

RESEARCH ARTICLE

Acceptance and Utilization of Long-Lasting Insecticide-Treated Nets (LLINs) by the Community of Mamboro Sub-district and Katiku Tana Sub-district, Central Sumba Regency, East Nusa Tenggara

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Abstract

Distribution of mosquito nets is one healthcare strategy implemented to control the number of malaria cases in Indonesia. East Nusa Tenggara is one of the provinces contributing to high malaria rates. Cases are high in several areas, including Central Sumba regency. This study aimed to describe the behavior of the people of Mamboro and Katiku Tana sub-districts in using long-lasting insecticide-treated nets (LLINs), the number of LLINs owned, number of beds, number of family members, number of pregnant women and toddlers, distribution of LLINs in families, and LLINs utilization. This is a descriptive quantitative study with a cross-sectional design. The research was conducted in the work area of the Mananga Health Center of Susu Wendewa village of Mamboro sub-district and Malinjak Health Center of Makata Keri village of Katiku Tana sub-district, Central Sumba regency. The research was carried out from 9–19 September 2021 with 341 heads of families as respondents. Data were collected using questionnaires and in-depth interviews. Most families had LLINs (n=287; 94.1%); the total number of LLINs owned was 341, used by 1,220 (94.7%) family members with ten pregnant women and 35 children under five. The number of installed LLINs was 290 units (85%), LLINs obtained from the health centers within 1–3 months was 44% (126 families), 314 units (92%) were used while sleeping, and there were still family members who did not use LLINs every night. We conclude that the acceptance and utilization of LLINs should not stop at the distribution of LLINs to the public and must be supported by an evaluation in the form of regular surveys to ensure that LLINs are correctly used.

Keywords: Acceptance, LLINs, utilization

Introduction

Malaria is a zoonotic disease through mosquito bites still found in East Nusa Tenggara province, especially Central Sumba regency. Malaria is a disease caused by vectors (protozoa) of the genus *Plasmodium* which is transmitted through the bite of the *Anopheles* mosquito.^{1,2}

The epidemiological triad explains that disease is determined by three factors: the host, the cause of the disease (agent), and the environment (environment). Malaria transmission is related to humans as hosts and their behavior, the presence of *Plasmodium* in the female mosquito, and the environment as a breeding and resting place for vectors.³ These three factors determine the risk of malaria transmission; thus, the three factors of human behavior, the presence of agents, and the environment must be considered to prevent

malaria transmission. Prevention by controlling vectors and preventing mosquito bites to humans needs to be done to break the chain of transmission.^{4,5}

One of the programs carried out by the government to control malaria to achieve elimination is the distribution and use of long-lasting insecticide-treated nets (LLINs).⁶ LLINs are recommended as a strategic factor in breaking the malaria transmission chain because the insecticide content in the fiber can kill mosquitoes.^{7,8} The use of LLINs, or polished nets, has been recommended by the World Health Organization since November 2004.⁹ Several efforts have been made by the Indonesian government to control malaria, including the distribution of insecticide-treated nets since 2007 and strengthened by the issuance of Minister of Health of Indonesia Decree Number

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293 of 2009. Insecticides used in LLINs are safe for humans and have been used by many countries. In Indonesia, insecticides from the pyrethroid group recommended in the malaria control program are permethrin, deltamethrin, and lambda-cyhalothrin.¹⁰

Utilizing LLINs to minimize malaria is one of the most commonly used and cheapest alternatives, as well as free of charge. Using LLINs will protect pregnant women from mosquito bites, thereby reducing anemia and maternal mortality, low birth weight, and newborn mortality, increasing growth and development during pregnancy.^{11,12} The LLINs distribution program in malaria-endemic areas is one of the efforts made by the Ministry of Health of Indonesia to prevent malaria transmission, especially in high-endemic areas, with a minimum target of 80% of the population in the area getting it. The Ministry of Health of Indonesia estimates that 35% of the population living in endemic areas may be at risk of malaria.

