



ARSI UNIVERSITY

COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF PUBLIC HEALTH

Utilization Of Long-Lasting Insecticidal Nets And Associated Factors Among Mothers Who Have Under-Five Children In Dodota District, Southeast Ethiopia

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Acronyms and Abbreviations

AOR	Adjusted Odd Ratio
CI	Confidence Interval
COR	Crude Odd Ratio
FGD	Focus Group Discussion
HH	Households
IQR	Inter Quartile Range
ITN	Insect Treated Nets
KII	Key Informant Interviews
LLIN	Long-Lasting Insecticidal Nets
NGO	Non-Government Organization
ODK	Open Data Kit
SPSS	Statically Package of Social Science
SSA	Sub-Saharan Africa
VIF	Variance Inflation Factor
WHO	World Health Organization

Table of Contents

Acknowledgements.....	I
Acronyms and Abbreviations	II
Lists of Tables.....	IV
Lists of Figures	V
Abstract.....	VI
1. Introduction.....	1
2. Literature Review.....	5
3. Objectives.....	10
4. Methods and Materials	11
4.1 Study Area.....	11
4.2 Study design and period	11
4.3 Population.....	11
4.4. Sample size determination and sampling procedures	12
4.5 Variables of the study.....	15
4.6 Operational definitions.....	15
4.7 Data collection tools and procedures	16
4.8. Data quality assurance.....	17
4.9. Data Processing and analysis	17
4.10. Ethical considerations	18
4.11 Dissemination of results	18
5. Results.....	19
6. Discussions	31
7. Strengths and limitations.....	34
8. Conclusions and recommendations.....	35
9. References.....	36
10. Annexes.....	41

Lists of Tables

Table 1: Sample size calculation for factors associated with utilization of LLIN among under five children by stat calc epi info.	13
Table 2: Socio demographic characteristics of the mothers with children under five years in Dodota district, Southeast Ethiopia, 2025.....	20
Table 3: Household level and health service-related characteristics of study participants in Dodota district, Southeast Ethiopia, 2025.....	21
Table 4: Knowledge of respondents on use of LLIN in Dodota district, Southeast Ethiopia, 2025.	23
Table 5: Bivariable and multivariable analysis of factors associated with utilization of LLIN among mothers with children under five years in Dodota district, Southeast Ethiopia, 2025.	26

Lists of Figures

Figure 1: Figure 1: Conceptual framework indicating factors utilization of LLINs among under five children in Dodota district,2025(16,17,19).....	9
Figure 2: Schematic presentation of the Sampling procedure for utilization of LLINs and associated factors among under five children in Dodota District, 2025	14
Figure 3: Utilization of LLIN among mothers with children under five years in Dodota district, Southeast Ethiopia, 2025.	24
Figure 4: Reason for not utilization of LLIN among mothers with children under five years in Dodota district, Southeast Ethiopia, 2025.....	24

Abstract

Introduction: Long-Lasting Insecticidal Nets (LLINs) are crucial for malaria prevention, particularly for children under five, who face the highest mortality rates in sub-Saharan Africa, including Ethiopia. However, there is insufficient information on maternal health service-related factors influence LLIN utilization among mothers with children under five years in Ethiopia.

Objectives: To assess utilization of long-lasting insecticidal nets and associated factors among mothers who have under-five children in Dodota district, Southeast Ethiopia, 2025.

Methods: A community-based cross-sectional study was conducted from October 1 to 30, 2025, among 605 randomly selected mothers of children under five in Dodota District, and was supplemented with qualitative data for in-depth investigation. A multistage sampling technique was employed to recruit the study participants. Data were collected through face-to-face interviews by using kobo toolbox and exported to SPSS software version 27 for analysis. Descriptive statistics and binary logistic regression were computed. Variables with P-value less than 0.25 in bivariate analysis were entered into a multivariate analysis. An adjusted odds ratio with a 95% confidence interval was used to measure the strength of the association and statistical significance was declared with a p-value less than 0.05. After translation and transcription, manual thematic analysis was applied to the qualitative data.

Results: Utilization of LLIN among mothers of children under five years was 58.7% (95% CI: 54.7–62.6). Maternal age ≥ 45 years (AOR = 2.91, 95% CI: 1.09–7.69), having a family size of four or fewer members (AOR = 2.54, 95% CI: 1.67–3.85), good knowledge of LLIN use (AOR = 1.83, 95% CI: 1.24–2.72), and receiving counseling on LLIN use during antenatal care (AOR = 2.37, 95% CI: 1.49–3.75) were significantly associated with LLIN utilization. Moreover, misbeliefs, misconceptions, use the LLIN for other purposes and insufficient accessibility were the most commonly identified barriers by the qualitative data.

Conclusion and recommendation: Utilization of LLINs among mothers of children under five years was below the national target. Maternal age, family size, knowledge of ITNs, and receipt of counseling on LLIN use during antenatal care were significant factors associated with LLIN utilization. Strengthening awareness creation sessions by health care providers on LLIN utilization for under-five children is recommended.

Keywords: Utilization, Long-last insect nets, associated factor, under five children, Ethiopia

1. Introduction

1.1 Background

Long-Lasting Insecticidal Nets (LLINs) are certified mosquito nets offer long-term protection against diseases spread by mosquitoes, including malaria. These nets are made with insecticides, usually pyrethroids like deltamethrin or permethrin, that are either coated on their surfaces or integrated directly into their fibers. This ensures that the insecticide works for three to five years without needing to be retreated (1). In contrast to insecticide-treated nets (ITNs), which require re-dipping on a regular basis, LLINs provide long-lasting effectiveness through daily use and numerous washings. In order to reduce individual exposure their dual mechanism of action combines a chemical kill effect with a physical barrier against bites (2,3).

LLINs have significantly reduced malaria morbidity and mortality, particularly in endemic areas, and are a key component of malaria prevention, as recommended by the World Health Organization (WHO). They are frequently given out or subsidized to guarantee fair access because of their affordability and robustness, which make them perfect for widespread distribution in environments with limited resources (4). Vulnerable groups, such as pregnant women and young children, benefit disproportionately, as they face higher risks of severe malaria (5).

Using insecticide-treated nets, indoor residual spraying, and case management are cost-effective malaria interventions that have significantly reduced the prevalence of malaria in sub-Saharan Africa, including Ethiopia (6). One of the most important strategies for malaria infection prevention in underdeveloped countries is the distribution and utilization of Insecticide-treated bed nets (ITNs) (7).

By 2022, a total of 254 million ITNs were distributed in all malaria endemic countries with about 235 million (93%) distributed in sub-Saharan Africa (SSA). Half of the ITNs distributed to SSA were received by six countries which include the Democratic Republic of the Congo (33.6 million), Nigeria (28.4 million), Ethiopia (21.4 million), Sudan (18.9 million), Uganda (13.8 million) and Mali (12.5 million) (8).

1.2 Statement of the problem

Malaria remains a significant global health challenge, with nearly half of the world's population at risk of infection. Among the vulnerable populations, children under the age of five are the most susceptible to severe malaria and its associated morbidity and mortality due to their underdeveloped immune systems(9).

In 2023, globally, there were an estimated 597,000 malaria deaths, with approximately 95% occurring in the WHO African Region. Children under five accounted for about 76% of all malaria deaths in the African Region which is roughly 453,000 under-five deaths in Africa due to malaria in 2023(10). In Ethiopia, between January and October 2024, over 7.3 million malaria cases and 1,157 deaths were reported, it's acknowledged that malaria contributes significantly to child mortality, with up to 20% of deaths among children under 5 in malaria-endemic areas being attributed to the disease(11).

Globally, the proportion of LLIN utilization ranges from 19.5% to 51% (12,13). A study conducted in East Africa revealed that the proportion of ITN use among households having under-five children was 46.32%, which ranging from 11.8% in Zimbabwe to 70.03% in Rwanda (14). According to studies reported in different parts of Ethiopia, LLIN utilization among under-five children ranged from 37.2% in Gamo Gofa Zone to 69.3% in Kellem Wollega Zone(15,16).

Different literatures identify the factors that influence the utilization of LLIN among under five children. Those are maternal age, maternal occupation, maternal educational status, family size and place of residence were significantly associated with utilization of LLINs among under five children(15–19).

The improper use of Long-Lasting Insecticidal Nets (LLINs) among children under five has devastating, multifaceted consequences. The absence of LLIN protection puts this susceptible population at greater risk of contracting malaria, which is a major cause of death for children under five in endemic areas (20). Young children are particularly vulnerable to severe malaria, including cerebral malaria, due to their developing immune systems. Cerebral malaria can cause death or lead to permanent neurological problems, including motor and cognitive difficulties(21). Repeated malaria infections worsen anemia, reducing physical endurance, decreasing growth,

and affecting brain development, which reduces a person's ability to succeed in school and subsequent productivity(22).

Ethiopia's national malaria prevention policy, particularly its LLIN distribution strategy, aims to achieve near-zero malaria deaths, significantly reduce malaria cases, and ultimately eliminate malaria nationwide. This is done by ensuring widespread LLIN ownership and use among populations at risk, aiming for 100% household ownership in malarias areas and 80% usage among those at risk (23).

Even though various factors were studied(15–19) have focused on LLIN ownership and general use, the role of maternal and child health service utilization in LLIN use for under-five children remains poorly understood. This study addresses this gap by examining how such maternal services influence LLIN utilization. Thus, this study was aimed at assessing utilization of LLIN and its associated factors among under five children in Dodota district, Southeast Ethiopia.

1.3. Significance of the Study

This study aims to identify gaps in LLIN utilization and the factors that hinder the community from using LLINs properly to prevent malaria.

The result of this study helps program managers and health care planners to create targeted, empirically supported programs on prevention of malaria infection and reduction of corresponding indirect maternal and children's mortalities and/ or morbidities. The results of this study help local and national policy-makers understand how LLINs was implemented in the research setting. The result of this finding will provide necessary information for woreda health office and health care providers for addressing issue related with LLINs utilization.

It is also intended that the study would offer baseline data for future research into the study's field.

2. Literature Review

Long-lasting insecticidal nets (LLINs), which are specially designed bed nets treated with insecticides that remain effective for 3–5 years even after repeated washing and serve as a core malaria intervention to protect vulnerable groups particularly children under five, create a physical and chemical barrier against anopheles' mosquitoes to reduce human-mosquito contact and interrupt malaria transmission(24).

