

*Full Length Research Paper*

# **Proper utilization of long lasting treated net and associated factors at Zuway Dugda district, Arsi zone, Ethiopia**

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**Insecticide-treated net is one of the main malaria control strategies reducing its incidence by half. This study measured proper utilization of insecticide-treated nets in the study area. To assess proper utilization of insecticide treated net and determinants among households of Zuway Dugda district, Ethiopia. Community based cross-sectional multistage study conducted using structured questionnaire via interview and observation. The collected data entered into EPI INFO Version -7 and analyzed using SPSS version 21 software. Variables having  $p < 0.2$  in the bi variate logistic regression were entered into multi variable logistic regression analysis and finally  $p < 0.05$  considered to declare association. Among study population 84.2% of 821 households had at least one ITNs, while only 18% used it the night proceeding the data collection day. Educational status, having separate sleeping room, frequency of using ITNs, ITNs ever been washed and shape preference of respondents were associated factors for utilization. Although ownership was moderate, only small proportion of household members slept at least under one ITN. Improving housing condition, when to wash ITNs and benefit of washing and education coverage for the community also needed.**

**Key words:** Households, insecticide treated net, ownership, utilization.

## **INTRODUCTION**

Malaria is a protozoan disease transmitted to man by the bite of the female anopheles mosquito (Tizazu et.al, 2006). It remains an important cause of illness and death in children and adults in malaria endemic countries (WHO, 2015a). Globally, 3.3 billion people in 97 countries and territories are estimate to be at risk of being infected with malaria and developing the disease (WHO, 2015b).

It is estimated that 190–330 million malaria episodes and at least 1 million malaria deaths occur annually (WHO and UNICEF, 2008).

In Ethiopia approximately 52 million people (68%) live in malaria risk areas, primarily at altitudes below 2,000 m. The disease is mainly seasonal with unstable transmission in the highland fringe areas and of

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relatively longer transmission duration in lowland areas, river basins and valleys. Historically, there has been an estimated 10 million clinical malaria cases annually in the country (FMOH, 2012).

Ethiopia developed national malaria control strategy in August, 2014. It had goals to achieve near zero malaria death, to reduce malaria cases by 75% from baseline of 2013 and eliminate malaria in selected low transmission area through community empowerment and mobilization, diagnosis and treatment, vector control and malaria elimination. The two major malaria prevention service implemented in Ethiopia has targeted indoor residual spray with insecticide and distribution of Long-lasting Insecticide Treated Nets (LLINs) (FMOH, 2014a). ITN are nets dipped in a pyrethroid insecticide solution. This treatment creates a physical barrier, or a “halo” around the net, repelling or killing the mosquitoes. LLITNs are increasingly popular, as they last longer than traditional ITNs, repelling mosquitoes for up to four years. With LLITNs, the insecticide is woven into the fabric of the nets, causing it to self-replenish with each wash, by bringing the insecticide to the surface of the net (WHO, 2012). LLINs has three main functions: i) when mosquitoes are in contact with the net, it has a knock-down effect, temporarily incapacitating or even killing mosquitoes; ii) it has a repellent effect; and, iii) it reduces contact between the person sleeping under the net and mosquitoes by acting as a physical barrier (FMOH, 2012). When 80% of households use bed nets in a community, studies suggest that mortality from malaria for those living within 300 m is significantly reduced (WHO, 2012).

In Ethiopia experiences have shown that possession and appropriate use of ITNs do not automatically go hand-in hand. Many people who received ITNs did not sleep under them, reduced their efficacy through inappropriate washing practices, or failed to replace them when they became damaged or torn (WHO, 2007). Malaria is of the major health and socioeconomic burdens in Ethiopia (PMI, 2015). In 2013, there were more than 3,000,000 confirmed malaria cases making the first cause of morbidity (11.7 %) and the third leading cause of health facility admission (7.8%) (FMOH, 2013). The use of ITNs was one of the main malaria control strategies in most malaria endemic countries to reach the Roll Back Malaria (RBM) targets reduce the malaria burden by 50% in 2010 compared to 2000 levels and at least 75% by 2015 (RBM, 2005). ITNs have been shown to reduce the incidence of malaria cases by 50% in a variety of settings (FMOH, 2007). Despite the large scale distribution, there was a wide variation in the availability and use of ITNs/LLINs at the household level (RBM, 2005). This study was done, to assess LLINs utilization in Zuway Dugda district and similar studies done in different places but there is no study done on LLINs utilization in this area even though malaria is public health problem in

area.

