



Household characteristics as determinants of ownership of mosquito nets in urban households in Nigeria

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ABSTRACT

Malaria accounts for more than 435,000 deaths yearly. The mosquito net is a proven effective method for malaria prevention. Statistics from Nigeria shows that 55% of households in Nigeria possess at least one mosquito net for sleeping. Among these, only 48% of these households are in urban areas. Reports suggest that these figures might not be enough to contain and eventually eliminate malaria in Nigeria. Few studies have explored the relationship between household characteristics and ownership of mosquito nets especially in urban areas of Nigeria. Therefore, this study aims to explore the relationship between household characteristics and ownership of mosquito nets using the household recode dataset of the 2013 Nigeria Demographic and Health Survey ($n = 16,540$).

The analysis was conducted using Stata 14 analysis software. The chi-square statistics and binary logistic regression were employed to examine the association and determine the extent of relationships between variables respectively. Results showed that female headed households (OR = 0.87 CI: 0.80–0.95); households with family size ≥ 10 members (OR = 1.42 CI: 1.10–1.75); households with 6–10 rooms (OR = 1.35 CI: 1.00–1.83); households with surroundings sprayed in the last 12 months (OR = 2.47 CI: 1.77–3.46) were found to be significantly associated with ownership of mosquito nets in urban households of Nigeria.

The study concludes that socio-demographic factors influence ownership of mosquito nets in Nigeria. Therefore, Intensified efforts in the form of education on the importance of ownership and usage of mosquito nets, equitable distribution campaigns addressing the rural-urban divide is essential to improve ownership and usage of mosquito nets, therefore, contributing to efforts towards achieving the two critical 2020 milestones of the WHO Global Technical Strategy for Malaria 2016–2030: reducing case incidence and death rates by at least 40% from 2015 levels.

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Introduction

Malaria has always been a major public health challenge across the world especially in sub-Saharan Africa and remains the main concern of many health interventions because of the number of deaths being recorded on a yearly basis. According

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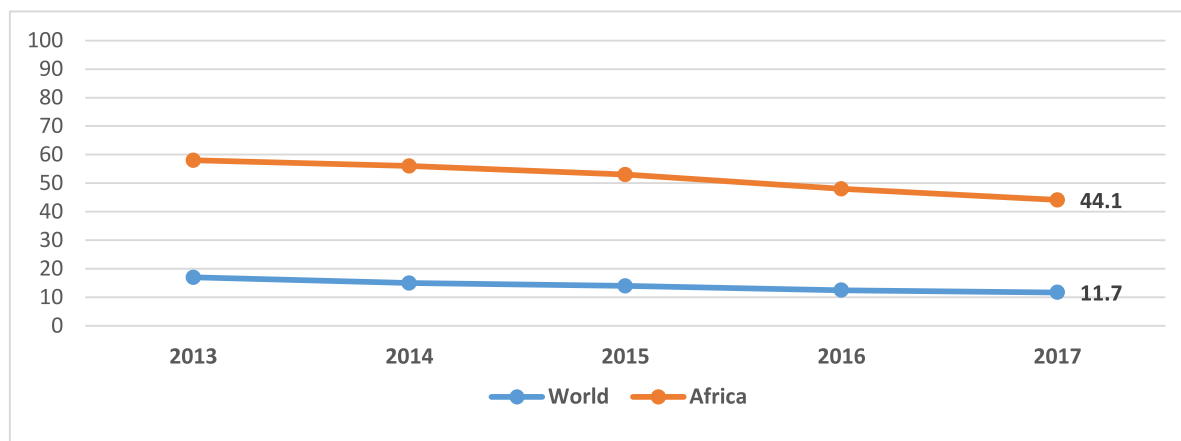
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Table 1

Estimated number of malaria deaths by WHO regions, 2013–2017.