2.1. LLIN utilization among under five children

A study conducted in Nigeria showed that 66.7% of under-five children slept under LLIN the night before the conduct of the survey (25). A study conducted in Nigeria revealed that 27.9% mothers of under-five children were utilized ITN (26). A study conducted among children aged less than five years in a tertiary health facility in south-west Nigeria showed that 39.3% were regular user of LLIN (27). A study conducted among mothers of under-five children in rural communities of Nigeria's Federal Capital Territory showed that 47.9% utilized the nets(28).

A study conducted in Ghana among caregivers of children under five years showed that 41.7% of study participants utilized ITN (29). A study conducted in Mozambique indicated that only 16.7% of mothers with children under 5 received utilized ITN (30). A study conducted among caregivers of children under five in Butiama district, Tanzania showed that 50.8% utilized ITN (31).

A systematic review and meta-analysis study conducted in Ethiopia showed that the pooled prevalence of ITN utilization among under-five children in Ethiopia was 53% (32). A study conducted in Pawie District, Benshangul Gumuz, Northwest Ethiopia found that 69.2% had utilized insecticide-treated bed nets (33). A study conducted in Fogera district, Northwest Ethiopia showed that utilization insecticide treated bed net utilization among under-five children and pregnant women was 63.3% (34). A study conducted in East Belessa District, Northwest Ethiopia showed that the prevalence of ITN utilization was 56.5% (35).

A study conducted in East Meseke District, Gurage Zone, Southern Ethiopia found that 58.2% of household participants used ITN for children under 5 years of age (36). A study conducted in

Mirab Abaya District, Gamo Gofa Zone found that 37.2% of the child had ITNs utilization during the previous night prior to the survey (37).

A study conducted in Hawwa Gelan Woreda, Kellem Wollega Zone revealed that 69.3% of children utilized ITNs (38). A community-based cross-sectional study conducted in Adami Tullu District of East Shewa Zone showed that 63.9% of under-five children slept under net the night preceding the survey among net owning households (39).

2.2 Factors associated with utilization of LLIN

2.2.1. Socio-Demographic Factors

A study conducted among caregivers of children under five in Butiama district, Tanzania showed that female participants was associated with ITN utilization (31). A community-based cross-sectional study conducted in Adami Tullu District of East Shewa Zone showed that bed net utilization among under-five children was affected by being male sex of the child (39).

A study conducted in East Africa (40), Gurage Zone, Southern Ethiopia (36), Fogera district, Northwest Ethiopia (34) and Gamo Gofa Zone(37) found that households with family size ≤ 5 members, was found to be significantly associated with under-5 years old children ITNs utilization. A study conducted in East Africa revealed that being married, widowed, and divorced, were associated with higher odds of ITN use (40).

A study conducted in Ghana and East Africa among caregivers of children under five years showed that being age between 25-35years was significantly associated ITN utilization (29,40). Another, study conducted among mothers of under-five children in rural communities of Nigeria's Federal Capital Territory showed that being aged 30 years and above were factors associated with utilized the nets (41). A study conducted in Mirab Abaya District, Gamo Gofa Zone found that age of mothers or caretakers 31–44 years, and ≥ 45 years of age was found to be significantly associated with under-5 years old children ITNs utilization(37) .

A study conducted in Nigeria showed that place of residence, was significantly associated with ITN utilized (25). A study conducted in Fogera district, Northwest Ethiopia showed that

being urban resident was found to be significant predictors of bed net utilization (34). A study conducted in Hawwa Gelan Woreda, Kellem Wollega Zone revealed that being urban resident was significantly associated with ITN use (38). However, a study conducted in East

Belessa District, Northwest Ethiopia showed that rural residence was significantly associated with ITN utilized (35).

A study conducted among mothers of under-five children in rural communities of Nigeria's Federal Capital Territory showed that having attained tertiary education was factors associated with utilized the nets (41). A study conducted in Uganda showed that mothers had primary education, secondary and higher education was significant associations ITN usage (42). A study conducted in East Africa revealed that primary and post-primary education was associated with higher odds of ITN use (40). A study conducted among caregivers of children under five in Butiama district, Tanzania showed that those with primary education was associated with ITN utilization (31). A study conducted in Hawwa Gelan Woreda, Kellem Wollega Zone revealed that literate parents was significantly associated with ITN use (38) .

A study conducted among mothers of under-five children in rural communities of Nigeria's Federal Capital Territory and Butiama district, Tanzania showed that being self-employed was factors associated with utilized the nets(28,43).

2.2.2. Knowledge on malaria and LLIN related Factors

A study conducted among caregivers of children under five in Butiama district, Tanzania showed that having knowledge on ITN use timing was associated with ITN utilization(43). A study conducted in East Mesekan District, Gurage Zone, Southern Ethiopia found that having knowledge of ITN importance increased ITN utilization significantly (17). A study conducted in Fogera district, Northwest Ethiopia showed that having good knowledge of bed net use was found to be significant predictor of bed net utilization(19).

2.2.3. Household Levels Factors

A study conducted in Nigeria showed that number of sleeping rooms significantly associated with ITN utilized(44). A study conducted in Fogera district, Northwest Ethiopia showed that households having <3 sleeping spaces was found to be significant predictors of bed net

utilization(19). A study conducted in Mirab Abaya District, Gamo Gofa Zone found that households with sleeping space ≥ 2 was found to be significantly associated with under-5 years old children ITNs utilization(45). A study conducted in East Belessa District, Northwest Ethiopia showed that ≥ 2 number of rooms in the house significantly associated with ITN utilized(46). A study conducted in Hawwa Gelan Woreda, Kellem Wollega Zone revealed that shared bedrooms was significantly associated with ITN use (16).

2.2.4. Availability Related Factors

A study conducted in Nigeria showed that number of mosquito bed nets was significantly associated with ITN utilized(44). study conducted in Fogera district, Northwest Ethiopia showed that nets available per house hold (≥ 2 nets was found to be significant predictor of bed net utilization(19). A study conducted in East Mesekan District, Gurage Zone, Southern Ethiopia found that having 1 ITN or 2 ITNs increased ITN utilization significantly (17).

2.3 Conceptual Frame Work

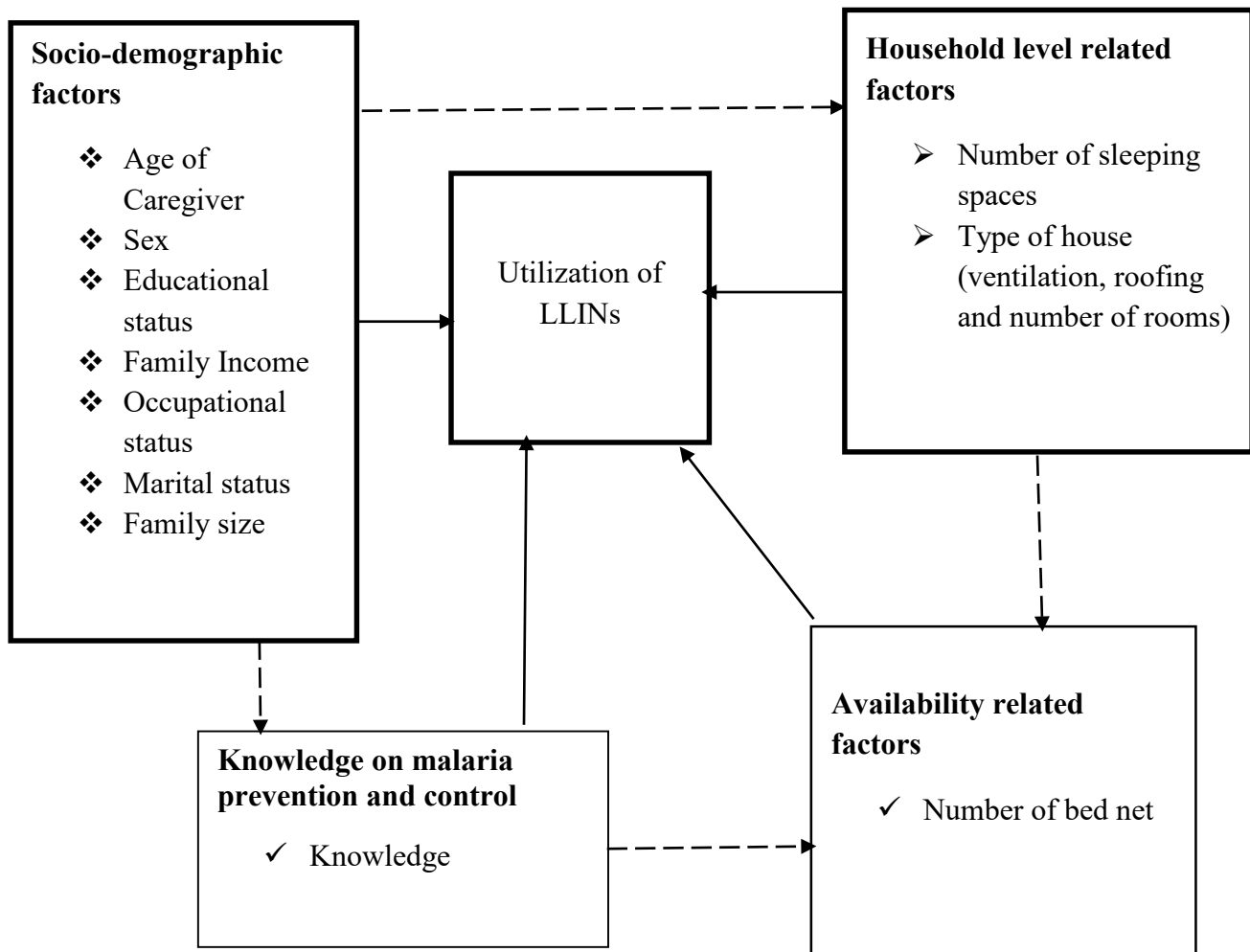


Figure 1: Figure 1: Conceptual framework indicating factors utilization of LLINs among under five children in Dodota district,2025(16,17,19).

3. Objectives

3.1 General Objective

To assess utilization of long-lasting insecticidal nets and associated factors among mothers who have under-five children in Dodota district, Southeast Ethiopia, 2025.

3.2 Specific Objectives

- To assess the level of LLIN utilization among mothers who have under-five children in Dodota district, Southeast Ethiopia.
- To identify associated factors with utilization of long-lasting insecticidal nets among mothers who have under-five children in Dodota district, Southeast Ethiopia.
- To explore reasons why the mothers who have under-five children do not utilize of long-lasting insecticidal nets.