## MATERIALS AND METHODS

### Study design and period

A community based cross sectional study design employed and quantitative method used to conduct at household level from 5th March, to 1st April, 2017.

### Study area

The study area was Zuway Dugda district, which is 47 km away from Assela Town, capital city of Arsi Zone. It is 222 km away from Addis Ababa. According to the 2007 Ethiopian census report, Zuway Dugda has a total population of 137,223 and 28,588 households. The district have 28 rural Kebeles and two Urban Administrative Kebeles which is all malarious and altitude below 2000 m. In the District there are rivers and irrigation sites which are suitable for mosquito breeding. On the West direction Lake Zuway is boarder of this district. The climatic condition has 85% low land and 15% semi high land. The district has six health centers and 32 health posts. Human resources of the District were 84 health workers and 58 health extension workers (Zuway Dugda Health Office, 2015/2016).

### Source and study population

All households in Zuway Dugda district were the source population of the study. Households that randomly selected after multistage sampling were study population. Randomly selected HH heads or any member of the HH >18 year who could provide credible information included in this study. Severely sick person or HH head, person or HH head unable to respond or not available in their home for three consecutive visit plus one more final visit at the end of data collection period.

### Ethical consideration

Ethical clearance was obtained from the Institutional Review Board (IRB) of Arsi University College of Health science, Department of Public Health. Project Protocol No. A/CHS/RC/02/17, Archive Protocol No. A/U/H/S/C/120/6143/09 and Date 09/05/09 Eth Calendar. Finally, all questionnaires were kept locked after data entry completion and will be destroyed when they are no more needed.

### Sample size and sampling procedures

#### Sample size determination

Sample size for the first objective were determined using 95% confidence level, margin error-5%, LLIN use proportion is from 2015 MIS in Oromia Region 41% (Table 1).

$$n = \frac{(1.96)^2 * 0.41(0.59)}{0.05^2}$$

n=371.7-372

For the second objective to determine sample size LLINs using

**Table 1.** Sample size determination of study participants for ITNs utilization and factors associated in the study population.

Objectives	Proportion (%)	Single population proportion formula	Design Effect	Non respondent rate (%)	Total sample size	Reference for p
Utilization	41	$n=z^2\alpha/2*p(1-p)/w^2$	2	10	818	Teklemariam et al., 2015
Ownership	58.5	$n=z^2\alpha/2*p(1-p)/w^2$	2	10	821	Teklemariam et al., 2015
Access	46	$n=z^2\alpha/2*p(1-p)/w^2$	2	10	684	Teklemariam et al., 2015

**Table 2.** Presentation of sampling procedure on LLINs utilization in the study population.

S/N	Selected Kebeles	35% of all	Total zone	Selected zone	Total House hold in selected zone	Selected household
1	Arba Chefa		3	2	647	84
2	Arata		3	1	454	59
3	Dimtu Rarety		3	1	416	54
4	Hallo		3	1	368	48
5	UboBericha		3	2	626	81
6	Herera		3	1	282	37
7	Ogolcho 01		3	2	883	114
8	Senbero		3	2	1068	138
9	Kiyansho		3	1	476	62
10	Sengo		3	2	426	55
11	Café Jila		3	2	684	89
	Total		33	17	6329	821

95% confidence level, margin error-5%, LLIN ownership proportion is from 2015 MIS in Oromia Region 58.5% (Teklemariam et al., 2015).

$$n = \frac{(1.96)^2 * 0.585(1 - 0.585)}{(0.05)^2}$$

n=373

For other factor access sample size of LLINS using 95% confidence level, margin error-5%, LLIN access proportion is from 2015 MIS in Oromia Region 46% (Tizazu and Anteneh, 2006).

$$n = \frac{(1.96)^2 * 0.46(0.44)}{(0.05)^2}$$

n = 311

Finally, the highest sample size was taken that is, 821 as the minimum sample size adequate for the generalization finding for the general population.

### Sampling procedure

The study was multistage. The district has a total of 30 kebeles. Thirty five percent were included in the study which were 11. These had 33 sub-kebeles (Zones) with 12,657 households that were

selected by lottery method. Then ArbaChefa, Arata, Dimtu Rarety, Hallo, Kiyansho, UboBericha, Sengo, Senbero, Ogolcho 01, Herera, Café Jila were selected for this study. Then in order to get sampling frame all zone in selected Kebeles were listed and 50% zone a total of 17 were selected proportionally. To select household a sampling frame existed with family folder registration at village's level. Households in zone were selected with a systematic simple random sampling technique. The first household selected by lottery method and the next by Kth interval. Finally 821 households selected proportionally for this study (Table 2).

