

# Possession, utilization and preference of long-lasting insecticidal nets after introduction in rural settings of Ethiopia

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## Abstract

**Background:** In recent years, Ethiopia has made significant strides in expanding coverage of key malaria interventions. It is known that lacking blanket coverage and under-utilization of intervention tools by the community will impede the efforts of malaria prevention and control programmes. The objectives of this study were to assess the coverage, utilization, preference of net shape and colour.

**Methods:** A community-based cross-sectional study was conducted from September 2011 to May 2012, in rural parts of Oromia, Amhara, Southern Nations, Nationalities, and Peoples' (SNNP) and Tigray Regional States of Ethiopia. A total of 2778 households were selected for the study using multi-stage sampling procedures. All households were visited by trained interviewers to collect the Long Lasting Insecticidal Nets (LLINs) coverage, the practice of using it regularly and net colour and shape preferences of the community at household level. Data were computerized using Epi-Info 7 and analysed using Stata/SE 11.0 version.

**Results:** Of the total households included in the study 86.4% (95% CI: 85.3 – 87.9) owned at least one net and 73.5% (95% CI: 71.3-74.9) of nets owned had someone sleeping under them every night. In terms of preferences, 58% (95% CI: 56.5-60.4) of respondents preferred blue; 32% (95% CI: 29.7-33.5) green; 6% (95% CI: 4.8-6.7) white, and 4% (95% CI: 3.4-5.0) other colours. With regard to shape preference, 46% (95% CI: 44.4-48.4) preferred circular shape, 43% (95% CI: 41.0-45.0) rectangular shape and 11% (95% CI: 9.3-11.8) have not specific shape preference.

**Conclusion:** The study found the highest net possession and better usage with varying shape and colour preferences among regional states. Furthermore, LLIN procurement could take the preference of varying community probably. [Ethiop. J. Health Dev. 2014;28(2):89-95]

## Background

Malaria in Ethiopia is estimated to affect 68 % of the population living in malaria-prone areas lying up to 2000 meters above sea level. The transmission of malaria is climate-and topography-dependent, peak transmission occurs during the months of September through December after the long rains of June through September, as well as just after the small rainy seasons of March and April. However, occasional epidemics have also been recorded in some areas 2000 meters above sea level (1, 2).

In accordance with Roll Back Malaria (RBM) guidelines to ease the burden of the disease, Ethiopia has made a significant progress in expanding coverage of key malaria interventions throughout the country (3, 4). The major scale-up efforts began in 2004/ 2005, with the introduction of Artemisinin-based Combination Therapy (ACT) as the first line treatment, expanded use of rapid diagnostic tests (RDT) as well as stepping up of vector control and prevention through the wide distribution of long-lasting insecticidal nets (LLINs), backed by targeted indoor residual spraying (IRS). The main aim of expanding access to these interventions was to achieve the objectives of the Ethiopian Federal Ministry of

Health (FMOH), 2006- 2010 five-year National Malaria Strategic Plan based on the 'Scale-up for Impact' (SUFI) approach (5).

In the period between 2004 and 2007, a total of 12.5 million RDT kits, 15.4 million treatment courses of artemether-lumefantrine, and 17.2 million LLINs were procured and distributed. Besides, the number of structures targeted for IRS also increased to 4.2 million between 2004 and 2005 as compared to the 3.4 million unit structures targeted between 2001 and 2003 [6]. Also, the coverage of LLINs in the country has increased from 3.4% in 2005 to 53.3% in 2007, with a Malaria Risk Population Adjusted Figure (MRPAF) of 69% (6, 7).

The 2008 Global Fund Impact assessment survey carried out by the Ethiopian Health and Nutrition Research Institute (EHNRI) and FMOH to assess the impact of Global Fund in 2008, found a 100% LLIN coverage (8). Among pastoralists, only 86.1% of respondents reported owning at least one LLIN (9). A study conducted in Ethiopia, reported 91% coverage (9); another study undertaken elsewhere also found 90.1% of households in the poor villages owned at least one LLIN (11).

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The claimed near universal coverage in LLIN distribution and the WHO target of 80% LLIN utilization especially by under-five-year-old children and pregnant women (12), has not been achieved in the entire country. An assessment that targeted under-five-year-old children who slept under LLINs reported a figure as low as 42.1% and 43% for pregnant women in the 2007 malaria indicator survey (6, 7). These numbers did not change in the 2008 EHNRI report (8). Baume and colleagues in a Net Mark study reported 65% usage rate (10).

