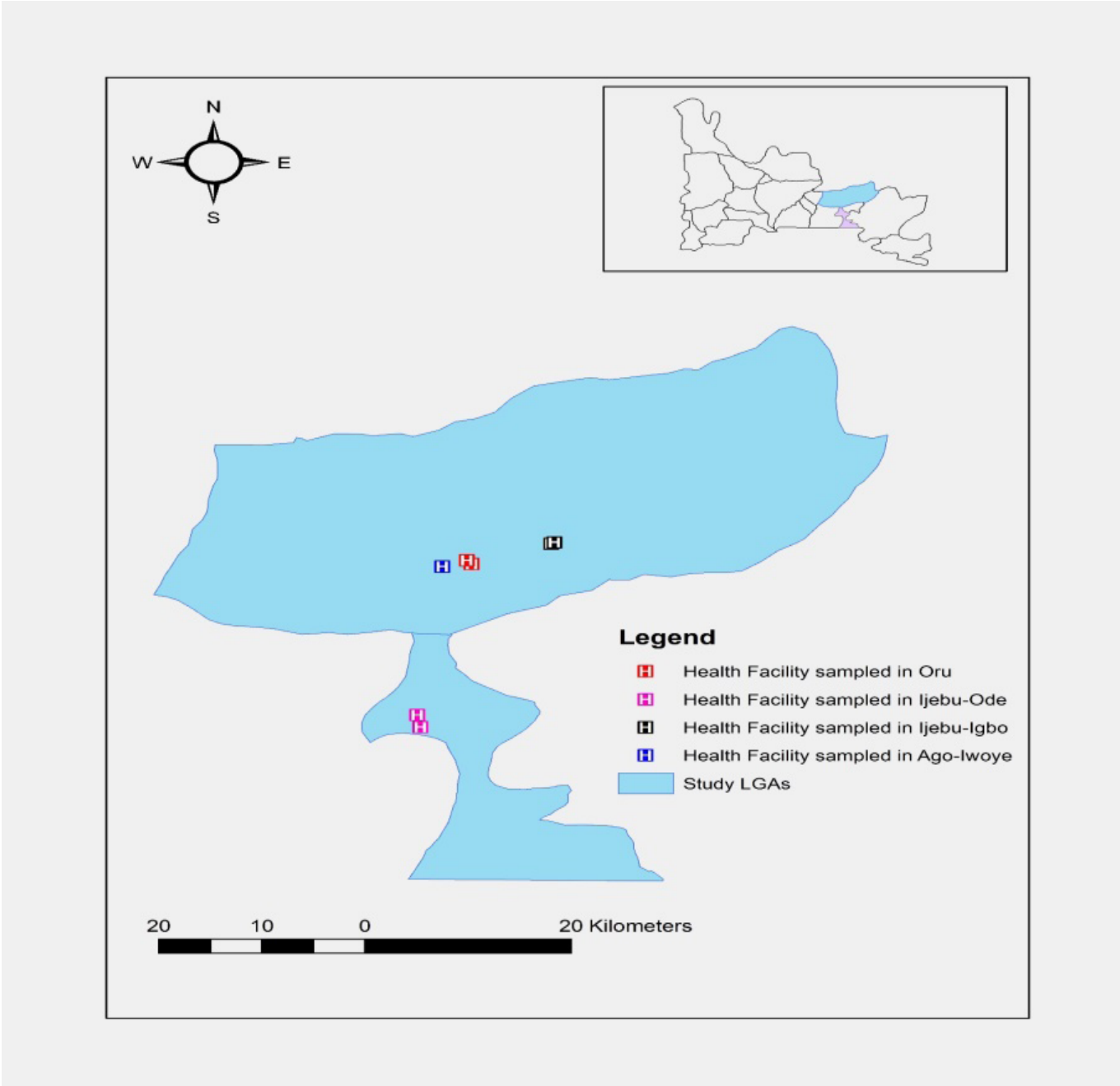

Figure 1: Map of study area showing the geographical representation of sampled health facilities with Ogun State as inset.

RESULTS

Demographic characteristics of study participants

A total of 499 respondents comprising 227 (55.5%) males and 222 (45.5%) females participated in this study. By age category, those within the age-groups 18-25 years and >15 years were more represented, 133 (26.7%) and 114 (22.8%) respectively compared to other age-groups. Adult respondents with the age group 36-40 years were the least represented, 31 (6.2%). In addition, majority of the participants were single, 271 (54.3%), followed by 217 (43.5%) who were married. There were significant differences in the demographic characteristics of the participants across the study communities ($p<0.05$) (Table 1).