Regions	Number of deaths				
	2013	2014	2015	2016	2017
African	467,000	446,000	432,000	413,000	403,000
Americas	400	300	320	460	630
Eastern Mediterranean	6750	8520	8660	8160	8300
European	0	0	0	0	0
South-East Asia	21,800	24,100	25,600	25,600	19,700
Western Pacifica	4600	4420	3510	3510	3620
World	500,000	483,000	451,000	451,000	435,000
World (children aged under 5 years)	344,000	322,000	283,000	283,000	266,000

Source: WHO estimates.

**Fig. 1.** Trends in malaria mortality rate (deaths per 100,000 population at risk), globally and the WHO African region, 2013–2017.

Source: WHO estimates Nigeria and the Malaria Burden.

to the World Health Organization (WHO), there has been a global reduction in malaria mortality rates (deaths per 100,000 population at risk) but malaria still account for more than 435,000 deaths across the world each year with 266,000 (66%) of these deaths in children aged under 5 years (Table 1) [1]. Among these deaths, sub-Saharan Africa counted for about 93% of all deaths in 2017 [2].

Estimates of regional malaria burden

Sub-Saharan Africa has consistently contributed more than 90 percent of all malaria deaths in the last 10 years. Although the specific number of deaths decreased consistently, the proportions it contributed remained as seen in Table 1. Further, the trends in malaria mortality rates (deaths per 100,000 population at risk) has consistently decreased globally and in the African region, however, Africa still has a staggering 44.1 malaria mortality rate in comparison to the global figure of 11.7 [1–3], as shown in Fig. 1.

Nigeria accounted for 25% of all malaria cases and 19% of malaria deaths globally in 2018 [3]. It also recorded the highest number of increases in overall malaria cases with about 1300,000 additional cases between 2016 and 2017 [1]. Also, In Nigeria, malaria affects maternal health and is a major cause of under-five deaths, with a child dying every two minutes from malaria [1,2,4].

Ownership of insecticide treated nets

Vaccines and the use of mosquito nets [3,5]. Insecticide-treated bed nets are important in malaria control and prevention in many countries around the world [5–8]. Globally, there was a steady increase in Insecticide Treated (ITN) distribution and usage between 2010 and 2017. Currently, 50% of the population at risk; 61% of children aged under 5 and 61% pregnant women slept under an ITN. There has also been an increase in household ownership of ITN as 72% of households currently own at least one ITN, 40% of households possess at least one ITN for every two people while access to ITN (percentage of population that could be protected by an ITN, assuming each ITN in a household is used by two people) increased to 56% from 33% [1,2,4] as observed in Fig. 2. In sub-Saharan Africa, household ownership of mosquito nets reached 80% in 2016 [1]. Irrespective of these increments in ITN distributions and coverages, Nigeria still falls short of the operational universal target for ITN as only 55% of households own mosquito nets, with 48% of these households in urban areas.

