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ABSTRACT

INTRODUCTION: Insecticide-treated mosquito nets are often used as a physical barrier to prevent infection of malaria. In sub-Saharan Africa, one of the most important ways of lowering malaria burden is the utilization of insecticide-treated nets (ITNs). However, there is no sufficient information on ITN utilization and its associated factors in Ethiopia. Therefore, this study aimed to assess the utilization of insecticide-treated bed nets and its associated factors among households in Ilu Galan district, Oromia Region, Ethiopia.

METHODS: A community-based cross-sectional study was conducted in the Ilu Galan district to select 550 households using systematic random sampling techniques. Interviewer-administered questionnaire and observational checklists were used to collect data. The collected data was entered into Epi data version 3.1 and exported to SPSS version 23 for analysis. The results were presented by texts, tables, and graphs. Both binary and multivariate logistic regressions were used to assess factors associated with ITN utilization.

RESULTS: A total of 532 study participants responded to the questionnaire making a response rate of 96.7%. About 72.2%, [95% CI: 68.4%, 75.8%] of the respondents utilized insecticide-treated nets in the night before the day data was collected. Being female [AOR = 0.55, 95% CI: 0.36, 0.81], age less than 25 years [AOR = 0.38, 95% CI: 0.23, 0.95], monthly income >1000 ETB [AOR = 2.24, 95% CI: 1.14, 4.69], and having more than 3 beds [AOR = 2.04, 95% CI: 1.29, 3.51] were significantly associated with ITN utilization.

CONCLUSIONS: Insecticide-treated nets utilization was found to be low in this study. There is a gap between the ownership and ITN utilization. Sex, age, monthly income, and number of beds were factors associated with ITN utilization. The provision of behavioral change communication to the community on the importance of ITN utilization is compulsory.

KEYWORDS: Associated factors, households, insecticide-treated nets, Oromia, utilization

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Introduction

Net embedded with insecticide to destroy or irritate mosquitoes is known as insecticide-treated nets (ITNs). Malaria remains a major public health problem with almost half of the populations in the world are at risk.¹ According to a 2020 World Health Organization (WHO) Malaria report, approximately 229 million cases of malaria occurred in 87 malaria endemic countries resulting in almost 409 000 deaths with 67% of the deaths occurred in children under the age of 5. Around 215 million malaria cases occurred in WHO African region which accounted 94% of global malaria cases.^{2,3} Malaria contributed to increased poverty in sub-Saharan African nations resulting in global losses of up to 12 billion dollars.⁴ Long-lasting insecticide net (LLIN) is a form of vector control strategy which helps to reduce the global burden of malaria.⁵ Adequate coverage and proper ITN utilization are methods used to reduce the density of indoor mosquitoes resting, contact of mosquito vector with human being, and malaria

infection.⁶ ITN utilization reduce malaria incidence among children under the age of 5 by approximately 50% and reduce mortality by 17%. According to the survey conducted by the Ethiopian Federal Ministry of Health (EFMOH), ITN ownership has risen from 42% to 68% from year 2005 to 2015. World Health Organization (WHO) planned to reduce global malaria cases by 75% and malaria deaths to near zero by universal coverage of ITN and adequate utilization according to the 2015 WHO Roll Back Malaria (RBM) initiatives.^{7,8} The 2011 Ethiopian national malaria indicator survey indicated that 46.9% of households have their own LLINs and 64.5% of children and 58.6% of pregnant women slept under ITN.⁹ In addition to coverage, appropriate ITN utilization is important for malaria prevention since either some of the ITNs that are owned by a household can be left unused or even those that are utilized were not given priority for the needy members of the households and utilization cannot be consistent.¹⁰ The Ethiopian demographic health survey showed that only 16.6%



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LOCATION MAP OF ILU GALAN DISTRICT



Figure 1. Map of the Ilu Galan district with sub-districts (kebeles), 2020.