Table 1: Demographic parameters of study respondent

Demographic factors	Locations					
	Ago-Iwoye (NE=101)	Ijebu-Igbo (NE=102)	Ijebu-Ode (NE=200)	Oru-Ijebu (NE=96)	**Total (NE=499)**	p-value
Age group in years						
≥15	6(5.3)	35(30.7)	72(63.1)	1(0.9)	114(22.8)	0.000*
16-25	28(21.1)	14(10.5)	51(38.3)	40(30.1)	133(26.7)	
26-30	12(38.7)	12(38.7)	0(0)	7(22.6)	31(6.2)	
31-35	19(48.7)	8(20.5)	2(5.1)	10(25.6)	39(7.8)	
36-40	2(6.1)	8(24.2)	14(42.4)	9(27.3)	33(6.6)	
41-45	3(5.7)	6(11.5)	28(53.8)	15(28.8)	52(10.5)	
46-50	18(36.7)	10(20.4)	13(26.5)	8(16.3)	49(9.8)	
>50	13(27.1)	9(18.8)	20(41.6)	6(12.5)	48(9.6)	
Gender						
Male	41(14.8)	39(14.1)	120(43.3)	77(27.8)	277(55.5)	0.000*
Female	60(27)	63(28.4)	80(36)	19(8.6)	222(44.5)	
Marital Status						
No response	2(100)	0(0)	0(0)	0(0)	2(0.4)	0.000*
Divorced	1(50)	0(0)	1(50)	0(0)	2(0.4)	
Married	54(24.9)	45(20.7)	66(30.4)	52(23.9)	217(43.5)	
Single	42(15.5)	57(51)	133(49.1)	39(40.6)	271(54.3)	
Widowed	2(28.6)	0(0)	0(0)	5(71.4)	7(1.4)	

*Significant difference when p is less than 0.05

LLIN ownership among study participants

A total of 360 respondents (72.1%) affirmed to possession of at least one LLIN. More net owners were observed in Ijebu-Ode (115, 31.9%), followed by Oru-Ijebu (83, 23.1%), Ago-Iwoye (83, 23.1%) and Ijebu-Igbo, (79, 21.9%). Majority of the respondent with nets obtained it from the government (176, 48%) or during antenatal care visit in the hospitals (153, 42%). Some of the respondents purchased these LLINs (35, 9%), while others got their LLINs from families and friends (4, 1%). There were significant differences between ownership of LLINs amongst the respondents across the study communities ($p<0.05$) (Table 2).

Table 2: Ownership of LLINs amongst respondents across the study area.

Ownership of LLIN	Locations					
	Ago-Iwoye (NE=101)	Ijebu-Igbo (NE=102)	Ijebu-Ode (NE=200)	Oru-Ijebu (NE=96)	**Total (NE=499)**	p-value
Do you have LLIN at home?						
Yes	83(23.1)	79(21.9)	115(31.9)	83(23.1)	360(72.1)	0.000*
No	14(17.1)	13(15.9)	45(54.9)	10(12.2)	82(16.4)	
No response	4(7)	10(17.5)	40(70.2)	3(5.3)	57(11.4)	
Where did you get LLIN?						
Family/Friends	1(25)	0(0)	2(50)	1(25)	4(1)	0.000*
Government/NGOs	50(28.4)	45(25.6)	53(30.1)	28(15.9)	176(48)	
Hospital	29(18.9)	28(18.3)	40(26.1)	48(31.4)	153(42)	
Purchase	3(8.6)	9(25.7)	19(54.3)	4(11.4)	35(9)	

*Significant difference when p is less than 0.05

Usage of LLINs among study participants

Out of the 360 participants who own a LLIN, only 204(56.7%) slept under them the last night before the survey. The overall prevalence of non-usage was 44.3%. The most common reason for not sleeping under the net was because it causes heat, 133 (85.3%). There were significant differences in the proportions recorded for those who owns net (p= 0.000) and reasons for non-usage of nets (p= 0.000) across the study communities (Table 3).