### Variable of the study

#### Dependent variable

Proper utilization of ITNs.

#### Independent variable

**Sociodemographic variables:** Age, educational status, occupation, family size, types of house construction, availability of separated sleeping room, income, knowledge about the cause and prevention of malaria, Source of information, benefit of ITNs, availability of ITNs, number of ITNs, Source of ITNs, frequency of using ITNs.

**Current status of ITNs:** Age of ITNs, ever washed ITNs, shape, color.

### Operational definitions

**HH fully covered by ITNs:** An HH with an ITN for each and every sleeping area/beds and observed by enumerators during data collection (FMOH, 2012).

**ITN ownership:** HHs with one or more ITNs per HH (FMOH, 2012).

**Proper utilization:** Refers to HHs that owned an ITN in which one or more members of the HH slept under a net, confirmed through observation by enumerators during the early morning preceding this study (FMOH, 2013, 2007).

**Access:** The proportion of the population that could sleep under an LLIN if each LLIN in the household was used by up to two people (Tulu et al., 1993).

**LLINs:** Are nets that are treated at factory level by a process that binds or incorporates insecticide into the fibers. They are designed to maintain their biological efficacy against vector mosquitoes for at least 3 years (WHO, 2008).

**Illiterate:** Respondents who cannot read and write or who can read and write but informal education (FMOH, 2004).

**Literate:** Respondents who have formal education (FMOH, 2004).

### Data collection procedures

A structured questionnaire was used for data collection. The questionnaire was prepared originally in English and translated to Afan Oromo. Data were collected by a combination of face-to-face interview and observation. The data were collected by six trained diploma nurses during early morning session. ITN use was cross-checked with the interview response of HHs, through direct observation of the enumerators. They checked to confirm that HH ITNs were really utilized/hung up just above sleeping beds/areas or not. Two supervisors who were skilled in the malaria-prevention and -control program of the district health office and principal investigator were assigned to supervise the data-collection process and quality assurance. The data collectors and supervisors were trained for 2 days by the principal investigator.

### Data quality assurance

The questionnaire was prepared originally in English and translated to Afan Oromo and back to English by language experts to keep the consistency of the questions. Training of data collectors and supervisors, and pre testing of questionnaire on 5% of the sample from households from Hetosa district were done to ensure the quality of data. Checking on spot and double data entry on EPI INFO-7 was done to ensure completeness and consistency of the information collected. To decrease recall bias 24 h recall time was taken for utilization.

### Data processing and analysis

Data were entered, cleaned and edited using EPI INFO version-7 statistical software and then exported to SPSS Version 21 for further analysis. Descriptive statistics of the collected data were done for most variables in the study using statistical measurements. Frequency tables, percentages, means and standard deviation were used. Bi variable logistic regression analysis was conducted primarily to check which variable have association with the dependent variable individually. Variable found to have association

with the dependent variable at 0.2 probability were entered in to multi variable logistic regression for controlling the possible effect of confounders and finally the variables which have significant association were identified on the basis of OR, with 95% CI and 0.05 p-value to fit in to the final model.

Among variables studied, bivariable logistic regression analysis of ITNs used in this study, some variables showed significant difference with p-value of <0.05. Variables that were significant at p-value  $\leq 0.2$  were entered for back ward step wise logistic regression, which controlled undesirable effect of cofounder between variables and the problem of multicollinearity and declared true association. Hosmer and Lemeshow goodness of fit statistics were checked for fullness of the model. The final model showed 0.684 goodness. Very far from 0.05 and clearly indicating the outcome variables was fully explained by the independent variable entered in the full model.

### Ethical considerations

The study carried out after getting clearance from the ethical review committee, college of health science, Arsi University. Then an informed consent obtained from each institution and study participants to participate in the study. Those households who refuse to participate in the study not forced. Each respondent informed about the objective of the study. Confidentiality granted for information collected by keeping the privacy of respondents while filling the questionnaire. Those households who did not use long lasting treated net properly advised for proper utilization.