The LLINs distribution program is done regardless of the socioeconomic status of the recipient. The program is aimed at at-risk populations living in malaria vector areas, especially the patient's location and receptive areas. Residents who live within *Anopheles*' flight distance from the patient's house received top priority. The type of LLINs distributed are two pieces of 160×180×150 cm and are distributed for each family. The distribution of 2 mosquito nets is intended so that all family members can be accommodated.¹³

Controlling the *Anopheles* population in the home is an excellent effort to reduce the potential for bites in family members. Prevention efforts can be made by increasing awareness of the risk of mosquito bites, including using LLINs at night. LLINs are durable, with an adequate insecticide level that lasts at least three years, have the power to kill perched mosquitoes, and are resistant to 20-washing cycles in laboratory testing. After being washed, LLINs still maintain their effectiveness level, including reducing the person-hour density of mosquitoes.¹⁴ The effectiveness of LLINs is influenced by people's behavior in their use, such as sleeping habits outside the home, perceptions of their reliability, duration of use, how to install and wash the type of insecticide added, and the support from the community to use them.^{15,16} Community behavior can differ in each region concerning culture,

and ethnicity as a predisposing factor.^{6,9,17}

In addition to the use of LLINs, efforts to control malaria vectors have been carried out by controlling the adult mosquito population through an indoor residual spray, larviciding, and modification/manipulation of mosquito breeding habitats to shorten the lifespan of mosquitoes so that the spread and transmission of malaria can be interrupted.^{18,19}

Malaria control that has been carried out in Central Sumba regency, East Nusa Tenggara province, includes the distribution of LLINs and spraying homes with insecticides (indoor residual spraying, IRS) with active ingredients of the pyrethroid group.²⁰ Distribution has been carried out since 2017, regularly every six months; however, there has never been an evaluation of using LLINs. This study aimed to assess the behavior of the people of Mamboro and Katiku Tana sub-districts in using LLINs, assessing the number of LLINs owned, number of beds, number of family members, number of pregnant women and toddlers, distribution of LLINs in families, and LLINs utilization. In addition, the way the family installed LLINs and the physical condition of the LLINs used were also surveyed.

Methods

This is quantitative descriptive research. The research was carried out in the work area of the Mananga Health Center of Susu Wendewa village of Mamboro sub-district and Malinjak Health Center of Makata Keri village of Katiku Tana sub-district, Central Sumba regency. The research was carried out from 9–19 September 2021. We use an affordable population sampling technique, simple random sampling with a minimum target of 150 household heads/health centers. The number of respondents was 301 heads of families who were met during home visits. Data were collected by in-depth interview guides using questionnaire sheets, focus group discussion (FGD) guidelines, observation guides, recording devices (smartphones), laptops, and cameras. The questionnaire we use is a checklist form; respondents do not fill in directly but answer questions through interviews, and field enumerators fill in the answers. Data were presented in narrative form (sentences) and tabulated in tables. This research has received a research ethics permit from the Health Research Ethics Committee of the Politeknik Kesehatan

Kementerian Kesehatan Kupang, number LB.02.03/1/0119/2021. All respondents signed the informed consent as a sign of willingness to participate in the study.

Results

Table 1 shows that the respondents 166 were women (55.1%) and 135 were men (44.9%). Most of the respondents belonged to 30–39 years (31.6%), followed by 40–49 years (19.3%), and most of the respondents were farmers 184 (61.1%). Most of the respondents came from Makata Keri 184 (61.1%) and Susu Wandewa 124 (41%), under the working area Laimajori Health Center 99 (32.9%) and Wunga Health Center 49 (16.3%).

Table 1 Respondent Characteristics

| Characteristics | n=301 (%) |
|-----------------------|------------|
| Gender | |
| Male | 135 (44.9) |
| Female | 166 (55.1) |
| Age (years) | |
| 20–29 | 46 (15.3) |
| 30–39 | 95 (31.6) |
| 40–49 | 58 (19.3) |
| 50–59 | 49 (16.3) |
| 60–69 | 53 (17.6) |
| Occupation | |
| Farmer | 184 (61.1) |
| Civil servant | 19 (6.3) |
| Private sector | 12 (4.0) |
| Other | 86 (28.6) |
| Origin | |
| Makata Keri | 136 (45.0) |
| Susu Wandewa | 124 (41.0) |
| Laitapedang | 9 (3.0) |
| Katiku Kana | 1 (0.3) |
| Rahwoya | 3 (1.0) |
| Other | 28 (9.3) |
| Nearest health center | |
| Paledi | 29 (9.6) |
| Karendi | 13 (4.3) |
| Mamboro | 2 (0.7) |
| Makata Keri | 41 (13.6) |
| Wunga | 49 (16.3) |
| Tana Bara | 19 (6.3) |
| Kabondok | 43 (14.3) |
| Laimajori | 6 (2.0) |
| Other | 99 (32.9) |

Most families have LLINs (n=287, 94.1%), and only a small proportion do not have LLINs 17 or 5.9% (Table 2). Total LLINs owned were 341 units, used by 1,220 (94.7%) family members with ten pregnant women and 35 children under five. Families that do not have LLINs consist of 68 family members, with five pregnant women and 25 children under five.