4. Methods and Materials

4.1 Study Area

This study was conducted in Dodota district, which is located in Arsi Zone, Southeast Ethiopia, about 52 km distance to Asella zonal town and 125 km from Addis Ababa, the Capital city of Ethiopia. The district lies at an altitude between 1,400 and 2500 m above sea level. The average annual rainfall ranges from 700 to 1,300 mm. Malaria transmission in the district is seasonal and epidemic type, peaking from September to December. The district has 12 kebeles (10 rural and 2 urban) with 3 health centers and 12 health posts. The total population of the district in 2025 is 75,348, of which about 12,380 were estimated to be under-5 years old children (47). Malaria is endemic in the district throughout the year.

4.2 Study design and period

Community-based, mixed-methods, cross-sectional study was conducted from October 1-30, 2025, Dodota district, Southeast Ethiopia. This study was integrated quantitative and qualitative approaches to gain more insight and more comprehensive understanding of the utilization of Long-Lasting Insecticidal Nets (LLINs) among mothers with under-five children.

4.3 Population

4.3.1. Source Population

Mothers having under 5 years old children in the district were the source population for quantitative data.

For qualitative data resident in kebele, health extension workers, health centers malaria focal, woreda malaria focal and zonal malaria focal person were source population.

4.3.2 Study population

Mothers having under 5 years old children in the selected kebeles of the district were the study population for quantitative data.

For qualitative data selected participants from community, health extensions workers, health centers malaria focal, woreda malaria focal and zonal malaria focal person were study population.

4.3.3. Inclusion and exclusion criteria

Inclusion criteria: Mothers or caretakers of the index child who lived in the district for more than six months were included in the study.

Exclusion criteria: Respondents who were severely or critically ill and unable to communicate during the data collection periods were excluded from the sample.

4.4. Sample size determination and sampling procedures

4.4.1 Sample Size Determination

Sample size was calculated using single population proportion formula or by using Epi info version 7.2.5. Accordingly, the sample size was calculated by consideration of the following assumptions.

P: Proportion of utilization of Insecticide-Treated Nets in Households for under-5 Children in East Mesekan District, Gurage Zone, Southern Ethiopia, 2023 was 58.2%(17).

d =the margin error was 5%.

$Z_{\alpha/2}$ = critical value at 95% confidence level was 1.96

n: sample size

$$n = \frac{\left(Z_{\frac{\alpha}{2}}\right)^2 P(1 - P)}{d^2}$$

$$n = \frac{(1.96)^2 0.582(1 - 0.582)}{0.05^2}$$

$$n = 374$$

By adding 10% for the non-response rate and using design effect 1.5, the sample size was 617.

For the second objective: The sample size was calculated by using EPI Info version 7.2.5 software by considering power=80%, 95% CI, ratio=1, % of outcome in unexposed group and outcome in exposed group (%).

Table 1: Sample size calculation for factors associated with utilization of LLIN among under five children by stat calc epi info.

S/N	Variables	Proportion of utilization of LLIN		OR	Sample size	Reference
		Non-exposed (P1)	Exposed (P2)			
1	Having two ITN in the home	46.74	67.49	2.36	196	(17)
2	Medium knowledge on ITN	27.56	45.45	2.19	248	
3	Shared bedrooms	11.01	23.03	2.41	338	(16)

By comparing the sample size of both objectives, the largest sample size was 374 taken from the first objective. By considering design effect 1.5 and 10% of non-response rate the final sample size was 617.

Sample size for qualitative

A total of 26 study participants were divided into three focus group discussions (FGDs) to ensure diverse representation of experiences and perspectives. Additionally, seven in-depth interviews were conducted with health professionals as part of the key informant interviews.

4.4.2 Sampling procedure

For quantitative study, multi-stage sampling technique was used to select the study participants. The study was conducted in four kebele's of Dodota district which is 30% of the total kebeles. In the first stage, kebeles were stratified into urban and rural to select the representative samples. From 12 kebele's found in the district, four (three rural and one urban) kebele's were selected using simple random sampling method. Every kebele in district was further classified into 3 gores(the small administrative structures) from which one was selected randomly. A total of 1751 mothers with under five children were identified in the selected kebeles from the folder of the community health extension workers registration book. Then, the sample was allocated proportionally based on the number of mothers with under five children in each selected kebele. The mothers with under five children in each gores were selected with a systematic random sampling technique. The sampling interval was determined by dividing the

total number of mothers with under five children in selected kebeles into the final sample size which was gave a sampling interval of three ($k=3$). The first caregiver was selected using the lottery method at each kebele. When more than one eligible respondent was found in the selected household, only one respondent was recruited by lottery method. In case the eligible was not be presented in the recruit household, three revisits were conducted and if the participants were not found, data collectors were considered as non-respondents (figure 2).

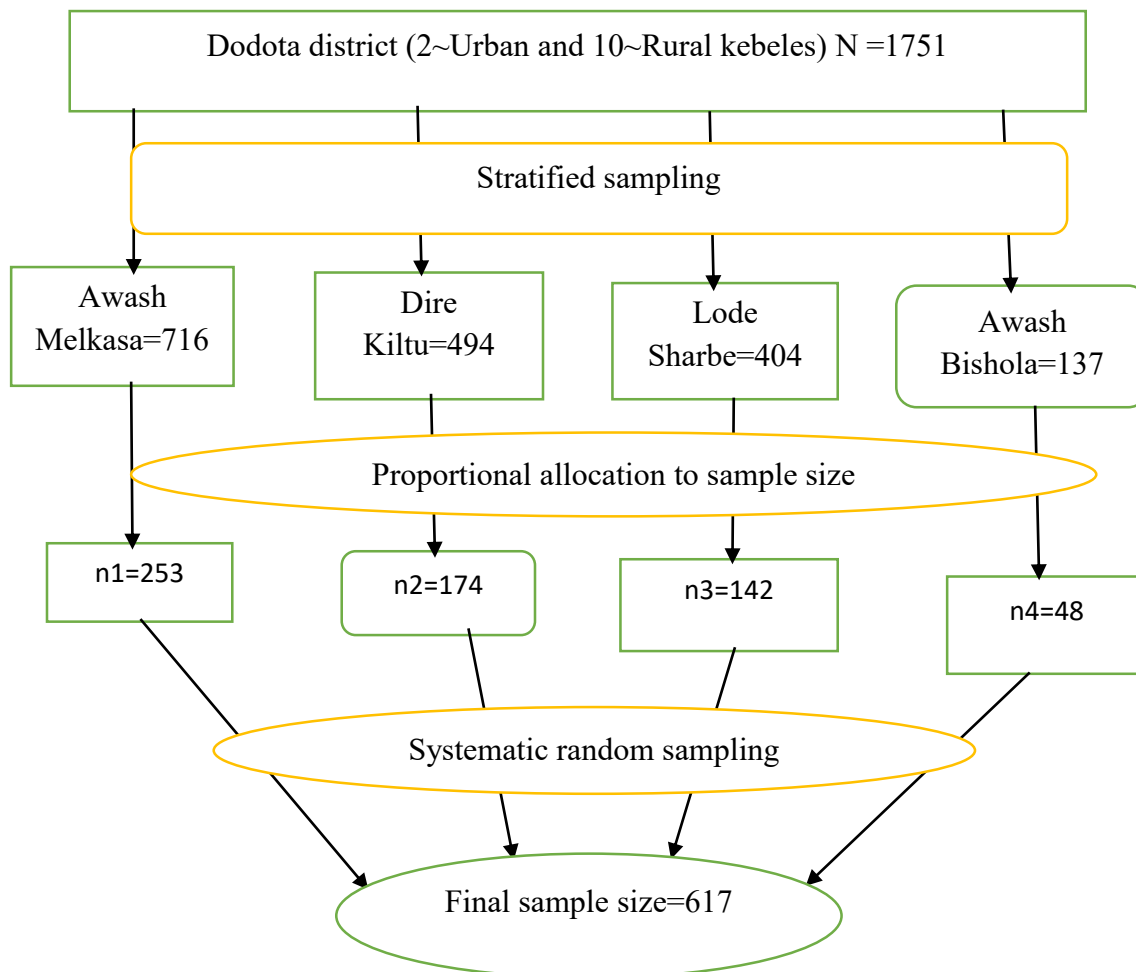


Figure 2: Schematic presentation of the Sampling procedure for utilization of LLINs and associated factors among under five children in Dodota District, 2025

For the qualitative study, the purposive sampling technique was used. The open-ended questionnaire was prepared to obtain an in-depth and FGD understanding of LLIN utilization. A total of seven in-depth interviews (IDIs) were conducted. The IDIs involved 4 health extension workers, one health center malaria focal, one woreda malaria expert, and one zonal malaria

expert all of whom were selected purposively based on an assumption to be the richness of information on the topic of the study. A total of 26 study participants for the focus group discussions (FGDs) were purposively selected by the principal investigator in consultation with the kebele leaders and health extension workers. Participants included members of the Women's Health Development Army, male caregivers of children under five, and pregnant women, excluding those involved in the quantitative data collection. They were selected from three kebeles: Awash Melkesa, Dire Kiltu, and Lode Sharbe. Each FGD consisted of a minimum of eight and a maximum of ten participants, fostering dynamic discussions while allowing all voices to be heard. The number of FGD was determined based on the level of saturation of the required information.

4.5 Variables of the study

4.5.1. Dependent Variable

LLIN utilization (Yes/No)

4.5.2 Independent Variables

Socio-demographic variables: Education level of mothers/caretakers, occupation of mothers/caretakers, age of mothers/caretakers, presence of under-five child, religion, ethnicity, sex of index child and age of child.

Household level variables: family size of HH, number of sleeping room in the HH

Knowledge: Respondents knowledge on malaria transmission and prevention.

Availability of resource: having bed nets and number of bed nets

4.6 Operational definitions

LLIN utilization was measured if a mother or a caregiver reported that the children under five years slept under an LLIN during the night prior to the survey date and the LLIN was hung over the bed/sleeping area during the observation day; it was considered as utilized; otherwise, it was considered as not utilized (17).

Knowledge of respondents on use of LLIN: Participants who answered median among the total knowledge related questions was classified as having a good knowledge; where as participants who answered < media it was classified as having poor knowledge(19).