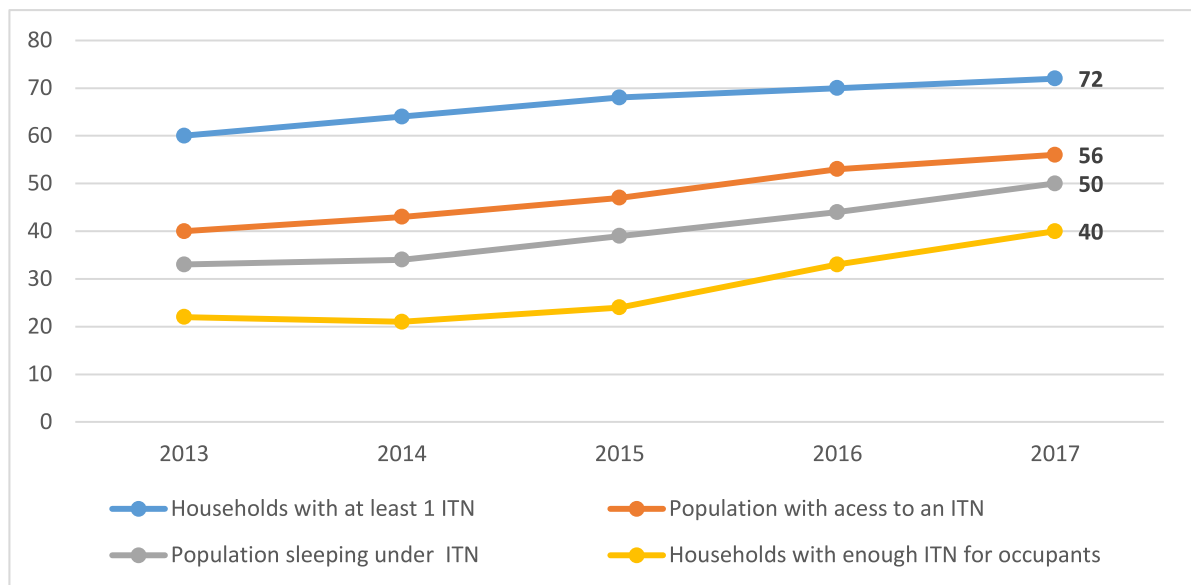


Fig. 2. Percentage of the population at risk with access to an ITN and sleeping under an ITN, and percentage of households with at least one ITN and enough ITNs for all occupants, sub-Saharan Africa, 2010–2017

Source: ITN coverage model from MAP.

This present study, therefore, seeks to examine the role of household factors in ownership of mosquito nets in urban households in Nigeria, as majority of other studies on insecticide treated nets or mosquito nets have focused on under-five children or pregnant women or rural areas with the assumption that rural dwellers do not have sufficient information on health-related issues, neglecting urban households especially urban slums where studies have shown that the conditions are worse off in comparison to rural settlements [1,9–14].

The findings of this study would be very vital in designing interventions to combat malaria related morbidity, mortality and associated economic losses caused by malaria. It would also ensure an equitable intervention design with adequate consideration for all associated factors of malaria control and programming. These would specifically contribute to the achievement of the critical 2020 milestones of the WHO Global Technical Strategy for Malaria 2016–2030 and broadly to the achievement of the Sustainable Development Goal 3.

Materials and methods

The study utilized data from the 2013 Nigeria Demographic and Health Survey (NDHS), a survey of demographic and health indicators conducted in many countries around the world with technical assistance provided by Measure DHS and financial assistance provided by the USAID. This study utilized both the Household and Individual recode datasets, merging both datasets to incorporate variables required for statistical analysis. The sample size for the study was 16,450. The data analysis was conducted at three levels of statistical analysis. At the univariate level, a frequency distribution of each household characteristics was presented, the bivariate analysis employed the Pearson chi-square statistic to test the association between the selected household characteristics and the dependent variable while binary logistic regression models using the odds ratios were developed at the multivariate level to determine the extent of relationships between study variables.

For the models developed, the first model revealed the relationship between ownership of mosquito nets and household characteristics that were found to be statistically significant at the bivariate level while the second model determined the relationship between household characteristic and ownership of mosquito nets while accounting for the influence of some intervening variables including number of under children in the household and presence of a currently pregnant woman in the household. Table 2 displays the operational definition of variables examined in the study.

