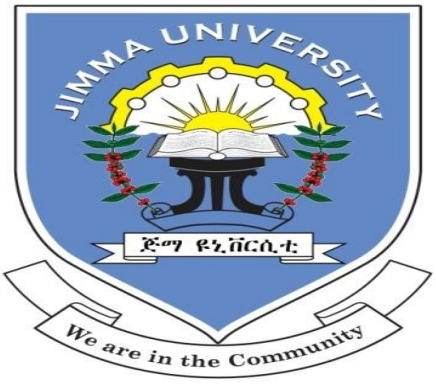

LONG LASTING INSECTICIDE TREATED NET UTILIZATION AND ASSOCIATED FACTORS AMONG HOUSEHOLDS IN ZIWAY DUGDA DISTRICT, ETHIOPIA

By: Birhanu Desta (BSC)

A RESEARCH THESIS TO BE SUBMITTED TO THE DEPARTMENT OF EPIDEMIOLOGY, INSTITUTE OF HEALTH, FACULTY OF PUBLIC HEALTH, JIMMA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF FIELD EPIDEMIOLOGY

June, 2017

JIMMA, ETHIOPIA

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Advisors:

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Abstract

Introduction: Long-lasting insecticidal nets (LLINs) have proved to be an important tool for the control of malaria and other vector-borne diseases In Ziway dugda district, a total of 66250 LLINs were distributed in 2015/2016 but still malaria prevalence is high in the district. Thus, this study aimed to assess utilization of LLIN among households and its associated factors in ziway dugda district, Ethiopia.

Methods: A cross sectional study design was conducted using structured questionnaire adapted from malaria indicator survey (MIS) 2011. A total of 684 households (HHs) were included in this study. A simple random sampling technique was used to select HHs from each kebele. Epidata Version 7.1.3 was used to enter data and logistic regression model was fitted to identify associated factors with HH's LLIN utilization using SPSS version 20.

Result: There was 94% response rate and among the total households surveyed, 508(74.3%) households used at least one LLIN the night prior to the study. According to the respondent's perception, household members LLIN usage priority was 57% for children, 53.9% for pregnant mothers and 3% for head of the household. Average household income of 100-299 (AOR=0.42, 95%CI, 0.22-0.78), household wife heads (AOR=3.23, 95%CI=, 1.10-9.50), presence of at least one child in the household (AOR=1.49, 95%CI, 1.001-2.218) and knowledge of respondent on malaria transmission and prevention (AOR=1.64, 95%CI, 1.02-2.62) were significantly associated with household's LLIN utilization.

Conclusion and recommendation: The findings of this study showed that LLIN utilization was low in Ziway dugda district compared to WHO roll back malaria target. Being house wife, presence of at least one child and having good knowledge were positively associated factors while low average monthly income was negatively associated with LLIN use. So to achieve the strategic plan of the country which is sustained malaria control and pre elimination, distribution of nets alone is not enough. Public health intervention should also address problems related to LLIN utilization status. Interventions to increase the community knowledge about malaria transmission and prevention should be done by stake holders who are working on malaria.

Key words: LLIN, LLIN Utilization, Ziway dugda district, cross sectional

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Acronym/Abbreviation

ACT	Artemisinin Combination Therapy
AOR	Adjusted odds ratio
CI	Confidence interval
COR	Crude odds ratio
ETB	Ethiopian Birr
FMOH	Federal Ministry of Health
HH	House Hold
IRS	Indoor Residual Spray
ITNs	Insecticide Treated Nets
JU	Jimma University
LLIN	Long Lasting Insecticide treated Net
MBN	Mosquito barrier net
MIS	Malaria indicator survey
OR	Odds ratio
RBM	Roll Back Malaria
RDT	Rapid Diagnostic Test
SNNPR	Southern Nations Nationalities and Peoples Region
SPSS	Statistical package for social sciences
WHO	World Health Organization

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1. Introduction

1.1. Background

Long-lasting insecticidal nets (LLINs) have proved to be an important tool for the control of malaria and other vector-borne diseases. Several studies in malaria endemic countries have shown the usefulness of LLINs in reducing man-vector contact from malaria. In populations with bed nets, LLINs have been shown to reduce all-cause child mortality by about 20%, decrease clinical cases of malaria by about 50%, and severe malaria by 45% [1-5]. Additionally, LLIN 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. LLINs also have an effect on other insects, such as head lice, sandflies, ticks and other household pests (e.g. bedbugs and cockroaches)[6].

LLINs, indoor residual spray (IRS), and Artemisinin-based combination therapy (ACT) are the central components of current malaria control campaigns. As a result ten countries eliminated malaria between 2010 and 2015, and malaria has not been re-established in any malaria free country since 2000. In 2015, 10 countries had fewer than 150 indigenous cases, and another nine had between 150 and 1000 cases[3, 7]. Current malaria control strategies in Ethiopia include indoor residual spraying (IRS) and long-lasting insecticidal nets (LLINs) to prevent malaria vectors biting humans inside houses. Moreover, other interventions such as effective case management and malaria rapid diagnostic tests (RDTs) are parts of the malaria control, prevention and elimination strategies [8-10].

A cornerstone for malaria disease prevention in Ethiopia is the use of LLINs. The key strategy used by the country is a rolling periodic (every three years) free distribution of LLINs to all population groups living in endemic, high and moderate malaria risk areas of Ethiopia. Currently, Ethiopia aims to achieve universal coverage by distributing one LLIN per two persons (sleeping space) through mass, free campaigns at the community level, through the health extension workers and/ or health facilities. Ethiopia has distributed about 40 million LLINs since 2005[6, 11, 12]

Indicators related Insecticide-treated mosquito nets are Proportion of population at risk that slept under an ITN the previous night; Proportion of population with access to an LLIN within their household; Proportion of households with at least one LLIN for every two people; Proportion of households with at least one LLIN; Proportion of existing LLINs used the previous night; Proportion of targeted risk group receiving LLINs (antenatal and immunization clinic attenders)[2-4].

There are two types of malaria preventing nets. Insecticide treated net (ITN) and long lasting insecticide treated nets (LLINs). ITNS are ordinary mosquito nets treated with insecticide provide much more effective protection than the ordinary plain nets by repelling and killing the mosquitoes. But these nets need to be re-impregnated after six month (twice a year). LLINS are nets have insecticide incorporated in their fiber so that the insecticide is not removed by as many as 20 washes. The efficacy of the insecticide is retained up to 3- 5 years[13]. The current internationally recognized standard for malaria protection from mosquito bites is the LLINs[11].

1.2. Statement of the Problem

About half of the world's population lives in countries at risk of malaria and 97 countries and territories are affected by malaria [6]. The most commonly used methods to prevent mosquito bites are sleeping under an LLIN and spraying the inside walls of a house with an insecticide – indoor residual spraying (IRS).

Use of LLINs has been shown to reduce malaria incidence rates by 50% in a range of settings, and to reduce malaria mortality rates by 55% in children aged under 5 years in sub-Saharan Africa[3]. Although LLIN utilization shows substantial increase since 2000, they fall short of universal (100%) coverage of this preventive measure. The continent-wide estimates of those sleeping under an LLIN obscure variations in progress among and within countries[14]. Apart from coverage, issues regarding the utilization of LLIN are very crucial. This is because the LLIN that are available at a household level may be left unused or even if they are used, vulnerable members of the household may not be given priority and/ or the usage may be intermittent[6].

Although ITN distribution has been massively expanded in most parts of malaria endemic sub-Saharan countries since 2005, there is limited information on community based actual use of nets owned, area specific reasons for non-use, and the possible impact of the variations in use on malaria vector densities and transmission in either Kenyan highlands or other countries where malaria is seasonal and unstable [15].