4.7 Data collection tools and procedures

For quantitative study, the questionnaires were developed after reviewing different relevant literature. A structured interview questionnaire was prepared in the English language and translated to Afan Oromo by a language expert then the questionnaire was designed in Kobo toolbox software for electronic data collection. The questionnaire contains variables on sociodemographic characteristics, household level variables and environmental variables. In addition, an observational checklist was used to check if the net has been hung over the bed or sleeping place. The data were collected by four BSC nurse and supervised by two health officers based on their experiences. Data was collected by face-to-face interviews with mothers or caretakers using a Kobo toolbox and observational checklist for utilization of LLIN.

For qualitative study, open ended questions were developed based on objectives intended to measure were prepared in English and translated Afan Oromo language for FGD and KII. Series of three group discussions were carried out among purposefully selected study participants. Participants of the focus group discussions were selected after communicating with health extension workers. The health extension workers were informed on the objective of the study and then assisted in selecting those study participants who were expected to be active participants in the discussion. The principal investigator was to moderate the group discussion, and the assistant moderator was to take detailed notes, tape record the discussion, and handle any interruption to the focus group. The data collection process continued till information started to saturate. In-depth interviews with health professionals were conducted by the principal investigator and assistant data collector after obtaining verbal consent from each participant. These interviews were recorded using a tape recorder and supplemented with note-taking until all research questions were thoroughly addressed.

4.8. Data quality assurance

For quantitative study, to ensure quality of data, the questionnaire was pretested on 5% sample size in Adama district which is located 5km's away from the study area (Awash Melkasa) and necessary modification of the data collection tool was made on sequence, ambiguity, skipping order and grammar. The training was given to data collectors and supervisors for one day on contents of the questionnaires and the Kobo Toolbox software. Data were reviewed and checked for completeness and consistency by the supervisors on a daily basis and send it to the investigator through the Kobo toolbox. The principal investigator was reviewed and examined daily the data prior to export from the Kobo Toolbox.

For qualitative study, a smooth discussion environment was created and tried to encourage communication and interaction in every possible way for Focus Group Discussions. FGDs were held in a neutral setting which encouraged participants to express their views freely. I tried my best to make sure that no disturbances, adequate lighting, and well-ventilated room were arranged for discussion, because the data collection period was too hot and sunny. To create a conducive discussion area, the chairs were arranged in a circle. For the KII, the sessions took place privately in the participants' offices. During the interviews, probing techniques were employed based on the participants' responses to explore possible factors in detail, ensuring the consistency of the data collected.

4.9. Data Processing and analysis

The data were collected by Kobo Toolbox and exported to SPSS version 27 for analysis. Any missing values and outliers were checked before the analysis of the data. The normality of continuous variables was checked using a histogram. Descriptive statistics was computed for continuous variables and reported as a median with interquartile range for non-normal distribution variables. For categorical variables, the descriptive analysis was done and reported using frequency and percentage. A binary logistic regression model was used to identify the association between the dependent variable and the independent variables. Bivariable analysis was done to select candidate variables for multivariable analysis. Those variables with a p-value <0.25 in the bivariate analysis were transferred to the multivariable logistic regression analysis to control for possible confounders. Multicollinearity was checked among independent variables

using variance inflation factors, and then the highest VIF between the independent variables was found to be 1.355, which was below cut -off points. The model fitness was checked by using the Homer-Lemeshow goodness of fit test and found to be p-value=0.862. In the multivariable logistic regression, adjusted odds ratios with a 95% confidence interval were used to estimate the strength of association, and variables with a p-value <0.05 was considered statistically significant.

For qualitative study, the in-depth interviews and focus group discussions (FGDs) were transcribed and translated notes and audio records into English by the principal investigator. Different ideas in the text were coded and merged in their thematic areas, and a thematic framework analysis was employed manually. The data was presented in narrative supported with quantitative data.

4.10. Ethical considerations

Ethical clearance was obtained from Arsi University Research and Ethical Review Committee. Permission letter was obtained from Dodota woreda Health Office and cooperation letter was taken to each kebele. All the participants were informed about the purpose and their right to participate or not to participate in the study and verbal consent was obtained from individual respondents. Personal identification was not be written on the questionnaire and confidentiality of all information was kept.

4.11 Dissemination of results

The final report of this study will be submitted Arsi University's department of public health. It will also send to woreda health offices and Arsi zonal health department. The dissemination also goes to different non-governmental organizations (NGOs) found in Arsi zone that are working on malaria prevention and control activities. Efforts will make to disseminate results through publication and presentation in conferences.

5. Results

5.1 Sociodemographic characteristics of the study participants

A total of 605 respondents with a response rate of 100% were included in this study. The participants had a median age of 29 years, with an interquartile range of 24-35 years. About 356 (58.8%) were resided in rural. On the other hand, 518 (85.6%) of respondents were Oromo in Ethnicity and 287 (47.4%) respondents were Muslim followers. The study indicates that 264(43.6%) of participants had primary education and 380 (62.8%) of respondents were housewife by occupational status. Two hundred thirty-eight (39.3%) of husband had attended primary education. Regarding to occupational status of child father, 268(44.3%) were farmer. About 368 (60.8%) of participants had more than four family members (Table 2).

Table 2: Socio demographic characteristics of the mothers with children under five years in Dodota district, Southeast Ethiopia, 2025.

Variables(N=605)		Frequency	Percentage
Age category	18-24	163	26.9
	25-34	267	44.1
	35-44	133	22.0
	>=45	42	6.9
Place of residence	Urban	249	41.2
	Rural	356	58.8
Marital status	Married	572	94.5
	Widowed	13	2.1
	Divorced	9	1.5
	Single	11	1.8
Religion	Muslim	287	47.4
	Orthodox	224	37.0
	Protestant	94	15.5
Ethnicity	Oromo	518	85.6
	Amhara	55	9.1
	Gurage	14	2.3
	Silte	18	3.0
Mother education	No formal education	160	26.4
	Primary education	264	43.6
	Secondary and above	181	29.9
Mother occupation	Government employee	34	5.6
	Trader	79	13.1
	Housewife	380	62.8
	Daily laborer	112	18.5
Husband education	No formal education	210	34.7
	Primary education	238	39.3
	Secondary and above	157	26.0
Husband occupation	Government employee	102	16.9
	Trader	114	18.8
	Farmer	268	44.3
	Daily laborer	121	20.0
Family size category	<=4	237	39.2
	>4	368	60.8
Number of children <5	One	372	61.5
	Two	218	36.0
	Three	15	2.5

5.2 Household level and health service-related characteristics of study participants

About 274 (45.3%) study participants had three sleeping rooms, and 515 (85.1%) did not share a bedroom. Among the respondents, 517 (85.5%) attended ANC for their last pregnancy. Of those who received ANC, 398 (77%) were counseled on LLIN use. Furthermore, 511 (84.5%) visited the EPI/under-five clinic for their last child, with 342 (66.9%) receiving LLIN counseling (table 3).

Table 3: Household level and health service-related characteristics of study participants in Dodota district, Southeast Ethiopia, 2025.

Variables		Frequency	Percentage
Sleeping room	One	32	5.3
	Two	193	31.9
	Three	274	45.3
	Four	106	17.5
Shared bedroom	Yes	90	14.9
	No	515	85.1
History of ANC attend for last pregnancy	Yes	517	85.5
	No	88	14.5
Received counseling on bed net during ANC	Yes	398	77.0
	No	119	23.0
Attended EPI/under five clinics for your last child	Yes	511	84.5
	No	94	15.5
Received advise on mosquito net use during EPI or under five clinic visits	Yes	342	66.9
	No	169	33.1
Received counselling on LLIN during home visits	Yes	213	35.2
	No	392	64.8
Participate on community campaign	Yes	342	56.5
	No	263	43.5

5.3 Knowledge of respondents on LLINs

Regarding participants' knowledge, 353 (58.3%) recognized that the effective duration of LLINs is 3-5 years. Additionally, 381 (63%) stated that LLINs with holes are ineffective, and 212 (35%) believed that children are more at risk for malaria. Furthermore, 452 (74.7%) knew that mosquitoes breed in stagnant water, while 448 (74%) understood that malaria is transmitted at night. About 318 (52.6%) recommended washing LLINs three times a year, and 299 (49.4%) identified the primary function of LLINs as mosquito elimination. Overall, 359 (59.3%) of study participants had good knowledge of LLINs (table 4).

Table 4: Knowledge of respondents on use of LLIN in Dodota district, Southeast Ethiopia, 2025.

Variables(n=605)		Frequency	Percentage
Duration of LLIN effective	1-2 years	58	9.6
	3-5 years	353	58.3
	6-10 years	104	17.2
	I don't know	90	14.9
LLIN with hole effective	Yes	224	37.0
	No	381	63.0
Group of people higher risk of malaria	Children	212	35.0
	Pregnant women	122	20.2
	All members	202	33.4
	I don't know	69	11.4
Place of mosquito breed	Soil	22	3.6
	Running water	46	7.6
	Stagnant water	452	74.7
	I don't know	85	14.0
Time mosquito bite	Day	101	16.7
	Night	448	74.0
	I don't know	56	9.3
Recommended washing of LLIN	Every month	88	14.5
	Three times a year	318	52.6
	Never washed	105	17.4
	I don't know	94	15.5
Methods of LLIN washing	Strong soap and hard scrubbing	55	9.1
	By using hot water	96	15.9
	Gently with mild soap and water	352	58.2
	I don't know	102	16.9
Primary function of LLIN	To prevents mosquito bites	152	25.1
	To kill mosquitoes	299	49.4
	To prevents other insect bites	66	10.9
	I don't know	88	14.5
Knowledge status	Good	359	59.3
	Poor	246	40.7

5.5 Utilization of LLIN

Out of 605 respondents, 355 (58.7%, 95% CI: 54.7–62.6) mothers with children under five children utilized LLIN (figure 3). Regarding the reasons for not using Long-Lasting Insecticidal Nets (LLINs), 95(38%) of study participants reported that they did not have access to an LLIN (figure 4).