Study variables

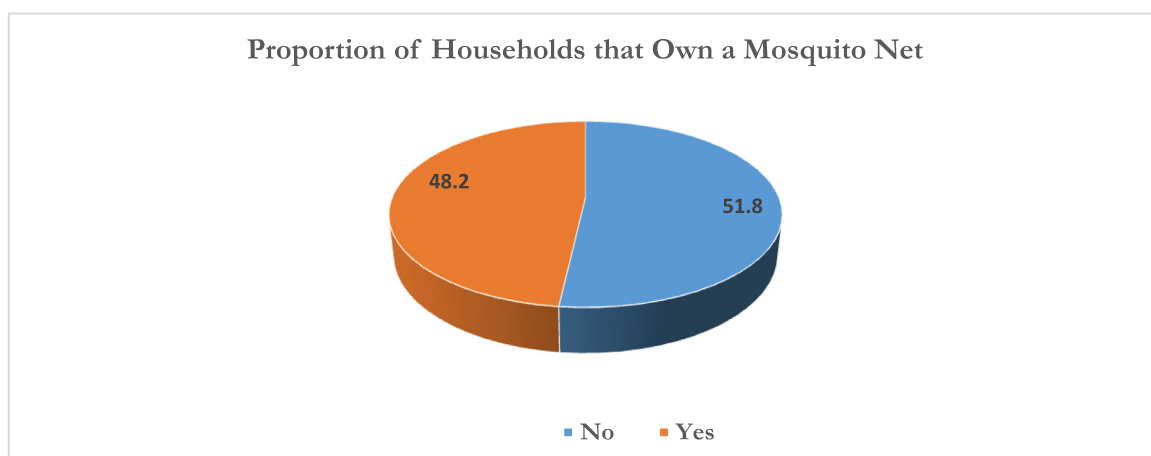
The pie chart (Fig. 3) reveals the proportion of ownership of mosquito nets in urban households in Nigeria. Data shows that 52% of urban households do not possess a mosquito net for sleeping.

In Table 3, the frequency distribution of the dependent variables in the study and the selected household characteristics. It can be reported that the majority of the households in urban areas of Nigeria are headed by men (77%). The frequency distribution of the age of the household head reveals that 66% of the household heads are less than or exactly 50 years old, 34% is greater than 50 years. Majority of the households in the study (99%) have between 0 and 7 rooms for sleeping.

Table 2

Operational definition of variables in the study.

Variables used in the study	
Variables	Operational definition
Ownership of mosquito bed net	The refers to whether the household owns mosquito nets for sleeping coded as; Yes (1) and No (0) due to the use of binary logistic regression for the multivariate analysis.
Sex of household head	The head of the household coded; Male (1) and Female (2).
Region	This refers to the region of the country where the household members reside coded as North-Central (1), North-East (2), North-West (3), South-East (4), South-South (5), South-West (6).
Household rooms for sleeping	The number of rooms in the household used for sleeping by the household members recategorized and coded; 0–7 rooms (1), 8–14 rooms (2) and 15–24 rooms (3).
Number of household members	The number of residents of the household coded as less than 10 (1) and more than 10 (2)
Sprayed compound in the last 12 months	Had the compound of the house sprayed in the last 12 months coded; No (0) and Yes (1)
Age of household head	The age of the head of the household was asked and for the purpose of analysis in this study, we categorized and coded into 10–50 years (1) and 51–95+ (2)
Household wealth index	Composite Index of household items grouped into a quintile; (1) Poorest (2) Poorer (3) Middle (4) Richer (5) Richest. This variable in the DHS was developed using the response of the household member to a series of questions asking whether the household owns some items.
Presence of pregnant woman in the household	This relates to whether the household currently houses a pregnant woman coded as Yes (1) and No (0)
Number of under-five children in the household	The number of children under the age of five years in the household categorized and coded as; 0–3 (1), 4–6 (2) and 7–8 (3).

**Fig. 3.** Ownership of Mosquito Nets in Urban Households of Nigeria.

95% of the households in urban areas of Nigeria have less than 10 household members while about 5% have more than 10 individuals living in the household. Majority of the households in urban Nigeria have not been sprayed for mosquito in the last 12 months (97%), even as less than 5% reported that their surroundings have had their surroundings sprayed in the last 12 months. Considering the household wealth index, one-third of the households were in the richer category, 46% are in the richest category, 15% are in the middle category, 5% fell under poorer and the about 2% in poorest household wealth index categories.

The bivariate analysis presented in [Table 4](#) revealed the association between selected household characteristics (independent variables) in this study and the ownership of mosquito nets (dependent variable). It found that in urban households of Nigeria, more than half of the households where the household head is less than 50 years do not possess a mosquito net for sleeping. 60% of poorest households had mosquito nets in. For other categories of household wealth index, richer households were less likely to have mosquito nets. More urban households in the South East region the country possessed mosquito nets while the lowest proportion of households in possession of mosquito were in the south-south region of the country.