Regardless of decades of sustained control efforts, malaria still remains as the major cause of morbidity, mortality and socioeconomic problems in Ethiopia[16]. The use of LLINs is one of the main malaria control strategies in Ethiopia to reach the national targets to achieve malaria elimination within specific geographical areas with historically low malaria transmission and achieve near zero malaria death in the remaining malarious areas of the country by 2020 [10]. Between 2005 and 2014, over 64 million LLINs were distributed in mass campaigns by the FMOH nationwide[17]. Despite high percentages LLIN ownership, there is still a gap between ownership and use of LLIN[6].

The coverage and proper utilization ITNs which is one of the most promising malaria preventive measure in the country is also limited due to lack of sustainable distribution and issues related to

replacement of nets, seasonality of malaria, and poor knowledge of the community with regard to the link between mosquitoes and malaria [18]. Both the 2007 and 2011 MIS showed the gaps in the scale-up of malaria interventions, clearly indicating needs for better targeting and a comprehensive SBCC approach to maximize use of LLINs[19]. Oromia region had the lowest achievement in net ownership (45.6% in 2007 and 44.3% in 2011) compared to other regions. Nationally, progress has been observed in terms of net use among children U5 in households that owned nets. Oromia showed a decrease in net use by children under five [11].

A wide gap exists between coverage and utilization of LLINs [20]. A total of 66250 LLINs was distributed in 2015/2016 but still malaria prevalence high in the district[21]. This shows that, mosquito net ownership in itself is not synonymous with utilization. Hence, in addition to scaling up LLINs distribution, periodic assessment of the utilization and associated factors among high risk population is highly recommended [22]. Thus, this study aimed at assessing utilization of LLIN and its associated factors in ziway dugda district, Ethiopia.

1.3. Significance of the study

The result of this study helps to identify gaps in ITN utilization and to design appropriate information, education and communication (IEC) interventions towards improving its utilization. The result will also be useful to evaluate the progress of the woreda towards achieving the regional and national target and to take immediate actions in planning and implementation of prevention and control strategies. The finding of this study could also be a baseline for further studies.

2. Literature Review

2.1. LLIN Utilization

The ownership and use of insecticide-treated nets (ITNs) has been shown in multiple settings across sub-Saharan Africa to reduce clinical episodes of malaria and all-cause of child mortality. Survey was conducted in Sierra Leone six months after mass ITN distribution campaign including 4,620 in 2010.The survey revealed 87.6% of households own at least one ITN. Among individuals in households possessing one ITN, 95.7% hanged at least one ITN the night preceding the survey [23].

A community based cross sectional study conducted in Raya, Tigray in 2013 revealed that among 649 households 445(68.6%) of them were utilizing the long lasting Insecticidal treated nets. The proportion of under five children and pregnant women who slept under the net during early morning survey was 71.64 % and 69% respectively [24]. Another cross-sectional study conducted in Kersa, Eastern Ethiopia showed that, of the total 2867 households, 65.5% (1879) had at least one LLIN, but 33.5% (630) of LLINs owned households had used at least one LLIN the night before the survey[25]. A study conducted in Chewaka, Southwest Ethiopia revealed that 334 (80 %) of the households used at least one of their freely supplied ITNs. The night before the day of the survey, 77.4 % (418) of all children under five and 75 % (54) of all pregnant women slept under LLIN [26].

A cross sectional study in Afar showed that the proportion of children under 5 years of age who slept under treated nets during the night preceding the survey was 728(82.0%) and 676 (76.1%) in the surveyed households for reported and observed respectively. Likewise, the proportion of pregnant women who slept under treated nets was 166 (79.1%) and 147(70.0%) for reported and observed respectively [9].Another study in Harar revealed about 57.9% of participants had at least one ITN. The utilization of ITNs based on history of sleeping under net in the previous night was 73.3%. Regarding proper use of ITNs, 57.9% of respondents demonstrated proper hanging and tucking [18].

2.2. Factors affecting LLIN utilization

A research conducted in Cameron showed. MBN utilization was 69.7%. A total of 83.4%, 13.8% and 3.4% used MBNs throughout the year, during the rainy and dry seasons respectively. MBN use in children under five was associated with being from an urban area (P = 0.01). MBN use in pregnant women was associated with living in block-louver houses than in block-pane houses (P = 0.047) [27].

A cross sectional survey in Kenya revealed that important factors affecting the use of ITNs include: a household education level of at least primary school level, significantly high numbers of nuisance mosquitoes, and low indoor temperatures [15].

A study conducted in Amahara and Oromia regions showed that Number of ITNs in the household (AOR = 2.93, 95%CI = 2.21–3.90), number of ITNs hung per household (AOR = 4.23, 95% CI = 2.93–6.12), knowledge that ITNs kill malaria mosquitoes (AOR = 1.52, 95% CI = 1.02– 2.27), and no problem while using ITNs (AOR = 1.94, 95% CI = 1.03–3.63) increased the likelihood of ITN use by at least one member of the household. Presence of at least one pregnant mother and presence of at least one under five children was not significantly associated[28].

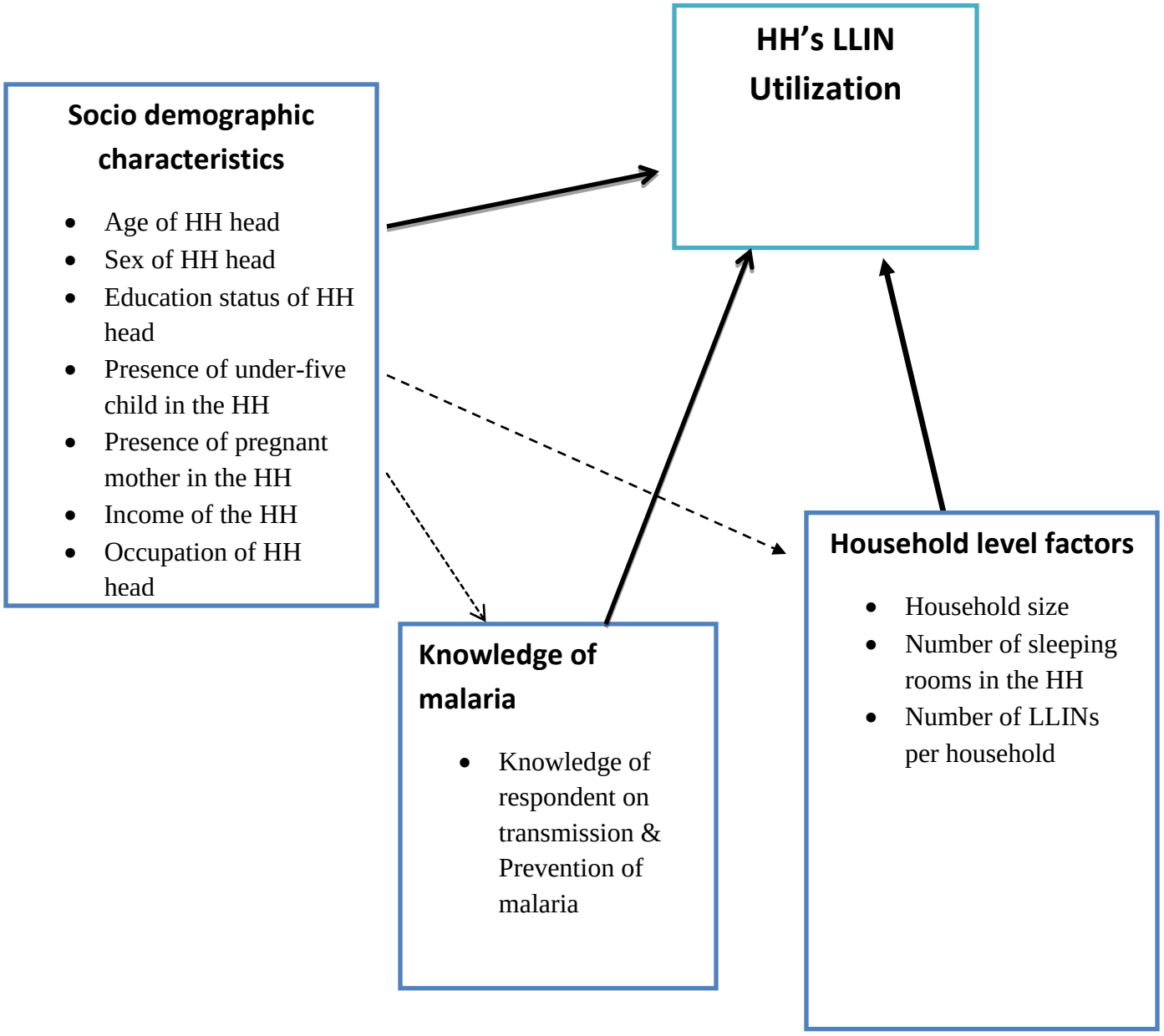
According to the study in Harari Region those farmer were more likely to utilize ITNs than other occupation (AOR: 2.262(1.002, 5.108)). Those household who have knowledge about ITNs use were less likely to utilize ITNs (AOR: 0.373(0.151, 0.918)) [18]. Another study done Itang, Gambella showed that HH awareness of malaria prevention, number of ITNs, family size, number of family members sharing sleeping area/beds, sleeping patterns of adolescents, HH-head age, and inconvenience of using ITNs were found to be barriers to the use of ITNs [29].