of households slept under ITN the night before the survey.¹¹ Malaria affected 3-quarters of Ethiopia's landmass with Oromia being the first region from 9 regions of Ethiopia to bear the health and economic burden of the disease. In the West Shewa Zone, where the current study was conducted, 56% of the kebeles (an administrative unit lower than the district or the smallest administrative unit in Ethiopia) are malaria endemic areas. Malarial diseases peak in the study area (Ilu Galan district) when rain begins and ends (May 1-June 15 and September 1-October 15).¹² Study from southern Nigeria found that 31.6% of the households did not utilize ITN.¹³ In Burkina Faso, 70% of households utilized ITN the night before the study.¹⁴ The Ethiopian government has scaled up ITN utilization since 2005.¹⁵ ITN utilization vary from place to place in Ethiopia which was 21.5% in Eastern Ethiopia,¹⁶ 66.6% to 68.8% in southern Ethiopia,^{17,18} 73% in Arbaminch, Ethiopia.¹⁸ According to a study conducted by the new mark Project in AED and funded by the United States Agency for International Development (USAID) in the Oromia and Amhara regions, 73% and 60% of households in the Amhara and Oromia regions respectively utilized ITN the night before data collection day.¹⁹ Although some researches on ITN utilization have been carried out in Ethiopia, almost all of them have focused on only utilization rather than factors associated with ITN utilization. Therefore, this study aimed to assess ITN utilization and its associated factors in the Ilu Galan district.

Methods

Study design, period, and area

A community-based cross-sectional study was conducted in Ilu Galan district from May 1 to 30, 2020. Ilu Galan district is

located in the West Shewa Zone and 215 km far from Addis Ababa which is the capital city of Ethiopia. It is located between 8°56'30"N and 8°59'30"N latitude and 37°47'30"E and 37°55'15"E longitude. The mean temperature of district is estimated to be around 18.87°C. The altitude of the district ranges from 16000 to 1900 m above sea level. The overall population of the district was 86006 (42143 males and 43863 females) in 2020. The district had 14131 children under the age of 5 and 29840 pregnant women. There were 17918 households and 17 kebeles in the district, with 95% of the district being malaria endemic¹² (Figure 1).

Sample size determination and sampling technique

A single population proportion formula was used to calculate sample size by taking 65% proportion of ITN utilization from the study conducted in Limmu Seka District of South West Ethiopia²⁰ and assuming 95% confidence level and 5% marginal error. After multiplying by 1.5 (design effect) and adding 10% non-response rate, the final sample size was 550 study participants.

A 2-stage sampling approach were applied to select the study participants. In the first stage, 6 kebeles were selected by lottery method from the total of 17 kebeles in the district. In the second stage, households were selected from selected kebeles using systematic random sampling techniques after proportional to size allocation based on the number of households in each kebele. The total number of households in each kebeles was obtained from community health information system (CHIS) of the kebele. The sampling interval was determined by dividing the total number of households by the sample size. The initial household was selected by the lottery method. The

study unit was the head of the household and if the house is closed at the time of data collection, a re-visit was attempted up to 3 times.

Data collection tool and techniques

An interviewer-administered questionnaire was used to collect data which was developed after reviewing different literatures.^{16,21-32} The questionnaire contains sociodemographic characteristics, ITN utilization, information of malaria prevention, reason for not utilizing ITN, and observation of the households. The English version of the tool was translated to Afan Oromo which is the local language of the district and translated back to English by language expert to check consistency. Twelve health extension workers and 6 BSc Nurses were recruited for data collection and supervision respectively. In addition, observation was made on the type of bed nets, the condition of the net/any thorn/burn parts/and proper utilization. In this study, sleeping places were beds or other areas like floors and reed mats, which were equipped either by mattress or locally formed materials and utilized as sleeping places by household members. The data collectors counted the number of these locations by entering into the homes of the study participants together with the respondents. ITN utilization was measured based on respondents' self-report. Accordingly, ITN utilization was recorded to be "utilized" if 1 or more members of the household reported that 1 or more members of the household slept under ITN the night preceding the study. On the other hand, ITN utilization was labeled to be "not utilized" if 1 or more members of the household reported that 1 or more members of the household did not sleep under ITN the night preceding the study.³³⁻³⁶

Data quality control and management

The collected data were reviewed for completeness every day at the end of data collection. Three days of training was given for data collectors and supervisors. The pretest was conducted at one of kebele where actual data collection was not done. The data collectors were closely supervised and the collected data were double-checked for consistency by the supervisors and investigators.

Data processing and analysis

The collected data were checked for completeness, coded and entered into Epi data version 3.1 and exported to statistical package for social science (SPSS) version 23 for analysis. Texts, frequencies, percentages, tables, and graphs were used to present results. Binary and multivariate logistic regressions were computed to assess factors associated with ITN utilization. Variables with a *P*-value <.25 in bivariate logistic regression

were entered into multivariate logistic regression analysis after checking for Multicollinearity using VIF. Finally, *P*-value of <.05 and adjusted odds ratio (AOR) with 95% CI were used to declare statistical significance.

