Factors associated with use of long lasting insecticidal net in Kailali District, Nepal

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INTRODUCTION

Malaria is the protozoan disease caused by the parasite of genus plasmodium. As per the World Health Organization Global Malaria Program, the primary intervention for effective malaria control is distribution of insecticide-treated nets, more specifically long-lasting insecticidal net, to achieve full coverage of populations at risk of malaria. The aim of the study was to identify associated factors with use of long-lasting insecticidal net in Kailali district.

METHODS: A community based quantitative cross-sectional study was carried out in 5 village development committees of Kailali district. Altogether 450 households which were determined based on probability proportional to household size. Analysis of association was made by bivariate logistic regression and multivariate logistic regression. Ethical approval was taken from Institutional Review Board, Institute of Medicine and written informed consent from each participant.

RESULTS: The study showed the proportion of use of long-lasting insecticidal net was 60% and net retention rate was about 96%. About 53% of households had net density of less than 0.5. Almost one-third of respondents had good knowledge about malaria. There were bad practices regarding to handling of nets. The study found strong significant association between long lasting insecticidal net use and factors such as wealth status, education, net density and knowledge about malaria.

CONCLUSIONS: There were some bad practices in regards to handling nets. It needs to be focused on net utilization behaviours change activities. Further extensive study particularly qualitative one on behaviours related to use of bed nets should be carried out.

Keywords: Long lasting insecticidal net, Net retention rate, Village development committees
cases have been reported continuously.\textsuperscript{3,4} The World Health Organization/Global Malaria Program (WHO/GMP) recommends the following three primary interventions for effective malaria control to move towards achieving the MDG by 2015:\textsuperscript{5} 1) Diagnosis of malaria cases and treatment with effective medicines. 2) distribution of insecticide-treated nets (ITNs), more specifically long-lasting insecticidal net (LLIN), to achieve full coverage of populations at risk of malaria and, 3) indoor residual spraying (IRS) to reduce and eliminate malaria transmission. Vector control is one strategy that Nepal is employing to eliminate Malaria. Long lasting insecticidal treated nets are an integral component of the recommendation for vector control. Nepal aims to eliminate or achieve near zero transmission of malaria by 2015. LLIN distribution is one of the major strategic interventions being implemented to achieve national goal. Activities are being focused in order to fulfil gaps between control and pre-elimination with a vision of malaria free Nepal by 2026.\textsuperscript{6}

It is clear that, net ownership is a necessary prerequisite for net utilization. However, whether or not a net owner will use a net every night, some nights or not at all depends on complex multi-level interactions between individual characteristics, household characteristics, social and cultural factors, community level factors, aspect of the physical environment and the characteristics of net itself.\textsuperscript{6,8} The aim of the study was to identify associated factors with use of long-lasting insecticidal net in Kailali district.

**METHODS**

**Study design, study population, and sample size**

The paradigm of the study was quantitative. The study was community based cross-sectional study. Five VDCs of 16 VDCs in which government of Nepal distributed LLIN in the year 2013 were selected as study area. Total households across the study VDCs were taken as sampling frame. Each household was considered as sampling unit. Kailali district was selected purposively. Ward of each VDC was considered as cluster. There were altogether 45 clusters across 5 VDCs and 15 clusters were selected based on probability proportional to HH size and 30 HHs were taken from each cluster by spin-the-pen method. Households that hadn’t received LLIN were not included in the study. Respondent less than 18 years of age was excluded from the study.  Sample size determination

The sample size was 446 calculating by using Epi info version 7 with estimation of the values; expected frequency- 50%, confidence limits- 7%, confidence interval- 95%, design effect- 2, clusters- 15, calculated sample size- 405. Assuming non response rate of 10%, final sample size was 446 (30 were taken from each cluster).

**Data collection procedures**

Data were collected by researcher himself and trained enumerator. One enumerator was selected for data collection. In net owning households, interviewer asked permission to enter and observe LLINs and observe whether the net was hanging correctly over sleeping places. The respondents were asked about: presence, number, use, duration of acquisition, practice regarding washing. Face-to-face interview with the head of household was used as data collection techniques. Semi-structured questionnaire and observation checklist were used as tools. Interview was conducted with the head of household, or another adult was taken as respondent if the head of household absent or unable to respond for any reason.