A study conducted in Gursum district, Eastern Ethiopia showed that households who received or were told about ITN in the last 6 months were three times more likely to have used it than those who were not (OR 3.25; 95% CI 1.5–7.10). Households whose heads were engaged as a farmer (adjusted OR 0.137; 95% CI: 0.04–0.50) and housewife (OR 0.26; 95% CI: 0.08–0.82) were less likely to use ITN than those of other occupations [30]. A study conducted in Bahir dar also showed Knowledge about malaria risks and ITNs importance (AOR= 2.3; 95% CI 1.23- 4.40),

formal education (AOR= 2.39; 95% CI 1.40- 4.08) and better income was significantly associated with ITN utilizations (AOR= 1.83; 95%CI 1.05- 3.20 [31].

Another study conducted in Adama district, Oromia Region showed that those households who are literate (AOR = 2.05, 95% CI =1.53-7.09), governmental employees (AOR=2.52, 95% CI=1.1-6.53), roof made up of corrugated iron sheet (AOR=1.90, 95% CI=1.79- 4.6) were almost two times more likely to slept under LLIN during the previous night prior to interview[6]. A study conducted in Raya district, Tigray showed that, the number of net in the households [AOR (95% CI) = 0.085 (0.26-0.281)], household's marital status [AOR (95% CI) = 0.431 (0.186-0.997)] and occupation of the household head [AOR (95% CI) = 0.297 (0.113-0.781)] were the significant predicators for utilization of long lasting Insecticidal treated nets [32]. A study conducted in Southwest Ethiopia showed that Factors associated with use of at least one ITN by households were knowledge of malaria transmission by mosquito bite (Adjusted OR = 3.44, 95 % CI: 1.80–6.59). Sex and age of respondents, number of ITNs freely supplied presence of children under five / any children in the household, and age of ITNs were not associated with the use of ITNs by households.

2.3. Conceptual Framework



Key

Shows association but it will not assessed in this study

Shows association that will be assessed in this study

Figure 1: conceptual frame work for LLIN utilization and associated factors in Ziway dugda district, Ethiopia 2016(*source: reviewing different literatures.*

3. Objective

3.1. General Objective

To assess utilization of long lasting insecticide treated nets and associated factors among households in Ziway Dugda district, Ethiopia 2017.

3.2. Specific Objective

- To assess utilization status of long lasting insecticide treated nets among households in Ziway Dugda district
- To determine factors associated with household's LLIN utilization in Ziway Dugda district

4. Methods and Materials

4.1. Study area and period

The study was conducted in Ziway Dugda district, Arsi zone, Oromia region which is found in the Great Rift Valley from March 1-30/2017. The district has a total population of 159, 154 (projected population from 2007 national population census to 2016)[33]. From these 79643 are females (50.04%). The altitude of the district ranges from 1635 to 2000m above sea level. It is located in 7˚ 43'30.0" to 8˚ 15' 53.0"N latitude and 38˚56'34.0" to 39˚08'13.0" E longitude. The district climatic condition is 10% “woynadega” and 90% “kola”. The annual rainfall ranges from 600 - 700 ml and its temperature ranges from 19 - 32°c. The district shares some area of Lake Ziway in the Northwest. Malaria is endemic in the district throughout the year. About all kebeles of the district are malarious in which the total population is at risk of being infected by malaria. Ziway Dugda district has a total of 30 kebeles (the lowest administrative unit of the country); two urban and 28 rural and has six health centers and 30 health posts. All kebeles of the district have health posts.

4.2. Study Design

Cross sectional study design was used.

4.3. Population

4.3.1. Source Population

The source population was all LLIN owned households in Ziway Dugda District.

4.3.2. Study Population

LLIN owned households in randomly selected kebeles from the source population. Finally randomly selected households from the study population were included in the study.

4.3.3. Inclusion criteria

Households of residents who lived six months and above in the district

4.4. Sample Size Determination

Sample size was determined based on the single population proportion formula for cross-sectional study assuming 68.6% of the households used at least one LLIN in previous night from a study conducted in Raya district, North Ethiopia[32]. Assuming 5% margin of error, 95% confidence interval and 10% non -response rate, sample size was calculated.

The following formula was used to calculate the sample size

$$n = \frac{(Z\alpha/2)^2 P(1-P)}{D^2}$$

Where:

n = sample size

Zα/2= Standard score for 95% confidence level (1.96)

P= proportion of HHs using at least one LLIN (68.6%)

D= margin of error (5%)

n = 331

The sample size was calculated using 10% non-response rate (33) and design effect 2.

Finally, 364*2=728 households were taken as final sample size.

4.5. Sampling technique and Procedures

Lottery method was used to select 30 % of the kebeles in the district[29]. Based on this, nine kebeles were selected from the total of 30 kebeles of the district. Sampled households were proportionally allocated to the selected kebeles based on number of households in each kebele. Finally simple random sampling technique was used to select households from each kebeles. List of households with address was obtained from health post in the Kebele.