## RESULTS

### Socio demographic characteristics

In this study, total of 821 households included, with 821(100%) response rates. Among study participants 707(86.1%) were rural and 442(53.8%) were females. The mean (SD) age of respondent's were 37.96(12.3) and mean (SD) family size were 5.09(2.28). The majority respondents 631(76.9%) were farmers and 272(33.1%) unable to read and write and 265(32.3%) were primary school. Among the studied HHs 573(69.8%) were living in corrugated iron sheet roof houses while 433(52.7%) had separate sleeping room, and 354(81.8%) had single sleeping room (Table 3).

### Knowledge of respondents about malaria transmission and prevention among respondents of LLIN utilization in the study population

Almost all respondents had ever heard of malaria. From 817 respondents 619(75.4%) of them mentioned mosquito bite as the main mode of malaria transmission, 95(11.65%) said that malaria transmitted by living near stagnant water. Majority of respondents 623(75.9%) reported ITNs as main prevention measure against malaria. Peak biting hour for mosquito was reported to be at night time by 775 (94.4%). Majority of them 621 (75.6) had ever heard/seen educational message on ITNs. Health extension workers or health workers were the

**Table 3.** Socio-demographic characteristics of respondents involved in the study of LLIN in the study population.

<b>Variable (n=821)</b>	<b>Frequency</b>	<b>Percent</b>
<b>Residence</b>		
Urban	114	13.9
Rural	707	86.1
<b>Age of respondent</b>		
15-29	227	27.6
30-44	373	45.4
>45	221	26.9
<b>Sex</b>		
Male	379	46.2
Female	442	53.8
<b>Religion</b>		
Muslims	668	81.4
Christians	153	18.6
<b>Marital status</b>		
Single	37	4.5
Married	700	85.3
Divorced	17	2.1
Widowed	67	8.2
<b>Occupation</b>		
Farmer	631	76.9
Government employee	101	12.3
Merchant	27	3.3
Private work	61	7.4
Fisherman	1	0.1
<b>Educational status</b>		
Unable to read and write	272	33.1
Able to read and write	85	10.4
Primary (1-8)	265	32.3
Secondary (9-12)	120	14.6
Tertiary	79	9.6
<b>Ethnicity</b>		
Oromo	711	86.6
Amhara	40	4.9
Gurage	36	4.4
Tigre	1	0.1
Zeyi	26	3.2
Wolayita	7	0.9
<b>Family Size</b>		
1-4	349	42.5
5-8	407	49.6
>8	65	7.9

Table 3. Contd.

<b>House roof construction</b>		
Thatched roof	248	30.2
Corrugated Iron sheet	573	69.8
<b>Separated sleeping room</b>		
Yes	433	52.7
No	388	47.3
<b>No of sleeping room</b>		
1-2	428	98.8
>2	5	1.2
<b>Income</b>		
<500	381	46.4
500-1000	299	36.4
>1000	141	17.2

main source of information (Table 4).

#### ITNs ownership and Utilization among households in the study population

From 821 HHs who participated in this study 692(84.2%) owned at least one ITNs. 691(99.8%) were supplied freely by government. One hundred seventy six (25.5%) of the HHs were supplied with one, 293(42.4%) with two, remaining with three or more ITNs. 1516 ITNs were supplied to the HHs included in this study. Of those 692 HHs who owned at least one ITNs, Only 125(18%) used or slept under ITNs the night prior to data collection (Table 5).

#### Condition of ITNs in HH who owned ITNs and their preference among study participants of LLIN utilization in Zuway Dugda district, Arsi Zone, Oromia Region, Ethiopia, 2017

Among (n=692) households who owned ITNs, 643(92.9%) of them had age one year. While, 384 washed at least once and 360(93.8%) washed 1-3 times (Table 6).

#### Multivariable analysis for factors associated with ITNs utilization in the study population

From entered variables only five remained significant predictor of the outcome variable. HHs head who were literate 1.88 times more likely to use ITNs than their counter parts, with AOR(95%CI) of 1.879(1.067-3.309).

HHs that had separate sleeping room were 2.15 times more likely to use ITNs than HHs who had not had separate sleeping room. HHs who were their shape preference rectangular were, 47% less likely to use ITNs than those who prefer conical shape with AOR (95%CI) of 0.535(0.310-0.923) (Table 7).

#### DISCUSSION

In this study ITN ownership and utilization was found to be 84.2 and 18% respectively. Only 18% of HHs use ITNs regularly without interruption. From this study, even though net was available in the HHs less than one fourth of them used at least one of their LLINs in previous night prior to data collection.