Most families have two units of LLINs, with 136 families (45.2%). A total of 69 households owned three units of LLINs (23%), and 54 households owned one unit of LLINs (18%); no families had six units of LLINs. Most families only have 2-bed units in 1 house (n=124; 41.2%), 3-bed units (n=73; 24.3%), and 1-bed unit (n=54; 18%), and no family with six bedrooms (Table 3).

Of all LLINs owned (341 units), most of them have been installed, with 290 units (85%) and 51 units (15%) not installed, permanent brands are 273 units (80%), and other brands are 68 units (20%). Based on the respondent's confession, they received LLINs from the health centers about 1–3 months ago, as many as 126 families (44%), and 85 families (29%) received three months ≤1 year ago, the remaining 76 families (27%) received <3 months ago (Table 4).

Even though having LLINs installed and installed does not mean they are used every night, of the 341 units of LLINs owned, only 314 units (92%) are used while sleeping, 17 units (5%) are sometimes used, and 14 units (4%) are not used. It was still found that there were family members who did not use LLINs every night, namely, 29 households (10%), and most of them had used LLINs 258 households (90%). We also found several problems with the installation of LLINs, and there were still parts of the LLINs that allowed mosquitoes to enter, namely 177 units (52%). LLINs were correctly installed, covering all parts of the bed, namely 116 units (34%), and there were still LLINs that had been installed dependent but not used, i.e., 48 units (14%). Holes were still found in 188 LLINs (55%), and 153 units (45%) had no holes (Table 4).

We also asked what efforts were made to prevent mosquito bites, including whether there was spraying from the health centers in the past <1 year, 291 households (90%) answered no, and the remaining ten families (10%) answered there was spraying. In addition to using LLINs, only 80 households (30%) used mosquito coils, and 45 families (15%) used mosquito lotion; most of them did not use mosquito repellent,

Table 2 Distribution of LLINs Ownership

| LLINs Ownership | Families n=301 (%) | Individual n=1,288 (%) | Nets n=341 (%) | Pregnant Women n=15 | Toddler n=60 (%) |
|--------------------|-----------------------|---------------------------|-------------------|---------------------------|---------------------|
| Owned LLINs | 287 (94.1) | 1.220 (94.7) | 341 (100.0) | 10 | 35 (58.0) |
| Does not own LLINs | 17 (5.9) | 68 (5.3) | 0 (0.0) | 5 | 25 (42.0) |

namely 167 people (56%). The mosquito bite prevention device is also not routinely used every night, recognized by 203 households (68%) and routinely used by 98 households (32%).

We also asked what efforts were made to prevent mosquito bites, including whether there was spraying from the health centers in the past <1 year, 291 households (90%) answered no, and the remaining ten families (10%) answered there was spraying (Figure). In addition to using LLINs, only 80 households (30%) used mosquito coils, and 45 families (15%) used mosquito lotion; most of them did not use mosquito repellent, namely 167 people (56%). The mosquito bite prevention device is also not routinely used every night, recognized by 203 households (68%) and routinely used by 98 households (32%).

Discussion

The results of our study still found pregnant women and toddlers who did not use LLINs. Families that do not have LLINs (17 families) consist of 68 family members, with five pregnant women and 25 children under five. When pregnant women or toddlers are infected with mosquito bites that cause malaria, it becomes a unique problem and requires serious treatment.²¹

Table 3 Distribution of LLINs in families

| Number of LLINs per Bed per Household | Number of Household Owning LLINs n=301 (%) | Number of Household Owning Bed n=301 (%) |
|---------------------------------------|---|---|
| 0 | 17 (5.7) | 13 (4.3) |
| 1 | 54 (18.0) | 54 (18.0) |
| 2 | 136 (45.2) | 124 (41.2) |
| 3 | 69 (23.0) | 73 (24.3) |
| 4 | 23 (7.6) | 33 (11.0) |
| 5 | 2 (0.7) | 4 (1.3) |
| 6 | 0 (0.0) | 0 (0.0) |