Factors limiting the usage of LLINs among study participants

A total of 135(27.1%) of the 499 respondents interviewed affirmed that there are challenges with the usage of LLIN, with majority of them from Ijebu-Igbo (36, 26.6%), followed by Ago-Iwoye (34, 25.2%), Ijebu-Ode (33, 24.5%) and Oru-Ijebu (32, 23.7%). The greatest challenge was attributed to LLINs causing heat (70, 51.9%), harboring dust (40, 29.6%) and causing skin irritation (16, 11.9%). There were significant differences in the proportions recorded for the challenges limiting usage of nets across the study communities (p= 0.000). Furthermore, majority of the respondents abuse the LLIN as window nets (63.4%), fishing nets (13.9%) and other domestic uses such as sieves and sponges (13.9%) (Table 4).

Table 3: Usage of LLINs Among Study Participants.

	Locations					
	Ago-Iwoye (NE=83)	Ijebu-Igbo (NE=82)	Ijebu-Ode (NE=114)	Oru-Ijebu (NE=81)	**Total (NE=360)**	p-value
If you have LLIN, how many?						
1-5	79(24.3)	76(23.4)	105(32.3)	73(22.5)	325(90.2)	0.130
6-10	4(4.8)	6(7.3)	7(6.1)	8(9.9)	25(6.9)	
>10	0(0)	0(0)	2(100)	0(0)	2(0.5)	
Did you sleep under the LLIN last night?						
Yes	42(20.6)	47(23)	73(35.7)	42(20.6)	204(56.7)	0.000*
No	41(26.3)	35(22.4)	41(26.3)	39(25)	156(43.3)	
If No, Why did you not?						
Causes heat	36(27.1)	23(17.3)	33(24.8)	37(27.8)	133(85.3)	0.000*
Net is too small	0(0)	1(33.3)	2(66.7)	0(0)	3(1.9)	
Absence of mosquitoes	3(15)	11(55)	6(30)	0(0)	20(12.8)	
Hanging problem	2(50)	0(0)	0(0)	2(50)	4(2.6)	

*Significant difference when p is less than 0.05

Table 4: Factors Limiting the Usage of LLINs Amongst Respondents.

	Locations					
	Ago-Iwoye (NE=101)	Ijebu-Igbo (NE=102)	Ijebu-Ode (NE=200)	Oru-Ijebu (NE=96)	**Total (NE=499)**	p-value
Do you think there are challenges in LLIN usage?						
No	67(18.4)	66(18.1)	167(45.9)	64(17.6)	364(72.9)	0.000*
Yes	34(25.2)	36(26.6)	33(24.5)	32(23.7)	135(27.1)	
What are the challenges						
Harbours dust	16(40)	6(15)	13(32.5)	5(12.5)	40(29.6)	0.000*
Causes heat	25(35.7)	11(15.7)	29(41.4)	5(7.1)	70(51.9)	
Hanging problem	1(50)	0(0)	0(0)	1(50)	2(1.5)	
Causes skin irritation	1(6.25)	3(18.8)	2(12.5)	10(62.5)	16(11.9)	
Not used to using it	2(28.6)	2(28.6)	2(28.6)	1(14.2)	7(5.1)	
What other activities do you use LLIN for?						
For domestic uses e.g.sieving, sponges	2(15.4)	4(30.7)	2(15.4)	5(38.4)	13(13.9)	0.209
Used as window or door nets	20(33.8)	13(22)	15(25.4)	11(18.6)	59(63.4)	
Hung as football goal posts	1(100)	0(0)	0(0)	0(0)	1(1.1)	
Protection of farm produce on farms from rodents and flies	2(28.5)	3(42.8)	2(28.5)	0(0)	7(7.5)	
As fishing nets	3(23)	7(53.8)	0(0)	3(23)	13(13.9)	

*Significant difference when p is less than 0.05

DISCUSSION

This study investigated factors associated with ownership and usage of LLINs amongst residents in Ijebu-North and Ijebu-Ode LGAs of Ogun State, Nigeria. We observed a high (72.1%) ownership level of LLINs amongst the study participants, this is in line with the reports of 71.3% in South Western Nigeria (Omonijo and Omonijo, 2019) but lower than 95.3% and 89.9% reported by Aderibigbe *et al.* (2014) and Ntonifor and Veyufambom (2016) in Nigeria and Cameroon. The high LLINs ownership in this study was as a result of massive distribution of LLINs by Non-Governmental Organizations (NGOs) and the malaria control programs at the state and federal level. The roles of these NGOs and the Government in the increasing LLIN coverage cannot be overemphasized as studies reported by Kateera *et al.* (2015), Ntonifor and Veyufambom (2016) and Omonijo and Omonijo (2019) in various parts of Africa have established their contribution in the free distribution of LLINs.