World malaria report of 2015 showed wide range estimates of ITNs utilization in Africa. Among five surveyed countries the median proportion of population sleeping under ITNs highest and lowest estimates were 74 and 20% respectively. The report showed that in sub-Saharan countries the proportion of population who use ITNs was 55% (WHO, 2015b), and the current study finding falls in the lowest estimates. Another studies done in Togo and Rwanda showed 71.4 and 72.3% utilization which is four fold than this result (America Association for Advancement of Science, 1991; ORHB, 2001). Similarly another study done in Kenya showed utilization of 53% (Wairo and Awoke, 2016), which is three fold of the current study finding. This might be due to geopolitics and socioeconomic differences of the study areas.

In Ethiopia, from 2015 EMIS it was reported 40% HHs used (slept under) ITNs the night before the survey. It also differs from region to region in the country with the highest in Afar Region (51%) and lowest in Dire Dawa

**Table 4.** Knowledge of respondents about malaria Transmission and Prevention among respondents of LLIN utilization in the study population.

<b>Variable</b>	<b>Frequency</b>	<b>Percent</b>
<b>Ever heard about malaria(n=821)</b>		
Yes	817	99.5
No	4	0.5
<b>Cause of malaria (n=817)</b>		
Bitten by mosquito	619	75.4
Leaving near stagnant water	95	11.6
From unclean environment	52	6.3
Being hungry	21	2.9
I don't Know	8	1.0
Leaving with people caught by malaria	7	0.9
Working in the sun	5	0.6
Cooled weather	10	1.2
<b>Main preventive measure (n=817)*</b>		
ITNs	623	75.9
Drainage of stagnant water	340	41.4
Take tablet	232	28.3
Proper disposal of waste	178	21.7
IRS	145	17.7
Close door and window	23	2.8
Use fumigants	19	2.3
Nothing	8	1
Use traditional plant	3	0.4
Eating	1	0.1
<b>Mosquitoes peak biting hour(n=817)</b>		
Day time	2	0.2
Night time	775	94.4
All time	20	2.4
I don't know	20	2.4
<b>Educational message on ITNs(n=821)</b>		
Yes	621	75.6
No	200	24.4
<b>Source of information(n=621)*</b>		
Radio	97	11.8
Television	40	4.9
Community meeting	160	19.5
HEW/Health worker	468	57
School	23	2.8
<b>ITNs benefits</b>		
Yes	813	99
No	8	1

Table 4. Contd.

<b>Benefit of ITNs(n=813)*</b>		
Don't get bitten by mosquitos	584	71.1
Don't get malaria	190	23.1
Prevent other insects	429	51
To get warmth	4	0.5
Other	4	0.5

\* Shows variable with multiple answers.

City Administration (16%). This study was also similar to the lowest utilizing region (Tulu et al., 1993). Study done in Wanago and ItangGambella of Ethiopia showed that utilization was 75.5 and 52.3% respectively which is higher than this study result (FMOH, 2004; Teklemariam et al., 2015). In Oromia ITNs utilization was 41% (Tulu et al., 1993) more than double of Ziway Dugda. Studies done in Harari and Chawaka showed 73.3 and 80.1% which were four fold of the current study and proxy to national target (Tomass, 2011; Kateera et al., 2015) that also is by far more than the current finding. Similarly, study done in Jimma and Kersa showed low ITNs utilization of 38.4 and 21.8% respectively which was still better than the result of this study (Stevens et al., 2013; FMOH, 2014b).

The national strategic plan targeted to reach 100% ownership and 80% utilization in malaria endemic areas by all ages and biological groups to brought heard immunity by using LLINs (FMOH, 2014b). ITNs utilization in studied area was lower when compared to world malaria report and a number of studies done in the country. This might be due to the current cross sectional study was conducted during the dry season of the area with no other mosquito's' nuisance and 332(58.6%) responded they didn't use available ITNs due to absence of mosquitoes. Additionally, the reason might be from knowledge as a large proportion of illiteracy among participants which 43.5% and majority, 86.1% were rural community.

When we see LLINs ratio to person there were 2.75 persons per ITN. Another study done in Chewaka showed there were 4 person per ITN (Kateera et al., 2015) while similar study done in Wanago showed 3.98 persons per ITN [FMOH, 2004]. National strategic plan targeted one ITN for 1.8 persons (FMOH, 2014b). The current study showed a better access of ITNs than in Chawaka and Wanago though less than the national target which might be due to the distribution of ITN done before one year and gap filling performed in the current study area.