**Data management and statistical analysis**

The data obtained in manual form were checked for consistency and completeness. Then the data were subjected to electronic form through data entry process in Epi Data version 3.1. Further data were exported to SPSS version 20. Descriptive analysis of all indicators regarding LLIN usage with respect to predictor variables was done through calculating frequency, proportions and appropriate with 95% confidence intervals. Firstly, a bivariate analysis was performed to test the existence of significant association between utilization of LLIN and selected factors.

Secondly, the significant variables (p value <0.05) observed in bivariate analysis were subsequently included in multivariate analysis. Logistic regression model was applied to examine independent associations between independent variables and binary dependent variable (LLIN use).

**Validity and reliability**

Questionnaire was developed based on study objectives and variables, using related articles. Using the standard questionnaire used by malaria indicator survey, roll back malaria with necessary modification in the local context, maintained validity of the study. For ensuring validity of the information, observation of the net was made along with interview.

The language of the study technique and tool was Nepali. Translation of the tool into Nepali and back translation into English was done.

**Ethical consideration**

Approval letter and certificate of consent was taken from Institutional Review Board (IRB) of Institute of Medicine (IOM), University (TU). The purpose of the study was
shared and informed written consent was obtained from each respondent. Permission was obtained from Department of Community Medicine and Public Health (DCMPH), IOM and DPHO Kailali.

RESULTS

As information depicted in Table 1, about 48% populations was in the group 20 to 39 years, 42% and the mean age of the study population was 41.1 years with the standard deviation 11.7 years.

Table 1: Socio-demographic and wealth status of the respondents.

| Characteristics       | Number (n=445) | %   |
|-----------------------|----------------|-----|
| **Age (years)**       |                |     |
| 20-39                 | 214            | 48.1|
| 40-59                 | 187            | 42.0|
| ≥60                   | 44             | 9.9 |
| **Mean age; Mean±SD** | 41.1±11.7      |     |
| **Sex**               |                |     |
| Male                  | 270            | 60.7|
| Female                | 175            | 39.3|
| **Education**         |                |     |
| Illiterate            | 156            | 35.0|
| Non formal education  | 71             | 16.0|
| Primary               | 113            | 25.4|
| Secondary             | 68             | 15.3|
| SLC or above          | 37             | 8.3 |
| **Marital status**    |                |     |
| Married               | 426            | 95.7|
| Widow or divorced     | 19             | 4.3 |
| **Occupation**        |                |     |
| Agriculture           | 348            | 78.2|
| Daily labour          | 24             | 5.4 |
| House maker           | 24             | 5.4 |
| Business              | 16             | 3.6 |
| Private employee      | 14             | 3.1 |
| Public servant        | 11             | 2.5 |
| Others                | 8              | 1.8 |
| **Religion**          |                |     |
| Hindu                 | 411            | 92.4|
| Buddhist              | 23             | 5.2 |
| Christian             | 6              | 1.3 |
| Others (Kirat, Muslim, Nirankar) | 5 | 1.1 |
| **Ethnicity**         |                |     |
| Disadvantaged janajati | 221     | 49.7|
| Upper caste           | 135            | 30.3|
| Dalit                 | 84             | 18.9|
| Religious minorities  | 3              | 0.7 |
| Advantaged janajatis  | 2              | 0.4 |
| **Wealth quintile**   |                |     |
| Lowest quintile       | 86             | 19.3|
| Second quintile       | 90             | 20.2|
| Middle quintile       | 89             | 20.0|
| Fourth quintile       | 90             | 20.2|
| Highest quintile      | 90             | 20.2|

In regards to sex of the study population, 60.7% were male and 39.3% were female. More than one-third (35%) of the study populations were illiterate. In regards to marital status, 95.7% of study populations were married and 4.3% were widow or divorced. Majority of the study population were involved in agriculture which was 78.2%, followed by daily labour and house maker. Majority (92.4%) of the study populations were from Hindu religion and regarding ethnicity almost half (49.7%) of study populations were from disadvantaged janajati. About 19% of respondents were from lowest quintile, 20.2% from second quintile, 20% from middle quintile, 20.2% from fourth quintile and 20.2% from highest wealth quintile.

Status of bed nets and household characteristics

As per information shown in Table 2, there were altogether 1256 usable nets. Among those 1184 were LLIN and 72 were other than LLIN.