Consequently, the non-usage level of LLIN amongst respondents which was 56.7% was higher than 3.2% reported by Koudou *et al.* (2010) in Cote-D'Ivoire, 23.5% by Gerstl *et al.* (2010) in Sierra-Leone and 21.7% in Cross-River, Nigeria by Ibor *et al.* (2012) and 33.4% Omonijo and Omonijo (2019) in Nigeria respectively. This was not in conformity with 89.9% and 86% of the respondents' LLIN usage the previous night reported by Ntonifor and Veyufambom (2016) and Adaji and Gabriel (2019) respectively. Despite already being educated on LLINs as major tools used in controlling malaria disease, wide variations in LLINs non-usage across Africa have been documented. Respondents' various reasons of LLIN non-usage were attributed to cause of heat, hanging problem and absence of mosquitoes in the room. The identification of heat as one of the major challenges in this study is similar to studies reported by Komomo *et al.* (2016), Ntonifor and Veyufambom (2016), Isreal *et al.* (2018) and Onyemaechi *et al.* (2017). Also, Ajegena and Oti (2020) reported that the Nigeria's epileptic power supply at night plays a major role in the heat responses. This was also corroborated by Adebayo *et al.* (2014) in Oyo State, Southwestern Nigeria. In contrast, Harvey *et al.* (2008) in Peru reported that LLINs users enjoyed its warmth during its usage at night as the climate condition of the country is cold. Other reasons for not sleeping under LLINs as reported by Scott *et al.* (2021) in Mozambique were insufficient availability of the nets amongst household members and taking the decision to not use LLIN the previous night because the rainy or malaria season had not yet begun, in spite of transmission occurring throughout the year with seasonal peaks.

According to Johnson *et al.* (2015) and Teh *et al.* (2021) ownership of LLINs do not generally translate to its proper usage. We observed insignificant differences in LLIN abuse across the study communities, which is understandable considering the structure and needs of the four communities assessed. More people abused the LLINs for agricultural-related activities such as farming, fishing and sieving. Respondents' improper usage of LLINs such as being used for domestic uses, window or door nets, used on the farms against rodents and flies as observed in this study are likely to increase their chances of being bitten by mosquitoes which in turn could lead to higher malaria prevalence in the study area. Other improper usage of LLIN as reported by Ntonifor and Veyufambom (2016) in Cameroon include nursing seeds, wall cover and harvesting of beans.

For now, LLINs usage still remains a positive control measure in curtailing malaria (Strode *et al.,* 2014). Recent observations have shown that there are still wide variations in the ownership, utilization and abuse of LLIN amongst people of rural and semi-urban areas despite the distribution of LLINs in Nigeria and other countries. These observations will seem to negate the Global Technical Strategy (GTS) targets in achieving global 90% reduction malaria cases and mortality and elimination of the disease in at least 35 countries by 2030.

CONCLUSION

In conclusion, this study has provided a database on factors which determine respondents' possession of LLINs and the challenges which hinders LLINs usage in the study area. Hence, we the authors recommend constant health malaria programmes on the utilization of LLINs by the health authorities across the LGAs in Ogun State, Southwest Nigeria. These programmes are to emphasize on the proper hanging of LLINs, the implication of non-usage of LLINs and distribution of education materials on the impact of poor environmental conditions in the role of transmission of malaria. As the present alteration in climate will enhance the breeding of mosquitoes, the provision of electricity by the appropriate authorities in the communities will play an encouraging role in the usage of LLINs by the populace.

REFERENCES

Adaji, J., and Gabriel, O. E. (2019). Access and usage of Long-Lasting Insecticidal Nets (LLIN) in rural communities of Benue State, Nigeria. *Health Science Journal*, *13*(1), 618.

Adebayo, A. M., Akinyemi, O. O., and Cadmus, E. O. (2014). Ownership and utilization of insecticide-treated mosquito nets among caregivers of under-five children and pregnant women in a rural community in Southwest Nigeria. *Journal of Preventive Medicine and*

Hygiene, 55, 58–64.

