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Effective use of Insecticides Treated Nets (ITNs) in the Prevention of Malaria among Pregnant women in Sagnarigu Municipality

Alhassan Osman[1], Mumuni Alaru[1*], Doreen-Remember-Donkor[2], Faustina Yin Yariga[2], Qorinah Estiningtyas Sakilah Adnani[3]

[1]Technical University College, Ghana-Tamale, Post Office Box TL 2159, Tamale
[2]Nurses' and Midwives Training College Tamale, Post Office Box TL 565, Tamale
[3] Department of Public Health, Faculty of Medicine, Universitas Padjadjaran, JlEyckman 38 Pasteur, Bandung 40161, Indonesia

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Abstract: Introduction: Insecticide Treated-Nets (ITN) manufactured from treated mosquitos has shown to be less costly while still offering effective malaria protection. Ghana is still working to achieve universal ITN coverage (defined as use by 80% or more of the population in an endemic region) in order to provide the best possible protection. The main objective of this study is to assess the effective use of Insecticides Treated Nets (ITNs) in the prevention of malaria among pregnant women in Sagnarigu Municipality.
Methods: The study was conducted in the Sagnarigu Municipal using the descriptive cross-sectional methods. A total of 362 pregnant women were interviewed using the closed-ended and open-ended questionnaire. The study participants were recruited using a simple random sampling method. All statistics were performed at 95% confidence level and a p value < 0.05 was considered significant.
Results: Most (39.0%) of the respondents were within the ages of 20 and 29 years, majority (86.2%) of the pregnant women were married. Almost all respondents (91.2%) have heard about mosquito bed nets. The majority (93.6%) of the respondents stated that ITN could be obtained via health facilities, majority of them (84.3%) dried their ITN in the shade before using them. On whether ITNs can be retreated, 86.7% agreed. The majority of the study participants (95.0%) own a mosquito bed net. About 75.0% of pregnant women used ITNs. The study revealed a significant association between age and utilization of ITNs (X^2=36.95, p<0.001). Also, education was found to be associated with IT Ns (X^2=14.97, p=0.002). The study revealed a statistically significant association between utilization of ITNs and Religion (X^2=37.69, P<0.001), employment status (X^2=17.14, p<0.001), ethnicity (X2=88.27, p<0.001) and average monthly income (X^2=29.31, p<0.001).
Conclusion: There is high awareness and knowledge about insecticide-treated mosquito Nets (ITNs). Though the majority of the study participants owned Insecticides Treated Mosquito Nets (ITNs), this does not translate to effective utilization of ITNs. Also, the free distribution of ITNs was the major means most people obtain ITNs. Based on the findings of this study it was recommended alongside others that pregnant women should be continuously sensitized during ANC and child welfare clinics about the consequences of malaria in pregnancy and the benefits of ITNs for them as we as their unborn babies.

Keywords: Effective, Insecticides Treated Nets (ITNs), Usage, prevention, malaria, pregnant women

INTRODUCTION

In many lower-middle-income nations, malaria is a major cause of ill health, mortality, poverty, and decreased productivity[1]. Malaria continues to be a serious hazard to public health despite several attempts to eradicate it, negatively affecting the economics and productivity of endemic nations[2]. Global data shows that as of 2015, about two hundred and fourteen (214) Million new cases of malaria were recorded, and nearly 400, 000 deathsassociated with malaria [3]

Insecticide-treated nets (ITNs) are said to be the single mosteffectiveway of eliminating mosquito bites and decreasing malaria incidence[4, 5]. It is further argued that the ITNs provide nearly 70% protection and are believed to be more effective than the untreated bed nets at all, these nets provide more than 70% protection and are thought to be twice as effective as untreated ones [3, 6]. About 30% of countries considered Malaria endemic, the incidence of malaria has been observed to have reduced by half within the last 10 years due to deliberate policies like "indoor pesticide spraying, anti-malarial drugs, fast diagnosis, accurate testing, and the use of long-lasting insecticidal nets (LLINS)"[7].