Table 2: Status of bed nets and household characteristics.

| Characteristics       | Number | Percentage |
|-----------------------|--------|------------|
| **Usable bed net**    | 1256   |            |
| LLIN (among usable bed net) | 1184  |            |
| Other than LLIN       | 72     |            |
| **Number of LLIN when got** | 1234  |            |
| **Number of LLIN at present** | 1184  |            |
| **Number of LLIN Lost** | 50   |            |
| **Reason for loss(n=50)** |       |            |
| Destroyed             | 50     | 100        |
| **Net retention**     |        |            |
| Net retention rate    | 1184/1234 *100 | 95.95 |
| **Average number of nets per household** | 2.7±0.9 | |
| **Household size**    |        |            |
| Two to four           | 94     | 21.1       |
| Five to seven         | 247    | 55.5       |
| Eight and above       | 104    | 23.4       |
| **Average household size** | 6.1±2.2 | |
| **Net density**       |        |            |
| zero to 0.499         | 237    | 53.3       |
| 0.5                   | 131    | 29.4       |
| 0.51                  | 77     | 17.3       |
| **Wall material**     |        |            |
| Mud                   | 372    | 83.6       |
| Cement                | 68     | 15.3       |
| Wood planks           | 3      | 0.7        |
| Sticks                | 1      | 0.2        |
| Others                | 1      | 0.2        |
| **Roof material**     |        |            |
| Mud sheet             | 159    | 35.7       |
| Cement sheet          | 138    | 31.0       |
| Galvanized sheet      | 97     | 21.8       |
| Thatch                | 28     | 6.3        |
| Cement                | 23     | 5.2        |
At the time of receiving, there were 1234 LLIN and within one year of time period, the LLIN were 1184 remained. Fifty bed nets were lost. The main reason for losing net was destroyed. The average number of nets per household was 2.7 with the standard deviation of 0.9. About 21% of the households had household size of two to four people, 55.5% HHs had five to seven people and 23.4% had eight and above. The average household size was 6.1 with standard deviation of 2.2. In regards to net density, 53.3% households had net density of 0 to 0.499, 29.4% households had 0.5 and 17.3% household had greater than 0.51. Eighty four percent of households had wall made up of mud, 15.3% of HHs had wall made up of cement and regarding the roof material, 35.7% had mud sheet, 31% cement sheet, 21.8% had galvanized sheet, 6.3% had thatch and 5.2% had cement.

Knowledge about malaria

As information depicted in Table 3, about 82% of the respondents had known that malaria was transmissible disease. However, only about 20% of respondents had known about the route of transmission of malaria. About 27% of respondents had known about the signs and symptoms of malaria. Similarly, 27.2% of respondents had known about the ways of prevention of malaria. In regards to overall knowledge, about 52% of the respondents had average knowledge on malaria, 32% had good knowledge, and 16% had no knowledge on malaria.

Table 3: Knowledge about malaria.

| Characteristics                                  | Number | %   |
|--------------------------------------------------|--------|-----|
| Does malaria transmit? (n=445)                    |        |     |
| Yes                                              | 363    | 81.6|
| No                                               | 82     | 18.4|
| Know about ways of transmission (n=363)           |        |     |
| Yes                                              | 71     | 19.6|
| No                                               | 292    | 80.4|
| Know about cause of malaria (n=445)               |        |     |
| Yes                                              | 7      | 1.6 |
| No                                               | 438    | 98.4|
| Know about signs and symptoms of malaria (n=445)  |        |     |
| Yes                                              | 120    | 27  |
| No                                               | 325    | 73  |
| Know about way of prevention (n=445)              |        |     |
| Yes                                              | 121    | 27.2|
| No                                               | 324    | 72.8|
| Overall knowledge about malaria (n=445)            |        |     |
| Good knowledge                                   | 142    | 31.9|
| Average knowledge                                | 232    | 52.1|
| No knowledge                                     | 71     | 16.0|

Long lasting insecticidal net use and handling

As per the information shown in Table 4, the proportion of use of LLIN was found 60%. Among the users of last night, 98.9% had tucked the net while sleeping.

Table 4: Long lasting insecticidal net use and handling.