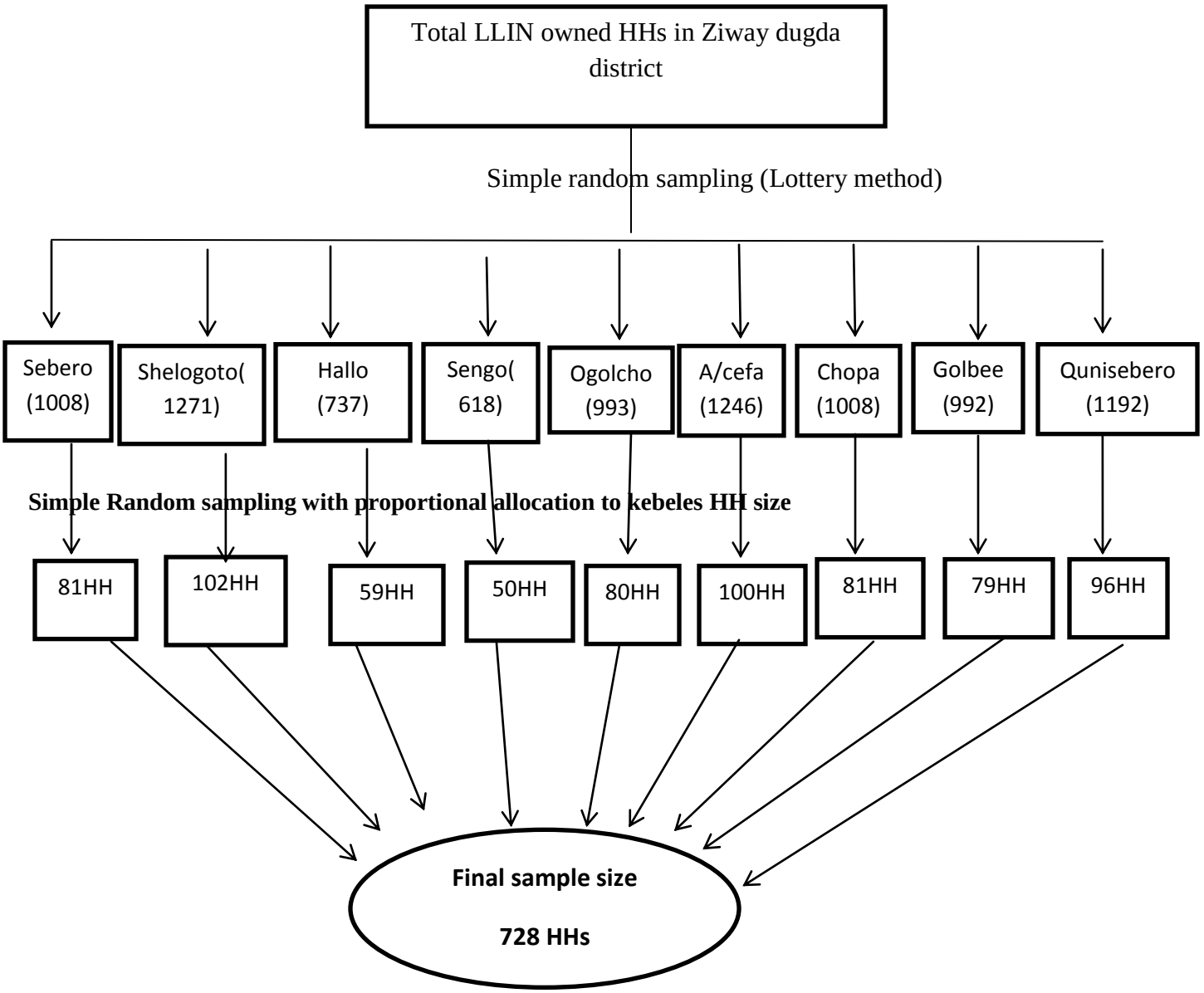


Figure 2: Schematic sampling technique of HHs in Ziway dugda district

4.6. Study Variables

4.6.1. Dependent Variables

- Household LLIN Utilization status

4.6.2. Independent Variables

- Socio-demographic variables: sex of HH head, education level of HH head, occupation of HH head, age of HH head, average monthly income of household, presence of under-five child and presence of pregnant mother in the household.
- Household level variables: family size of HH, number of sleeping room in the HH, number of LLIN in the HH.
- Knowledge: Respondent's knowledge on malaria transmission and prevention.

4.7. Data Collection

4.7.1. Data collection Instrument

A structured questionnaire adapted from malaria indicator survey (MIS) 2011 and observation checklist was used for data collection. The questionnaire was prepared originally in English and translated to Afan Oromo and back to English to check consistency.

4.7.2. Data collection technique

Data were collected by a combination of face-to-face interviews and observation tequinique by nine trained nurses during an early morning session. Household heads were primarily interviewed, if this was not possible spouse of household head was interviewed for data collection. LLIN utilization was cross-checked with the interview response of Households through direct observation. It was checked that HHs LLINs were really utilized/hanged up properly just above sleeping beds/areas or not and asked to demonstrate how they were using during sleeping. Three supervisors who are skilled in the malaria-prevention and -control program of the district health office were assigned to supervise the data-collection process and quality assurance.

4.8. Data Quality assurance

To ensure the quality of the questionnaire, data collectors and supervisors were trained for two days by the principal investigator, including the practice for one day to familiarize them with the data collection tool. The questioner was pretested on 5% of sampled HHs outside the study kebeles. After the pretest, some adjustments to some variables were made to make it more understandable by the respondents. Supervision was conducted by three supervisors and the principal investigator supervised the overall data collection process. Every day, collected data was cross-checked for completeness by supervisors and principal investigator.

4.9. Data Processing and Analysis

Epidata Version 7.1.3 was used to enter the data after checking the completeness the questionnaire manually. Then data was exported to SPSS version 20.0 statistical package for further analysis. Descriptive statistics was used to describe frequency and percentage of household's LLIN utilization status. Bivariate analyses were performed to nominate candidate variables for multivariable analysis with p value less than 0.20. Multiple logistic regression was used to identify associated factors with HH's LLIN utilization. Variables with p value less than 0.05 was used as significant.

4.10. Ethical consideration

Ethical clearance was obtained from Jimma University Research and Ethical Review Committee. Prior to data collection regional health bureau, local officials and the community were approached through formal letters written from Jimma University and Arsi Zone health department. All the participants were informed about the purpose and their right to participate or not to participate in the study. Those who gave their verbal consent only were interviewed. Moreover, all personal information of the participants was kept confidential.

4.11. Dissemination Plan

The final report will be presented to Jimma University Institute of health, Department of Epidemiology. Copies will be provided to Oromia Regional Health Bureau, Arsi Zone and health office of Ziway dugda district. It will be also tried to disseminate through publication of the findings, in peer-reviewed journals and presentations on scientific conferences.

4.12. Operational definition

Household ownership of LLINs: - Households was considered as LLIN owners if they had at least one LLIN at the time of the interview[17].

Long Lasting Insecticide Nets: - is a net treated with insecticide by the manufacturer and does not need to be retreated until after 20 washes or four years of use[17]. All mosquito nets in Ethiopia are LLINs [34].

LLIN utilization of households: -refers to HHs that owned LLIN and at least one LLIN is used (properly hanged up above sleeping area/bed) by any member of the household the night prior to the study [8, 23, 25, 26, 28, 35].

Knowledge of respondent's on malaria transmission and prevention: was assessed through six questions a six-point score each. One point was given to each correct answer, and 0 to each wrong answer. The mean knowledge score was used to dichotomize knowledge scores. Knowledge about malaria prevention was categorized into "good" (4–6) and "poor" (0–3)[36].

5. Result

5.1. Socio-demographic characteristics

A total of 684 households responded in this study with response rate of 94%. In terms of sex composition of the household heads majority 595(87%) were males with median age of 35 years. Concerning religion almost all were Muslim 657(96.5%) and 99.1% were Oromo in ethnicity.

Table 1 : socio demographic characteristics of respondents in Ziway Dugda district , Oromia Region, 2017.

Variables	frequency	Percent (%)
Sex of HH head		
Male	**595**	**87**
Female	**89**	**13**
Religion		
Muslim	**657**	**96.1**
Other	**27**	**3.9**
Ethnicity		
Oromo	**678**	**99.1**
Other	**6**	**0.9**

5.2. LLIN owner ship and utilization

Out of the 684 households 315(46.1%) had two LLINs and 255 (37.3%) had three and above LLNs. The average number of LLINs per household was 2.3. Among 684 households, 508 (74.3%) used at least one LLIN the night prior to the study. Of 3655 members of all households 1880 (51.4%) slept under LLINs the previous night and 49.4% of the LLINs were used.

