IBOM MEDICAL JOURNAL
Vol.14 No.4 Oct, 2021. Pages 489 - 497
www.ibommedicaljournal.org

Determinants of insecticide treated net utilization among under-fives in Nigeria

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Abstract

Introduction: Insecticide treated net (ITN) is pivotal to malaria control but reports show a relatively low ITN utilization when compared to household ownership. It is important to explore the determinants of ITN utilization in order to bridge this gap.
Objectives: To determine the factors associated with ITN utilization among under-fives.
Method: A cross sectional study was conducted from February to April 2015 among under-fives in Afaha Ikot Obio Nkan in Akwa Ibom State, Nigeria. A systematic random sampling technique was used to select 494 households from which 413 under-fives were recruited. Information on ITN utilization was obtained using a WHO validated tool. The independent predictors of ITN utilization were determined.
Result: ITN was mainly used to prevent mosquito bites (48.3%) and malaria (29.2%). Non-utilization was mainly attributed to heat (38.5%), 'no reason' (11.5%) and low mosquito activity (11.1%). Household head of 30-39 years, the presence of two under-fives in a household and the number of ITNs observed hanging over bed spaces were the independent of predictors utilization.
Conclusion: Caregivers aged 30 – 39 years, presence of two under-five children in a household and the number of ITNs observed hanging over bed spaces were the predictors of ITN utilization.

Keywords: Treated-net, utilization, under-fives, malaria

Introduction

Malaria still remains a leading cause of under-five morbidity and mortality globally. Nigeria and the Democratic Republic of Congo currently contribute over 35% of the global malaria mortality.[1] The Nigeria National Malaria Elimination Program (NMEP) listed the use of ITNs as a key component of its malaria control strategy.[2] ITNs reduce malaria morbidity by preventing human-mosquito contact, offering personal protection to the net user and repelling mosquitoes from houses with treated nets.

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The effectiveness of ITNs have been established through several operational researches.[3-5] ITN use has been shown to reduce the prevalence of *Plasmodium falciparum (P. falciparum)* malaria, the incidence of severe malaria and childhood malaria mortality. Proper and consistent use of ITNs among under-fives can reduce malaria episodes by 50% and all-cause mortality by about 17%.[6] One of the targets of the 2014 – 2020 national malaria strategic plan is that at least 80% of the population utilize appropriate preventive measures by 2020.[2]
The concerted effort of the NMEP has resulted in the distribution of about 100 million Long Lasting Insecticidal Nets (LLINs) to the Nigerian population between 2007 and 2013 with strategies in place for cyclical mass campaigns and continuous distribution targeting all households in the subsequent years.[2,7] This has resulted in a steady

increase in household ownership of ITNs from 42% in 2010 to 60% in 2018 and utilization from 36.5% in 2013 to 52.4% in 2018 among under-fives.[2,8]

Even though there is an overall national improvement in household ownership and utilization of ITN, the observed improvement is not uniform across the various regions of the country. The 2018 National Demographic and Health Survey (NDHS) report showed marked regional variation in the utilization of ITN that ranged from 73% - 79% in the north and 29% - 34% in the south.[8] Identifying and addressing the reasons for the relatively low utilization of the ITN in the south will go a long way to improve the malaria situation in the country.

Akwa Ibom is one of the states in the southern part of Nigeria with low ITN utilization among under-fives. Despite free distribution of millions of long-lasting insecticidal bed nets by the World Bank Booster Project for malaria control, ITN utilization among under-fives in the state is 36.5%.[8] It is therefore necessary to assess the determinants of ITN utilization among under-fives in the southern part of the country to generate the needed evidence for informed decision on strategies for improving ITN utilization among under-fives in the region. This study was aimed at identifying the determinants of ITNs utilization among under-fives in Akwa Ibom State, Nigeria.