| Characteristics                                      | Number | %   |
|------------------------------------------------------|--------|-----|
| Slept under LLIN last night (n=445)                  |        |     |
| Yes                                                  | 265    | 59.6|
| No                                                   | 180    | 40.4|
| Proportion of use of LLIN                            | 59.6 (95% CI 55.1-64.1) |
| Reason for not using net (n=180)                     |        |     |
| Not enough Net                                       | 109    | 60.5|
| No mosquito now                                      | 83     | 46.0|
| Torn net                                             | 24     | 13.3|
| Any other reason                                     | 4      | 2.2 |
| Tuck a net among users (n=265)                        |        |     |
| Yes                                                  | 262    | 98.9|
| No                                                   | 3      | 1.1 |
| Period of the year net use (n=445)                   |        |     |
| All year                                             | 50     | 11.2|
| Only the rainy season                                | 395    | 88.8|
| LLIN taken outside the house for use (n=445)         |        |     |
| No                                                   | 440    | 98.9|
| Yes                                                  | 5      | 1.1 |
| Where does these nets used(n=5)                      |        |     |
| Field                                                | 4      | 80  |
| Farm hut                                             | 1      | 20  |
| Period of taking LLIN outside the house (n=5)        |        |     |
| Rainy season                                         | 5      | 100 |
| LLIN use over material                               |        |     |
| Reed mattress                                        | 81     | 18.2|
| Wooden bed                                          | 422    | 94.8|
| Washing net ever had (n=445)                         |        |     |
| Yes                                                  | 379    | 85.2|
| No                                                   | 66     | 14.8|
| Washing material (n=379)                             |        |     |
| Soap and detergent powder                            | 198    | 52.2|
| Plane water                                          | 101    | 26.6|
| Detergent powder                                     | 80     | 21.2|
| Net soaked during washing (n=379)                    |        |     |
| Soaked                                               | 200    | 52.8|
| Not soaked                                           | 179    | 47.2|
| Scrub net during washing (n=379)                     |        |     |
| No                                                   | 378    | 99.7|
| Yes                                                  | 1      | 0.3 |
| Drying net after washing (n=379)                     |        |     |
| Other than shade                                     | 195    | 51.5|
| Shade                                                | 184    | 48.5|
| Keeping net over the bed (n=445)                     |        |     |
| Tightly hanging over bet                             | 424    | 95.3|
| Folded on the bed                                    | 11     | 2.5 |
| Softly hanging over bed                              | 10     | 2.2 |

In regards to the net use of the year, 88.8% of the population used LLIN during the rainy season only and 11.2% used throughout the year. It was found that 94.8% of LLIN used over wooden bed and 18.2% over reed mattress. About 85% of the respondents reported they had washed their net at least once before. Among those who washed the net, 52.2% used soap and detergent powder
while washing, 26.6% washed with plain water and 21.2% used detergent power only. About 53% of the population reported that they soaked net during washing. After washing net, nearly half of the study population dried net under sun. In regards to net hanging over the bed, 95.3% of respondents hung net tightly over the bed.

### Table 5: Bi-variate analysis showing association between different independent variables and LLIN use.

| Characteristics         | LLIN use (n=445) |               |               | COR   | 95% CI | P value |
|-------------------------|------------------|---------------|---------------|-------|--------|---------|
|                         | No (n=180) number (%) | Yes (265) number (%) |               |       |        |         |
| **Age**                 |                  |               |               |       |        |         |
| 20 to 39 years          | 83 (46.1)        | 131 (49.4)    | 1             |       |        |         |
| 40 to 59 years          | 77 (42.8)        | 110 (41.5)    | 0.91          | 0.61-1.35 | 0.626 |         |
| ≥60 years               | 20 (11.1)        | 24 (9.1)      | 0.76          | 0.4-1.46 | 0.412 |         |
| **Sex**                 |                  |               |               |       |        |         |
| Male                    | 92 (51.1)        | 178 (67.2)    | 1.96          | 1.33-2.89 | 0.001 |         |
| Female                  | 88 (48.9)        | 87 (32.8)     | 1             |       |        |         |
| **Education**           |                  |               |               |       |        |         |
| Illiterate              | 133 (73.9)       | 94 (35.5)     | 1             |       |        |         |
| Literate                | 47 (26.1)        | 171 (64.5)    | 5.13          | 3.39-7.81 | <0.001 |         |
| **Marital status**      |                  |               |               |       |        |         |
| Widow or divorced       | 10 (5.6)         | 9 (3.4)       | 1             |       |        |         |
| Married                 | 170 (94.4)       | 256 (96.6)    | 1.67          | 0.67-4.20 | 0.273 |         |
| **Ethnic group**        |                  |               |               |       |        |         |
| Dalit(Ref)              | 62 (34.4)        | 22 (8.3)      | 1             |       |        |         |
| Others                  | 118 (65.6)       | 243 (91.7)    | 5.8           | 3.40-9.9 | <0.001 |         |
| **Occupation**          |                  |               |               |       |        |         |
| Agriculture             | 140 (77.8)       | 208 (78.5)    | 1             |       |        |         |
| Others                  | 40 (22.2)        | 57 (21.5)     | 0.959         | 0.607-1.52 | 0.858 |         |
| **Wealth status**       |                  |               |               |       |        |         |
| Lowest                  | 114 (63.3)       | 32 (12.1)     | 1             |       |        |         |
| Middle                  | 50 (27.8)        | 99 (37.4)     | 7.05          | 4.2-11.85 | <0.001 |         |
| Highest                 | 16 (8.9)         | 134 (50.5)    | 29.84         | 15.58-57.15 | <0.001 |         |
| **Household size**      |                  |               |               |       |        |         |
| Zero to 5               | 90 (50)          | 116 (43.8)    | 0.78          | 0.53-1.14 | 0.196 |         |
| Six and above           | 90 (50)          | 149 (56.2)    | 1             |       |        |         |
| **Net density**         |                  |               |               |       |        |         |
| 0-0.499                 | 115 (63.9)       | 122 (46.0)    | 1             |       |        |         |
| 0.5                     | 47 (26.1)        | 84 (31.7)     | 1.63          | 1.09-8.61 | 0.020 |         |
| 0.51 and above          | 18 (10)          | 59 (22.3)     | 3.09          | 1.72-5.55 | <0.001 |         |
| **Knowledge about malaria** |          |               |               |       |        |         |
| Good knowledge          | 42 (23.4)        | 100 (37.7)    | 9.24          | 3.96-21.54 | <0.001 |         |
| Average knowledge       | 89 (49.4)        | 143 (54.0)    | 6.24          | 2.86-13.61 | <0.001 |         |
| No knowledge            | 49 (27.2)        | 22 (8.3)      | 1             |       |        |         |