Table 2: LLIN possession and utilization in Ziway Dugda district, Oromia region, Ethiopia, 2017.

Variable	frequency	percent
Distribution LLINs per HH		
one LLIN	114	16.7
two LLINs	315	46.0
three and more LLINs	255	37.3
Households that used at least one LLIN last night		
Yes	508	74.3
No	176	25.7
Number of people that slept under LLIN the previous night(n=3655)	1880	51.4
Total number of LLINs used(n=1602)	791	49.4

According to the respondent's perception, household members LLIN usage priority was 57% for children, 53.9% for pregnant mothers and 2.9% for head of the household.

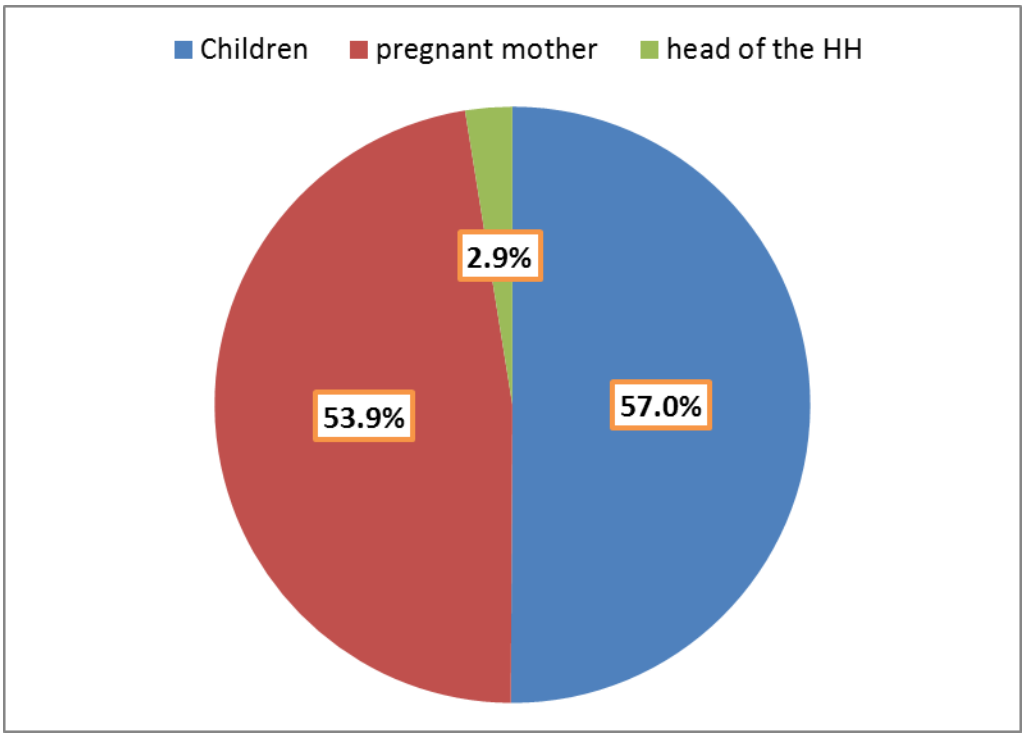


Figure 3: Household priority of LLIN use in Ziway Dugda district, Oromia region, 2017.

5.3. Factors affecting long lasting insecticide treated nets utilization of households

The findings revealed that, in the bivariate analysis age of household head, occupation of household head, presence of at least one pregnant mother, presence of at least one under five child in the household and average monthly income of household head were nominated with p-value ≤ 0.2 for further analysis to multivariable analysis.

Table 3: Associated factors related with respondents characteristics with HH's LLIN utilization in bivariate analysis in Ziway Dugda district, Ethiopia, 2017.

Variables	LLIN utilization		COR(95%CI)	P value
	Yes n (%)	No n (%)		
Sex HH head				
Male	445(74.8)	150(25.2)	1.22(0.75, 2.00)	0.421
Female	63(70.8)	26(29.2)	1	
Age of HH head				
18-24	34(63)	20(37)	0.69(0.38,1.28)	0.242
25-31	168(76.7)	51(23.3)	1.34(0.89,2.03)	0.163*
32-38	122(80.3)	30(19.7)	1.66(1.02,2.68)	0.040*
>=39	184(71)	75(29)	1	
Marital status of HH head				
Married	451(75.4)	147(24.6)	1.84(0.44, 7.80)	0.407
Single	16(72.7)	6(27.3)	1.60(0.29, 8.86)	0.590
Divorced	4(57.1)	3(42.9)	0.80(0.10, 6.35)	0.833
Widowed	32(65.3)	17(34.7)	1.13(0.24, 5.31)	0.878
Separated	5(62.5)	3(37.5)	1	
Occupation				
Farmer	385(74)	135(26)	1.38(0.71,2.68)	0.348
Trader	44(75.9)	14(24.1)	1.52(0.63,3.65)	0.351
Daily laborer	6(60)	4(40)	0.73(0.18,2.99)	0.655
House wife	44(84.6)	8(15.4)	2.66(0.99,7.13)	0.053*

Gove/NGO employed	14(32.6)	29(67.4)	1	
Education status of HH head				
Literate	242(73.8)	86(26.2)	1.05(0.75, 1.48)	0.779
illiterate	266(74.7)	90(25.3)	1	
Presence of at least one pregnant mother in the HH				
Yes	351(78.2)	98(21.8)	1.78(1.25,2.53)	0.126*
No	157(66.8)	78(33.2)	1	
Presence of at least one child in the HH				
Yes	351(78.2)	98(21.8)	1.78(1.25,2.53)	0.001*
No	157(66.8)	78(33.2)	1	
Average monthly income HH				
100-299	39(57.4)	29(42.6)	0.41(0.23,0.72)	0.002*
300-599	97(65.5)	51(34.5)	0.58(0.36,0.91)	0.018*
600-799	200(82)	44(18)	1.37(0.88,2.16)	0.166*
>=800	172(76.8)	52(23.2)	1	

*= p value ≤ 0.2

From household and knowledge related variables, respondent's knowledge on malaria transmission and prevention, family size of household, number of LLINs in the household and number of sleeping rooms in the household were with p- value ≤ 0.2 and nominated for multivariable analysis.

Table 4: Associated factors related with household and respondent's Knowledge with HH's LLIN utilization in bivariate analysis in Ziway Dugda district, Ethiopia, 2017.

Variables	LLIN utilization		COR (95%CI)	P-value
	Yes n (%)	No n (%)		
Knowledge on malaria transmission and prevention				
Good	435(77.0)	130(23.0)	2.11(1.39,3.20)*	0.000*
Poor	73(61.3)	46(38.7)	1	
No. of sleeping rooms				
One sleeping room	121(79.1)	32(20.9)	1.41(0.91,2.17)	0.123*
Two and more sleeping rooms	387(72.9)	144(27.1)	1	
Family size				
≤5	276(72.3)	106(27.7)	0.79(0.55,1.11)	0.175*
>5	232(76.8)	70(23.2)	1	
No. of LLINs in the HH				
1 LLIN	92(80.7)	22(19.3)	1.26(0.73,2.18)	0.411
2 LLIN	220(69.8)	95(30.2)	0.69(0.48,1.02)	0.061*
3 and above LLINs	196(76.9)	59(23.1)	1	

*=p value ≤ 0.2

Multivariable Analysis

In multivariable analysis occupation, average monthly income, presence of at least one under-five child and respondents knowledge on malaria transmission and prevention were significantly associated with household's LLIN use while adjusted for other factors.