Ethical approval and consent to participate

This study was carried out in accordance with the declaration of Helsinki. The Ethical Review Committee of the Rift valley University approved the study procedure and methods. The letter of cooperation was written to Ilu Galan district administrator office and to each selected kebele administrator. After explaining the aim and objective study, each study participant signed a written consent form. All respondents received health education on the benefits of ITN utilization.

Results

Socio-demographic characteristics of study participants

A total of 532 study participants responded to the questionnaire giving a response rate of 96.7%. Around 62.4% of the respondents were between the ages of 25 and 44 years with a mean age of 39.41 ± 10.25 years. More than half (51.1%) of the households had family size greater than 5. About 73% of households had 2 or less rooms, and 90.8% of households had 2 or less beds. In terms of household average monthly income, 46.6% of households received 500 to 999 Ethiopian Birr per month (Table 1).

Information on malaria prevention

Most, 480 (90.2%) of the respondents knew malaria disease and 89.7% said that malaria is a preventable disease. About one-third of the study participants (34%) used ITN as a malaria prevention tool and 30.8% believed that indoor residual spray can avoid malaria. About 72.6% of the study participants reported that one of their family members had acquired malaria in the last 1 year. All of the respondents (100%) had ITN at home at the time of data collection. Majority of the respondents, 87.6% believed that sleeping under ITNs saves them from malaria (Table 2).

ITN utilization

About 72.2% [95% CI: 68.4%, 75.8%] of the households utilized ITN the night before the day the data was collected. Two hundred forty-eight (46.6%) of the households utilized ITN for all family members (Table 2).

Reasons for not utilizing ITN

According to the response obtained from the respondents, lack of sufficient space to hang the net 49 (33.1%), thrown away of ITN due to old age 39 (26.3%), using the net for other purpose

Table 1. Sociodemographic characteristics of study participants in Elu Galan district, west Shewa zone, Oromia region Ethiopia, 2020 (n=532).

VARIABLES	FREQUENCY	PERCENTAGE (%)
Sex of respondent		
Male	338	63.5
Female	194	36.5
Role of respondent		
Father	331	62.2
Mother	196	36.8
Others ^a	5	1.0
Age group (y)		
<25	30	5.6
25-40	332	62.4
>40	164	30.8
Education status		
Illiterate	163	30.6
Grade 1-6	166	31.2
Grade 7-8	61	11.5
Grade 9-12	118	22.2
College and above	24	4.5
Occupational status		
Farmer	243	45.7
House wife	78	14.7
Merchant	103	19.4
Government employee	71	13.3
Daily laborer	33	6.2
Private work	4	0.8
Marital status		
Single	19	3.6
Married	501	94.2
Others ^b	12	2.3
Family size of household		
<5	260	48.9
>5	272	51.1
Number of rooms		
<2	387	72.7
>3	145	27.3

(Continued)

Table 1. (Continued)

VARIABLES	FREQUENCY	PERCENTAGE (%)
Number of beds		
<2	493	90.8
>3	49	9.2
Number of under-5 children		
0	177	33.3
1	234	44.0
2	108	20.3
3	13	2.4
Availability of pregnant women in the household		
Yes	209	39.3
No	323	60.7
Monthly income		
<500 birr	187	35.2
500-999 birr	248	46.6
1000 birr and above	97	18.2

^aSon and daughters.

^bWidowed and divorced.

35 (23.7%), and not have enough bed net 5 (16.7%) were the reasons that were mentioned for not utilizing ITN (Figure 2).

Findings from observation of households

According to the results of direct observation of households, more than half of the study participants (51.1%) had 2 beds and 46.1% of the households had 1 bed net at home. In terms of the number of beds/sleep places, 50.4% of households had 2 beds with ITN hung over the beds and 66.4% of ITN were long lasting types of bed nets owned by households. Only 55.6% of the families that self-reported sleeping beneath a net were found to have a properly hung (positioned) bed net on their bed or other sleeping areas as confirmed by observation. The remaining 16.6% who reported using the nets had no observable verification of ITN utilization which might be due to net care practice to remove or tie up nets during the day while they are not in use to avoid getting torn or might not utilized at all. In this study, 148 (27.8%) of the respondents had WHO-defined access to ITNs (Table 3).

