

Ownership, usage, and perception of insecticide-treated nets (ITNs) for the prevention of malaria among students of a tertiary institution in northeastern Nigeria

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ABSTRACT

INTRODUCTION The appropriate use of insecticide-treated nets (ITNs) has been regarded as a successful, cost-effective, and efficient method of controlling malaria. The objective of this study is to determine the level of ownership, usage, and awareness of ITNs in the control of malaria among students of a tertiary institution in northeastern Nigeria.

METHODS This survey was a cross-sectional study that recruited 451 students of a tertiary institution in northeastern Nigeria by a simple random sampling technique from June to August 2022. The study employed a closed-ended questionnaire with responses on a 4-point Likert scale. Statistical significance was taken at a 95% confidence interval with $p < 0.05$.

RESULTS Of the 451 respondents, 229 (50.78%) and 222 (49.22%) were female and male, respectively. The participants were aged 16–36 years, with those aged 16–25 years numbering 343 (76.1%). Of the total respondents, 261 (57.87%) owned ITNs, while 190 (42.13%) did not own ITNs. Ownership of ITNs was not associated with gender

(OR=1.41; 95% CI: 0.97–2.06, $p=0.07$) or age (OR=0.93; 95% CI: 0.60–1.44, $p=0.73$). The results showed that government support in the prevention of malaria through the distribution of free ITNs was relatively adequate ($p < 0.001$). Of the 261 respondents with ITNs, 236 (90.42%) used the ITNs the night before the administration of the questionnaire. There was no significant association between ITNs usage with gender (OR=1.33; 95% CI: 0.58–3.03, $p=0.49$) or age (OR=1.90; CI=0.79–4.53, $p=0.1502$). The majority of the respondents (407; 90.24%) had the perception and awareness that regular sleeping in ITNs helps to prevent malaria.

CONCLUSIONS The study highlighted ITNs ownership, perception, and awareness of ITNs usage among the study population which were high and encouraging. However, there is need for the government to introduce distribution of free ITNs among school-aged children in dormitories, and students of higher institutions.

INTRODUCTION

Malaria is a communicable disease, caused by the protozoan parasite of the genus *Plasmodium*. The four main species of *Plasmodium* responsible for malaria include *P. vivax*, *P. falciparum*, *P. malariae*, and *P. ovale*¹. Malaria transmission to humans occurs when an infected female anopheles mosquito takes a blood meal from an uninfected individual thereby

introducing the infective stage (sporozoites) of the parasite into the circulatory system of the host.

Malaria is endemic in the poorest countries of the world, causing hundreds of millions of clinical cases and more than 2.6 million deaths each year². More than 90% of malaria deaths occur in Sub-Saharan Africa, resulting in an estimated 3000 deaths per day³. Mortality due to malaria occurs in

all age groups but is much more pronounced and critical in children aged <5 years. Other high-risk groups include pregnant women, non-immune travelers, displaced persons with no concrete shelter, and people of all ages living in areas of erratic malaria transmission^{2,3}.

The appropriate use of insecticide-treated nets (ITNs) has been regarded as a successful, cost-effective, and efficient method of controlling malaria⁴. ITNs are known to kill mosquitoes and have demonstrated repelling properties that help to lower the number of mosquitoes that enter the house. Their effectiveness is two times that of untreated nets and their protective role when used is highly rated when compared with no nets⁴. Results from previous studies showed that the use of ITNs led to the reduction of new cases of uncomplicated malaria by half and to a >16% reduction in mortality compared to settings that did not use nets^{3,5}. This explains why the Federal Government of Nigeria and non-governmental organizations (NGOs) embarked on the provision and distribution of ITNs to vulnerable groups and to the entire population at large⁵.

Despite the wide distribution of ITNs, malaria is still highly endemic in Nigeria, with a continuous increase in incidence, morbidity, and mortality^{1,6}. A report of the World Health Organization (WHO) revealed that Nigeria in 2017 had the highest number of malaria cases and associated mortality^{3,5}. This may be attributed to many factors particularly poor compliance with its use, as previously documented in several studies⁷⁻¹⁰. Also, the persistent endemicity of malaria in Nigeria may be attributed to its climatic conditions which are favorable for the breeding of mosquitoes³.

Several studies on the subject in Nigeria and Sub-Saharan African countries focused mainly on vulnerable children and pregnant mothers^{4,6,7}. However, it is view that malaria control and prevention can be extended to other populations at risk such as students in boarding houses and tertiary institutions. The aim of this study was to determine the level of ownership, usage, and perception or awareness of ITNs for the control of malaria among students of the Federal Polytechnic Mubi, Adamawa State, Nigeria. We also aimed to compare the relationship between ownership and usage of ITNs with gender and age. This will help the government and stakeholders in the fight against malaria to develop life-changing policies and operations that will enhance ITNs ownership and usage among similar populations and the general public.