Female headed households reported the highest percentage of households with no mosquito nets (54%). More than 65% of households with a number of rooms between 11 and 24 had mosquito nets for sleeping. It can also be reported that close to 60% of households with 10 or more household members were in possession of mosquito nets while 47% of households with less than 10 members had mosquito nets for sleeping. In addition, more than half of the urban households who didn't have their surroundings sprayed in the last 12 months did not possess a mosquito net (52%) while for households who had

Table 3
Characteristics of Urban Households in Nigeria.

Variables	Frequency	Percentage
Sex of household head		
Male	12,752	77.09
Female	3789	22.91
Household rooms for sleeping		
0–7	16,406	99.19
8–14	129	0.78
15–24	5	0.03
Number of household members		
<10	15,720	95.04
10+	820	4.96
Sprayed compound in the last 12 months		
No	16,029	96.91
Yes	511	3.09
Age of household head		
10–50	10,976	66.36
51–95+	5564	33.64
Household wealth index		
Poorest	390	2.36
Poorer	943	5.70
Middle	2494	15.08
Richer	5048	30.52
Richest	7666	46.35
Currently pregnant woman in household		
No/Don't know	13,637	82.44
Yes	2904	17.56
Number of under-five children in household		
0–3	16,267	98.34
4–6	263	1.59
7–8	11	0.06
Total	16,541	100

their surroundings sprayed, 31% of these urban households did not have mosquito nets while 69% of these urban households possessed mosquito nets.

In the multivariate analysis (Table 5), binary logistic regression that examined the household determinants of ownership of mosquito bed nets among urban households in Nigeria is presented. The result showed that urban households where the age of the household head is more than 50 years were more likely to own mosquito net compared to households where the age of the head is less than 50 (OR = 1.05). The female headed household was 13% less likely to possess a mosquito net compared to male headed households (OR = 0.87). Assessment of the regions revealed that the odds of possessing a mosquito net is more than double in the North East and South East regions compared households in the North central region of the country (OR = 2.35 and 2.23), respectively. There was an equal likelihood of possessing mosquito nets in the North West and South South regions (1.01) while households in the south west region had 13% higher odds of possessing a mosquito net compared to those in the North central (OR = 1.13).

Furthermore, the analysis also revealed that the odds of possessing a mosquito net is 5% higher for poorer urban households than the poorest households (OR = 1.05). The odds of possessing mosquito net is higher for households with 6–10 rooms (34%; OR = 1.35) and more than 10 rooms (51%; OR = 1.47) for sleeping (OR = 1.51) respectively compared to households with 5 or a smaller number of rooms. The odds of having a mosquito net is 42% higher for urban households with 10 or more household members compared to urban households with less than 10 members (OR = 1.42). Also, the analysis revealed that the odds of owning mosquito nets doubled for households that reported spraying their surroundings in the last 12 months. Finally, the odds of owning a mosquito was found to increase with an increasing number of children while currently having a pregnant woman in the household did not reveal increased odds of owning a mosquito net. The number of under-five children in the household and currently having pregnant women in the household were not significant predictors of mosquito net ownership in urban households in Nigeria.

Discussion

The result of the study has revealed that ownership of mosquito nets is low among urban households in Nigeria and this supports the findings of other studies conducted overtime, where it has been found that ownership of Insecticide treated nets among households in Nigeria is generally low [6,15–18], same for a study in rural Madagascar where it was found that ownership of bed nets was low [19], but a study in River state Nigeria has reported otherwise in their study as it was reported in the study that about two-third of the households interviewed in the survey possess an insecticide-treated

Table 4

Bivariate association of ownership of mosquito nets and household characteristics in urban households in Nigeria.