Factors associated with ITN utilization

The result of multivariate logistic regression analysis indicated that women were 45% less likely to use ITN than men (AOR=0.55, 95% CI: 0.36, 0.81). Those whose age were less than 25 years were 62% less likely to use ITN compared to those

Table 2. Ownership and utilization of ITN among the houses in Elu Galan district, West Shewa Zone, Oromia Region, Ethiopia, 2020 (n=532).

VARIABLES	FREQUENCY	PERCENTAGE (%)
Know malaria disease		
Yes	480	90.2
No	52	9.8
Know that malaria is preventable		
Yes	477	89.7
No	55	10.3
Methods of malaria prevention mentioned by households		
ITN utilization	162	34.0
Indoor residual spray	147	30.8
Clearing/draining stagnant water	96	20.1
Take oral anti-malaria medication	71	14.9
Environmental management	1	0.2
Had family members caught by malaria in the last 1 year		
Yes	386	72.6
No	146	27.4
Heard about ITN		
Yes	532	100.0
Availability of ITN at home		
Yes	532	100.0
Think that sleeping under ITNs have benefit		
Yes	468	88
No	64	12
Think that sleeping under ITNs protects from malaria		
Yes	466	87.6
No	62	11.7
Don't know	4	0.8
Number of ITNs owned		
1	148	27.8
2-3	348	65.4
4 and above	36	6.8
Source of ITNs		
Government	455	85.5
Private/market	59	11.1
NGO	18	3.4

(Continued)

Table 2. (Continued)

VARIABLES	FREQUENCY	PERCENTAGE (%)
Utilized ITNs as reported by respondents		
Yes	384	72.2
No	148	27.8
Priority given for malaria prevention at household level for family members		
Under-5 children	137	25.8
Mother and father	102	19.2
Pregnant mother	45	8.5
All family	248	46.6
Frequency of ITNs utilization		
Always	318	59.8
Sometimes	214	40.2
Cheek ITN hole		
Yes	105	19.7
No	427	80.3
Re treat ITN		
Yes	27	5
No	505	95

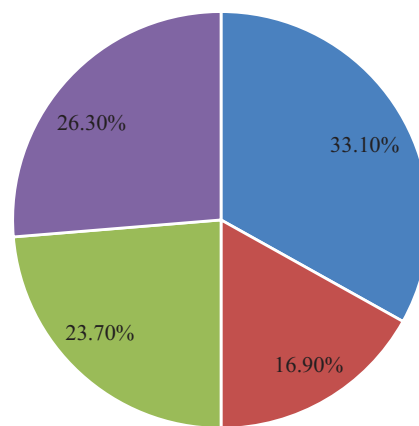


Figure 2. Reasons for not utilizing ITNs the night before data collection day in Elu Galan district, West Shewa Zone, Oromia Region, Ethiopia, 2020 (n=148).

who were greater than 40 years of age (AOR=0.38, 95% CI: 0.23, 0.95). Those who earned greater than 1000 Ethiopian Birr monthly income had 2.24 times higher odds of utilizing ITN compared to those who earned less than 500 Ethiopian Birr (AOR=2.24, 95% CI: 1.14, 4.69). Households that had 3 and above beds had 2 folds' higher odds of utilizing ITN than those with less than 2 beds (AOR=2.04, 95% CI: 1.29, 3.51) (Table 4).

Table 3. ITNs direct observation result in Ilu Galan district, West Shewa Zone, Oromia region, Ethiopia, 2020 (n=532).

CHARACTERISTICS	FREQUENCY	PERCENTAGE (%)
Number of bed or places of sleeping (floor and reed mats)		
1	200	37.6
2	272	51.1
3 and above	60	11.3
Number of bed nets observed in the household		
2	188	35.3
1	245	46.1
3 and above	99	18.6
Number of beds/places of sleep observed with bed nets		
1	197	37.0
2	268	50.4
3 and above	67	12.6
Type of bed net that household-owned		
Re treatable	179	33.6
Permanently treated	353	66.4
Observed bed net hanged properly over the bed or sleeping area		
Yes	296	55.6
No	236	44.4
Availability of any hole (throne) in the bed net		
Yes	193	36.3
No	339	63.7
Having WHO-defined access to ITN in the house hold		
Yes	148	27.8
No	384	72.2