COR= Crude odds ratio, CI= Confidence interval, Significant= p value<0.05.

Bivariate association between different independent variables and LLIN use is shown in Table 5. The association between age as independent variable and LLIN use as dependent variable was not found significant. Regarding the sex of the heads of household, the LLIN use among male is 1.96 times higher than households of having female as household head (95% CI 1.33-2.89).

The association between LLIN use and independent variables such as occupation, marital status were not found significant. In regards to educational level of heads of household, the LLIN use among literate was found 5.13 times higher than households of having heads were illiterate (95% CI 3.39-7.81). In regards to ethnic group, the use of LLIN was found 5.8 times higher among other ethnic groups than Dalit (95% CI 3.4-9.9). In this bivariate analysis, the use of LLIN was found 29.84 and 7.05 times higher among highest wealth status (95% CI 15.58-57.15) and middle wealth status (95% CI 4.2-11.85) than that of respondents from lowest wealth status.

The study showed no any significant association between household size and LLIN use. The use of LLIN was found 3.09 times higher among the households of net density over 0.51 (95% CI 1.72-5.55) and 1.63 times...
higher among the households of net density of 0.5 (95% CI 1.09-8.61) than households of net density less than 0.5.

As information shown in the table, the association between LLIN use and knowledge about malaria was found highly significant. Population having good knowledge about malaria had 9.24 times higher use of LLIN (95% CI 3.96-21.54) and of having average knowledge about malaria had 6.24 times higher use of LLIN (95% CI 2.86-13.61) than population having no knowledge about malaria.

Table 6: Multi-variate binary logistic regression analysis.

| Characteristics          | Unadjusted OR | AOR 95% CI  | P value |
|--------------------------|---------------|-------------|---------|
| Wealth status            |               |             |         |
| Lowest                   | 1             | 3.3-16.89   | <0.001  |
| Middle                   | 7.05          | 2.13-17.85  | 0.001   |
| Highest                  | 29.84         | 2.05-14.26  | 0.001   |
| Knowledge about malaria  |               |             |         |
| No knowledge             | 1             | 2.91        | 0.004   |
| Average knowledge        | 6.24          | 1.41-6.01   | 0.004   |
| Good knowledge           | 9.24          | 1.03-5.65   | 0.043   |
| Education                |               |             |         |
| Illiterate               | 1             | 1.03-5.65   | 0.043   |
| Literate                 | 5.15          | 1.03-5.65   | 0.043   |
| Net density              |               |             |         |
| 0-0.499                  | 1             |             |         |
| 0.5                      | 1.63          | 2.41        |         |

AOR = Adjusted odds ratio, CI = Confidence interval, Significant= p<0.05

As shown in Table 6, the multi-variate binary logistic regression analysis revealed that knowledge about malaria was a significant independent variable influencing LLIN use. The use of LLIN was found 5.4 times higher among population who had good knowledge (95% CI 2.05-14.26) and 6.17 times higher among population who had average knowledge (95% CI 2.13-17.85) than population who had no knowledge about malaria. Net density has also significant role in using LLIN. Households having net density of 0.5 had 2.41 times higher use of LLIN (95% CI 1.03-5.65) than HHs of having net density of 0.499 and less. The study showed that education was the independent factor of using LLIN. The LLIN use was found 5.15 times higher among literate (95% CI 1.41-6.01) than among illiterate.