Variables	No (Does not own net)	Yes (Owns net)
Age of Household Head		
10–50	5802 (52.86%)	5174 (47.14%)
51–95+	2764 (49.68%)	2800 (50.32%)
$\chi^2=14.27$ DF=1 $p < 0.05$		
Household wealth index		
Poorest	156 (40%)	234 (60%)
Poorer	366 (38.77%)	577 (61.23%)
Middle	1240 (49.73%)	1254 (50.27%)
Richer	2743 (54.34%)	2305 (45.66%)
Richest	4062 (52.98%)	3604 (47.02%)
$\chi^2 = 102.55$ DF=4 $p < 0.05$		
Region		
North Central	953 (58.20%)	684 (41.80%)
North East	473 (35.04%)	876 (64.96%)
North West	1659 (56.61%)	1271 (43.39%)
South East	1164 (38.52%)	1858 (61.48%)
South-South	1118 (58.62%)	789 (41.38%)
South West	3200 (56.19%)	2495 (43.81%)
$\chi^2 = 476.15$ DF=5 $p < 0.05$		
Sex of household head		
Male	6530 (51.20%)	6223 (48.80%)
Female	2037 (53.76%)	1752 (46.24%)
$\chi^2 = 7.30$ DF=1 $p < 0.05$		
Number of rooms for sleeping		
0–5	8390 (52.20%)	7684 (47.80%)
6–10	166 (38.06%)	270 (61.94%)
11–24	11 (34.29%)	21 (65.71%)
$\chi^2 = 36.17$ DF=2 $p < 0.05$		
Number of household members		
<10	8232 (52.37%)	7489 (47.63%)
10+	334 (40.75%)	486 (59.25%)
$\chi^2 = 40.16$ DF=1 $p < 0.05$		
Sprayed surroundings in the last 12 months		
No	8408 (52.45%)	7622 (47.55%)
Yes	159 (31.09%)	352 (68.91%)
$\chi^2 = 0.03$ DF=1 $p > 0.05$		
Currently Pregnant woman in a household		
No/ Don't Know	4951 (46.55%)	5686 (53.45%)
Yes	637 (46.86%)	722 (53.14%)
$\chi^2 = 86.39$ DF=1 $p < 0.05$		
Number of children under-five		
0–3	8464 (52.03%)	7803 (47.97%)
4–6	99 (37.52%)	165 (62.48%)
7–8	4 (37.28%)	7 (62.72%)
$\chi^2 = 5.9$ DF=1 $p < 0.05$		

net [18]. It is important to note that the majority of the studies reviewed in literature considered individual characteristics, but this present study considered household characteristics. This study found that the significant household determinants of ownership of mosquito nets were the sex of household head; region of residence; the number of rooms for sleeping; the number of household members and spraying of household surroundings in the last 12 months. These findings can be substantiated and supported with findings from other studies of mosquito net ownership and utilization in Nigeria and other parts of the world. For number of household members that has been found to significantly influence use of mosquito nets in Nigeria, this findings is similar to what was found in a similar study in Malawi where it was also found that number of household members influenced ITN usage among the class of women in the study [7], another study in Eastern Nigeria found that an association exists between the number of household members and use of insecticide treated nets for children [20]. The same study in Malawi also lends credence to the findings of this study on the influence of region by reporting that women in some regions were more likely to use ITNs [7]. In the study of the factors associated with the utilization of insecticide treated nets among under-five children in Ethiopia, it was found household family size is a significant predictor of utilization of nets [21–23], although our present study is about ownership, this can find support in the study in Ethiopia.

Furthermore, this study also found that spraying of the house, either internal residual or surroundings have been found to be significantly associated with ownership and use of mosquito nets, similar study in Mozambique also found that having compound sprayed is significantly associated with the use of mosquito or insecticide treated nets [24], same for studies in Ethiopia, Equatorial Guinea, and Madagascar, where it was reported that indoor residual spraying is significantly associ-

Table 5

Binary logistic regression of household determinants of ownership of mosquito nets in urban households in Nigeria.