Another study conducted in Arba Minch Zuria District of Southern Ethiopia, demonstrated a slightly improved rate of 73.3% (13). Besides the results of 2011 malaria indicator survey, the practice of properly utilizing nets reached 64.5% (14). A study conducted by Abebe et al. (15) overall ITN distribution and utilization were 97.6% and 81.6% respectively. The majority of households (53.2%) owned a single net per family and 38% of the respondents owned two nets per household. In line with this, the result of the study conducted in southern Ethiopia (16) showed that, out of the households which owned nets, over one-third reported that they had owned single mosquito nets (31.8%) , half (54.1%) owned two nets, and 11% had three net. This study in addition confirmed that, the average number of nets per net-owning household was 1.86.

The current, malaria vector control in Ethiopia largely relied on LLINs and Indoor Residual Spray (IRS). These interventions are reliable and effective in a wide range of situations (17-20). Under-utilization of intervention tools by the community was found to be one of the major drawbacks in the control programme whose goal is malaria elimination from low transmission areas of the country by 2015 (21-24). The objectives of the current study were to assess the LLIN coverage, utilization, and the net preference of household members in the selected malaria transmission areas of the country. In Ethiopia although different studies were conducted in the coverage and utilization of LLINs in various parts of the country, there is a limitation of data particularly on determinant factors that hinder utilization (25, 26). This study will provide information to be used during replacement of LLINs, especially with regard to preferences for shape and colour in the community.

## Methods

### *Ethiopian Health Delivery Structure:*

The current study was conducted in rural areas of four administrative regions of Ethiopia. Administratively, Ethiopia is divided into nine federal regional states (Oromia, Amhara, Southern Nations Nationalities and Peoples, Tigray, Gambela, Beni-Shangual Gumuz, Afar, Somali, Hararri) and two City administrations (Addis Ababa and Dire Dawa). Health service delivery in the

country follows a four-tier system. This paper used important terminologies based on their definitions as given on the 2009/10 Healthcare Indicators Manual [27]. The Federal Ministry of Health defines population at risk of malaria in Ethiopia, as a section of the population that lives in malaria prone areas, within the Anopheline altitudinal range that normally extends up to 2000m a. s. l. During the present study period, these comprise around 10,500,000 households (HH) based on the 2009/10 estimates (27), adjusted to 2011/12, using a 3% demographic growth rate per annum.

### *Sample Size Determination:*

The sample size was determined using Epi-Info software package, on the bases of population survey using random sampling with the assumption of 44% LLIN utilization (5), with 95% confidence level, 5.0% margin of error, design effect of 2, and 5.0% adjustment for non-response. Thus, in the four regions 2,956 households were included in the sample size. However, 6% (178) of the data was rejected due to poor quality; hence data collected from 2778 households was used for the analysis.

### *Sampling Procedures:*

Using purposive sampling technique, four regional states (i.e. Oromia, Amhara, SNNP and Tigray) were purposively selected. The selected regions have larger population size and thus believed to represent countrywide trends. In these regions multi-stage sampling method was applied to select districts, in which we involved local health personnel from each region. The selection of districts within each region was based on representativeness of the districts, (1) in terms of malaria transmission after long and short rainfall seasons; (2) the presence of at least one Health Centre (HC) with the required number of Health Posts (HPs), each selected districts encompasses two Peasant Associations.

### *Selection of Peasant Associations:*

The study used a total of 16 Peasant Associations (PAs) and the framework of the study design shown in figure 1 below. It was done by random selection from the list of PAs in the district health office. The PAs were the enumeration areas where, the sample population was determined in proportion to the Pas' total population. The study was carried out in 16 study sites/PAs so selected from Oromia (Aneno Shesho, W. Kenchera, Abosa Gebriel, and B. Giresa); from Amhara (Yelen, Jib Amba, Tachegnaw Saramba, and Jewesa Negesa); from Southern Nations Nationalities Peoples' (Jolie One, Jolie Two, Gogete One, and Gogete Two) and Tigray (Bethe Yohanes, Lakhia, Modogo, and Hatsebo) from September 2011 to May 2012. All of the study areas in these regions are located below 1900 meters above sea level.