Household whose heads were housewives were about three times (AOR=3.23, 95%CI=1.10-9.50) more likely to use LLIN compared to households whose heads were government/NGO employed. Households with at least one under five child were 1.5 times (AOR=1.49, 95%CI=1.01-2.22) more likely to use LLIN compared to households with no child. Households with respondents that had good Knowledge about malaria transmission and prevention were

more likely (AOR=1.64, 95%CI=1.02-2.62) to use than those who had poor knowledge. Households whose heads with average monthly income of 100-299 ETB were 58% (AOR=0.42, 95%CI=0.22-.78) less likely to use LLIN compared to households whose heads with average monthly income 800 and above ETB.

Table 5: Final logistic regression model for household's LLIN utilization in Ziway Dugda district, Oromia region, Ethiopia, 2017.

Variable category	**Utilization of LLINs**		**AOR(95%CI)**
	Yes n (%)	No n (%)	
Occupation			
Farmer	385(74)	135(26)	1.54(0.73,3.23)
Trader	44(75.9)	14(24.1)	1.56(0.61,3.98)
Daily laborer	6(60)	4(40)	1.39(0.30,6.51)
House wife	44(84.6)	8(15.4)	3.23(1.10,9.45)**
Gove/NGO employed	14(32.6)	29(67.4)	1
Average monthly income of HH			
100-299	39(57.4)	29(42.6)	0.5(0.26,0.98)**
300-599	97(65.5)	51(34.5)	0.56(0.34,0.93)**
600-799	200(82)	44(18)	1.28(0.79,2.08)
>=800	172(76.8)	52(23.2)	1
Presence of at least one under-five child			
Yes	351(78.2)	98(21.8)	1.49(1.01,2.22)**
No	157(66.8)	78(33.2)	1
Knowledge about malaria			
Good	435(77.0)	130(23.0)	1.64(1.02,2.62)**
Poor	73(61.3)	46(38.7)	1

**=p-value <0.05

6. Discussion

This study aimed to assess LLIN utilization among households with at least one LLIN in Ziway dugda district. The finding revealed that 74.3% of households utilized at least one LLIN in the previous night. In a study carried out in Oromia and Amhara after two years of free LLIN distribution campaign, 22.6% of the households in Oromia and 50.6 % of households in Amahara, at least one member of the household slept under LLIN in the previous night[28]. Similar studies conducted in Kersa, Eastern Ethiopia (33.5%) and Raya district, Tigray (68.6%) also reported lower utilization compared to this study finding [25, 32]. And findings from studies conducted in Southwest Ethiopia (95.1%) and Sierra Leone (95.7%) reported higher utilization than this study finding [23, 26]. In Ethiopia, the study carried out in Arbaminch zuria district revealed that LLINs utilization was 73% which was almost similar with this finding [20] . Similarly LLINs utilization was reported to be 73.3 % in a study conducted in Harari, Ethiopia [18]. The variations might be due to seasonal difference where research conducted and difference in policy preference between countries. This study was conducted in dry season where malaria transmission was low and LLIN utilization may be more likely lower. In addition to the response from study participant, availability of hanged LLIN above the bed or sleeping space was considered as a proxy indicator of LLIN use which may increase utilization figure.

This study revealed that there was significantly positive association between LLIN use and respondent's knowledge on malaria transmission and prevention and the finding is supported by a study done in Southwest Ethiopia and Bahir dar [26, 31]. This indicates that continuous health education about malaria transmission and prevention mechanisms to the community may increase LLIN utilization in the district.

Households with at least one under five years child were more likely to use LLINs. This is supported with a report from a study done in Kersa, Eastern Ethiopia [25]. This may be due to care preference to children than other members of the household. However, other studies in Ethiopia reported that presence of at least one under five year child was not significantly associated with net use [26, 28]. The difference might be due to cultural difference from other areas.

House wife household heads were more likely to use LLIN than employed heads in this finding. This is in contrary with a study in Adama district in which employed heads are more likely to use LLINs than housewife heads [6]. Other studies in Ethiopia also report different findings [9, 18, 30, 31]. This difference might be due to socio demographic difference of different study places. Average monthly income of household head was also significantly associated with LLIN use in this study which is similar with a study in Adama district [6]. This might be due to heads with increased income have a probability to have equipment to listen health information about net utilization. Family size was significant predictor of LLIN usage in some studies done in Ethiopia [30, 37]. But it was not significant in this study. Similarly it was not significant in studies done in Kersa district, Adama district and Bahir dar, Ethiopia [6, 25, 31]. The observation of households showed that several LLINs were used for other purposes than the intended use. Some households used it to cover household properties and some of them put it under the mattress.

6.1. Strength of the study

Presence and functionality of LLIN was verified through observation.

6.2. Weakness of the study

The study was conducted in March which is low malaria transmission season compared to the high transmission season (October-December). So LLIN utilization might be lower. The use of nets in the previous night in the households was based on respondents self-report even though they were asked to demonstrate. LLIN utilization status was assessed by asking only one night utilization.

7. Conclusion and Recommendation

7.1. conclusion

The findings of this study showed that LLIN utilization among households were low in Ziway dugda district as compared to WHO RBM target. The factors affecting LLIN utilization includes: being house wife in occupation, average monthly income of HH, presence of at least one child and knowledge on malaria prevention and control.

7.2. Recommendation

To achieve sustained malaria control in the district, distribution of nets alone is not enough. Public health intervention should also address problems related to LLIN utilization status. Based on the findings of this study, the following recommendations are forwarded. District health office and health extension workers should encourage and monitor households to utilize the available nets. They should also encourage all family members to sleep under LLINs every night since malaria is endemic in the district. NGOs should work on increasing community Knowledge about malaria transmission and prevention by giving emphasis to low income HHs and employed household heads to increase LLIN utilization. Finally this study recommends further study on LLIN utilization with another design to identify determinants between utilizers and non-utilizers.

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9. Annex

Annex I. Informed Consent Form (English version)

Information Sheet

I. Greeting: - Good morning/ afternoon

Hello, I am _____. I am from an institution called Jimma University, Institute of health sciences department of epidemiology. Then explain the purpose of the Study for the respondent by saying that the reason why I came here is to ask you some questions related to malaria and its prevention methods. The purpose of this interview is to have your opinion on the insecticide treated nets utilization in the house hold. This in turn will help to design the intervention to tackle the transmission of malaria. You are selected randomly to be participant of this study if you are willing to participate after you understand the information sheet.

II. Informed consent

To conduct our study, I am going to ask you some questions which take 30 to 40 minutes. I kindly request you to give me your answer. All the information that you are going to give me will remain confidential and you don‘t need to mention your name. Participation is based on your willingness. Are you willing to participate in the interview? Yes_____ (continue the interview). No_____ (Thank and stop)

Signature_____ Date_____

(Signature of the interviewer certifies that consent has been obtained verbally.)