In Ghana, Malaria is still considered a major issue and features prominently among the first ten diseases with those under five years and pregnant women being the hard hurt[8–10]. Despite the numerous preventive measures against malaria, malaria still tops among patients admitted in various hospitals across the country and Out-of-Patient Department (OPD) cases, particularly in children under five[11].

ITNs lead to a 50% drop in malaria cases as well as a nearly $1/5^{th}$ reduction in deaths related to malaria; thus indicating that ITNs are successful in preventing malaria [12, 13]. Despite the widespread distribution of bed nets in Ghana, available literature suggests that not all household uses bed nets [14, 15].

Ghana is unable to attain universal coverage of ITNs despite its best efforts, which means that continuous monitoring and assessment of access and use is necessary, especially in vital regions of the nation [16]. There seems to be very scarce

literature in developing countries. In Ghana, the majority of those conducted are often done in the urban areas [17–21]. It is against this background that this study is conducted to assess the Insecticide-treated mosquito net (ITN) utilization among pregnant women in the Sagnarigu Municipality.

The outcome of this research could help in efforts to lower malaria-related morbidity and mortality. Also, this study could help in providing contextual explanations onhitches in using ITNs. The findings might serve as a foundation for formulating and executing evidence-based strategies aimed at enhancing malaria control efforts in Ghana and similar contexts.

METHODS

Study setting:

The study was conducted in the Sagnarigu Municipality. The Municipality has a total land area of 454 km². Tolon District to the west, Savelugu Municipal to the north, Tamale Metropolis to the south and east, and Kumbungu District to the northwest are its neighbors.
The Municipality's population, as reported by the 2021 Population and Housing Census, is 341,711, with 170,199 men and 171,512 women.

Study design:

A descriptive "cross-sectional study" using a quantitative methodology was used in this investigation. Data may be gathered at a particular moment in time using the cross-sectional approach, which provides a snapshot of the topic (Polit & Beck, 2008). This strategy was selected due to its effectiveness, which enables quick and economical information gathering (Setia, 2016).

Study population:

The study encompassed the entire population of pregnant women residing in the Sagnarigu Municipality.

INCLUSION AND EXCLUSION CRITERIA

To be included in this study, the participants ought to have been pregnant, reside in Sagnarigu Municipality not less than six months, the participants should not be seriously ill or mentally ill. The participants should also voluntarily agree to participate in this study. All pregnant who did not meet the inclusion criteria would be excluded.

Sample size:

The sample size was estimated using the Snedecor & Cochran formula[22]. The z-score is constant (1.96). The ITN usage among pregnant women in Northern Ghana was 62% [7]. Thus, p==62%, which means that q=1-0.62 whereasthe margin of error is set at 5%.
Substituting these variables into the equation, the sample size was determined as 362.

Sampling techniques:

With the aid of the balloting system, a simple random sampling was used for the study. Daily, yes and No were written on small pieces of paper, and those who picked “yes” were included in the student and those who selected “No” were excluded. This process was continued until the 362 was exhausted.

DATA COLLECTION TOOL AND PROCEDURE

A structured questionnaire was used to collect data from the study participants. This questionnaire was developed after reviewing other literature [4, 23, 24]. Thereafter, the questionnaire was structured per the specific objectives of the study. To questions included both open and closed-ended questions to solicit the best response from them. The question was given to those who read and write to answer by themselves. For those who were deficient in the English language, the questions were translated to a common language for easy understanding.

Participants were selected randomly and the processes were repeated until the 362sample size was exhausted. The researchers hired three enumerators to assist in the data collection. These enumerators were trained on the data collection tools and the selection of sample units. The enumerators were monitored and assistance was provided where necessary to enhance the smooth running of the data collection process.