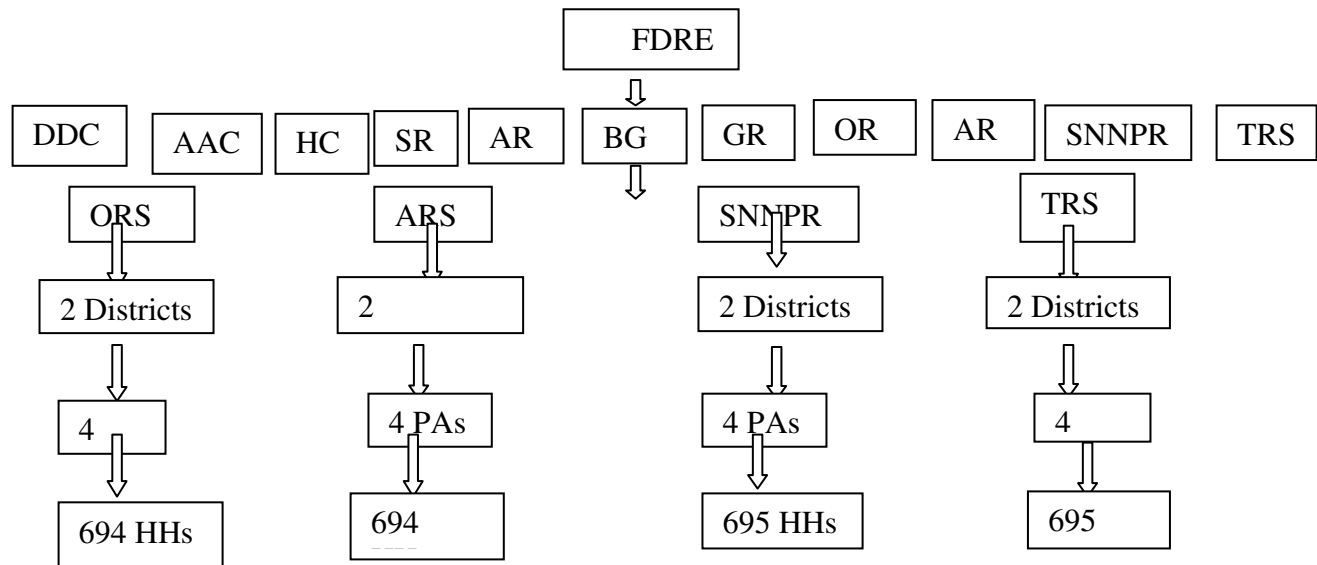


Figure 1: Framework of the study design used, for possession, utilization and preference of Long-lasting Insecticidal Nets after introduction in rural settings of Ethiopia, conducted from Sept 2011 to May 2012

Note: Federal Democratic Republic of Ethiopia (FDRE), Dire Dawa City Administrative (DDCA), Addis Ababa City Administrative (AAC), Hararri City Administrative (HCA), Somali Regional State (SRS), Afar Regional State (ARS), Beni-Shangul Gumuzi Regional State (BGRS), Gambela Gional State (GRS), Oromia Regional State (ORS), Amhara Regional State (ARS), Southern Nation Nationalities Peoples' Regional State (SNNPRS), Tigray Regional State (TRS),

#### **Selection of Households:**

Household (HH) was defined as a single person living alone or a group of persons voluntarily living together, having a common housekeeping arrangements for supply of basic living needs. The mean number of people per household was considered to be five with an assumption that the family size might range from a single HH to an extended family of greater than seven (27, 28).

The sampling frame was the list of households of each PA. Households in the enumerated PAs were the study units. The participating households were selected using systematic random sampling, taking one in every 6th HH, from the list of eligible households in each Peasant Association. Selection and enrolment of households were based on the criteria that they need to be residents of the study site at least for the last seven years and the head of the HH be willing to participate in the study.

#### **Data Collection:**

The core indicator data collection tool was prepared to evaluate the household LLIN coverage level, the practice of regular LLIN use and net shape as well as colour preferences of the community. The questionnaire covered background characteristics of the respondent's household level information, the number of LLINs owned, and the

source from which they acquired the LLINs, shape and colour preference at household level, as well as utilization practices. The questionnaire was prepared in English, and translated into each local language the participants spoke: Amharic, Afan Oromo, Tigray and Guragegna/Chistanigna. The questionnaire was then pre-tested by trained data collectors outside the study PAs which had similar settings. The necessary revision was made based on the feedback obtained during the pre-test. The experience gained in the pre-testing was used in organizing the study properly. Net utilization was documented by trained local assistants visiting in person the HHs every other morning to observe the status of the net use and ask the participants to demonstrate how they hung and stretched their LLINs over the bed or sleeping mattress.