In current study independent factors for ITNs use were educational status of respondents, having separated sleeping room, frequency of using ITNs, ITNs ever been washed and shape preference of respondents. Similarly studies done in Wanago, Harari, Kersa and Gilgelgibe in

Ethiopia showed that educational status of respondents were predictive factor for LLINs utilization (Tulu et al., 1993; Tomass et al., 2011; FMOH, 2015; Seyoum et al., 2017). The current study showed that literates were 1.88 times more likely to use ITNs than their counter parts. Research done in Harari of Ethiopia also revealed those respondents learned to secondary school were 1.78 times more likely to use ITNs than those who could not read and write (Tomass et al., 2011). Similarly study done in Wanago literates were 1.31 times more likely to use ITNS than their counter parts (FMOH, 2004). Differently study done in Gilgel Gibe South West Ethiopia Illiterates were 2.3 times more likely not to use ITNs than those who learned grade 9 or above (Seyoum et al., 2017). This is because educated people are more likely to get knowledge through formal learning or by reading any form of readable materials and even more access and understand information from mass media.

Having separated sleeping room also had positive association with ITNs utilization. Those HHs with separate sleeping room were 2.16 times more likely to use ITNs than those who haven't separate sleeping room. Study done in Wanago showed that HHs with separate sleeping room were 1.98 times more likely to use ITNs (FMOH, 2004). Study done in Kersa also identified that use of ITNs depended on housing construction and absence of separated sleeping room to hang it (FMOH, 2015). This might be due all activities done in single room. Food also prepared by open fire in this single room so hanging net in the room unfavorable with all activities.

Insecticide treated net ever been washed shows significant increase of utilization compared to HHs with unwashed ITNs. This might be due to HHs perception to use clean ITNs as opposed to dirty ITNs. Washing dirty ITNs also increase chemical emission fibers of nets. Similar study done in Chewaka district showed HHs ever washed ITNs were 2.66 times more likely to use ITNs than unwashed (Kateera et al., 2015).

Shape preference of respondent's also found to be one barrier of ITNs utilization. Those households who prefer rectangular shape were 47% less likely to use ITNs than who prefer conical shape. Probably rectangular shape were more suitable to use for other purposes like collecting agricultural products. A study done in Wanago also showed that those who prefer rectangular were 1.17



**Table 5.** ITN possession and ITN utilization by household of participants involved in the study in study population.

<b>Variable</b>	<b>Frequency</b>	<b>Percent</b>
<b>Availability of ITNs (n=821)</b>		
Yes	692	84.2
No	129	15.8
<b>Reason for unavailability (n=129)</b>		
Don't get	50	38.8
Used for other purpose	12	9.3
Worn out	64	49.6
Give to others	3	2.3
<b>Source of ITNs (n=692)</b>		
Government	691	99.8
Purchased	1	0.2
<b>Frequency of using ITNs (n=692)</b>		
Consistently	223	32.2
Intermittently	469	67.8
<b>Time they use intermittently(n=469)</b>		
Rainy season	458	97.7
Winter	11	2.3
<b>No of ITNs (692)</b>		
1-2	469	67.8
3-4	216	31.2
>4	7	1
<b>Utilization (n=692)</b>		
Yes	125	18
No	567	82
<b>Given priority to slept under ITN (n=125)*</b>		
HH head	25	3
Children $\geq$ 5 years	3	0.4
Children under 5 years	99	79.2
Pregnant women	59	47.2
<b>Reason for not using available ITNs(n=567)</b>		
Absence of mosquito	332	58.6
It's dirty	149	26.3
It's too hot slept under	33	5.8
It takes place	22	3.9
It takes time to tuck	14	2.4
It's difficult to get up	9	1.6
Gave to others	8	1.4
<b>IRS against mosquito(n=821)</b>		
Yes	440	53.6
No	381	46.4
*Shows variable with multiple answer		

**Table 6.** Condition of ITNs in HH who owned ITNs and their preference among study participants of LLIN utilization in the study population.