Adeneye, A. K., Jegede, A. S., Nwokocha, E. E., and Mafe, M. A. (2014). Perception and affordability of long-lasting insecticide-treated nets among pregnant women and mothers of children under five years in Ogun State, Nigeria. *Journal of Infection and Public Health, 7*, 522–533.

Adeniran, A. A., Mogaji, O. H., Oluwole, S. A., Abe, M. E., Bankole, O. S., and Ekpo, F. U. (2014). Commodity utilization of malaria intervention and control tool: Access and utilization of long-lasting insecticide net in rural communities of Imeko Afon and Odeda local government area of Ogun state, Nigeria. *Annals of Tropical Medicine and Public Health*, *7*(2), 85–90.

Aderibigbe, S. A., Olatona, F. A., Sogunro, O., Alawode, G., Babatunde, O. A., Onipe, A.I., Bolarinwa, O. A., …… Akande, T. M. (2014). Ownership and utilization of long lasting insecticide treated nets following free distribution campaign in South West Nigeria. *The Pan African Medical Journal*, *17,* 263.

Ajegena, B. K., and Oti, V. B. (2020). The challenges of using Insecticides Treated Nets (ITNs) in curbing malaria in Nigeria: A 2000-2018 Systematic Review. *Journal of Infectious Diseases and Epidemiology, 6*, 140.

Aina, S. A., Kolejo, O. S., Adekunle, O. N., Osalade, O. O., Ibitoye, O. S., and Agarawu, D. R. (2020). Human malaria incidence rate versus vector control: Perception among Ijebu-North Local Government inhabitants. *FUW Trends in Science & Technology Journal*, *5*(2), 586–589.

Atinga, A., Babylon, P., Galaya, T., and Obiano, E. C. (2019). Evaluation of long-lasting insecticidal nets mass distribution campaign and malaria among under-five children in Mayo Belwa L.G.A. Adamawa State, Nigeria. *International Journal of Biomedical Laboratory Sci*ence, *8*(1,2), 28–33.

Edogun, H. A., Daramola, G. O., Adeleye, T. E., Ojerinde, A. O., Agbaje, A. A., Ogunbola, O., Ajala, O.O., ... Akerele, E. F. (2012). Use of long-lasting insecticidal-bednets among people living with HIV/AIDS accessing care in a tertiary health facility in Southwest, Nigeria. *International Journal of Tropical Disease and Health*, *31*(2), 1–5.

Gerstl, S., Dunkley, S., Mukhtar, A., Maes, P., De Smet, M., Baker, S., and Maikere, J. (2010). Long-lasting insecticide-treated net usage in eastern Sierra Leone-The success of free distribution. *Tropical Medicine and International Health*, *15*(4), 385–394.

Harvey, S. A., Olórtegui, M. P., Leontsini, E., Pezo, C. B., Pezantes, L. O., and Winch, P. J. (2008). The whole world will be able to see us: Determining the characteristics of a culturally appropriate bed net among Mestizo communities of the Peruvian Amazon. *American Journal of Tropical Medicine and Hygiene*, *79*(6), 834–838.

Ibor, U. W., Aigbe, G. O., Iwara, A. I., Okongor, O. E., and Okino, I. I. (2012). Ownership and utilization of insecticide nets in Cross River State, Nigeria. *Journal of Medical Sciences*, *10*, 1–9.

Israel, O. K., Fawole, O. I., Adebowale, A. S., Ajayi, I. O., Yusuf, O. B., Oladimeji, A., and Ajumobi, O. (2018). Caregivers' knowledge and utilization of long-lasting insecticidal nets among under-five children in Osun State, Southwest, Nigeria. *Malaria Journal, 17*, 231.

Johnson, O. E., Inyang, A. C., Etuknwa, U. I., Ekanem, U. D., Udo, U. O., Ubom, I., Tommy, D. P., Ichah, M. E., …… Ntukidem, U. B. (2015). Awareness, ownership and utilization of insecticide treated nets among households in a rural community in Southern Nigeria. *Scholars Journal of Applied Medical Sciences, 3*(2A), 608–613.

Kateera, F., Ingabire, C. M., Hakizimana, E., Rulisa, A., Karinda, P., Grobusch, M. P., Mutesa, L., ... Mens, P. F. (2015). Long-lasting insecticide treated net source, ownership and use in the context of universal coverage: a household survey in eastern Rwanda. *Malaria Journal*, *14*, 390.