METHODS

Study area

The study was carried out among students of Federal Polytechnic Mubi. The Federal Polytechnic Mubi is located in the Mubi-north Local Government Area (LGA) of Adamawa State. The study area is characterized by a tropical climate with a rainy season (May–October) and a dry season (November–April). Temperature ranges 23–29°C with

high humidity, all favorable conditions for malaria vector development.

Study design

An institutional-based cross-sectional design was used in this study. For this study, only one public higher institution (Federal Polytechnic Mubi) was selected. A total of 460 students were recruited for this study using simple random sampling technique. The study employed a closed-ended questionnaire (Supplementary file) with responses on a 4-point Likert scale (strongly agree, agree, disagree, and strongly disagree).

Data collection

Data for this study were obtained through the administration of a questionnaire. A total of 460 questionnaires were randomly administered to students who provided informed consent. Sociodemographic information was collected as well as data on ITNs ownership, usage, and perception or awareness of ITNs. Data collection occurred during the rainy period when the school was in session and lasted for three months from June to August 2022.

Data analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) for Windows software version 26 (SPSS Inc., Chicago, IL, USA). Frequencies and percentages were generated for the relevant variables. Odds ratios were used to test for association between ITNs ownership, and usage with gender and age, while non-parametric Mann-Whitney test was used to examine for significance. Statistically significance was set at $p < 0.05$.

RESULTS

Sociodemographic characteristics of the respondents

Of the 460 questionnaires distributed among the student population, 451 were filled in and returned, which constitutes a response rate of 98.0%. Of these, 229 (50.78%) and 222 (49.22%) were female and male, respectively. The participants were aged 16–36 years, with those aged 16–25 years numbering 343 (76.1%).

The ownership and usage of ITNs among the study population

Of the 451 respondents, only 261 (57.87%) owned an ITN, while 190 (42.13%) did not own an ITN (Table 1). The result of the non-parametric Mann-Whitney test showed a significant difference ($p < 0.001$). Of the respondents with ITNs, 108 (41.38%) agreed that the ITNs they were using were not from the government's free distribution (Table 1) ($p < 0.001$). Of the 261 respondents with ITNs, 236 (90.42%) used the ITNs the night before the administration of the questionnaire, while 19 (7.28%) did not use the ITNs. Furthermore, the result of the non-parametric Mann-Whitney test showed a significant difference ($p < 0.001$) that

agrees with the alternative hypothesis. The results further showed that respondents that were happy to use the ITNs (Table 1) were significantly more than those that were not ($p=0.021$).

Knowledge and perception of ITNs usage in the prevention of malaria

In total, 407 (90.24%) of the 451 respondents agreed that regular sleeping in ITNs helps to prevent malaria, while 44

Table 1. Ownership, perception, and knowledge of ITN usage for the prevention of malaria among the study population, Nigeria, 2022

| | Strongly agree | | Agree | | Disagree | | Strongly disagree | |
|--|----------------|--------|-------|--------|----------|--------|-------------------|--------|
| | Male | Female | Male | Female | Male | Female | Male | Female |
| I don't own an ITN | 41 | 33 | 62 | 54 | 57 | 82 | 62 | 60 |
| Total | 74 | | 116 | | 139 | | 122 | |
| The ITN I'm using was given to me free by the government | 17 | 40 | 47 | 49 | 31 | 27 | 24 | 26 |
| Total | 57 | | 96 | | 58 | | 50 | |
| I did not use my ITNs last night | 6 | 4 | 7 | 8 | 50 | 64 | 56 | 66 |
| Total | 10 | | 15 | | 114 | | 122 | |
| I don't enjoy sleeping in ITNs | 24 | 18 | 55 | 53 | 75 | 97 | 68 | 61 |
| Total | 42 | | 108 | | 172 | | 129 | |
| Regular sleeping in ITNs helps to prevent malaria | 120 | 101 | 79 | 107 | 10 | 9 | 13 | 12 |
| Total | 221 | | 186 | | 19 | | 25 | |

Table 2. Relationship between ITNs ownership with gender and age, Nigeria, 2022

| Variable | ITNs ownership | Non-ownership of ITN | OR | 95% CI | p |
|--------------------|----------------|----------------------|------|-----------|--------|
| Gender | | | | | |
| Female | 142 | 87 | 1.41 | 0.97–2.06 | 0.0711 |
| Male | 119 | 103 | | | |
| Total | 261 | 190 | | | |
| Age (years) | | | | | |
| 16–25 | 197 | 146 | 0.93 | 0.60–1.44 | 0.7377 |
| ≥26 | 64 | 44 | | | |
| Total | 261 | 190 | | | |