Materials and methods

Study Location

This study was conducted at Afaha Ikot Obio Nkan in Ibesikpo Asutan Local Government Area of Akwa Ibom State from February to April 2015. This is a rural community of about 10,000 inhabitants with the majority being women and children.[9] It lies between latitudes 4'55 and 5'00 North, and longitudes 7'54 and 7'57 East, and has a mean altitude of 30m. It's an area of stable malaria which peaks during the rainy season.[2] The inhabitants are predominantly *Ibibios, Annangs* and *Oros* who are mainly traders, artisans and subsistence farmers. They live in houses with corrugated roofing sheets or thatch houses. Most of the houses lack windows and door screens against mosquitoes or insects.

Study Design/duration

This is a descriptive cross-sectional study that was conducted over a period of 10 weeks (February 2015 – May 2015).

Ethical Clearance

Ethical clearance was obtained from the Health Research Ethics Committee of the University of Uyo Teaching Hospital. Approval for the conduct of the study was also obtained from the Village Head. Written consent was obtained from literate caregivers while verbal informed consent supported by thumb printing was obtained from the uneducated ones.

Eligibility Criteria

Children aged one to fifty-nine months who are members of the household and slept in that house the night prior to the visit whose caregivers consented to their participation in the study were included. Neonates and children above 59 months were excluded from the study.

Sample Size Estimation

The minimum sample size was calculated using the formula for single population proportion i.e. $n = z^2pq/d^2$.[10] This was based on a confidence interval of 95% and 5% margin of error. Based on 42% prevalence of household ITNs ownership in Nigeria[2] and an allowance of 10% attrition, a minimum sample size of 413 was obtained.

Study Procedure

Subject Selection

There were about 2000 households in the community. Households were selected by spinning a bottle at the Chief's compound and following the direction of the tip of the bottle. Starting at the Chief's compound, a systematic random sampling technique was used to select every fourth household. On reaching the village boundary in one direction, the team returned to the starting point to continue in another direction until the entire community was navigated. One eligible child was chosen in each household while in households with more than one eligible child balloting was done to choose one of them.

Data Collection

A semi structured validated questionnaire was used to obtain relevant information on ITN ownership and utilization from the head of each household or his/her proxy in English Language, or 'pidgin' English or the local dialect. The major thematic areas in the questionnaire were: age and sex of the under-five (the subject), socio-demographic

characteristics, ownership of insecticide treated net (ITN) and type of ITN, means of acquisition of ITN, history of washings of ITN, use of ITN by the subject the night preceding the study, reason(s) for use or non-use, history of fever in the subject in the preceding two weeks, number of under-fives in the home, number of ITNs owned.

Data Management and Analysis

Data generated from this study was analyzed using the Statistical Package for Social Sciences version 18 statistical software. The results are presented as texts and tables. The prevalence of ITNs ownership was calculated as the ratio of households with at least one ITN over the total number of households surveyed while utilization rate by under-fives was computed as the ratio of under-fives that reported sleeping in an ITN the previous night over the total number evaluated. Chi-square test and Fischer's exact test were used as tests of significance for categorical data. A multivariate logistic regression model was used to identify the independent predictors of ITN utilization. The result was considered statistically significant if P- value <0.05.

Results

Characteristics of the Study Population

A total of 494 households with 2, 697 occupants in them were included in the study. This gave an average of 5.5 people per household. The household heads were mainly within the age group of 20-29 years (40.1%) as displayed in Table 1. The fathers were farmers, traders or artisans in 327 (66.2%) households. In 155 (31.4%) they were civil servants, professionals, clerics or pensioners while in 12 (2.4%) households, the fathers were late. The mothers had secondary level of education in 301 (60.9%) households, tertiary level of education in 99 (20.0%), primary level of education in 78 (15.9%), and no formal education in 15 (3.0%).

Of the 494 households, 413 (83.6%) had children below five years of age. Most of the children were within the age bracket of 48-59 months as shown in Table 2. There were 217 males (52.5%) and 196 females (47.5%), which gave a male to female ratio of 1.1:1.

Factors associated with utilization of ITNs by Under-fives in the Community

The main reasons for utilization of ITNs among caregivers of under-fives were to prevent mosquito bites 43 (48.3%) and malaria fever 26 (29.2%) as represented in Table 3.

The main reasons for non-utilization of ITN by caregivers were "heat" in 80 (38.5%), "no reason" in 24 (11.5%) and low mosquito activity in 23 (11.1%) as displayed in Table 4.