Table 1: The knowledge about the disease caused by dog bite (n=111).

| Disease      | Frequency (%) |
|--------------|---------------|
| Rabies       | 52 (46.8)     |
| Don’t know   | 59 (53.2)     |
| Total        | 111 (100)     |

DISCUSSION

Kailali is one of the high malaria risk districts of Nepal. Therefore, government has adopted free distribution of net in the district as a major preventive measure for malaria. This study has tried to assess utilization of LLIN in household of Kailali district. The study also tried to find out the status and proportion of use of LLIN along with practices of handling of it. In each household, the practice of LLIN use was observed among head of households.

The proportion of use of LLIN was fairly low in Kailali district where as many as 60% of respondents were reported to have used LLIN the previous night. It was below the WHO target of 80% after free distribution of net.9 Study carried out in Ethiopia showed that the proportion of net use was 50.9%.10 Similarly several studies found the use of LLIN was in between 50% and 84.8%.11-13 One of the reasons for low use of LLIN as compared to WHO target could be the lack of strong educational campaigns accompanying LLIN distribution. Another reason for low uses could be seasonality, the study carried out during late rainy season.

The study found that the reasons for not using net were; not having enough net, no mosquitoes at present and torn nets. As per Pulford et al low mosquito density is the most widely identified reason for LLIN nonuse.14 The study found good practice of using net, almost all net users tucked the net under the bed. The study carried out in Kenya, showed this practice is quite low. In regards to use of net round the year, only 11.2% of users used net throughout the year. Study carried out in Kenya found 93.9 % used all round the year.15 The retention among those who received the LLIN found 95.95% was found higher than that found in similar studies.16,17
The study found 85% of the respondents washed their net before, which was higher than the finding of study carried out in Ethiopia. Majority of respondents used some washing materials (soap, detergent or both) while washing, similar findings were observed in Kenya. However, the proportion of washing net with plain water was higher than the study carried out in Kenya. This bad practice of washing might be due to very dirtiness of net and it was because of nearby kitchen of sleeping room. The practice of scrubbing net while washing was quite low, which was consistent with the findings from Kenya. The practice of drying net under other than shade was 51.5% which was as high as found in Kenya study. This study found that good practice of handling bed net over the bed as compared to the finding of the study carried out in Kenya. The study found about one third of the population had good knowledge about malaria and half of the population had average knowledge while in other studies showed it was less than this finding.

The study tried to find out the associated factors with use of LLIN through bivariate analysis and multi-variate binary logistic regression analysis. In bivariate analysis, the association is analyzed with different categories of variables like demographic characteristics, socioeconomic characteristics, household characteristics and individual characteristics. The study found no statistical association between LLIN use and age group of the study population which was in contrast to other several studies. The study of Tokponnon et al in Benin and study carried out in Africa showed statistical significance association with age group. Therefore, it is recommended for the further study. The study found gender of heads of household significantly associated with use of LLIN. In household having male as head of HHs had 1.96 times higher use of LLIN than the HHs of having female as head. This could be due to behavioral nature of female giving net to other member of household in case of net scarcity. However, the study carried out by Sena et al in Ethiopia showed, there was no any statistical association between gender of head of household and use of LLIN. Socio-economic factors such as education, marital status, ethnic group, occupation and wealth status put into bivariate analysis to identify the association with LLIN use. Education, ethnic group and wealth status were found significantly associated with LLIN use. Several other studies had shown insignificant association with level of education and use of LLIN. Level of education might have strong implication on use of net.

The study found the significant association of LLIN use with ethnicity of population. The use of LLIN was 5.8 times higher among other ethnic groups than Dalit. This might be due to low social characteristics of Dalit in the community. Similar finding had been observed in study carried out in China by Xu et al in 2014 and they had shown the low use of bed net among Jinuno people the marginalized ethnic community. This study found the more use of LLIN among households from higher wealth status. The association between LLIN use and wealth status was found significant. The use of LLIN was 29.84 and 7.05 times higher among households from highest and middle wealth status than households of lowest wealth status. The study also showed independent association of wealth status of household with use of LLIN in multivariate analysis. The study carried out by Nagolde et al and Graves et al had shown the similar association of LLIN with wealth status.6,7 Since wealth status is associated with higher education, having standard of living, it was likely that use of LLIN associated with this factor, as was observed by Hwang et al 2010.