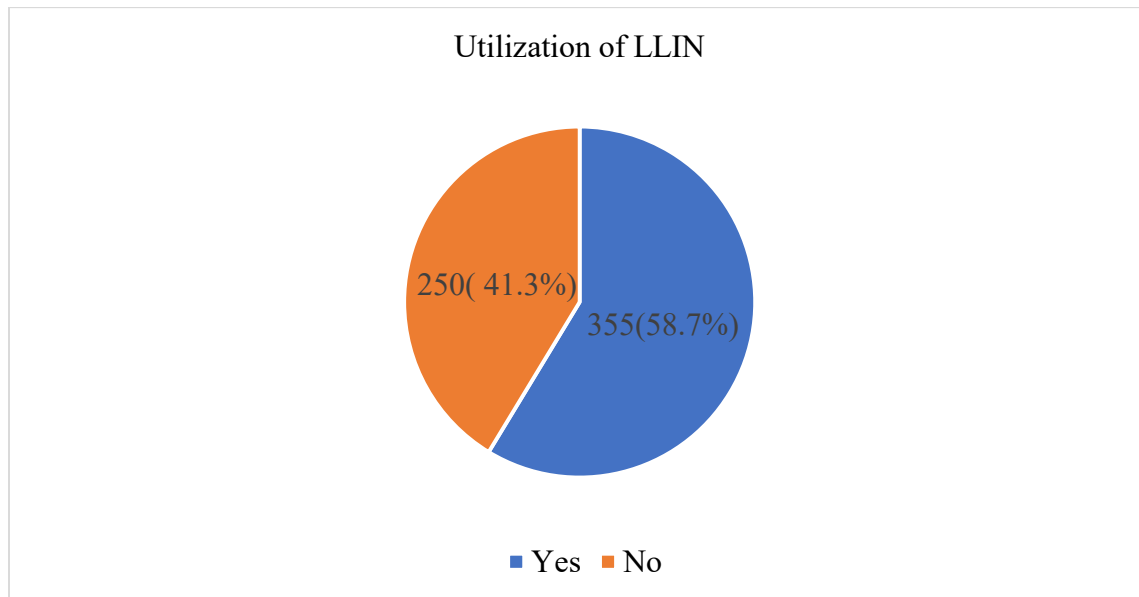


Figure 3: Utilization of LLIN among mothers with children under five years in Dodota district, Southeast Ethiopia, 2025.

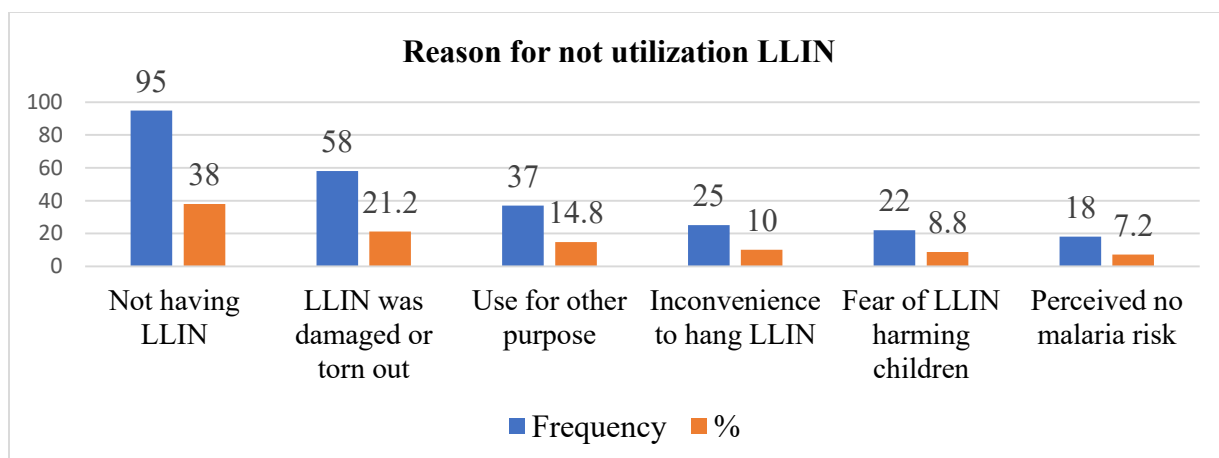


Figure 4: Reason for not utilization of LLIN among mothers with children under five years in Dodota district, Southeast Ethiopia, 2025.

5.6 Factor associated with utilization of LLIN

In the bivariate logistic regression analysis, maternal age, place of residence, maternal education, father education, father occupation, family size, knowledge status, and received counseling on LLIN use during ANC were considered candidates for multivariable analysis at a p-value < 0.25. The multivariate analysis revealed that maternal age, family size, knowledge status, and counseling on LLIN use during ANC significantly associated with LLIN utilization among mothers of children under five years at a p-value < 0.05.

Study participants with age ≥ 45 years were 2.91 times more likely to utilized LLIN than those age 18-24 years (AOR=2.91, 95% CI:1.09-7.69). Study participants having family size $\leq$ four were 2.54 times more likely to utilized LLIN when compared to those family size greater than four (AOR=2.54, 95% CI: 1.67-3.85). Mothers who had good knowledge on use of LLIN were 1.83 times more utilized LLIN compared to those who had poor knowledge (AOR=1.83, 95% CI: 1.24-2.72). Mothers who received counseling on use of LLIN during ANC for last pregnancy were 2.37 times utilized LLIN to those who didn't receive counseling (AOR=2.37, 95% CI: 1.49-3.75) (Table 5).

The final model demonstrated a good fit (Hosmer-Lemeshow test, $p = 0.862$), and multicollinearity was not a concern ($VIF < 2$ for all independent variables included in the multivariable model).

Table 5: Bivariable and multivariable analysis of factors associated with utilization of LLIN among mothers with children under five years in Dodota district, Southeast Ethiopia, 2025.

Variables (n=605)	Utilization of LLIN		COR (95% CI)	AOR (95% CI)
	Yes	No		
Mother age				
18-24	99	64	1	1
25-34	146	121	0.78(0.52-1.15)	0.90(0.56-1.44)
35-44	78	55	0.91(0.57-1.46)	1.21(0.68-2.16)
≥45	32	10	2.07(0.95-4.49)	2.91(1.09-7.69) *
Place of residence				
Urban	159	90	1.44(1.03-2.01)	1.38(0.93-2.04)
Rural	196	160	1	1
Mother education				
No formal education	85	75	1	1
Primary education	147	117	1.11(0.75-1.64)	1.13(0.68-1.89)
Secondary and above	123	58	1.87(1.20-2.91)	1.62(0.94-2.79)
Husband education				
No formal education	108	102	1	1
Primary education	137	101	1.28(0.88-1.86)	1.16(0.71-1.89)
Secondary and above	110	47	2.21(1.43-3.42)	1.99(0.79-5.04)
Husband occupation				
Government employee	74	28	1.99(1.13-3.50)	1.92(0.78-4.75)
Trader	69	45	1.16(0.69-1.94)	1.52(0.76-3.05)
Farmer	143	125	0.86(0.56-1.33)	1.27(0.69-2.34)
Daily laborer	69	52	1	1
Family size				
≤4	163	74	2.02(1.43-2.84)	2.54(1.67-3.85) **
>4	192	176	1	1
Knowledge status				
Good	228	131	1.63(1.17-2.27)	1.83(1.24-2.72) *
Poor	127	119	1	1
Received counseling during ANC (n=517)				
Yes	253	145	1.84(1.21-2.77)	2.37(1.49-3.75) **
No	58	61	1	1

**P<0.001; *P<0.05; AOR: Adjusted odds ratio; COR: Crude odds ratio; CI: Confidence interval; ANC: Antenatal care; LLIN: Long-lasting insecticidal nets; Hosmer and Lemeshow test = 0.862, VIF<2.

Qualitative study results

Sociodemographic characteristics of participants of the qualitative study

A total of 26 participants were involved in three FGDs. Each FGD had 8-10 participants. The participants ranged from 18 to 55 years of age. Sixteen (61.5%) of the FGDs participants were female. In addition, seven participants were engaged in KII. Among these four (57%) females regarding to their educational status level IV, one (14.4%) Health officer and two (28.6%) Masters of public health. The KII participants ranged from 25 to 38 years of age, and all of them (100%) were governmental employees.

Perceived benefits of LLIN utilization

(36 years, Female FGD). "We prevent malaria by using bed net and by keeping hygiene. Bed nets can protect from the bite of a mosquito. Not only this, but also it can protect from other insect bite such as cockroaches, fleas, flies and spiders, and against snake bites was a very occasionally reported non-malaria related benefit of ITN utilization" (25 years, male FGD).

(50 years old kebele leader): "I think we should also talk to those who use the nets for other purposes and explain the risks. If they see how important the LLINs are for protecting against malaria, they might change their minds."

A 55-year-old male participant stated, "In the past, when we didn't use LLINs, my family was affected by malaria. However, since we started using the nets properly, we haven't been exposed. I make sure all my family members use the nets correctly, and I've taught them why it's important."

Individual level barriers

Most common individual-level barriers were related to misbeliefs and misconceptions towards LLIN utilization. Participants claimed that they did not use LLIN as they believed that it creates warm and bed bugs.

The main barriers to LLIN utilization in the community include beliefs that bed nets attract bugs, are too hot, and that malaria only occurs in the summer. As a result, pregnant women and children under five often do not sleep under bed nets " (female FGD). Additionally, some believe

that bed nets are harmful to newborns due to their sensitive skin, leading many to avoid using them for infants" (Male FGD).

"A 42-year-old resident of Kebele reported issues with equitable distribution, stating that local leaders often prioritize their relatives and themselves during the allocation of government-provided LLINs, thereby creating disparities in access to this essential malaria prevention resource."

"We believe bed nets are harmful to newborns because their skin is very delicate. As a result, many people advise against using bed nets for infants" (30 years old, female FGD).

A male Key Informant Interview participant from Woreda malaria officer stated that individual who received LLIN were often repurposed for various uses rather than malaria prevention, such as carrying donkey loads, decorating homes, assembling straw, storing straw, covering furniture to keep it clean, and even vegetable spinning. A 38-year-old FGD participant, stated, "We use LLINs for straw assembly and storage. Once they are worn out, we use them for other purpose."

A 38-year-old farmer stated, "We received a bed net and used it properly, but it no longer prevents malaria due to multiple holes and tears."

A 28-year-old Kebele resident remarked, "We receive bed nets only once every three years, with one or two distributed per family. While we wash them when they get dirty, this process releases chemicals, reducing their effectiveness in killing insects."

A 32-year-old Health Extension Worker explained, "While our community uses LLINs, there are misconceptions. Many believe they create heat and attract bugs, making sleeping uncomfortable and unfeasible for hanging. They agree with my teachings, but not all families implement the." (HEW KII).