<b>Variable</b>	<b>Frequency</b>	<b>Percent</b>
<b>Age of ITNs (n=692)</b>		
1year	643	92.9
2 years	40	5.8
≥3 years	9	1.3
<b>ITNs ever been washed (n=692)</b>		
Yes	384	55.5
No	308	45.5
<b>Frequency of washing (n=384)</b>		
1-3 times	360	93.8
>3 times	24	6.2
<b>Presence of hole or tear on ITNs (n=692)</b>		
Yes	118	17
No	574	83
<b>Shape owned(n=692)</b>		
Rectangular	690	99.7
Conical	2	0.3
<b>Shape preferred(n=821)</b>		
Rectangular	622	75.7
Conical	199	24.3
<b>Color owned (n=692)</b>		
Blue	692	100
<b>Color preferred (n=821)</b>		
Blue	716	87.2
Green	58	7.1
White	47	5.7

times more likely to use ITNs than who prefer conical (FMOH, 2004). Frequency of using ITNs had strong association with utilization. In this study those HHs who responded using ITNs consistently were found 18 times more likely to use it than those who use intermittently. This might be appearance of mosquito nuisance only during wet season.

Respondent's awareness on mode of transmission and malaria prevention measure was analyzed. Accordingly, 75.4% answered transmission was by mosquito bite and 75.9% respondents answered that use of ITNs was preventive measure. So those who know malaria transmission know prevention as well. This might be due to many non-governmental organizations done on

awareness creation on malaria and ITNs, even though, they could not come with behavioral change on ITNs utilization.

### **Strength and limitation**

Direct observation was carried out to check the actual behavior of the study population with regard to ITNs utilization. The study was carried out after one year of long lasting treated net distribution to the community better timing to measure behavior. The study was conducted in malaria endemic area where malaria had public health importance using raw data. It lacks

**Table 7.** Bivarible and Multivariable analysis model for factors associated with ITNs utilization among the study participants in the study population.

Variables	Category	ITNs Uses		COR	95%CI		AOR	95%CI	
		Yes	No		Lower	Upper		Lower	Upper
Education	Literate	29	285	3.45	1.88	6.32	1.88	1.07	3.31
	Illiterate	96	282	1	1	1	1	1	1
Separate sleeping room	Yes	86	288	2.14	1.41	3.23	2.16	1.25	3.76
	No	39	279	1	1	1	1	1	1
Frequency of using ITNs	Consistently	107	116	23.11	13.48	39.64	18.01	10.26	31.61
	Intermittently	18	451	1	1	1	1	1	1
Ever washed ITNs	Yes	94	290	2.90	1.87	4.49	3.28	1.93	5.59
	No	31	277	1	1	1	1	1	1
Shape preference	Rectangular	66	456	0.27	0.18	0.41	0.54	0.31	0.92
	Conical	59	111	1	1	1	1	1	1

qualitative method complement the quantitative data. No cause and effect be depicted.

## Conclusion

Although LLINs ownership was moderate, only small proportion of the HH members utilize or slept at least under one ITN in previous night prior to data collection. The consistent use of ITNs in this study was poorest (18%) when compared to country target (80%). On average three individuals share a single ITN which is better than other studies findings. Factors determine LLINs utilization in surveyed HHs includes Educational status, having separated sleeping room, frequency of using ITN, washing ITNs at least once and shape preference of respondents.

## RECOMMENDATION

### At Kebeles level

Health extension workers (HEWs) evidence based practice should be designed. Enhanced health education and community mobilization should be employed to increase proper utilization of ITNs by demonstrating proper hanging of ITNs. HEWs teach how to wash and when to wash ITNs and benefit of washing. House to house visit should be done by HEWs to see HHs utilization ITNs. Better prepare and facilitate community conversation on why available ITNs could not be used properly and come to solution with community. Encourage

those HHs those use ITNs properly and consistently. Cooperate with Kebeles leaders and control ITNs used for other purpose.

### At district health office

Review malaria control programs mainly ITNs utilization. Plan for gap filling those HHs who did not get ITNs and those reported worn-out.

### At FMOH

Monitor and evaluate LLINs utilization. Encourage qualitative and quantitative research's done around this program. Work with stake holders to improve housing quality. Distribute ITNs in line with national target that is, 100% ownership. Jointly work with wash program to improve personal hygiene and washing habit of ITNs.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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## ABBREVIATION

**ASL**, Above sea level; **FMOH**, Federal ministry of health; **HH**, Household; **HEW**, Health extension worker; **IRS**, Indoor residual spray; **ITN**, Insecticide treated net; **LLITN**, Long lasting insecticide treated net; **MIS**, Malaria indicator survey; **RBM**, Roll back malaria; **SD**, Standard deviation.

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