The present study found no any association between LLIN use and marital status of household head. This was the similar finding of the study carried out in Ethiopia by Sena et al. Other studies carried out in Kenya and Nigeria reported marital status of head of household was not associated with use of LLIN. Similarly, this study found, there was no any significant association between LLIN use and occupation of head of household. The study carried out by Sena et al in Ethiopia, had shown that there was no any significant association between LLIN use and type of occupation of head of household.

The present study found the high significant association between knowledge about malaria and use of LLIN. The study found knowledge about malaria as independent factor for use of LLIN, which was observed in multivariate model of analysis. Having knowledge about malaria particularly ways of transmission, methods of prevention might have increased the perceived risk of malaria. Several other studies carried out in different part of the globe showed significant association of LLIN use with level of knowledge about malaria.

The study found significant association between use of LLIN and net density. Net density of less than 0.5 represents the inadequacy of net and such condition decrease use of LLIN. The study found 3.09- and 1.63-times higher use of LLIN in household having net density of greater or equal to 0.51 and 0.5 respectively than the net density of less than 0.5. In general, increase availability of nets in households as assessed in cross sectional surveys was associated with increased net use. The study carried out by Ngondi et al and Graves et al in Ethiopia had similar association observed between use of LLIN and net density. The study found that there was no any significant association between household size and use of LLIN as found in study carried out by Tokponnon et al in Benin and Baume et al in Ethiopia.

CONCLUSION
The study was carried out across five VDCs of Kailali districts, in which government of Nepal with partnership of development agencies had distributed long lasting insecticidal net free of cost in 2013. The main general
objective of the study was to assess the factors associated with use of LLIN.

Based on the findings and objectives of the study following conclusions are made. The proportion of use of LLIN was found 60%. The retention rate of the nets was found higher in the community where it was 95.95%. Among the users, the practice of using net was good. Majority of users used their nets in their own house, hung nets correctly and tuck their net under the bed while sleeping. Knowledge about malaria, wealth status, education level and net density were associated with use of LLIN. Having good knowledge about malaria showed strong association with use of LLIN. The use of LLIN was 19 times higher among highest wealth status than of having lowest wealth status.

Although free distribution of net is one of the ways of achieving universal coverage of LLIN in the community, it is an important to focus on behaviour change communication part of the program that would promote the use of LLIN. The behaviour program interventions should find on targeted groups in which the use of LLIN was found low.