#### **Data Management and Analysis:**

The collected data were computerized using Epi-Info 7 and analysed using Stata/SE 11.0. Proportions and number of respondents were used to summarize categorical variables; 95% CI was constructed around selected proportions to help in making inference about the target population.

#### **Ethical Clearance:**

The study was approved by the Ethiopian Health and Nutrition Research Institute, Scientific and Ethical Review Committee, and was conducted with the understanding and informed consent of all respondents. The participants were informed in clear, comprehensible terms in the local language about the objectives, study protocol, and advantages and inconveniences. Besides, participants were told they had complete liberty to participate or refuse to participate. The content of an information sheet cleared by the ethics committee was

made available to every community member. Thus, verbal or written consent was obtained from the study participants before administering the questionnaire.

## Results

### **Overall LLINs Ownership and Use:**

Out of 2778 surveyed HHs 86.4% (95% CI: 85.3 – 87.9) owned at least one net (Table 1). Among net owning households, 46.0% (95% CI: 44.0-48.0) owned one mosquito net, 36.0% (95% CI: 34.1-38.0) two nets and 17.9% (95% CI: 16.4-19.5) three nets. The total number of nets owned by households was 4138, with an average of 1.71 nets per net-owning household. Net possession at regional level was 79.1% in Oromia, 90.0 in Amhara, 84.5% in SNNP and 92.0% in Tigray (Table 1).

Overall household net utilization reached three-fourth 73.5% (95% CI: 71.3-74.9) and above one-fifth 22.7% (95% CI: 20.8-24.2); occasionally, it also fell below 5%. Of the surveyed households 4.3% (95% CI: 3.5-5.2) did not use completely (Table 1). However, regional level net utilization every night varied from 63.4% (Oromia) to 79.4 (Tigray) (Table 1).

### **Hangings and Stretching of LLINs:**

Throughout the survey time, the respondents were asked to demonstrate how they hung and stretched the net. It was observed that the majority of them (67.9%; 95% CI: 66.0-69.8%) demonstrated it correctly (i.e. when the net was hanged over the bed and tucked under the mattress or their sleeping mat); the rest 19% (95% CI: 17.5-20.6) were partially correct and 13% (95% CI: 11.6-14.4) were totally incorrect.

Table 1: Number and percentage of households LLINs possession and utilization, in the selected four regions of rural Ethiopia, collected from September 2011 to May 2012

| Characteristics     | Oromia<br>n (%) | Amhara<br>n (%) | SNNPR<br>n (%) | Tigray<br>n (%) | Total<br>n (%) |
|---------------------|-----------------|-----------------|----------------|-----------------|----------------|
| Possession          | n = 694         | n = 694         | n = 695        | n = 695         | n = 2778       |
| No                  | 145 (20.89)     | 69 (9.94)       | 108 (15.54)    | 55 (7.91)       | 367 (13.21)    |
| Yes                 | 549 (79.11)     | 625 (90.06)     | 587 (84.46)    | 640 (92.09)     | 2,401 (86.43)  |
| Utilization         | n = 549         | n = 625         | n = 587        | n = 640         | n = 2401       |
| Used every night    | 348 (63.39)     | 448 (71.68)     | 460 (78.36)    | 508 (79.37)     | 1764 (73.47)   |
| Used occasionally   | 154 (28.05)     | 156 (24.96)     | 108 (18.40)    | 126 (18.13)     | 544 (22.66)    |
| Not used completely | 47 (8.56)       | 21 (3.36)       | 19 (3.24)      | 17 (2.45)       | 104 (4.33)     |

n = number

### **Colour and Shape Preferences:**

More than half 58.3% (95% CI: 56.5-60.4) of LLINs-owning households preferred blue, followed by the rest one-third (31.9%, 95% CI: 29.7-33.5) green. However, about 6% (95% CI: 4.8-6.7) preferred white colour and a few 4%, (95% CI: 3.4-5.0) preferred other colours. Similarly, regional level variability was observed, moreover above half (56.5%) of the households in Amhara preferred green. In SNNP, respondents were indifferent between blue and green (Table 2).

With regard to shape, most of the LLINs, 93.4 %, (95% CI: 92.3% - 94.3%) of LLINs were rectangular, followed

by 5% (95% CI: 4.7% - 6.5%) circular and a few 1.0% (95% CI: 0.6% - 1.5%) a combination of both circular and rectangular (Table 2). However, a significant number of respondents were indifferent between circular 45.9% (95% CI: 44.4-48.4) and rectangular 43.4% (95% CI: 41.0-45.0). Although, regional level variability was observed, about two-thirds (76.96%) of the households in the Amhara region preferred circular nets. In SNNP, two-thirds (66.61%) of respondents preferred rectangular pieces. However, about 11% (95% CI: 9.3-11.8) did not exhibit specific preference. Most (97.96%) of the households LLINs were obtained freely from the government and the rest might be from NGOs (Table 2).