A logistic regression analysis done to determine the independent predictors of ITN utilization in the multivariate model showed age of household head of 30-39 years (P value = 0.01), the presence of two under-fives in a household (P value = 0.002) and the number of nets actually seen hanging (P value = 0.02) as predictors of ITN utilization by under-fives in the community. The univariate and multivariate analyses are shown in Tables 5 and 6 respectively.

Table 1: Age groups of household heads in the study

Age group (years)	Frequency	% of total
<20	15	3.0
20-29	198	40.1
30-39	188	38.1
40-49	59	11.9
50-59	20	4.1
>60	14	2.8
Total	**494**	**100**

Table 2: Age group of children in the study

Age (months)	Frequency	% of total
2-11	68	16.5
12-23	68	16.5
24-35	88	21.3
36-47	94	22.7
48-59	95	23.0
Total	**413**	**100**

Table 3: Reasons for utilization of ITNs by under-fives in the community

Reasons for use of ITNs	Frequency	% of total
To prevent mosquito bites	43	48.3%
To prevent malaria	26	29.2%
To ward off other insects	5	5.6%
High mosquito activity	5	5.6%
To avoid the nuisance of mosquitoes	3	3.4%
To prevent other sicknesses	3	3.4%
To prevent cold at night	2	2.3%
"We keep doors open at night"	1	1.1%
"Was encouraged to use by my doctor"	1	1.1%
Total	**89**	**100%**

Table 4: Reasons for non-utilization of ITNs by under-fives in the community

Reasons for non-utilization of ITNs	Frequency	% of total
Heat	80	38.5%
"No reason"	24	11.5%
Low mosquito activity	23	11.1%
No space to set up	13	6.3%
Use of window and door screens	11	5.3%
Hard to set up	10	4.8%
Yet to air dry	9	4.3%
Yet to wash	8	3.6%
Nets are torn	5	2.4%
Converted the ITNs to window screens	4	1.9%
My children dislike the nets	4	1.9%
Waiting for heavy rains	4	1.9%
Nets are itchy and cause rashes	4	1.9%
Others	9	4.3%
Total	**208**	**100%**

Table 5: Logistic Regression Model for Predictors of Utilization

VARIABLE	UNIVARIATE ANALYSIS Odds Ratio (95% CI; P-Value)
Number of persons in the Household	0.89 (0.77-1.03; 0.11)
Age group of Household Head(yrs)	
20 - 29	1
30 –39	0.34 (0.16 – 0.70; 0.004)
40 - 49	0.78 (0.26 – 2.40; 0.76)
50 - 59	1.02 (0.24 – 4.35; 0.98)
>60	8.13 (0.87 – 75.98; 0.07)
< 20	2.54(0.64 – 10.16; 0.19)
Gender of Household Head	
Male	1
Female	1.01(0.56 – 1.83; 0.98)
Mother's educational level	
No formal education	1
Primary	1.56 (0.68 – 3.57; 0.29)
Secondary	0.86 (0.30 – 2.51; 0.79)
Tertiary	1.52 (0.32 – 7.12; 0.59)
Number of under-fives	
1	1
2	0.26 (0.12 –0.59; 0.001)
3	0.64 (0.12 – 3.29; 0.59)
Number of ITNs owned	0.90 (0.72 – 1.13; 0.37)
Number of ITNs observed hanging	1.20 (0.98 – 1.47; 0.08)