Reliability and validity:

The importance of validity and reliability in research cannot be overstated, since they assess the quality and precision of the used methodologies. The field enumerators were trained on the data collection tool to ensure that the data gathered was consistent. To further test the consistency, the tool was pretested. This offered the enumerators, the opportunity to provide some feedback to be included in the question before the actual data collection process. The pretesting was done in Tamale Metropolis with thirty (30) pregnant women. The use of this proactive technique significantly improved the validity and reliability of the surveys, allowing for necessary enhancements to be made before collecting data. This ensured that the devices were optimized, precise, and appropriate for obtaining substantial and reliable data.

Data analysis:

Data was cleaned in Microsoft Excel 2019, and data was exported to the Scientific Package for Social Sciences (SPSS) version 24.0, statistical analyses were performed. The statistical tool was used to analyze the data.
Graphs and tables are used to present the data. Chi-square analysis was used to determine the association with the use of ITNs with ap-value<.05 considered to be statistically significant.

Ethical clearance:

A rigorous approach was followed to get the appropriate authorization for the research, which was conducted under the Declaration of Helsinki. An introduction letter was sought from the nursing department at the Technical University College. Additionally, permission was sought and granted from the Municipal Health Directorate and the Municipal Chief Executive. Beforethe interview, oral and written consent was sought from the participants after they were taken through the study protocols. Participate participation was voluntary and participants had no benefits for participating in the study.

RESULTS

Socio demographics:

About 40.0% of the respondents were between 20 to 29 years of age. Marital status indicated that 86.2% were married, while 13.8% had never married. Employment status reflected 55.0% unemployed and 36.7% employed participants. Urban residency was predominant at 63.3%, contrasting with 36.7% residing in rural areas. Income distribution showed 25.7% earning between GHS 500.00 to 1000.00, and 21.0% earning above GHS 2,000.00. Ethnicity-wise, 42.0% were Dagombas, 29.8% had Senior High School as their highest education, and 55.5% identified as Muslims, with 44.5% as Christians (Table 1).

Knowledge about Insecticide-treated bed nets (ITNs):

All pregnant participants in the study expressed significant concern about malaria. A substantial majority, 91.2%, were aware of Insecticide-Treated Nets (ITNs) and had encountered or handled mosquito bed nets. Health centers were the predominant source for obtaining ITNs, according to 93.6% of respondents. The majority recognized ITNs for preventing malaria (64.1%), while opinions on the duration of effectiveness varied. A noteworthy 86.7% acknowledged the possibility of retreating ITNs. In terms of preparation, 84.3% reported drying ITNs in the shade before use (Table 2).

Source of information on Insecticide-treated bed nets:

The majority of the respondents (n=246, 74.5%) have heard about Insecticide-treated bed nets (ITNs) from health workers, 54(16.4%) have heard of ITNs from friends and relatives and 30(9.1%) reported having heard about ITNs from the media (TV & Radio) (figure 1).

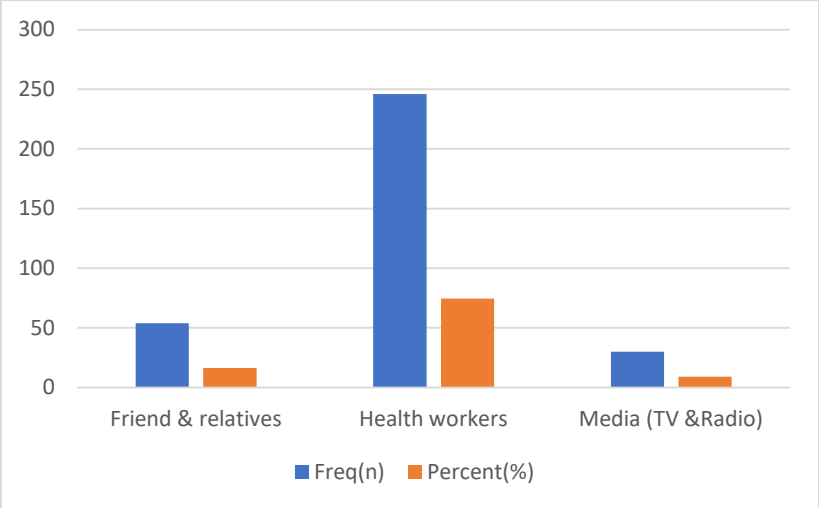

Figure 1: Source of information on ITNs

Field survey, 2023

Utilization of Insecticide-treated bed nets (ITNs) among pregnant women:

The survey unveiled that a substantial 95.0% of respondents own Insecticide-Treated Mosquito Nets (ITNs), with 90.6% specifically possessing ITNs. Assessing ITN effectiveness, 44.8% deemed them very effective in preventing malaria. Recent usage indicated that 69.6% slept under ITNs the night before the survey, and 30.5% did not. In terms of consistency, 32.6% used ITNs year-round, 14.1% most of the night, and 41.2% during rainy seasons. Despite positive perceptions, 35.1% disagreed that they would consistently use ITNs if readily available. These findings, detailed in Table 3, provide insights into ITN ownership, effectiveness perceptions, and usage patterns among the surveyed population.

Reasons for not using Insecticide-treated bed nets (ITNs) among pregnant women:

The reasons for not sleeping in the ITNs include; difficulty accessing ITNs (n=61, 55.5%), inadequate education (n=102, 92.7%), it is not necessary (n=53, 48.2%) and 7(6.4%) cited that ITNs were expensive (figure 2).

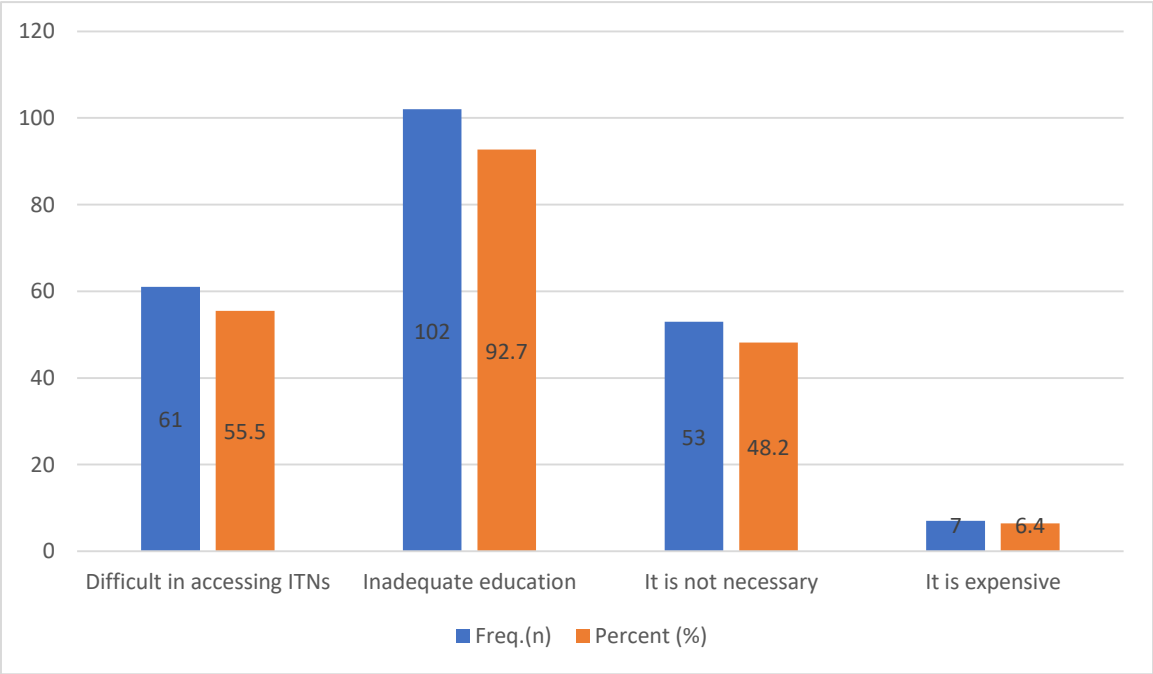

Figure 2: Reasons for not using ITNs (n=110)