Institutional level barriers

Most common institutional level barriers raised by the participants were: insufficient LLIN accessibility, failure to allocate LLIN proportional to household's family size, health education and failure to give vulnerable groups priority.

A 36-year-old resident stated, "Health extension workers do not regularly visit households to teach residents how to properly utilize bed nets. Without proper knowledge, these nets cannot be used effectively. The spread of malaria not only from societal gaps but is also a government issue; with adequate health education, our community would be more informed and willing to implement prevention strategies. For instance, someone knowledgeable about using a bed net will use it correctly, while someone lacking that information may discard the net or leave it unutilized at night." Similarly, a 46-year-old resident added, "No one has taught us how to use LLINs properly or how to wash them, beyond simply saying, 'Take it and use it' when they're distributed."

A male participant from a Key Informant Interview, serving as the Woreda malaria officer, stated, "We have integrated malaria counseling for pregnant mothers attending antenatal care, as well as for mothers visiting the under-five clinic, as they are a more vulnerable group in the population. This initiative ensures that they understand the importance of using Long-Lasting Insecticide Nets (LLINs) properly."

A 35-year-old malaria focal at the health center observed, "Our community faces significant challenges due to a prolonged shortage of LLINs. Community members often express concerns about insufficient distribution, which hampers our malaria control efforts. When we do receive LLINs, they are usually inadequate to meet our population's needs, increasing vulnerability to malaria." (Male KII)

A 45-year-old Kebele resident stated, "The government provided us with LLIN three years ago. Since then, we have not received any additional nets. As a result, many of us are not using the LLINs because the ones we received have become torn and damaged."

A 48-year-old male FGD participant stated that "Not all household members use LLINs equally because they aren't accessible. For instance, I have ten family members, but I only received three nets". Key informant interviews with zonal malaria expert concerns about access. "All family members do not sleep on LLIN because the bed net is not distributed based on family size... even three years ago no LLIN come and the previous net lose its effectiveness."

"Some households have large families and lack enough beds for everyone. During LLIN distribution, we prioritize under-fives and pregnant women. As a result, many family members

are unable to sleep under a bed net. In some homes, there is only one bed, while the rest of the family sleeps on the floor, making it difficult to use the LLIN effectively and even not comfortable to stretch on the floor”. (HEW KII).

Residents of the Kebele have highlighted the lack of HEWs as a critical issue. A 33-year-old resident stated, "Right now, we only have one health extension worker, and she can't reach all the households." A 32-year-old HEW added, "I'm on my own and unable to serve everyone in my Kebele. I've noticed some improvement when I teach households how to use LLINs properly. If we had additional HEWs, we could cover more homes and enhance utilization in our Kebele."

Socio-cultural level barriers

Participants identified several socio-cultural barriers to LLIN use, including the repurposing of nets for agricultural or domestic uses, a lack of adequate sleeping space to hang them, and cultural misbeliefs, most notably the perception that the nets themselves attract bed bugs.

A 40-year-old female participant in the Focus Group Discussion shared her thoughts: "I believed it was sufficient to use the LLIN only during the rainy season when malaria is more prevalent." This view resonated with several others in the group, who also thought that LLINs were primarily needed during peak malaria seasons.

A 55-year-old male participant discussed the influence of traditional practices on the utilization of LLINs. He remarked, "Traditional beliefs significantly influence how these nets are used. Some mothers mentioned that they prefer to keep their children near a fire at night for warmth, which results in inconsistent LLIN usage." He also noted, "Many believe that infants are less at risk for malaria, leading to lower net usage for younger children

A 35-year head of a health center said: "Among the challenges, resistance to health education is the foremost. When we visit each household, we see a problem with the use of LLINs, which means that there is a tendency to use the LLIN for other purposes, for example, to use the LLINs for chicken coops, to cover material things, to use the LLINs for mattress covers." Additionally, A 25-year-old resident mentioned, "Some people do not use bed nets for preventing malaria; instead, they use them for other things. Some even just keep the nets packed up in the house instead of hanging them over the beds.

6. Discussions

This study aimed to assess utilization of LLIN and associated factors among mothers with under-five children in Dodota district Southeast Ethiopia. In this study, the utilization of LLIN among mothers with under-five children was 58.7% (95% CI: 54.7–62.6). This finding is nearly consistent with studies in East Mesekan District, Gurage Zone, Southern Ethiopia 58.2% (95% CI:54.1%-62.2%) (36) and East Belessa District, Northwest Ethiopia 56.5% (95% CI 53.0-60.2) (35).

However, LLIN utilization in the study area is higher than in various African countries, with rates of 39.3% in South-West Nigeria (27), 41.7% in Ghana (29), 16.7% in Mozambique (30) and 50.8% in Tanzania (31). This discrepancy may be attributed to differences in study settings, periods, and awareness levels.

Moreover, this finding is higher than reported in various studies across Ethiopia, including a meta-analysis showing LLIN utilization 53% (32), and findings from the Mirab-Abaya District in the Gamo-Gofa Zone 37.2% (37). This might be due to pooled prevalence in case of study done in Ethiopia. Furthermore, the possible variation is due difference in study period and sample size in case of study done in Gamo-Gofa Zone

On the other hand, this finding is lower than the study conducted in Nigeria 66.7%(25), Pawie District, Benshangul Gumuz, Northwest Ethiopia 69.2%(33), Fogera District, Northwest Ethiopia 63.3%(34), Hawwa Gelan Woreda, Kellem Wollega Zone 69.3% (38) and Adami Tullu District, Oromia Regional State, Ethiopia 63.9%(39). Furthermore, this finding is far away from the national and global standard which 80% of the population at risk sleeping under a LLIN every night(48,49). The possible explanation for this discrepancy might be due to the sociodemographic differences, sample size differences, lack of adequate ITN per the number of household member, life span of ITNs vary widely between individual nets used within a single household or community.

Study participants with age ≥ 45 years were 2.91 times more likely to utilized LLIN than those age 18-24 years (AOR=2.91, 95% CI:1.09-7.69). This finding agreed with study conducted in Mirab-Abaya District, Gamo-Gofa Zone, Ethiopia (37). The possible justification is due to the

older people tend to accumulate more life experience, including direct or indirect exposure to the consequences of malaria, which may increase their perceived susceptibility and severity of the disease. Additionally, older people may have more exposure to community health education and outreach programs through local health facilities or social networks. This is supported by qualitative findings. *A 55-year-old male participant stated, "In the past, when we didn't use LLINs, my family was affected by malaria. However, since we started using the nets properly, we haven't been exposed. I make sure all my family members use the nets correctly, and I've taught them why it's important."*

Study participants having family size $\leq$ four were more likely to utilized LLIN when compared to those family size greater than four (AOR=2.54, 95% CI: 1.67-3.85). This finding supported with study conducted in East Africa (40), Gurage Zone, Southern Ethiopia (36), Fogera district, Northwest Ethiopia (34) and Mirab-Abaya District, Gamo-Gofa Zone, Ethiopia (37). This might be due to smaller families typically experience less overcrowding in sleeping arrangements, making it easier to hang and use LLINs effectively. In contrast, larger households often face limitations in sleeping space, which can result in multiple individuals sharing a bed or sleeping in locations not conducive to net use. This finding supported by qualitative finding. *"Some households have large families and lack enough beds for everyone. During LLIN distribution, we prioritize under-fives and pregnant women. As a result, many family members are unable to sleep under a bed net. In some homes, there is only one bed, while the rest of the family sleeps on the floor, making it difficult to use the LLIN effectively"* (HEW KII).

Mothers who had good knowledge on use of LLIN were more utilized LLIN compared to those who had poor knowledge (AOR=1.83, 95% CI: 1.24-2.72). This finding is similar to a study done in Tanzania (31), Fogera District, Northwest Ethiopia (34), and East Mesekan District, Gurage Zone, Southern Ethiopia (36). The possible justification for this might be due to mothers with greater awareness often maintain positive attitudes toward public health interventions and are more receptive to health education messages. Additionally, mothers who possess good knowledge about the use of LLINs are typically more aware of how malaria is transmitted, its potential severity, and the role of LLINs in preventing infection. This finding supported by qualitative finding. *A 36-year-old resident stated, "Health extension workers do not regularly visit households to teach residents how to properly utilize bed nets. Without proper knowledge,*

these nets cannot be used effectively. The spread of malaria not only from societal gaps but is also a government issue; with adequate health education, our community would be more informed and willing to implement prevention strategies”.

Mothers who received counseling on use of LLIN during ANC for last pregnancy higher utilized LLIN to those who didn't receive counseling (AOR=2.37, 95% CI: 1.49-3.75). The findings of this study were not supported by a previous study, which found that received counseling on use of LLIN during ANC for last pregnancy increased the likelihood of using ITN compared to those respondents who didn't receive counseling. This might be due to counseling during ANC fosters a supportive environment that motivates mothers to prioritize their health and that of their unborn children. When healthcare providers actively engage in discussions about the dangers of malaria and the protective advantages of LLINs, mothers may feel more empowered to incorporate LLIN usage into their daily routines. This support can also address misconceptions and build confidence in the mothers' ability to effectively use and maintain the nets, resulting in greater utilization rates among those who received counseling. This finding supported by qualitative data. *“A male participant from a Key Informant Interview, serving as the Woreda malaria officer, stated, "We have integrated malaria counseling for pregnant mothers attending antenatal care, as well as for mothers visiting the under-five clinic, as they are a more vulnerable group in the population. This initiative ensures that they understand the importance of using Long-Lasting Insecticide Nets (LLINs) properly."*

7. Strengths and limitations

This study was used mixed methods approach to triangulate quantitative and qualitative data to gain a better understanding of the problem. Additionally, utilization of LLIN was supported with observational checklist to confirm the LLIN hanged over the sleeping area during the interview. Despite this strength, the study has some limitations. Since the data for this study was collected based on self-report, it is susceptible to social desirability. This study also shared the limitation of the cross-sectional study nature which cannot establish a temporal relationship between the outcome and response variables.

8. Conclusions and recommendations

8.1 Conclusions

This study found that the utilization of LLIN among mothers with children under five years in Dodota district was lower the national target which is 80%. The mother's age being ≥ 45 years, family size $\leq$ four members, having good knowledge status on LLIN use, and receiving counseling on LLIN use during ANC significantly associated with LLIN utilization among mothers of children under five years.