Table 4 LLINs Utilization

| Characteristics | n (%) |
|---|----------|
| All LLINs installed | |
| Yes | 290 (85) |
| No | 51 (15) |
| LLINs brand | |
| Permanent | 273 (80) |
| Others | 68 (20) |
| Duration of use LLINs | |
| 3 months | 0 (0) |
| 1–3 months | 126 (44) |
| 3≤12 months | 76 (27) |
| 1–3 years | 85 (29) |
| LLINs used when sleeping | |
| Yes | 314 (92) |
| No | 14 (4) |
| Sometimes | 17 (5) |
| Family members not using LLINs during sleep | |
| Yes | 29 (10) |
| No | 258 (90) |
| Correct installation of LLINs | |
| Still have opening for mosquito to enter | 177 (52) |
| Correctly installed | 116 (34) |
| Not installed | 48 (14) |
| Condition of LLINs | |
| Holes | 188 (55) |
| No holes | 153 (45) |
| Reason for not owning LLINs | |
| Damaged | 17 (100) |
| Others | 0 (0) |
| Fogging within <1 year | |
| Yes | 10 (3) |
| No | 291 (97) |
| Mosquito repellents other than LLINs | |
| Mosquito coils | 45 (15) |
| Lotion | 167 (56) |
| None | |
| Using mosquito repellents regularly | |
| Yes | 98 (32) |
| No | 203 (68) |



Figure Properly Installed Mosquito Nets and In-depth Interview during Data Collection

Note: counter-clockwise

Malaria infection in pregnancy is very detrimental to both the mother and the fetus it contains because it can increase maternal and fetal morbidity and mortality. Pregnant women and the fetus they contain will have a higher potential for infection, and infected infants will experience long suffering.^{4,12} LLINs should be prioritized for pregnant women and toddlers to reduce further impacts.

Isir et al.²² in Sorong, Papua province, had previously reported the results of a study conducted on 178 pregnant women; as many as 65.38% of respondents had at least one LLIN in their homes obtained from the health centers (55.13%), as many as 34.62% of respondents said that LLINs were given to them when they were in the 3rd trimester of pregnancy. However, as many as 35.9% of respondents have not used it correctly. Respondents hoped that LLINs should be provided free of charge (43.59%). All pregnant

women know about LLINs, but their use is incorrect; all respondents are ready to use LLINs if adequate information is provided and LLINs are available at affordable prices or free.

Another study by Manik et al.²¹ in Biak Numfor Papua province reported two variables related to the incidence of malaria in pregnant women, namely sleeping without using LLINs (OR=3.768, $p=0.024$, 95% CI=1.158–12.270) and anemia Hb<9 g% (OR=5.500, $p=0.013$, 95% CI=1.323–22.862). In comparison, three variables, namely low economic status, first parity, and four and nutritional status, were not related to the incidence of malaria.¹⁸ Pregnant women who sleep without using LLINs risk becoming infected with malaria and other diseases transmitted through mosquito bites.

The results showed that most families had LLINs, namely 287 (94.1%), with 341 LLINs, used by 1,220 (94.7%) family members. Of all LLINs

owned, we surveyed most already installed, namely 290 units (85%). What is interesting, we found that although having LLINs installed and installed does not mean they are used every night, of the 341 units of LLINs owned, only 314 units (92%) are used while sleeping, 17 units (5%) are sometimes used and 14 units (4%) not used. This condition shows that some families still do not use LLINs well.

The factor likely to have a major influence is the knowledge/awareness of the importance of using these LLINs.^{9,23,24} Marina et al.²⁴ reported that the use of LLINs in the community is still low in West Sumba, East Nusa Tenggara, so more intensive socialization and education are needed to increase the use of LLINs in the community. Their results showed that 83.9% of respondents had LLINs and as many as 82.4% of the LLINs were obtained from the program (LLINs), and the use of LLINs was obtained by 60.5%. They concluded that socio-demographic factors related to using LLINs were gender, marital status, education, age, employment status, and the respondent's position.

Several researchers reported the same result that all respondents who received the distribution of LLINs had all used mosquito nets for three years, but not all family members slept in LLINs.¹⁵ The results also showed that most respondents installed LLINs correctly in all beds, fully or partially. Previous studies also mention that the knowledge of the use of LLINs by respondents is not maximized, and in the use of LLINs, a small number of respondents complain of heat, so it is necessary to evaluate the socialization activities of the benefits and how to install and maintain LLINs that have been carried out.^{9,20,25} New canal initiatives are needed to increase people's knowledge about using LLINs.²⁶

Widiastuti and Lesmana in Kulon Progo Yogyakarta province reported the contrast that knowledge was not related to adherence to using LLINs this was because even though the community had gained knowledge through counseling, and media information, there were still many other factors beyond knowledge to comply with using LLINs such as attitudes and perceptions of people who have a sense of belonging discomfort and feeling of heat while inside LLINs.²⁷

Previous studies have explained that the highest risk factor influencing the incidence of malaria is the use of LLINs ($p=0.001$,