Table 2: Number and percentage of households' LLINs colour and shape preference and sources, in the selected four regions of rural Ethiopia, collected from September 2011 to May 2012.

| Characteristics                 | Oromia<br>n = 549<br>(%) | Amhara<br>n = 625<br>(%) | SNNPR<br>n = 587<br>(%) | Tigray<br>n = 640<br>(%) | Total<br>n = 2401<br>(%) |
|---------------------------------|--------------------------|--------------------------|-------------------------|--------------------------|--------------------------|
| <b>Preference of net colour</b> |                          |                          |                         |                          |                          |
| Blue                            | 327 (59.56)              | 229 (36.64)              | 258 (43.95)             | 587 (91.71)              | 1401 (58.35)             |
| Green                           | 132 (24.04)              | 353 (56.48)              | 257 (43.78)             | 24 (3.75)                | 766 (31.90)              |
| White                           | 63 (11.47)               | 36 (5.76)                | 23 (3.91)               | 12 (1.87)                | 134 (5.58)               |
| Other                           | 27 (4.92)                | 7 (1.12)                 | 49 (8.35)               | 17 (2.65)                | 100 (4.16)               |
| <b>Preference of net shape</b>  |                          |                          |                         |                          |                          |
| Circular                        | 241 (43.90)              | 481 (76.96)              | 139 (23.68)             | 241 (37.66)              | 1102 (45.90)             |
| Rectangular                     | 234 (42.62)              | 88 (14.08)               | 391 (66.61)             | 329 (51.40)              | 1042 (43.40)             |
| No specific choice              | 74 (13.48)               | 56 (8.96)                | 57 (9.71)               | 70 (11.6)                | 257 (10.70)              |
| <b>Sources of net</b>           |                          |                          |                         |                          |                          |
| Purchased                       | 9 (1.64)                 | 2 (0.32)                 | 6 (1.02)                | 9 (1.41)                 | 26 (1.08)                |
| Loaned                          | 4 (0.73)                 | 1 (0.16)                 | 3 (0.51)                | 0                        | 8 (0.33)                 |
| Freely obtained                 | 530 (96.54)              | 617 (98.72)              | 576 (98.13)             | 629 (98.28)              | 2352 (97.96)             |
| Combination                     | 6 (1.09)                 | 5 (0.80)                 | 2 (0.34)                | 2 (0.31)                 | 15 (0.62)                |

Note: n = number

### Discussion

The present study was conducted aiming at assessing household LLIN coverage and consistent utilization as well as colour and shape preferences in Ethiopia. This study found an average between 8-9 out of 10 of the surveyed households located below 1900 m above sea level (malaria endemic or potentially suitable for malaria transmission) owned at least a LLINs from September 2011 to May 2012. However, consistent use of net every night varied among the regions. More interestingly, households from different regional states have reflected they preferred various shapes and colours if and when presented with an opportunity to make own choice. Be that as it may, caution is advised when interpreting the present findings due to the fact that a limited number of households were included to generate the data.

Our present findings revealed highest (86%) LLIN coverage which is in conformity with a study that found 86.1% in pastoralist areas of Afar Regional State (9, 19). High LLIN coverage was also reported in an earlier in-depth survey carried out by Net-Mark (10). However, our study comprised HHs from four regional states with varying LLINs ownership status. Another study found low (55.2%) LLINs ownership in the same regions, revealing high regional disparity (14). It reported that owning at least one net per household increased in Tigray, followed by SNNPR, but Oromia had the lowest achievement in net ownership (14, 22). The result of the present study showed similar trend 79.1% in Oromia, 90.0 in Amhara, 84.5% in SNNP and 92.0% in Tigray. Such differences may arise due to worn out nets that reduce ownership level, and it could also be that the indicator survey had been conducted just before the replacement programme of FMOH. As Ethiopia, targets *P. falciparum* malaria elimination, in low transmission areas by 2015 (21, 20), it needs to increase its coverage pace, hand in hand with LLIN replacement, in order to sustain the gains in malaria control and

achieve the planned targets, even though 41 million nets have already been distributed throughout the country to date (18). For instance, Madagascar has scaled up and already achieved a 90% net coverage for malaria control activities with a goal of elimination by 2009 (11) surpassing the global target, at an earlier date.