8.2 Recommendations

- Dodota district health care provider shall be strengthened awareness creation sessions on LLINs utilization of under-5 years old children.
- Health care providers shall be strength integrate comprehensive LLIN counseling into ANC programs to ensure that mothers receive tailored education on the importance of LLIN use for their children's health.
- Woreda health office and Health care providers shall distribute LLINs considering family size, particularly for families with four or fewer members, to maximize utilization and effectiveness.

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10. Annexes

Annex I: English version information sheet

Principal investigator: Mohammedin Jemal

Title: Utilization of Long-Lasting Insecticidal Nets and Associated Factors Among Under-Five Children in Dodota District, Southeast Ethiopia, 2025.

My name is_____. I am working as a data collector for the study being conducted in this community by Mr. Mohammedin Jemal who is studying for his Master's degree at Arsi University Department of Public Health. He is conducting research for the partial fulfillment of second degree on topic mentioned above in selected health facilities. I request you to take part in this study and to respond genuinely. The findings of this study can be used to identified utilization of Long-Lasting Insecticidal Nets and associated factors among under-five children. Moreover, the aim of this study is to write a thesis as a partial requirement for the fulfillment of a Master's Program in public Health for the principal investigator. The study will be conducted through face-to-face interviews which may take about 30 minutes, to help us in this study. The risk of participating in this study is very minimal, only taking few minutes from your time. There would not be any direct payment for participating in this study. But the findings from this research may reveal important information for concerned bodies. All information given by you will be kept strictly confidential and won't be accessible to any third party. Participation for this study is fully voluntary. You have the right to declare to participate or not in this study. If you decide to participate, you have the right to withdraw from the study at any time, this will not able you for any loss of benefit which you otherwise are entitled. You do not have to answer any question that you do not want to answer. If there are any questions or enquiry any time about the study or the procedure, please contact: phone: +251922044672

Are you willing to participate in this study?

1. Yes Continue to the next page
2. No Skip to the next participant

Annex II: English version of the questionnaire

English questionnaire Utilization of Long-Lasting Insecticidal Nets and Associated Factors
Among Who Have Under-Five Children in Dodota District, Southeast Ethiopia, 2025

Participant ID _____ Code of data collector _____ Data collection date _____

Name of kebele _____ (Lode Sharbe, Awash Bishola, Awash Melkasa, Dire Kiltu)

Part I: Socio demographic characteristics among study participants

S/N	Questions	Response	skip
101	What is mother age?	_____ years	
102	Place of residence	1. Urban 2. Rural	
103	What is your marital status?	1. Married 2. single 3. Divorced 4. Widowed Separated	
104	What is your religion?	1. Muslim 2. Orthodox 3. Protestant 4. Catholic 5. Other(specify) _____	
105	What is your ethnicity?	1. Oromo	

		2.Amhara 3.Gurage 4. Silte 5.Other specify_____	
106	What is mother educational status?	1. No formal education 2. Primary education 3. Secondary education 4.College/University	
107	What is mother Occupation?	1.Housewife 2.Farmer 3.Daily labor 4.Government/NGO employee 5.Trader 6.Other (Specify)_____	
108	What is your husband's/partner's highest level of education?	1. No formal education 2. Primary education 3. Secondary education 4.College/University	
109	What is husband Occupation?	1.Farmer 2.Daily labor 3.Government/NGO employee 4.Trader 5.Other (Specify)_____	

110	What is the average monthly family income? (ETB)	_____	
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Part II: Household level related characteristics

S/N	Questions	Response	Skip
201	How many family members live in your household?	_____	
202	How many children under the age of five year in this household?	_____	
203	How many rooms in this household are currently used for sleeping?	_____	
204	Are there one bed /sleeping area sharing habit in the house hold?	1. Yes 2. No	
205	If yes to Q 204, how many persons share a single bed?		

Part III: Knowledge about Malaria and LLINs

S/N	Questions	Response	skip
301	How long is an LLIN typically effective if used and maintained properly?	1.1-2 years 2.3-5 years 3.6-10 years 4.I don't know	
302	Are LLINs effective when they have holes?	1. Yes 2. No	

303	which group of people higher risk of malaria?	1. Children 2. Pregnant women 3. All members 4. I don't know	
304	Where does a mosquito's breed?	1. on the soil 2. in the running water 3. in the stagnant water 4. I don't know	
305	At what time do the mosquito bites human beings?	1. Day 2. Night 3. I don't know	
306	What is the recommended washing practice for LLIN ?	1 Every month 2 Only when dirty, up to 3 times a year 3 Never washed 4 I don't know	
307	How should you wash an LLIN?	1. Strong soap and hard scrubbing 2. By using hot water 3. Gently with mild soap and water 4.I don't know	
308	What is the primary function of LLINs?	1. To prevents mosquito bites 3.To kill mosquitoes 3.To prevents other insect bites 4.I don't know	

Part IV 4: Health service utilization related factors

S/N	Questions	Response	Skip
401	Did you attend ANC for your last pregnancy?	1. Yes 2. No	
402	Did a health provider advise mosquito net use during ANC for your last pregnancy?	1. Yes 2. No	
403	Did you attend EPI/under five clinics for your last child?	1. Yes 2. No	
404	Did a health provider advise mosquito net use during EPI or under five clinic visits?	1. Yes 2. No 3. Not visit	
405	Did health care provider advise you on LLIN use by visit your home?	1. Yes 2. No	
406	Have you participated in any community programs or campaigns that promote LLIN use and malaria prevention?	1. Yes 2. No	

Part V: LLIN Utilization

501	Do you have long-lasting insecticidal nets in your home currently?	1. Yes 2. No	
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502	How many LLINs do you have?	_____	
503	Did all of your under-five children sleep under the hung LLIN last night?	1. Yes 2. No	Check by observation
504	If no Q#503, why didn't your children/child sleep under bed net the previous night?	1.No LLIN available 2. Inconvenience to hang LLIN 3. Fear of LLIN harming children 4. Misuse or repurposing 5. LLIN was damaged or torn out 6. perceived no malaria risk	
505	For how long do you used current LLINs? (in year)	1.For 1 year 2.For 2 years 3.For 3 years 4.For 4 years 5.For 5 years	
506	What is the physical condition of the net your child uses? (Observation)	1.No holes 2.Few small holes 3.Many/Large holes	

Annex III. Observational checklist for LLIN utilization

Now I would like to observe the LLINs 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 LLIN observed in the home _____
3. The number of beds /places of sleep observed with LLIN hanged _____

Annex IV: KII and FGD Guide

Study Title: To explore reasons why the mothers who have under-five children do not utilization of long-lasting insecticidal nets in Dodota District

1. is the current system of net distribution sufficient to ensure every under-five child has access to a net? (Probe: Timing of distributions, number of nets per household, coverage of newborns and new mothers.)
2. what reasons do they give for *not* using a net for their child every night? (Probe: Do they mention heat, discomfort, low mosquito density, or other reasons?)
3. What are the most common practical challenges mothers face in hanging and using the net correctly? (Probe: Lack of space, lack of materials to hang it, difficulty tucking it in, damage to the net.)
4. What role do awareness and education play in LLIN non-utilization, and how could they be improved?
5. Can you describe any cultural or social factors that discourage LLIN use among families with young children?
6. From your observations, how do practical issues like net quality or household sleeping arrangements contribute to low utilization?
7. What misconceptions about LLINs have you heard from mothers, and how do they affect behavior?

Annex V. Ragaa Odeeffannoo (Afan Oromo Version)

Akkam jirtuu! Maqaan kiyya_____jedhama. Ani bakka barata Muhammadin Jemal kan Qorannoo Univaarsiity Arsii mummee fayyaa hawaasa barata digirii 2 ffaa kan taahe qorannoo wa'ee ittifayyadama saphana siree daa'ima wagga shan gadi fi sababoota wan kana wajjin walqabatan irratti qorachuudhaf. Bu'aan qorannoo kana akka aanaa Dodotatti halli fayyadama saphana bookee busa daa'imman wagga shani gadi irratti maali irraa akka jiruu adda baasuun furuuf gahee ol'aanaa qaba. Halli raga isin irraa itti funannu gaffile qopha'an isin gafachu dhan erga isin akka qoranno kana irratti hirmachuf eyyama tatan booda. Yeroo gaffile kana isin gafannu daqiiqa 30 kan fudhatuudha.

Qoranno kana irratti wan hirmattanif kallattidhan wanti isin kaffalamu hin jiruu akkasuma qoranno kana irratti yoo hirmattan midhan isin irra gahu hin jiru yeroo gaffiile isin gafannu isin irra fudhachuu yoo tahee malee. Qorannicha kana irratti kan hirmatan feedhidhan akkasuma yeroo hirmattan jidduudhan yoo isinitti hin tolee adda kuttan dhisuu ni dandettu. Ragaan isin irraa funanamme iccitidhan kan qabu akkasuma yeroo raga kana isin irra fudhannu maqaan kessan kan hin barrofne dha. Raga kessan kan itti fayyadamu abba qoranno kana gaggesse qofa tahu isin hubachifna. Gaaffii yoo qabattan qorata qorannoo kana kan tahe obboo Muhammadin Jamaal lakkoofsa bilbila ishee +251922044672 bilbiltan gafachuu dandeettu.

Qorannoo kana keessatti hirmaachuuf fedha qabda?