Kanyangarara, M., Hamapumbu, H., Mamini, E., Lupiya, J., Stevenson, J. C., Mharakurwa, S., Chaponda, M., …… Moss, W. J. (2018). Malaria knowledge and bed net use in three transmission settings in Southern Africa. *Malaria Journal, 17*, 41.

Kedebe, Y., Hayder, A., Girma, K., Abaecha, F., Alemayehu, G., Abebe, L., Sudhakar, M., and Birhanu, Z. (2021). Primary school students' poetic malaria messages from Jimma Zone, Oromia Ethopia: a qualitative content analysis. *BMC Public Health, 21*, 1688.

Komomo, E. A., Egena, R., Chuku, I., Akintoye, A. O., and Agada, P. O. (2016). Assessment of the utilisation of insecticides treated nets in Calabar Metropolis, Cross River State, Nigeria. *Journal of Health, Medicine and Nursing, 26*, 196–205.

Koudou, B. G., Ghattas, H., Esse, C., Nsanzabana, C., Rohner, F., Utzinger, J. (2010). The use of insecticide treated nets for reducing malaria morbidity among children aged 6-59 months in an area of high malaria transmission in central Cote d'Ivoire. *Parasite & Vectors*, *3*, 91.

Ntonifor, V. H., and Veyufambom, S. (2016). Assessing the effective use of mosquito nets in the prevention of malaria in some parts of Mezam division, Northwest Region Cameroon. *Malaria Journal, 15*, 390.

Omonijo, A., and Omonijo, A. O. (2019). Assessment of the status of awareness, ownership, and usage of long-lasting insecticide treated nets after mass distribution in Ekiti State, Nigeria. *Journal of Parasitology Research*.

DOI:10.1155/2019/1273714.

Onyemaechi, A. B., Obionu, C. N., Chikani, U. N., Ogbonna, I. F., and Ayuk, A. C. (2017). Determinants of use of insecticides treated nets among caregivers of under five children in Enugu, South-East, Nigeria. *Annals of Tropical Medicine and Public Health, 10*, 1037–1042.

Scott, J., Kanyangarara, M., Nhama, A., Macete, E., Moss, W. J., and Saute, F. (2021). Factors associated with use of insecticide-treated net for malaria prevention in Manica District, Mozambique: a community-based cross-sectional survey. *Malaria Journal*, *20*, 200.

Strode, C., Donegan, S., Garner, P., Enayati, A., and Hemingway, J. (2014). The impact of pyrethroid resistance on the efficacy of insecticide-treated bed nets against African anopheline mosquitoes; a systematic review and meta-analysis. *PLoS Medicine, 11*(3), e1001619.

Tarenmwa, I. M., Ashaba, S., Kyarisiima, R., Ayebazibwe, C., Ninsiima, R., and Mattison, C. (2022). Treatment-seeking and update of malaria prevention strategies among pregnant women and care-givers of children under-five years during Covid-19 pandemic in rural communities in South-west Uganda: a qualitative study. *BMC Public Health*, *22*, 373.

Teh, R. N., Sumbale, I. U. M., Meduke, D. N., Nkeudem, G. A., Ojong, S. T., Teh, E. A., and Kimbi, H. K. (2021). Insecticide-treated net ownership, utilization and knowledge of malaria in children residing in Batoke-limbe, Mount Cameroon area: effect on malariometric and haematological indices. *Malaria Journal, 20*, 333.

Tokponnon, F. T., Sissinto, Y., Ogouyémi, A., Sovi, A., Gnanguenon, V., Adéothy, A.A., Wapo, A., …… Akogbeto, M. C. (2014). Assessment of long-lasting insecticidal net coverage, use and physical integrity one year after universal distribution campaign in Plateau department in South-East Benin. *Journal of Public Health and Epidemiology*, *6*, 76–84.

White, M. T., Conteh, L., Cibulskis, R., and Ghani, A. C. (2011). Costs and cost-effectiveness of malaria control interventions - a systematic review. *Malaria Journal*, *10*, 337.

World Health Organization (2019). *World Malaria Report*. Briefing Kit. Pp. 14.

World Health Organization (2020). *World Malaria Report*. 20 years of global progress and challenges. Pp. 300.