$OR=12.98$),²⁸ ($OR=2.8$),²⁹ which means that the risk of malaria is more significant in people who do not install LLINs compared to people who install LLINs while sleeping. Other risk factors that were also reported were the type of wall of the house, individual activities to go out at night, use of wire netting, and trust with the behavior of using LLINs.²⁸⁻³¹

Simanjourang and Kodim³² in Manalu Sangihe islands, North Sulawesi province, found that most respondents (98%) had good knowledge of LLINs and adhered to using LLINs at night (83.1%), around 96.1% installed LLINs correctly, around 85.7% of respondents maintained and washed LLINs, and about 93.9% were exposed to direct sunlight. Currently, the LLINs owned by the community are mosquito nets with insecticide LLINs (96.8%) and ordinary mosquito nets (3.2%).

The use of LLINs every night is the primary choice for Mambo and Katiku Tana sub-district residents to avoid mosquito bites. The availability of sold mosquito coils and mosquito repellent lotions can be an additional effort, but it costs money to buy them. The results showed that only 80 households (30%) used mosquito coils, and 45 families (15%) used mosquito lotions; most of them did not use mosquito repellent, namely 167 people (56%). The mosquito repellent is also not routinely used every night, recognized by 203 households (68%) and routinely used by 98 households (32%). The influencing factor could be daily habits/low awareness to avoid mosquito bites.

Previous studies have shown similar results; Supranelfi and Oktarina²³ in South Sumatera reported that the most widely used mosquito bite prevention efforts in South Sumatra were using non-insecticide mosquito nets and mosquito repellents, while LLINs were generally used for more than three years. Respondents who live in areas that have obtained a certificate of malaria elimination tend to sleep using insecticide-treated mosquito nets; in addition, respondents with low levels of education also tend to use LLINs.

Based on the results of our research, we provide recommendations to health centers to improve preventive programs through family-approach counseling. Overall, the people of Mambo and Katiku Tana sub-districts have received LLINs, as indicated by data from respondents receiving mosquito nets from the health center about 1-3 months ago as many as 126 families (44%), and

85 families (29%) receiving three months \leq 1 year who received then.

It is known that at the Mamboro and Katiku Tana Health Centers, each has a malaria control program holder, the functions of the personnel are not only compiling malaria eradication activities, carrying out surveillance and detecting outbreaks but also monitoring and evaluating programs that have been running. Evaluation from the health centers would be a routine program to ensure that mosquito nets have been used correctly. We assess that mosquito nets are only distributed but not followed in their use. Regular surveys every year or semester can be a solution to maximize the use of mosquito nets.

Umasugi et al.³³ in Tomalehu Maluku province gave the same recommendation that in addition to conducting health education counseling and education strategies related to the use of good and correct mosquito nets with malaria prevention and control, education, and use of mosquito nets have been completed and are effective in increasing public understanding in using mosquito nets to prevent recurrence of malaria. Some houses using a house-to-house persuasive approach still keep the mosquito nets obtained from the distribution of the health department and NGOs. Persuasive education strategies go directly to homes and invite residents to install excellent and correct mosquito nets.

The same thing was concluded by Yahya³⁴ from South Sumatra that it is necessary to disseminate information regarding the purpose of distributing mosquito nets, how to use them, how to wash them, and which family members are prioritized to sleep with mosquito nets when the mosquito nets are distributed to the community. In addition, it is necessary to socialize the action of heating the bed net (heat-assisted regeneration) to increase the effectiveness of the insecticide in the mosquito net.

The coverage of the use of mosquito nets is low, influenced by many factors; for example, some people feel uncomfortable using mosquito nets in tiny homes. The frequency of use of mosquito nets is different in some areas. Several existing barriers, such as beliefs, culture, tourism, gender roles, seasons, and perceptions, affect the low use of mosquito nets. Consideration of social conditions, culture, and participation of community leaders and health workers positively affect the behavior of using malaria nets. The insecticide-treated bed net program

should be evaluated to assess its effectiveness, including why people in Bengkulu are unwilling to use it.³⁵ We offer solutions like routine visits to each family by malaria program holders from the health center. Another approach is through community and religious leaders so that people want to use insecticide-treated nets.

Conclusions

The distribution of LLINs has been going well, as evidenced by the fact that most families have mosquito nets and use them while sleeping, and there were still family members who did not use LLINs every night. Nevertheless, acceptance and utilization of LLINs should not stop at the distribution process; a good evaluation in regular surveys is required to ensure that LLINs are correctly utilized.

Conflict of Interest

All authors state whether there was a conflict of interest in this article or not.

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