Discussion

The finding of this study indicated that 72.2% of households utilized ITN the night before the data collection day. This finding is consistent with results from Arbaminch town in southern Ethiopia (71%),¹⁸ Alamata district in northern Ethiopia (73%),²¹ Harari regional state, Ethiopia (73.3%),²² Burkina Faso (70%),¹⁴ and Nigeria (75.4%).¹³ This is because all of the above studies including this study were conducted at malaria endemic area which might enforced the households to use ITNs due to the fear of malarial infection. However, the finding of this study is higher than the finding of Ethiopian DHS of 2016 in which 16.6% of the households utilized the ITNs.¹¹ This difference could be explained by the difference in the areas covered by the studies; the EDHS provides reports for areas with both lower malaria risk and higher malaria risk

merged together, whereas this study is conducted in a malaria-endemic area. The finding of this study is less than the result obtained from a study conducted among settlers in southwest Ethiopia²⁴ which found 80% of households used a bed net the night before the study. The disparity between this study and that of southwest Ethiopia study might be explained by the time gap between this study and the southwest Ethiopia study during which ITN distribution took place before the study was conducted. Others reason for the discrepancy of the 2 studies might be due to differences in the sociodemographic and socio-economic profiles of the study populations.

In this study, ITN was given priority to 25.8% of children under the age of 5 years and 8.5% of pregnant mothers. These figures are lower than the results of a study conducted in Nigeria¹³ where ITNs were given priority for 37.6% of children under 5 years of age and for 33.3% of pregnant mothers. This variation could be due to differences in geographical location and delivery of health services between the 2 countries and distribution of ITN at antenatal care (ANC) and delivery services.

According to the finding of this study, being female was identified as predictor of ITN utilization. This finding is consistent with study conducted in Addis Zemen Hospital northern, Ethiopia,³⁶ Raya Alamata districts of Ethiopia,²¹ and Arbaminch, Ethiopia¹⁸ that found that females were less likely to utilize ITN than males. This might be also due to sociocultural background in which men are given priority over women in Ethiopia. Moreover, this study was conducted in rural areas where males were more educated than females that lead males to have more awareness about ITN utilization. This result is inconsistent with a study conducted in 7 sub-Saharan African countries²³ that showed females were identified as more likely utilized ITNs than males. The reason for this disparity might be due to difference in study setting and socio-cultural background of the communities.

In this study, 27.8% of the study participants fulfilled the WHO-defined access to ITN in the house hold. This finding is lower than the study conducted in western Kenya where ITN access rate of the house hold was 59.1%.³⁷ The reason for this discrepancy might be because there was distribution of ITN by campaign before the survey in Kenya. Others possible reasons could be due to difference in sociodemographic characteristics, study setting, and lack of adequate ITN per the number of house hold member in the study area. Lifespan of ITNs vary widely between individual nets used within a single household or community, lack of free distribution, lack of continuous distribution through ANC and EPI programs are also others reasons for the discrepancy of the findings.^{38,39}

The findings of this study showed that participants under the age of 25 years were negatively associated with ITN utilization. This is similar with study conducted in rural communities of Oyo State, Nigeria where younger women utilized ITNs than older women.⁴⁰ This is because as the age increases the

Table 4. Factors associated with ITN utilization in the Ilu Galan district, West Shewa Zone, Oromia Region, Ethiopia, 2020 (Multivariate logistic regression analysis).