DISCUSSION

This study was conducted to assess the effective use of Insecticide-treated Treated Nets (ITNs) in the prevention of malaria among pregnant women in Sagnarigu Municipality. The survey revealed that 39.0% of the participants were within the age range of 20 to 29 years, while 86.2% of the pregnant women were found to be married. The majority of individuals were aware of mosquito bed nets (ITNs), with 91.2% reporting the ability to get them from health institutions, and 84.3% indicating the practice of drying them before use. 86.7% of respondents agreed that ITNs may undergo retreatment. The majority of participants had a mosquito bed net, with 75.0% using insecticide-treated bed nets (ITNs). The variables of age, education, religion, work status, ethnicity, and income were shown to have a substantial impact on the use of ITN.

The results of this study are consistent with previous research, highlighting the serious worry pregnant women have about malaria. According to Asumah et al.[4], people who have malaria infections often could become partially immune, in contrast to pregnant women who show decreased tolerance as a result of immune system modifications and the placenta's introduction [25, 26].

The study results indicate that 91.2% of pregnant women were aware of ITNs. This is supported by various studies conducted in Ghana[4, 27, 28]. This is because the information campaigns on ITNs are supported by the government of Ghana. Sources of information on ITNs are varied from various sources. Regarding the sources of information on ITNs, the study identifies health professionals as the most trusted source. This finding is consistent with existing literature, that health workers are the most reliable and efficient providers of advice for pregnant women[2, 27, 29].

Our study revealed that the overwhelming majority of pregnant women acquired insecticide-treated bed nets (ITNs) from hospitals. This underscores the efficacy of customized distribution methods. The success of educational programs may be measured by participants' comprehension and knowledge of the overarching purpose of ITNs. The level of proficiency in ITN use knowledge in this study is similar to that seen in other countries [30]. These findingschallenge earlier studies that suggested Nigerians had inferior comprehension. The upward trajectory indicates that the dissemination of information and access to education have advantageous outcomes.

Remarkably, 86.7% of believed that ITNs could be retreated. However, the way to retreat the ITNs was not well understood. As such it is imperative to understand the importance of the retreatment and how to do it to ensure the effectiveness of the ITNs[4]. In Ghana, to ensure the continuous use of ITNs, the Ministry of Health distributes the ITNS free during the malaria seasons (rainy seasons).The study emphasizes the need to ensure that malaria prevention and education are easily accessible to the general public.

Almost all participants own ITNs, this outcome is higher as compared to 71% in Western Kenya [31]and 64.9% in Nigeria [32]. Even though earlier studies suggested that the majority of participants had ITNs, the current investigation suggests that the Ghanaian Ministry of Health may gain advantages by using a more focused distribution approach.

Despite the huge numbers owning ITNs, not all are using them. About this finding, Abokyi et al. [33]reported that 95% of the study participants believed that ITNs could prevent mosquito bites. The study also showed that about 74.3 percent use bed nets. Whilst this may not be the best, the current findings are higher than the findings reported in other studies such as in Hohoe Municipality[27], in Wa, Upper West Region[34], and Ethiopia [35]. Conversely, the

use of insecticide-treated bed nets (ITNs) in Nigeria [32] and Uganda [36] was lower compared to the present study. The utilization rate of this study is encouraging; nevertheless, it is lower as compared to the average usage of ITNs in a multilevel analysis of 21 countries in Sub-Saharan Africa [37]. The difference in the study subjects could be because of differences in geography and participants' characteristics.