Table 3. Relationship between ITNs usage with gender and age, among respondents with ITNs, Nigeria, 2022

| Variable | ITNs usage | Non-usage of ITNs | OR | 95% CI | p |
|--------------------|------------|-------------------|------|-----------|--------|
| Gender | | | | | |
| Male | 106 | 13 | 1.33 | 0.58–3.03 | 0.4999 |
| Female | 130 | 12 | | | |
| Total | 236 | 25 | | | |
| Age (years) | | | | | |
| 16–25 | 182 | 16 | 1.90 | 0.79–4.53 | 0.1502 |
| ≥26 | 54 | 9 | | | |
| Total | 236 | 25 | | | |

(9.76%) argued that regular usage of ITNs does not prevent malaria (Table 1). Furthermore, the result of the Mann-Whitney test showed a significant difference ($p=0.0000$) that agrees with the alternative hypothesis.

The relationship between ownership of ITNs and gender showed that females are more likely (OR=1.41; 95% CI: 0.97–2.06, $p=0.0711$) to own ITNs than males, but the correlation was not statistically significant ($p=0.071$). Also, those aged 16–25 years were more likely (OR=0.93; 95% CI: 0.60–1.44, $p=0.74$) to own ITNs than those aged ≥ 26 years but the correlation had no substantial variance ($p=0.4250$), as shown in Table 2.

The results in Table 3 show the correlation between ITN usage with gender and age. The usage of ITNs was found to be more likely (OR=1.33, 95% CI: 0.58–3.03, $p=0.499$) higher in females than in males, and also more likely (OR=1.89, 95% CI: 0.79–4.53, $p=0.150$) higher in those aged 16–25 years than in those aged ≥ 26 years, but the relationships were not statistically significantly different in both instances.

DISCUSSION

Vector control through ITNs constitutes one of the effective control measures in reducing deaths due to malaria^{11,12}. Malaria occurs every year and efforts by WHO and roll back malaria (RBM) partners have promoted ITNs as a form of personal protection that reduces illness, severe disease, and deaths in malaria endemic regions¹³. This study surveyed the possession, usage, and perception of ITNs in the prevention of malaria among students of a tertiary institution in northeastern Nigeria.

In the present study, the word ownership was used to classify individuals that possessed at least one ITNs. The findings of this study showed that most of the students in the study area owned an ITN. This corroborated reports from Ghana^{13,14}. However, the 57.87% ownership of ITNs among the population was quite lower than the 71.0%¹⁵, 75.3%¹⁶, 81.7%¹³, 90.0%⁴, and 96.9%¹⁷ ownership reported in Kenya, South Africa, Ghana, Cameroon, and Kenya, respectively. Furthermore, the percentage ownership of ITNs in this study was higher than 11.1% reported among pregnant women in a rural community in southwest Nigeria². The differences in the percentage ownership of ITNs in this study could be due to sociodemographic attributes, study population, seasonal differences, and cultural beliefs.

The lack of significant difference in the relationship between ownership of ITNs with gender or age showed that these parameters may not have influenced the ownership of ITNs among the study population.

The high proportion (42.1%) of respondents without ITNs is of concern and could be explained partly by the carefree attitudes of the student population. Other factors could be financial constraints to purchasing ITNs from the market, and/or non-inclusion of the study population in the distribution of free ITNs in Nigeria.

The results of this study demonstrate that government

support in the prevention of malaria through the distribution of free ITNs was relatively high as more than 50% of the respondents were given free ITNs by the government. This observation is in agreement with a previous study in southwest Nigeria where they reported that more than half of their respondents were given free ITNs². In agreement with the results of the present study, a study from Ghana reported that the majority of their study population (62.8%) obtained free ITNs¹³. However, the findings of our study were in contrast to a similar study in western Ethiopia where only 3.8% of their respondents obtained their ITN free of charge¹⁸.

Although the results of this study suggest an elevated level of government effort in curbing the spread of malaria among the study population through the distribution of free ITNs; however, based on the respondents that did not own ITNs in this study, ITN ownership in the study area is below the Abuja declaration of 2000, which is to provide adequate individual and community protective measures such as the provision of ITNs to at least 60% of those at risk of malaria by 2005, and 80% ITN ownership by the end of 2010^{13,19,20}. Although the objective of the declaration was belated more than a decade ago, the concern of the declaration was mainly directed to children, especially those aged < 5 years and pregnant women. This notwithstanding, the relevance of the objective is still valid today. More so, the students in our study population are also at risk if not protected, and may constitute a population through which the parasite may spread to other vulnerable populations.

To roll back malaria in Sub-Saharan African countries like Nigeria, a concerted effort must be made to ensure that school-aged children especially those in boarding schools and students of higher institutions are direct beneficiaries of free ITNs distribution embarked upon by the government in collaboration with non-governmental organizations and other donor agencies. This would immensely help to attain the goal of ITN coverage in Nigeria, and also reduce the menace and endemicity of malaria in the country.