VARIABLES	CATEGORY	USED ITN LAST NIGHT		COR (95%CI)	AOR (95%CI)
		NO, N (%)	YES, N (%)		
Sex of respondents	Male	76 (22.5)	262 (77.5)	1	1
	Female	72 (37.1)	122 (62.9)	0.49 (0.33, 0.84)*	0.55 (0.36, 0.81)**
Age	<25	7 (14.3)	42 (85.7)	0.34 (0.13, 0.85)*	0.38 (0.23, 0.95)**
	25-40	81 (30.1)	188 (69.9)	0.87 (0.56, 1.35)	0.89 (0.59, 1.67)
	>40	60 (28.0)	154 (72.0)	1	1
Educational status	Illiterate	42 (25.8)	121 (74.2)	1	1
	Grade 1-6	47 (28.3)	119 (71.7)	0.57 (0.17, 1.96)	0.60 (0.23, 2.96)
	Grade 7-8	21 (34.4)	40 (65.6)	0.63 (0.19, 2.11)	0.68 (0.25, 2.65)
	Grade 9-12	33 (28.0)	89 (72.0)	1.09 (0.31, 3.82)	1.06 (0.36, 3.88)
	College and above	5 (20.8)	19 (79.2)	0.73 (0.22, 2.40)	0.76 (0.24, 2.46)
Occupational status	Farmer	57 (23.5)	186 (76.5)	1	1
	House wife	27 (34.6)	51 (65.4)	0.67 (0.30, 1.51)	0.69 (0.33, 1.57)
	Merchant	37 (35.9)	66 (64.1)	0.86 (0.35, 2.11)	0.90 (0.38, 2.22)
	Gov't employee	14 (19.7)	57 (80.3)	1.16 (0.50, 2.72)	1.12 (0.57, 2.79)
	Daily laborer	13 (35.1)	24 (64.9)	0.55 (0.2, 1.52)	0.58 (0.25, 1.58)
Monthly income	<500 ETB	73 (39.0)	114 (61.0)	1	1
	500-999 ETB	55 (22.2)	193 (77.8)	1.16 (0.58, 2.32)	1.112 (0.60, 2.37)
	≥1000 ETB	20 (20.6)	77 (79.4)	2.27 (1.11, 4.65)*	2.24 (1.14, 4.69)**
Number of beds	<2	120 (31.0)	267 (69.0)		1
	>3	28 (19.3)	117 (80.7)	2.10 (1.27, 3.48)*	2.04 (1.29, 3.51)**
ITNs use	Yes	121 (26.0)	349 (74.0)	1	1
	No	27 (40.9)	39 (59.1)	0.58 (0.33, 1.03)	0.61 (0.37, 1.11)

*Statistically significant at P -value $< .25$. **Statistically significant at P -value $< .05$.

frustration of being caught by malaria increases and make the people to utilize ITNs. However, this finding contradicts the results of the studies conducted in Addis Zemen Hospital, Ethiopia,⁴¹ Shashogo District, Southern Ethiopia,⁴² 5 sub-Saharan African nations,²³ sub-Saharan Africa,⁴³ and Sudan⁴⁴ where participants of younger ages were more likely to utilize ITNs. This could be due to variation in study setting, socio-demographic and socio-cultural aspects of the communities.

Having 3 or more beds was positively associated with ITN utilization in this study. This might be due to lack of enough ITNs in the household which make them bother to utilize ITNs.

Getting greater than 1000 Ethiopian Birr per month was positively associated with ITN utilization in this study. It is consistent with study from south west Ethiopia⁴⁵ where households

with higher wealth indexes were more likely to utilize ITN. This is because those households that have better income can afford ITNs and utilize than those with low monthly income.

In this study, lack of sufficient space to hang the net and no enough bed net were among the reasons that were mentioned by the respondents for not sleeping under the net in the previous night. This was almost similar with reason mentioned by the study participants from the studies conducted in Uganda⁴⁶ and eastern Ethiopia.²² This might be due to the socio-economic and demographic similarities of the studies areas.

Limitation

The study may be susceptible to social desirability bias with regard to ITN utilization. Another possible limitation of this study is that just only one family member was questioned if all

household members slept beneath a net or not the previous night. This might result in respondent bias.

Conclusions

ITN utilization was low in this study. Although ITN ownership was high in the study area, there was an inconsistency between ownership and ITN utilization. Sex, age, monthly income, and number of beds were factors significantly associated with ITN utilization. Health care professionals in the district need to provide behavioral change communication to the community on the importance of ITN utilization.

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Author Contributions

All authors contributed significantly to the creation, design, data collection, or data analysis, and interpretation. They have contributed in drafting or critical revision of essential materials of the article. All authors decided the submission of this paper to this Journal for publication. They agreed to be responsible for all aspects of the work and gave final approval to the edition of this article.

Data Availability

The evidence supporting this study is not currently available to the public. It will be made available from the corresponding author upon reasonable request.

Ethical Approval and Consent to Participate

This study was carried out in accordance with the Declaration of Helsinki. The Ethical Review Committee of the Rift valley University approved the study procedure and methods. The letter of cooperation was written to Ilu Galan district administrator office and to each selected kebele administrator. After explaining aim and objective of the study, each study participant signed a written consent form. All respondents received health education on the benefits of ITN utilization.

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