As stated above, only about 30.0% reported the use of ITNs every day. This is consistent with other studies conducted in Ghana[28], Kenya [31], and the Greater Accra Region (Amara, 2017). All these pieces of literature suggest ownership and usage of ITNs are not the same.People who took part in the study used insecticide-treated nets (ITNs) during the malaria outbreak that happens during the rainy season[17]. The difference between having an ITN and using one might be due to the number of safety features built into each. It can be postulated that the discrepancies between ownership and actual use of ITNs could be attributed to a lack of information. Like other maternal health services, we believe telemedicine can be utilized to provide timely information to the users to enable them to continuously use their bed nets. Telemedicine has been identified as a panacea for the utilization of maternal health services [38]. Also, the health workers should utilize antenatal care (ANC) and postnatal care (PNC) services to continue to educate the respondents to ensure the use of these malaria preventive strategies [39]

Extensive studieshave been conducted on the complicated components that hinder the effectiveness of ITNs. This research emphasizes the need totackle these challenges to ensure the effectiveness of free ITN programs. It is important to quickly resolve the several fundamental issues revealed in this study toEnhance the utilization of ITNs. Challenges include the Insufficient provision of warmth by ITNs, challenges in accessibility, Negative perceptions of potential consequences, and several other barriers.Linn et al. [40],In their study, found that People who use ITNs faced numerous challenges. These challenges include a Shortage of new nets, the essential substances for net re-treatment., and high-quality insecticide-treated nets (ITNs).

Based on this study, the expense of ITNs is a notable hindrance to their effectiveness. According to an alternative study conducted by Gobena et al., [41], 8% of participants expressed that insecticide-treated bed nets (ITNs) were excessively costly, while 20% said that none of the other options were affordably priced. Considering that Ghana and other African countries offerfree distribution channels for insecticide-treated mosquito nets (ITNs) at ANC units, CWCs, PNC service centers, and households, it is imperative to tackle this issue. Participants' worries about costs and accessibility are eased through the provision of free ITNs. Considering the difference, more inquiry is necessary. The remarks underscore the intricate nature of the problem and the need for further investigation, preferably using a mixed-method approach, to ascertain the factors contributing to the non-utilization of ITN. These thorough examinations may provide practical ideas for enhancing the utilization of ITNs.

There are several limitations to doing research. These limitations include fundamental random sampling, reliance on self-reported data, which may be influenced by social desirability bias or memory bias, and restricted generalizability of the findings to the Sagnarigu Municipality. The use of cross-sectional techniques adds complexity to the task of establishing causal connections and monitoring changes. The paper acknowledges the presence of ITN issues, but, it does not provide any explicit explanations for these challenges. The research has many notable features, including substantial sample size, a meticulously crafted structured questionnaire that effectively fulfills specific objectives, a wide range of information sources, and its pertinence to public health since it specifically addresses the prevention of malaria in pregnant women. All of them are exceptional. The study's focus on the rates of knowledge and use enhances the assessment of the impact of ITN diffusion and offers crucial insights to healthcare practitioners and policymakers.

CONCLUSIONS AND RECOMMENDATIONS

The survey findings indicate that the respondents showed a high level of knowledge of insecticide-treated mosquito netting. Although the majority own insecticide-treated bed nets (ITNs), they do not consistently use them to their full potential. Although free distribution is the most common method of obtaining personal identification numbers, it might be difficult to participate in locations with limited road access. Despite the high cost of ITNs, many individuals still find it necessary to purchase them. This Underlines the necessity for a broader distribution strategy to ensure universal accessibility, particularly in areas with inadequate infrastructure. The study emphasizes the importance of enhancing the convenience of insecticide-treated mosquito nets (ITNs) topromote their utilization. indicates that technological progress could result in the development of secure and enjoyable networking, hence promoting its extensive utilization. Investigate innovative approaches for distribution to tackle issues associated with availability.