Eeyyee..... Gara gaaffiiwwan itti annutti darbi

Lakki..... Asumatti dhaabii gara hirmaataa itti aanuutti
tari

Annex VI: Afaan Oromo version questionnaires

Maqaa ganda _____

Maqaa ragaa gaafata _____

Guyyaa _____

Lakkofsa icciti hirmataa _____

Kutaa I: Amaloota hawaas-dimoogiraafii hirmaattota qorannichaa

Koodii	Gaaffiilee	Deebii	Darbuu
101	Umriin haadhaa meeqa ?	Waggaa _____	
102	Bakka jireenyaa	1.Magaalaa 2.Baadiyyaa	
103	Haalli gaa’ela keessanii maali?	1. Gaa’ela keessa kan jiru 2. Kophaa kan jiru 3. Kan hiikte/ke 4. Kan irraa du’e 5. Kan adda/gargar bayan	
104	Amantiin kee maali?	1. Muslima 2. Ortodoksii 3. Pirootestaantii 4. Kaatolikii 5. Kan biroo(ibsi) _____ .	
105	Sabni kee maali?	1.Oromoo 2.Amaaraa 3.Guraagee	

		4. Siilxee 5.Kanneen biroo (ibsi)_____	
106	Haalli barnoota haadhaa maali?	1. Barnoota idilee hin qabu 2. Barnoota sadarkaa tokkoffaa 3. Barnoota sadarkaa lammaffaa 4.Kolleejjii/Yuunivarsiitii	
107	Hojiin Haadha maali ?	1.Haadha manaa 2.Qonnaan bulaa 3.Hojii guyyaa guyyaa 4.Hojjetaa mootummaa/NGO 5.Daldalaa 6.Kanneen biroo (Ibsi)_____	
108	Sadarkaan barnoota abbaa warraa/hiriyyaa gaa'elaa maali?	1. Barnoota idilee hin qabu 2. Barnoota sadarkaa tokkoffaa 3. Barnoota sadarkaa lammaffaa 4.Kolleejjii/Yuunivarsiitii	
109	Hojiin abbaa manaa maali?	1.Qonnaan bulaa 2.Hojii guyyaa guyyaa 3.Hojjetaa mootummaa/NGO 4.Daldalaa 5.Kanneen biroo (Ibsi)_____	
110	Galiin maatii ji'a ji'aan argamu giddu galeessaan meeqa?(ETB)	_____ .	

Kutaa II: Amaloota sadarkaa maatii waliin walqabatan

Koodii	Gaaffiilee	Deebii	Darbuu
201	Mana keessan keessa miseensonni maatii meeqatu jiraatu?	_____	
202	Mana kana keessatti daa'imman umriin isaanii waggaa shanii gadi ta'e meeqa?	_____	
203	Yeroo ammaa kanatti mana kana keessatti kutaa hirribaa meeqa qabdu ?	_____	
204	Mana kana keessatti siree /bakka ciisichaa tokko waliin fayyadamuun ni jiraa?	1. Eeyyee 2. Lakki	

Kutaa III: Beekumsa waa'ee Busaa fi Agoobara Yeroo Dheeraa

Koodii	Gaaffiilee	Deebii	Darbuu
301	Yoo sirnaan itti fayyadamamee fi kunuunfame toorri ilbiisota yeroo dheeraa yeroo hangamiif bu'a qabeessaa?	1. Waggaa 1-2 2. Waggaa 3-5 3. Waggaa 6-10 4. Hin beeku	
302	Toorri ilbiisotaa yoo boolla/qaawwa qabaate bu'a qabeessaa?	1. Eeyyee 2. Lakki	
303	Garee namootaa kamtu irra caalaan dhukkuba busaatiin	1. Ijoollee 2. Dubartii ulfaa	

	miidhamuu danda'aa ?	3. Miseensota hunda 4. Hin beeku	
304	Bookeen busaa eessatti wal hortii?	1. biyyee irratti 2. bishaan yaa'u keessatti 3. bishaan dhaabbate/ciisaa keessa 4. Hin beeku	
305	Bookeen busaa yeroo akkamiitti nama ciniintii/idditii?	1. Guyyaa 2. Halkan 3. Hin beeku	
306	Haalli dhiqaa toora ilbiisota yeroo dheeraa gorfamu maal maali ?	1. Ji'a ji'aan 2. Yeroo xuraa'u qofa, waggaatti hanga yeroo 3 3. Gonkumaa hin dhiqanne 4. Hin beeku	
307	Toora ilbiisotaa yeroo dheeraa akkamitti dhiquu qabda?	1. Saamunaa cimaa fi dhiqiinsa cimaa 2. Bishaan ho'aa fayyadamuudhaan 3. Suuta suutaan saamunaa fi bishaan salphaadhaan 4. Hin beeku	
308	Faaydaan toora ilbiisotaa yeroo dheeraa inni jalqabaa maali?	1. Ciniinnaa bookee busaa ittisuuf 3. Bookee busaa ajjeesuuf 3. Ciniinnaa ilbiisota biroo ittisuuf 4. Hin beeku	

Kutaa IV: Qabxiilee itti fayyadama tajaajila fayyaa wajjin walqabatan

Koodii	Gaaffiilee	Deebii	Darbuu
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401	Ulfa kee isa dhumaa hordoftee jirtaa?	1. Eeyyee 2. Lakki	
402	Ogeessi fayyaa yeroo hordoffii ulfa kee isa dhumaa toora ilbiisota fayyadamuu si gorse jiraa?	1. Eeyyee 2. Lakki	
403	Daa'ima kee isa dhumaa kanaaf kutaa talaallii daa'immannii /kutaa yaala daa'imman waggaa shanii gadii hordoftee jirtaa?	1. Eeyyee 2. Lakki	
404	Dhiyeessaan fayyaa tokko yeroo talaallii daa'immannii /yaala daa'imman waggaa shanii gadii fayyadama toora ilbiisotaa gorse jiraa?	1.Eeyyee 2.Lakk 3. Daawwachuu dhiisuu	
405	Dhiyeessaan fayyaa mana keessan daawwachuudhaan haala itti fayyadama toora ilbiisotaa yeroo dheeraa irratti isin gorse beekaa?	1.Eeyyee 2.Lakki	
406	Sagantaa hawaasaa ykn duula itti fayyadama toora ilbiisota yeroo dheeraa fi ittisa dhukkuba busaa guddisan kamiyyuu irratti hirmaattanii beektuu?	1.Eeyyee 2.Lakki	

Kutaa V: Itti Fayyadama Toora Ilbiisotaa Yeroo Dheeraa(LLIN)

Koodii	Gaaffiilee	Deebii	Darbuu
501	Yeroo ammaa kana mana keessan keessaa toora ilbiisota yeroo dheeraaf turu qabduu?	1.Eeyyee 2.Lakki	
502	Toora ilbiisota yeroo dheeraa meeqa qabdan?	_____ .	
503	Ijoolleen keessan umuriin isaanii waggaa shanii gadi hundinuu halkan edaa toora ilbiisotaa yeroo dheeraa fannifame jala rafanii jiruu?	1. Eeyyee 2. Lakki (Ilaalchaan sakatta'uu)	
504	Gaaffii #503 hin jiru yoo ta'e, ijoolleen/mucaan keessan halkan edaa maaliif toora siree jala hin rafne?	1. Hin jiru/Hin qabnu 2. Fannisuuf rakkisaa waan ta'eef 3. Sodaan daa'imman miidhuu waan jiruuf 4. Sirna hin taane fayyadamuu ykn kaayyoo irra deebi'anii fayyadamuu 5. Miidhamee ykn ciccitee waan jiruuf 6. busaan hin jiru jennee waan hubanneef	
505	Toora ilbisotaa/Bookee busaa ammaa kana yeroo hammamiif fayyadamtan? (waggaan) 1.	1.Waggaa 1'f 2.Waggaa 2'f 3.Waggaa 3'f 4.Waggaa 4'f 5.Waggaa 5'f	
506	Haalli qaamaa toora ilbiisotaa/bookee busaa daa'imni keessan itti fayyadamu maal fakkaata? (Ilaalcha)	1.Qaawwa hin qabu 2.Qaawwa xixiqqoo muraasa 3.Qaawwa hedduu/Guddaa	

Annex VII. Cheeckliistii itti fayyadama saaphana siree ilaaluun guutamu

Haala saaphana siree fi itti fayyadama keessanii sirrii tahuu fi dhiisuu isaa akkuma waliin 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. 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.

Annex VIII: KII and FGD Guide

Mata duree Qo’annoo: Haadholiin ijoollee waggaa shan gadi qaban Aanaa Dodota keessatti itti fayadama agoobara wajjin walqabatee rakkoo jiruu adda basuu.

1. Ssirni raabsa agobara amma jiru daa’imni umuriin isaa waggaa shanii gadi ta’e hundi net akka argatu gochuuf gahaadhaa? (Qorannoo: Yeroo raabsaa, baay’ina toora mana tokkoo, uwwisa daa’imman reefuu dhalatanii fi haadholii haaraa.)
2. Halkan hunda daa’ima isaaniif agoobara fayyadamuu dhiisuuf sababoota akkamii kaa’u? (Qorannoo: Ho’a, mijataa ta’uu dhabuu, hoomaa awwaannisaa gadi aanaa ta’uu ykn sababoota biroo ni kaasu?)
3. Rakkoowwan qabatamaa haadholiin agoobara fannisuu fi sirritti fayyadamuu irratti mudatan maali? (Qorannoo: Bakka dhabuu, meeshaalee itti fannisan dhabuu, keessa galchuuf rakkachuu, kiyyoo irratti miidhaa geessisuu.)
4. Hubannoo fi barnoonni itti fayyadama dhabuu agoobara keessatti gahee akkamii qaba, akkamitti fooyya’uu danda’u?
5. Maatii ijoollee xixiqqoo qaban biratti itti fayyadama agoobara kan abdii kutachiisan wantoota aadaa ykn hawaasummaa kamiyyuu ibsuu dandeessaa?
6. Tajaajila keessan irraa dhimmoonni qabatamaan akka qulqullina qulqulluu ykn qophii hirribaa manaa itti fayyadama gadi aanaa ta’eef gumaacha akkamii godhu?
7. Waa’ee agoobara ilaalcha dogoggoraa akkamii haadholii irraa dhageessaniittu, akkasumas amala irratti dhiibbaa akkamii geessisu?

Declaration of Investigator

I, the undersigned student of General Master of Public Health, declare that this thesis is my original work in partial fulfillment of the requirement for the degree of General Master of public health to my best knowledge.

Name of investigator: _____

Signature: _____ Date _____

Declaration of Advisors

We, the undersigned Advisors, declare that this thesis is our original work in partial fulfillment of the requirement for the degree of General Master of public health for the stated student above to our best knowledge. We confirmed that this thesis is ready for examination with our approval as the university advisors.

Date of Submission: _____

Name of primary Advisor:	Signatures	Date
1. _____	_____	_____

Name of secondary Advisor:	Signatures	Date
2. _____	_____	_____

Examining Board Approval

We, the undersigned Examining board, approved that this thesis is original work with the basic scientific merits for partial fulfillment of the requirement for the degree of Master of public health for the stated student above to our best knowledge. We confirmed that this thesis is sufficient for the student's promotion to the higher level.

Name of internal Examiner

Signatures

Date

Name of Internal Examiner

Signatures

Date

Name of Department Head

Signatures

Date