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REFERENCES

1. Park K. Park’s Textbook of Preventive and Social Medicine. 21st edn. Banarasidas Bhanot Publishers; 2011.
2. Jongwutiwes S, Putaporntip C, Iwasaki T, Sata T, Kanbara H. Naturally acquired Plasmodium knowlesi malaria in human, Thailand. Emerg Infect Dis. 2004;10(12):2211.
3. World Health Organization. WHO Malaria Report. 2013. Available from: https://www.who.int/iris/bitstream/10665/97008/1/9789241564694_eng.pdf.
4. Health Division E and DC. Nepal Malaria Strategic Plan 2014-2025. Vol 2016; 2016. Available from: http://www.edcd.gov.np/resource-detail/nepal-malaria-strategic-plan-2014-2015.
5. GMP. Insecticide-treated mosquito nets: a WHO Position Statement. Available from: http://www.txdpg.or.tz/fileadmin/documents/dpg_internal/dpg_working_groups_clusters/cluster_2/health/Key_Sector_Documents/Malaria/ITNsposspaperfina1.pdf. Accessed on 1 October 2020.
6. Ngondi JM, Graves PM, Gebre T, Mosher AW, Shargie EB, Emerson PM, et al. Which nets are being used: factors associated with mosquito net use in Amhara, Oromia and Southern Nations, Nationalities and Peoples’ Regions of Ethiopia. Malaria J. 2011;10(1):92.
7. Graves PM, Ngondi JM, Hwang J, Getachew A, Gebre T, Mosher AW, et al. Factors associated with mosquito net use by individuals in households owning nets in Ethiopia. Malaria J. 2011;10(1):354.
8. Hawley WA, Phillips-Howard PA, ter Kuile FO, Terlouw DJ, Vulule JM, Oombok M, et al. Community-wide effects of permethrin-treated bed nets on child mortality and malaria morbidity in western Kenya. Am J Trop Med Hyg. 2003;68(4):121-7.
9. WHO | World Malaria Report 2011 [Internet]. [cited 2020 Dec 23]. Available from: https://www.who.int/malaria/publications/atoz/9789241564694/en/.
10. Baume CA, Reithinger R, Woldehanna S. Factors associated with use and non-use of mosquito nets owned in Oromia and Amhara Regional States, Ethiopia. Malaria J. 2009;8(1):264.
11. Tokponnon FT, Aholouke B, Denon EY, Gnanguenon V, Bokossa A, N’guessan R, et al. Evaluation of the coverage and effective use rate of long-lasting insecticidal nets after nation-wide scale up of their distribution in Benin. Parasite Vectors. 2013;6(1):265.
12. Sena LD, Deressa WA, Ali AA. Predictors of long-lasting insecticide-treated bed net ownership and utilization: Evidence from community-based cross-sectional comparative study, Southwest Ethiopia. Malaria J. 2013;12(1):406.
13. Gerstl S, Dunkley S, Mukhtar A, Maes P, De Smet M, Baker S, et al. Long-lasting insecticide-treated net usage in eastern Sierra Leone- The success of free distribution. Trop Med Int Health. 2010;15(4):480-8.
14. Pulford J, Hetzel MW, Bryant M, Siba PM, Mueller I. Reported reasons for not using a mosquito net when one is available: a review of the published literature. Malaria J. 2011;10(1):83.
15. Mejia P, Teklehaimanot HD, Tesfaye Y, Teklehaimanot A. Physical condition of Olyset® nets after five years of utilization in rural western Kenya. Malaria J. 2013;12(1):158.
16. Hassan SEDH, Malik EM, Okoued SI, Eltayeb EM. Retention and efficacy of long-lasting insecticide-treated nets distributed in eastern Sudan: A two-step community-based study. Malaria J. 2008;7(1):85.
17. Batissio E, Habte T, Tesfaye G, Getachew D, Tekalegne A, Kilian A, et al. A stitch in time: A cross-sectional survey looking at long lasting insecticide-treated bed net ownership, utilization and attrition in SNNPR, Ethiopia. Malaria J. 2012;11(1):1.
18. Noor AM, Kirui VC, Brooker SJ, Snow RW. The use of insecticide treated nets by age: implications for universal coverage in Africa. BMC Public Health. 2009;9(1):369.
19. Thawani N, Kulkarni MA, Sohani S. Factors associated with coverage and usage of long-lasting insecticidal nets in Madagascar. J Trop Med. 2009;2009:1-6.
20. Xu J, Liao Y, Liu H, Nie R, Havumaki J. Use of bed nets and factors that influence bed net use among Jinuo Ethnic Minority in Southern China. Gosling RD, ed. PLoS One. 2014;9(7):e103780.

21. Hwang J, Graves PM, Jima D, Reithinger R, Patrick Kachur S. Knowledge of malaria and its association with malaria-related behaviors- results from the Malaria Indicator Survey, Ethiopia, 2007. PLoS One. 2010;5(7).

22. N Ng'ang'a P, Jayasinghe G, Kimani V, Shililu J, Kabutha C, Kabuage L, Githure J, Mutero C. Bed net use and associated factors in a rice farming community in Central Kenya. Malaria J. 2009;8(1):1-8.

23. Babalola OJ, Sambo MN, Idris SH, Ajayi IOO, Ajumobi O, Nguku P. Factors associated with utilization of LLINs among women of child-bearing age in Igabi, Kaduna State, Nigeria. Malaria J. 2019;18(1):1-9.

24. Israel OK, Fawole OI, Adebowale AS, Ajayi IO, Yusuf OB, Oladimeji A, et al. Caregivers’ knowledge and utilization of long-lasting insecticidal nets among under-five children in Osun State, Southwest, Nigeria. Malaria J. 2018;17(1):1-9.

25. Eisele TP, Keating J, Littrell M, Larsen D, Macintyre K. Assessment of insecticide-treated bednet use among children and pregnant women across 15 countries using standardized national surveys. Am J Trop Med Hyg. 2009;80(2):209-14.

Korenromp EL, Miller J, Cibulskis RE, Cham MK, Alnwick D, Dye C. Monitoring mosquito net coverage for malaria control in Africa: Possession vs. use by children under 5 years. Trop Med Int Health. 2003;8(8):693-703.

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