Variables	Odds Ratio	CI	Odds Ratio	CI
Age of household head				
10–50	1		1	
51–95+	1.05	0.95–1.15	0.99	0.89–1.09
Sex of household head				
Male	1		1	
Female	0.87**	0.80–0.95	0.68**	0.61–0.75
Region				
North Central	1		1	
North East	2.35**	1.59–3.48	2.09**	1.42–3.05
North West	1.01	0.77–1.31	0.95	0.74–1.21
South East	2.23**	1.73–2.86	2.00**	1.54–2.61
South South	1.01	0.77–1.33	1.02	0.76–1.37
South West	1.13	0.89–1.44	1.14	0.88–1.48
Wealth index				
Poorest	1		1	
Poorer	1.04	0.73–1.48	1.15	0.83–1.60
Middle	0.76	0.50–1.16	0.90	0.61–1.31
Richer	0.73	0.47–1.12	0.81	0.54–1.20
Richest	0.79	0.51–1.23	0.85	0.57–1.27
Number of rooms for sleeping				
0–5	1		1	
6–10	1.35**	1.00–1.83	1.17	0.85–1.61
11–24	1.47	0.60–3.59	1.31	0.54–3.19
Number of household members				
<10	1		1	
10+	1.42**	1.10–1.75	1.07	0.85–1.34
Sprayed surroundings				
No	1		1	
Yes	2.47**	1.77–3.46	2.62**	1.73–3.98
Number of under-five children				
0–3			1	
4–6			1.19	0.84–1.68
7–8			1.23	0.21–6.96
Currently pregnant woman in a household				
No/ Don't know			1	
Yes			0.96	0.82–1.12

** $p < 0.05$.

ated with an increasing proportion of nets used [11,25,26]. Also, this present study has found that household family size is associated with ownership of mosquito nets in urban areas in Nigeria, this finding finds support from the result of some studies in Nigeria where it was discovered that is a predictor of net ownership [18,27,28], similarly, a comparative study in south-west Ethiopia also found an association between household size and use of insecticide treated nets [22]. Although this present study didn't find it to be significantly associated with use of mosquito nets, poverty level has been described as an important determinant of use of insecticide treated or mosquito nets, this present study found that richer the household, the less likely the household are to use mosquito net, this is against the findings of a qualitative study in Ethiopia where it was found that poverty is an important determinant of net usage [29]. In the same vein, a study in rural Madagascar also found that household wealth index is not a significant predictor of bed net ownership [19]. The finding of this study that the number of rooms for sleeping is a significant determinant of ownership is similar to the findings of a study in Eastern Rwanda where it was also found that the number of sleeping space is a determinant of ownership and use of nets for sleeping [30].

Conclusion

The malaria burden in sub-Saharan Africa is the highest in the world, given that the region has the highest number of young people in the world, this poses a great danger. A significant population of Africans reside in urban slums that have poor hygiene conditions which predisposes them to mosquitoes. This explains why this study set out to examine the household characteristics that determines the ownership of mosquito nets in urban households in Nigeria. The study revealed that ownership of mosquito nets is low among households in urban areas of Nigeria. The ownership of mosquito bed nets in urban areas of Nigeria is determined by a number of household characteristics; prominent among these factors were the sex of the household head; the number of household members, number of rooms for sleeping in the households and spraying of surroundings in the past 12 months.

Recommendations

Based on the findings of this study, it is hereby recommended that interventions should consider mass education across all resident areas (urban and rural) on the importance of mosquito nets in combating malaria. Interventions should take into consideration the effect of socio-economic and demographic characteristics during the implementation of programs. Also, if Nigeria is to contribute significantly to achieving the two critical 2020 milestones of the *WHO Global Technical Strategy for Malaria 2016–2030*: reducing case incidence and death rates by at least 40% from 2015 levels, further investments are required in mass campaigns and LLIN distributions to increase access to and uptake of lifesaving malaria tools and interventions and improve vector control measures and early diagnosis and treatment. Finally, the Integrated Community Case Management approach should be strengthened and deployed to improve coverage across all areas of Nigeria.

Declaration

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability

The household recode dataset of the [2013 Nigeria Demographic and Health Survey \(NDHS\)](#) was used for this study. The data can be obtained with permission through the Measure DHS website.

Declaration of Competing Interest

The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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