In this study, usage of ITN was defined to be sleeping under an ITN the night before the administration of the questionnaire. The finding that the majority (90.42%) of the respondents used ITNs the night before the survey was similar to the reports of previous studies in Kenya¹⁷, Myanmar, China²¹, and Ghana²² that documented 98.1%, 97.3%, and 89.0% usage rate among respondents that owned ITNs, respectively. The usage rate of 60–80% was also documented in other African countries^{13,23–25} which corroborates the finding of this study. However, the lower usage rate of 49.1%², and 15%²⁶, respectively, were reported among children and pregnant women in a rural community in southwest Nigeria, and among residents of the Calabar metropolis. Similarly, lower rates of 19.6%²⁷ and 33.5%²⁸ were also documented in Ethiopia, and 9.0% in Mozambique²⁹, in contrast to the finding of this study. The differences in the usage rate between the present study and others could be explained by the difference in the cultural

beliefs and the study population. More so, the differences in the usage rate in the various study populations mentioned earlier may reflect the availability and the level of compliance and awareness of the use of ITNs for the prevention of malaria. In support of this, a study conducted in Ethiopia attributed the higher use of ITNs in their study population to the distribution of free ITNs by the government³⁰.

The non-usage of an ITN among few respondents (9.58%) in this study may be attributed to many factors, including the heat or elevated night temperature, fear of chemicals^{3,26}, and non-accessibility to ITNs due to high cost, as documented in Nigeria³¹⁻³³, Ghana³⁴, and Zimbabwe³⁵.

The results of this study also show that the usage of ITNs among the study population was not influenced by gender or age.

The high (90.24%) perception of the respondents of the use of ITNs for malaria prevention is not unexpected. This is because the study population was students from an institution of higher learning and is thus expected to be more innovative and knowledge-driven. The high awareness of the effectiveness of ITNs for the prevention of malaria in our study population corroborates reports of previous studies in Ogun³⁶, Sokoto³³, Lagos³⁷, Cross-River²⁶, and Enugu States³⁸ of Nigeria, respectively, that documented that more than 97%, 74.4%, 84%, 80%, and 67.2% of their respondents believed in the effectiveness of ITNs usage in reducing the menace of the malaria vector. Also, in agreement with the finding of this study, another study from Ghana documented that 95% of their respondents had awareness of the effectiveness of ITNs usage in the prevention of malaria³⁹.

Lower awareness of ITN usage in the prevention of malaria was also documented in Nigeria; such as 41.1%³² in Osogbo Osun State, and 51.4%³¹ in Ile-Ife southwestern Nigeria. The differences in the level of awareness could be attributed to differences in the study population, geographical area, beliefs in other methods of malaria prevention such as the use of mosquito coil, mosquito spray insecticide, and the economic disposition of the study population.

Although the use of ITNs had been suggested as the most effective and most accessible method for the control of malaria in endemic communities¹², evidence from previous studies documented that long-term exposure to insecticides (chemicals used to treat the nets) may lead to poisoning, which is associated with some chronic diseases and sometimes death^{40,41}.

Strengths and limitations

The major limitation of this survey is the focus on only one tertiary institution. Also, the level of ITN usage was based only on the previous night before the survey, so it may not be appropriate to generalize the outcome to the entire study area and beyond. On the other hand, the outlined limitations do not undermine the logic and the perceptiveness of the study findings. This is because the findings of the study

provide insight on the knowledge, practice and perception of ITNs for the prevention of malaria among the study population, which could be an index of what is obtainable in their respective homes and communities.

CONCLUSIONS

The findings of this study provide baseline information on the ownership, usage and perception of ITNs for the prevention of malaria in the study area. The level of ITN ownership and awareness of its usage to combat malaria was encouraging. More so, the level of government involvement in malaria prevention through the distribution of free ITNs was also moderately high and encouraging. We recommended the introduction of free ITNs among study populations similar to that of our study area who are also at risk of the scourge of malaria. More of this type of study are needed in other institutions to ascertain the level of ownership and awareness of ITN usage.

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CONFLICTS OF INTEREST

The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

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The study was approved by the Research Board of the Department of Biological Science Technology, Federal Polytechnic Mubi (Approval number: FPM/BST/Vol. 1/101; Date: 10 May 2022). Participants provided informed consent.

DATA AVAILABILITY

The data are available from the authors on reasonable request.

AUTHORS' CONTRIBUTIONS

MYT designed the study protocols and wrote the first draft of the manuscript. TBD and TM helped with the literature search, data collation and analyses. OI and ASA gave professional and scientific advice, and corrected the draft. All authors read and approved the final manuscript.

PROVENANCE AND PEER REVIEW

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