Signature of the supervisor _____Date_____

Annex II: Questionnaire of long lasting net Utilization and its associated factors affecting their use in Ziway dugda district, Ethiopia

Section 1.Household Identification Information

No	Identification Response	Response
1.	Name of kebele	----------
2.	Name of Garee/GOT	----------
3.	Household number?	----------
4.	Questionnaire number?	----------
5.	Name of interviewe	----------
6.	Date of interview	(dd/mm/yyyy) /_____/_____/2009 EC

Section 2: Socio-demographic characteristics of the respondents

No.	Questions	Responses	Skip to
1	Sex of the respondent	1. male 2. female	
2	Relationship of the respondent to the head of household:	1. Head of household 2. Wife	
3	What is the sex of head of the household?	1. Male 2. female	
4	Age in years house hold head	_____	
5	Residence	1.rural 2.urban	
6	What is your religion	1.Muslim	

		2.Orthodox Christian 3.Protestant Christian 3 Other 4.(specify)_____	
7	What is your ethnic group	1.Oromo 2.Amhara 3.Gurage 4. other specify_____	
8	Marital status of the house hold head	1. Married 2. Never married (single) 3. Divorced 4. Widowed 5. Separated	
9	Occupation of House hold head	1. Housewife 2. Farmer 3. Daily laborer 4. Government/NGO employee 5. Trader 6. Other(specify)_____	
10	Educational status of head of the household	1. Can only read and write 2. Elementary school (1-4) 3. Junior secondary school (5-8) 4. Senior secondary school (9-12) 5. Above 12 grade 6. Other (specify)_____	
11	Educational status of spouse of HH	1. Can only read and	

	head	write 2. Elementary school (1-4) 3. Junior secondary school (5-8) 4. Senior secondary school (9-12) 5. Above 12 grade Other (specify)	
12	Is there a pregnant mother in the household?	1. Yes 2. No	
13	Is there under five children in the household?	1. Yes 2. No	
14	What is your average monthly income in the household?	_____	
15	How many rooms in this household are currently used for sleeping?	_____	
16	Family size	_____	
17	Are there one bed /sleeping area sharing habit in the house hold?	1. Yes 2. No →	No 20
18	If yes to Q 18 How many persons share a single bed?	_____	

Section 2: Knowledge related to malaria transmission and prevention

19	Can malaria be transmitted from one person to another?	1. Yes 2. No →	Q21
20	If yes, how is malaria transmitted or	1. Chewing	

	what causes malaria?	maize/sorghum Cane 2. Getting cold 3. Drinking dirty water 4. Living near collected water 5. Contact with person of malaria 6. Being bitten by mosquito 7. Other specify_____ 8. I don't know	
21	Where does a mosquitoes breed?	1. on the soil 2. in the running water 3. in the stagnant water 4. I don't know 5. others (specify)_____	
22	At what time do the mosquito bites people?	1. Early morning 2. Midday 3. Evening time 4. Midnight 5. I don't know 6. Other specify_____	
23	Is malaria preventable?	1. Yes 2. No →	Q25
24	If yes what are malaria prevention methods?	1. Uses of bed net (ITNs) 2. Take tablet 3. IRS(Spraying houses) 4. Closing windows and doors at night 5. Use of curtains	

		6. Cleaning surroundings 7. Drainage of collected water 8. ITNs and one or more of the above	

Section 3: Mosquito net(LLINs) knowledge, possession and utilization by households

25	What is the use of LLINs?	1. To kill mosquitoes 2. Repel(avoidance of biting) mosquitoes 3. Prevent malaria and kills fleas/bugs	
26	Do you have insecticide treated bed net in the household currently?	1. Yes 2. No	
27	If yes how many of them are now functional?	_____	
28	How did you obtain it?	1. I bought it from private or government 2. Freely supplied from NGO /Government 3. I didn't remember 4. one of them bought & one get free 5. other(specify_____	
29	How many of the nets are currently used by household members while sleeping	_____	
30	Did anyone from your household sleep under mosquito net last night	1. Yes 2. No	
31	If any one of the household members did not sleep under an ITN the	1. Sleeping under an ITN is not convenient	

	previous night, what is the main reason	2. ITN was not clean 3. ITN was not hanged 4. Forgotten to sleep under an ITN 5. No malaria during this time of the year 6. No mosquitoes during this time of the year 7. Other (specify) _____ 8. Don‘t know	
32	How many of the people who slept in this household in the previous night slept under a net, including you?	_____	
33	For whom do you give priority when there is shortage of LLIN	1.Children 2. pregnant mother 3. for head of HH 4 Other (specify)…….	

Annex III. Observational checklist for LLIN utilization

Now I would like to observe the ITNS and sleeping beds to see the condition of nets whether hanged correctly or not and verify what we have been talking so far.

1. Number of separate beds or places of sleep [_____]
2. The number of ITN observed in the household [_____]
3. The observed ITN is_____(For the recent owned one)

a. in package
b. hanged
c. Other specify_____

d. Number of beds /places of sleep observed with ITN hanged [_____]

That is the end of our interview. Thank you very much for taking time to answer our questions.

Data collector name and sig. _____ _____

Date _____

Annex IV. Consent Form of Afaan Oromo Version

Foormii Heeyyama (Afaan Oromo version)

Nagaa:-Akkam bultan/oltan?

Hello, Ani _____jeedhama. Ani kanaan dhufee Yuuniivarsiitii Jimmaa, Institiyuutii fayyaa irraati. Sanan booddee,faayidaa qooranoo kanaa nama deebii kenuuf akkana jeechuudhan ibsiif "Sabaabni mana keessan dhufneef dhukkuba busaa ilaalchisee gaaffiiwwaan tokko tokkoo isiin gaafachuudhaf. Faayidaan gaaffii kanaas itti fayyadama saaphana siree ilaalchiisee yaada keessan akka nuuf kennitaniifi. Kunis sagantaa fi karoora dhukkuba busaa ofirra dhowwuuf godhamu keessatti baay'ee nu gargaara" .

II. Heeyaama hubannoo irratti hunda'ee

"Qorannoo Keenya geggeessuudhaaf, ani gaaffii murtaa'en isin gaafadha. Deebii kessan akka anaaf kennitan kabajaa guddaadhaan isin gaafadha. Yaadnii fi deebiin isin anaaf kennitan hunduu icciitidhaan eegama. Maqaa keessan ibsuu hin baarbachiisu. Hirmaanan keessan fedhirratti kan hundaa'ee dha, Yeroo feetanitti dhaabuu ni dandeessu".

Gaafiif deebii kana keesatti hirmachuudhaf fedhaa qabduu?

Eyyeen_____(itti fufi). Miti_____ (Galatoomaa, dhaabi)

Mallatoo (nama ragaa walitti qabu)_____Guyyaa_____

(Mallattoon nama ragaa walitti qabu, qooqan heeyyama argachuu agarsiisa.)

Mallatoo to'aataa _____ Guyyaa_____

Kutaa 1: Oddeeffannoo Eenyummaa Maneennii

TL	Gaaffii Eenyummaa	Deebii
1	Maqaa Gandaa	----------
2	Maqaa Garee/ Gooxii	----------
3	Lakkoofsa Manaa	----------
4	Lakkoofsa Waraqa Gaaffii	----------
5	Maqaa nama Gaaffii gaafatuu	----------
6	Guyyaa Gaaffiin itti Gaafatammee	(dd/mm/yyyy) /_____/_____/2009 ALI

Kutaa 2: Haala hawaasumma fi ummaata namoota gaaffii deebisani

TL	Gaaffii	Deebii	Darbi
1	Saala	dhiira 1 dhalaa 2	
2	Walitti dhuufeenyi kee fi nama bulchaa/ Ittigaafatamaa mana kana maalii?	bulchaa / Ittigaafatamaa manaatti 1 Haadha warra 2	
3	Saali nama bulchaa/ itti gaafatamaa manaa kana maali?	dhiira 1 dhala 2	
4	Umriin kee waggaadhan meeqa?	Waggaa [_____]	
5	Bakki jireenyaa kee eessa?	1. Magaalaa 2. Baadiyyaa	
6	Amaantiin kee maali?	Islaama 1 Kiristaana Ortodooksii 2 Kiristaana	