Community health workers, mobile clinics, and local governance are all instances of individuals engaging in participation. Moreover, Individuals facing disadvantages require focused aid or financial assistance. It is important to create educational programs that dispel misconceptions about negative outcomes and promote the benefits of regular ITN use. Local organizations may Strengthen awareness initiatives by developing and implementing them. It is recommended to employ mixed-methods research to generate more targeted responses and gain a comprehensive understanding of specific challenges. Ultimately, health authorities, local communities, and non-governmental organizations need to work together toCreate a thorough and enduring plan for distribution., education, and promotion of insecticide-treated bed nets (ITNs). Malaria occurrence is expected to decrease in the areas under observation.

Consent for publication

Not applicable

Data Availability

Data used to support this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declared that they have no competing interests.

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The authors did not receive specific funding for this work.

Authors' Contributions
All authors contributed equally

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Table1: Socio demographic characteristics of respondents

Variable	Categories	Frequency	Percentage
Age			
	< 20 years	125	34.5
	20 to 29 years	141	39
	30 to 39 years	78	21.5
	40 years or above	18	5
Marital status			
	Married	312	86.2
	Single	50	13.8
Employment status			
	Employed	163	45
	Unemployed	199	55
Area of residence			
	Rural	133	36.7
	Urban	229	63.3
Average monthly income			
	< GHS 500.000	80	22.1
	GHS 500 - 1000.00	93	25.7
	GHS 1001 - 1500.00	55	15.2
	GHS 1501 - 2,000.00	58	16
	> GHS 2,000.00	76	21
Ethnicity			
	Akan	23	6.4
	Dagomba	152	42
	Gonja	55	15.2
	Mamprusi	61	16.9
	Others	71	19.6

Field survey, 2023

Table 2: knowledge of pregnant women on Malaria Prevention and Insecticide Treated Mosquito Nets (ITNs).

Variable	Categories	Frequency	Percentage
Is malaria a concern to you?			
	Yes	362	100
Cause(s) of malaria			
	The sun	68	18.8
	Heat	44	12.2
	Working without rest	33	9.1
	Eating only food	14	3.9
	Eating starchy food	33	9.1
	Unhygienic surroundings	167	46.1
	Mosquito bites	341	94.2
Have you heard of Insecticide treated mosquito bed nets			
	Yes	330	91.2
	No	32	8.8
Have you ever seen or handled mosquito nets?			
	Yes	330	91.2
	No	32	8.8
Where can one get ITNs			
	Health center	339	93.6

	Super markets	23	6.4
Uses of ITNs?			
	Avoid mosquito bites	123	34
	Prevent malaria	232	64.1
	Good night sleep	7	1.9
How long does the effectiveness of ITNs last			
	< 6 months	62	17.1
	6 to 12 months	80	22.1
	1 to 2 years	96	26.5
	3 years	44	12.2
	> 3 years	80	22.1
What to do first before using ITNs			
	Dry in a shade	305	84.3
	Dry in the sun	50	13.8
	Wash it	7	1.9
Can ITNs be retreated			
	Yes	314	86.7
	No	48	13.3

Field survey, 2023

Table 3: Utilisation of Insecticide Treated Mosquito Nets (ITNs)

Variable	Categories	Frequency	Percentage
Have a mosquito bed nets			
	Yes	344	95
	No	18	5
Type of bed used			
	ITNs	328	90.6
	Ordinary nets	16	4.4
	No bed net	18	5
Level of ITNs protection in preventing malaria			
	Very effective	162	44.8
	Effective	112	30.9
	Average	88	24.3
Slept under ITNs last night			
	Yes	252	69.6
	No	110	30.4
How consistent do you sleep under ITNs			
	All year round	118	32.6
	Most part of the night	51	14.1
	some part of the night	44	12.2
	During the mosquito's season	149	41.2
Would you consider using ITNs always if is readily available?			
	Yes	235	64.9
	No	127	35.1

Field survey, 2023