Table 6: Logistic Regression Model for Predictors of Utilization

VARIABLE	MULTIVARIATE ANALYSIS Odds Ratio (95% CI; P-Value)
Number of persons in the Household	0.97 (0.79-1.12; 0.76)
Age group of Household Head (yrs)	
20 - 29	1
30 –39	**0.35 (0.12 – 0.80; 0.01)**
40 - 49	0.96 (0.25 – 3.75; 0.96)
50 - 59	1.34 (0.21 – 8.71; 0.76)
>60	8.62 (8.74 – 101.06; 0.09)
< 20	1.87(0.39 – 8.89; 0.43)
Gender of Household Head	
Male	1
Female	0.76 (0.30 – 1.90; 0.56)
Mother's educational level	
No formal education	1
Primary	1.62 (0.62 – 4.21; 0.32)
Secondary	1.46 (0.43 – 4.98; 0.54)
Tertiary	1.38 (0.18 – 10.49; 0.76)
Number of under-fives	
1	1
2	**0.25 (0.11 – 0.60; 0.002)**
3	0.58 (0.08 – 4.32; 0.59)
Number of ITNs owned	0.69 (0.48 – 1.01; 0.06)
Number of ITNs observed hanging	**1.59 (1.09 – 2.29; 0.02)**

Discussion

The top two reasons caregivers of under-fives gave for using ITN in this study were to prevent mosquito bites and the occurrence of malaria. This finding indicates that the caregivers were aware of the relationship between mosquito bites and malaria infection. They were likely going to get the children to sleep in the nets at night since most mosquito bites occur at that time. This is similar to reports by other authors that knowledge of malaria, perceived malaria risk and correct knowledge of malaria transmission were strongly associated with bed net ownership and usage.[11-12] With a high proportion of caregivers residing in high-risk malaria areas getting to know why they should use ITNs, there is a likelihood that the utilization of the commodity will increase with a consequent reduction in the under-five malaria-related morbidity and mortality in the region.

Heat, "no reason" and low mosquito activity were the top three reasons for non-use of ITN in the community. A number of studies have identified heat as a major reason why caregivers of under-fives refuse to place their wards to sleep in an ITN. In a study conducted in Uyo about 25.8% of respondents mentioned heat as their reason for refusing to use ITN.[13] It was also the predominant reason for non-utilization in Abuja.[14] The complaint of heat as the reason for not using ITN in this study was 38.5% which is similar to 41% reported in Ghana.[15] As long as caregivers do not feel comfortable in the nets, they are not likely going to use them. This would invariably expose the children to mosquito bite and its attendant problems. One way of addressing the issue of heat is for the government to embark on rural electrification projects. This would ensure regular power supply for utilization of appliances like fans to reduce the heat. In addition, further research should be carried out to develop ITNs with less heat-retaining capacity.

The top three reasons for non-utilization of ITN among under-fives in the 2018 National Demographic and Health Survey report were "nets not needed", "there is no mosquito" and "it was too hot". These reasons are similar to those identified in this study but differed in their ranking. For example "it is too hot" (heat) which ranked as number three in the NDHS report was the topmost reason in this study. Thus, to improve ITN use in under-fives intervention programmes for increasing the use of ITN in the country should be seen to address the main factors militating against its use in a given area or setting.

About 10% of respondents in this study had no reason for not having their children sleep in the net. In a study in Enugu, Nigeria, about 40% of caregivers whose children did not sleep in ITN also had no reason for not using the commodity.[16] Though the nets were available in these households, the members of the households did not consider it needful to use them. Part of the reasons for non-utilization of ITN among under-fives as reported in the 2018 NDHS was because the caregivers felt they were not needed. The above reason was observed in 3% of respondents in Adamawa State and Plateau State, and in 70% of caregivers in Sokoto State.[8] This marked variation in the response of caregivers in different parts of the country further highlights the need for targeted intervention measures for improving ITN utilization in the country. It is quite unfortunate that effective life-saving intervention like ITNs could be available in a home for young children but not utilized by their caregivers'.

About 99% of nets owned in the study area were obtained free, either during a health facility visit or during mass distribution campaign. The main reason for free distribution of the nets is to increase access, and community ownership. Free distribution of ITNs cancels inequities in ownership occasioned by wealth quintile or socioeconomic status,[13,17] increases household ownership of the commodity and is likely to increase utilization, reduce malaria transmission as well as malaria-related morbidity and mortality in the community. Despite the free distribution of ITN in the community, utilization of the commodity was still quite low. It is therefore necessary to incorporate specific measures that will promote utilization in addition to free net distribution in the state.