		Pirootestaantii 3 Kan biroo (caqasii) _____ 88	
7	Lammummaan kee maali?	Oromoo 1 Amaara 2 Guraagee 3 Kan biroo (caqasii) _____ 88	
8	Haali Gaa'elakee kan ammaa maal fakkatta?	Kan heerumte/fuudhe 1 Takaa kan hin heerumne/fuune (single) 2 Kan hiikte/hiikee 3 kan haatti mana/abbaan manaa jalaa dute / du'e 4 kan adda jiratan 5	
9	Hojiin nama bulchaa/ itti gaafatamaa manaa kanaa maali?	7. Haadha manaa 8. Qonnaan bulaa 9. Hojii humnaa (guyyaa) 10. Hojjataa mootummaa/miti-mootummaa 11. Daldalaa 12. Kan biroo (caqasi)_____	
10	Sadarkaan barumsaa nama bulchaa/ itti gaafatamaa manaa kanaa maali?	7. Dubbisuu fi barreessuu qofa 8. Sadarkaa tokkoffaa marsaa duraa (1-4) 9. Sadarkaa tokkoffaa marsaa lammaffaa (5-8) 10. Sadarkaa lammaffaa (9-12) 11. Kutaa 12 oli 12. Kan biroo (ibsi)_____	
11	Sadarkaan barumsaa abbaa manaa/haadha manaa (spouse of head of HH) bulchaa/ itti	1. Dubbisuu fi barreessuu qofa 2. Sadarkaa tokkoffaa marsaa duraa (1-4)	

	gaafatamaa manaa kanaa maali?	3. Sadarkaa tokkoffaa marsaa lammaffaa (5-8) 4. Sadarkaa lammaffaa (9-12) 5. Kutaa 12 oli 6. Kan biroo (ibsi)_____	
12	Mana kana keessa dubartiin ulfaa ni jirtii?	3. Eyyee 4. Lakki	
13	Mana kana keessa daa'imman waggaa 5 gadii ni jirtii?	3. Eyyee 4. Lakki	
14	Giddugaleessaan galiin ji'atti argattan meeqa?	_____	
15	Mana keessan keessa kutaa meeqatuu cisichaaf tajaajilaa jira?	_____	
16	Baay'inni miseensa maatii keessani meeqa?	_____	
17	Mana kaeessan keessa barsiifatni siree/bakka ciisichaa/ tokko irra waliin ciisuun ni jiraa?	3. Eyyee 4. Lakki →	No 19
18	Gaaffii lakk.18 yoo **'Eyyee'** ta'e, namoota meeqatu siree tokko irra ciisa?	_____	

Kutaa 3: Beekumsa waa'ee dhukkuba busaa fi maloota ittisa isaa

19	Dhukkubni busaa nama tokko irraa gara nama birootti darbuu 9taruu0 ni dandeessii?	3. Eyyee 4. Lakki →	Q21
20	Yoo 'Eyye' ta'e, busaan akkamitti nama daddarba/maaltu fidaa?	1.Shonkooraa/ boqqoolloo nyaachuun 2.Qilleensa qorraaf saaxilamuu 3.Bishaan booruu dhuguun	

		4.Bakka bishaan ciisaa cinaa jiraachuu 5.Nama busaan qabde waliin wal tuquu 6.Yoo bookeen busaa nama hiddiite 7.Kan biroo (ibsi)_____ 8.Ani hin beeku	
21	Bookeen busaa eessatti wal hortii?	1.Biyyee irratti 2.Bishaan yaa'u irratti 3.Bishaan ciisu irratti 4.Ani hin beeku 5.Kan biroo (ibsi)_____	
22	Bookeen busaan yeroo kam nama hidditii?	7. Guyyaa 8. Halkan yeroo ala turan 9. Halkan yeroo ciisan 10. Ganama obboroo jala 11. Ani hin beeku 12. Kan biroo (ibsi)_____	
23	Dhubbuba busaa ittisuun ni danda'amaa?	3. Eyyee 4. Lakki ⟶	Q27
24	Yoo "Eyyee" ta'e, malootni dhukkuba busaa ittiin ittifnu maal fa'i?	9. Saaphana siree (ITN) fayyadamuu 10. Kiniinii fudhachuu 11. Mana jireenyaa biifsisuu (IRS) 12. Halkan halkan foddaa fi balbala cufuu 13. Golgaa fayyadamuu (use of curtains) 14. Qulqullina naannoo eeguu 15. Bishaan ciisaa dhangalaasuu 16. Saaphana siree fi kanneen armaan olii keessaa tokko	
Kutaa 3: Itti fayyadama, qabeenyaa fi beekumsaa saaphana siree			
25	Faayidaan saaphana siree maali?	4. Bookee busaa ajjeesuu	

		5. Bookeen busaan akka nama hin hiddine ittisa 6. Dhukkuba busaa ittisuu fi tafjii/geergoo dhabamsiisuu	
26	Saaphana siree mana keessan keessaa qabduu?	3. Eyyee 4. Lakki	
27	Yoo '**Eyyee'** ta'e, meeqan isaatu tajaajila kennaa jira?	_____	
28	Saaphana siree akkamitti argattan?	6. Nama dhuunfaa/mootummaa irraan bite 7. Bilisaan/tolaan mootummaan/ miti-mootummaan arganne 8. Ani hin yaadadhu 9. Tokko nan bite; tokko tolan fudhadhe 10. Kan biroo (ibsi)_____	
29	Mana keessa amma kana saaphanni siree yeroo hirribaaf tajaajilu meeqatu jira?	_____	
30	Halkan darbee mana keessaa namni saaphana siree jala rafe jiraa?	3. Eyyee 4. Lakki	
31	Yoo namni tokko illee miseensa maatii keessaa halkan darbee saaphana siree (ITNs) jala hin rafnee ta'ee, sabaabni isaa maalii?	9. Saaphana (ITNs) jala rafuun mijata miti 10. Saaphanni qulqulluu miti 11. Saaphanni hin rarrafaamnee 12. Saaphana jala rafuun ni irraanfatamee 13. Waggaa kessa Yeroo kana dhukkubni busaa hin jirtu 14. Waggaa kessa Yeroo kana bokeen busaa hin jirtu	

		15. Kan biroo (caqasii)_____ 16. Hin beeku	
32	Namoota halkan darbe mana kana bulan keessaa, sii dabalatee nama meeqatuu saaphana jala rafee?	_____	
33	Yeroo hanqiinnii saaphannaa siree siqinnamuu enyudhaaf dursa keennitaa?	1. Daa'imman 2. Dubartoota ulfaa 3. Abbaa warraadhaaf 4. Kan biroo(yaa'ibsamuu)__	

Annex III. Cheeckliistii itti fayyadama saaphana siree ilaaluun guutamu

Haala saaphana siree fi itti fayyadama keessanii sirrii tahuu fi dhiisuu isaa akkuma wwaliin haasawaa turre amma immoo mirkaneessuuf, saaphana siree fi siree ciisichaa keessan keessan ilaaluun barbaada.

1. Baay'ina siree (iddoo) ciisichaaf adda ba'e [____]

2. Baay'ina saaphana siree mana keessatti argame [_____]

3. saaphana siree mana keessatti argame _____ [saaphana siree isa dhiyeenya fudhatme]

A . paakii ta'ee /aguugamee jira [in package]

B . rarraafamee jira

C . Kan biroo (ibsi)_____

D . Baay'ina siree (iddoo) ciisichaa saaphana siree rarraafame waliin adda ba'e [_____]

Kun xumuraa gaaffii keenyatti. Yeroo kessan fuudhataanii gaaffii keenya waan nu deebiftaniif galatoomaa.

Nama data fuunannee. _____ _____ Mallattoo _____

Guyyaa _____