In Ethiopia malaria is mainly seasonal and unstable, due to which the population at large is non-immune. Hence the population at risk of malarial infection is not age dependent (2, 6, 7) as in most Sub Saharan countries. Multiple LLIN ownership and increasing indoor residual spray coverage for effective protection of all household members should be considered (17). The malaria control strategy in Ethiopia is to distribute LLINs with the target of ensuring ownership of two LLINs per household (21). The current finding showed that the mean LLIN ownership was 1.71 nets per HH which coincides with a study conducted by NetMark (10) and Malaria Consortium report in SNNPR (16); they reported a mean household ownership of 1.8 nets, per household.

The results of our study on utilization stood at 73%, which is consistent with the findings of a previous longitudinal study in Southern Ethiopia (13). Regarding the practice of hanging and stretching the nets, 68.0% of the respondents hanged, stretched and tucked their nets correctly. This result is nearly similar with the results of 2011 malaria indicator survey (14) where the practice of properly utilizing nets was 64.5%, even if it varied from 55% in Oromia to 67.7% in Tigray region. Our study showed regional utilization disparity, from 63.4% in Oromia to 79.4% in Tigray. Although, one of the objectives of 2011-2015 plan of the FMOH is to distribute 100% LLINs and ensure utilization rate of 80% (21), there is a gap between possession and usage, making the applicability of this key vector control tool less effective than desired (23). This indicates a need for

more Information Education and Communication or Behavioural Change Communication (IEC/BCC) work at a community level by the malaria control programme. Van den et al (25) recommend: "In order to reach the RBM goals for bed net coverage and increase ITN use, it will be useful for programs to identify and address the determinants of ITN use and non-use."

The finding related to preferences for shape and colour is an important aspect of the present study. So far, similar studies indicated rectangular shape and light blue colour are more preferable (26). In this study, however, 58% of the respondents preferred blue and 32.0% green, this is not in agreement with the freely distributed net colour, where the vast majority of nets (93%) were blue. This result is consistent with the report of Net Mark where the vast majority of nets owned (84%) were blue rectangular LLINs (10). In connection with this, it was reported that Light-blue, rectangular, polyester LLINs of different sizes were preferred by respondents in India and Nepal in a large-scale intervention trial in the prevention of visceral leishmaniasis (26). The shape of nets owned by the community was rectangular (93.4%). However, our findings showed that rectangular nets preferred by 43.0% of the community, while, 46.4% preferred circular ones. Similarly, a study conducted in eastern Ethiopia also identified the colour and shape preference were barriers to bed net use, suggesting that blue and cylindrical LLINs were more preferable to white and rectangular ones (24). At regional level, circular nets were the most preferred kind in the Amhara region (76.9%), whereas rectangular ones were the most preferred in SNNP (66.7%) and Tigray (51.7%) regions. In Oromia, both circular (43.8%) and rectangular (42.7%) nets were almost equally preferable. It would be fair to contend that net distributors did not take into account shape preferences of the beneficiaries. Factors that determine shape preference included the size and shape of the house, the number of holes to be bored into the wall to hang a net properly (four for rectangular nets and only one for circular ones) (10, 24). Besides, the tendency of many households to keep their walls unperforated especially during annual ceremonies was one of the problems. In addition, tukuls made net hanging difficult. The round structure with a pointed roof makes it difficult to find four hanging points for a rectangular net. The other problem was that rectangular nets did not have enough height for stretching. Due to this, the net did not reach the sleeping mat and was barely enough to tuck underneath (24). Due to these and other reasons, some families are obliged not to hang nets at all. Therefore shape and inadequate height of LLINs had somehow inhibited utilization.

Due to shortage of time and finance, increasing the number of study sites and sample size was not possible, nor was it feasible to repeat the observation for at least two years to significantly depict the ownership, utilization and preferences of LLINs in the study areas. Thus, it requires the need for caution in drawing general conclusions from the findings and generalizes to other rural parts of Ethiopia. However, the findings of the study will shed light on the wide range of ownership, utilization and preferences of LLINs from the point of view of diverse house structure, ethnic and cultural variations.

#### **Conclusion:**

The study found the highest net possession and better usage with the varying shape and colour preferences among regional states. Furthermore, LLIN procurement could take into account each community's shape and colour preferences

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