Low mosquito activity was also a reason for the non-utilization of ITN in the country.[8] A similar reason had been given for the non-utilization of ITN in Uganda.[18] The response of low mosquito activity by some caregivers is quite subjective and does not seem to take cognizance of the high entomologic inoculation rate associated with *Anopheles gambiae* which is the predominant vector in the area.[1,18] Besides, this region is characterized by a high

prevalence of *P. falciparum* which is known to be responsible for the severe forms of malaria and malaria-related deaths, especially in the under-fives.[1] Regardless of the assumed low mosquito activity, the use of ITN among under-fives is quite important in the study area based on the stable and perennial malaria transmission pattern in the area.[19]

The independent predictors of ITN utilization in under-fives based on multivariate regression model were heads of households aged 30-39 years, the presence of two under-fives in a household and the number of ITNs hanging in the homes. The finding of a significant association in ITN utilization among 30-39 years headed households may be due to the fact that most couples in developing countries start their families at about that age range. These new couples are likely to have few young children which makes for close parental attention.

The presence of two under-fives in a household was an independent predictor of ITN use in the community. This finding may possibly be explained by the fact that the fewer the number of children in a household, the more the attention they are likely to receive from their parents. Parenting skill and commitment to child health seem to peak when catering for two under-five children. This finding corroborates that of Okafor et al[20] in Lagos which reported a significant association between ITN utilization and having less than three under-five children in a household.[20] Alieu et al[22] in Kanifing, The Gambia, showed that with a unit increase in the family size of the household, the caregivers were 0.855 times less likely to utilize ITN.[21] It is necessary to advise couples on adequate child spacing for a manageable household size, improved health seeking behaviour and utilization of ITN among under-five children.

The number of ITNs owned by the household was not significantly associated with utilization. Some of the nets were found preserved in their packs in the house and unused. Lack of space in the house to set up the nets and difficulty in setting up the nets were among the reasons given by the caregivers for not utilizing them. A predictor for utilization of ITN in this study was the actual number of nets sighted to be hanging over sleeping spaces in a household. In the study by Alieu et al[21] in The Gambia, the number of bed nets in the households, the number in sleeping spaces and using bed nets when sitting outside were the predictors of utilization. Whereas household ownership of bed nets was associated with utilization in The Gambian study, that was not the case in our study area.

The positive association between nets hanging over sleeping area and utilization observed in this study is corroborated by the result of a cluster randomized trial in Uganda where the strongest predictor of ITN utilization following mass distribution campaigns was whether or not the nets were hanging over sleeping space.[18] There was a higher likelihood of ITN utilization in households where the nets were hanging over sleeping spaces compared to those where they were taken down.[18] Inability to hang the nets properly was among the reasons for non-utilization in that study as was the case in this study.[18]

Lack of space in the house to set up the nets and difficulty in setting up the nets were two prominent reasons for the non-utilization of ITN in this study. The above barriers to ITN utilization are best addressed using a multisectoral approach in malaria endemic regions. This will include designing and building spacious houses that permit proper hanging of nets. In addition, periodic "Net hang-up" campaign should be carried out in the State. The exercise has been shown to promote ITN utilization in Ghana.[22] School-based ITN distribution and demonstration on 'net hang-up' by the class teachers is a potential strategy for improving ITN use among under-fives in the State.[23] These children can become advocates for net use and for cascading the knowledge of proper 'net hang-up' in their communities.

The strength of this study lies in the fact that it identified and ranked the main reasons for non-utilization of ITN among under-fives in the study area which is a bit different from the ranking in the 2018 NDHS report. In addition to ranking the reasons for non-utilization of ITN among under-fives in the area, the study highlighted the independent predictors of ITN use in the areas. This additional information on predictors of ITN use which is not available in the 2018 NDHS report is pivotal for developing evidence-based strategies for improving ITN utilization among under-fives in the country.

Conclusion

The independent predictors of ITN utilization were household heads aged 30 – 39 years, the presence of two under-fives in a household and the number of ITN seen hanging over sleeping spaces. A multisectoral approach aimed at improving the knowledge of caregivers about malaria, ensuring optimum child spacing, spacious housing, production of customized ITNs and demonstration of net hanging can improve ITN utilization among under-fives in malaria endemic communities.

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