Long Lasting Insecticide-Treated Nets Utilization and Associated Factors Among Pregnant Women in Shebel Berenta District, Northwest Ethiopia

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Yeshitla Getnet[1], Abraham Teym[2], Moges Wubie[1], Sintayehu Shiferaw[1], Bayou Tilahun Assaye[3], Zelalem Aneley[4], Habitamu Mekonen Abera[4] and Habtamu Temesgen[4]

[1]Department of Public Health, College of Medicine and Health Sciences, Debre Markos University, Debre Markos, Ethiopia. [2]Department of Environmental Health, College of Medicine and Health Sciences, Debre Markos University, Debre Markos, Ethiopia. [3]Department of Health Informatics, College of Medicine and Health Sciences, Debre Markos University, Debre Markos, Ethiopia. [4]Department of Human Nutrition, College of Medicine and Health Sciences, Debre Markos University, Debre Markos, Ethiopia.

ABSTRACT

BACKGROUND: Insecticide-treated bed nets are cost-effective vector control methods for malaria prevention. Malaria during pregnancy poses a significant health problem in Ethiopia. This study aimed to assess insecticide-treated nets utilization and associated factors among pregnant women in Shebel Berenta District, Northwest Ethiopia.

OBJECTIVE: To assess insecticide-treated bed nets utilization and associated factors among pregnant women in Shebel Berenta District, Northwest Ethiopia, in 2023.

METHODS: A community-based cross-sectional study was conducted from March 15 to April 30, 2023, on 505 randomly selected pregnant women. Data were collected using a pre-tested structured questionnaire and observational checklist, analyzed with EpiData 3.1 and SPSS 25. Significant factors associated with long-lasting insecticide-treated nets were identified ($P < .05$, 95% CI) and were reported as statistically significant factors associated with the utilization of insecticide-treated bed nets.

RESULTS: The utilization of long-lasting insecticide-treated nets was 45.10% [95% CI: 40.5%-49.2%]. Mothers who had antenatal care follow-up (AOR = 3.359; 95%CI: 1.829, 6.166), mothers with illiterate educational status (AOR = 0.196; 95%CI: 0.064-0.603), and mothers who had received information (message) (AOR = 8.102; 95%CI: 3.942-16.653) were significantly associated with long lasting insecticide-treated net utilization.

CONCLUSION: Utilization of long lasting insecticide-treated nets by pregnant women was 45.1%, which was lower than the WHO standard. Attending antenatal care, receiving information (messages) about malaria and long lasting insecticide-treated net, and mother's being literate had a substantial impact on long lasting insecticide-treated net utilization. Therefore, efforts should be made to strengthen ANC service, health information and women's educational status to increase utilization of long lasting insecticide-treated nets.

KEYWORDS: Pregnant women, long lasting insecticide-treated nets, utilization, Ethiopia

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CORRESPONDING AUTHOR: Abraham Teym, Department of Environmental Health, College of Medicine and Health Sciences, Debre Markos University, Debre Markos, Amhara 269, Ethiopia. Email: abrishteym23@gmail.com

Introduction

Background

An insecticide-treated bed net is a protective mesh fabric that is intended to physically shield sleepers from mosquitoes and other insects while simultaneously providing insecticidal characteristics to repel or kill the insects and prevent diseases like malaria.[1] In addition, Long Insecticide-treated bed net (LLIN) is one type of cost-effective vector control approach for the prevention of malaria, and it has to be treated with insecticide and needs ongoing treatment. It implies that using LLIN is very helpful way in the prevention of malaria transmission in highly endemic areas.[2-4]

Malaria remains one of the most severe public health problems in the world, especially in Sub-Saharan Africa, and is taking an unacceptable toll on the health and financial stability of those who are least fortunate worldwide.[5,6] According to a World Health Organization investigation, the disease caused an estimated 1.3% annual reduction in economic growth in the countries with the highest burden.[7] As the World Health Organization's "World Malaria Report 2021" shows the worldwide burden of malaria has increased from 227 million in 2019 to an estimated 241 million in 2020. Furthermore, malaria-related mortality increased from 558 000 in 2019 to around 627 000 in 2020.[8] Sub-Saharan Africa accounted for approximately 95% of global malaria cases and 96% of malaria deaths

in 2021 and 2022, with Nigeria, the Democratic Republic of Congo, Uganda, Mozambique, and Angola bearing the greatest malaria burden, accounting for nearly half of all malaria cases worldwide.[9]

Malaria is particularly intensive in SSA countries, accounting for 25% to 35% of all outpatient visits, 20% to 45% of hospital admissions, and 15% to 35% of hospital mortality, exerting a significant load on the existing health-care systems.[10] Every year, millions of individuals in Ethiopia are affected by malaria, resulting in hundreds of deaths, making the disease significant public health challenge in the country.[11,12] Annually, up to 6 million clinical cases are reported; however, estimates suggest that the actual number of clinical malaria cases may range between 8 and 10 million each year.[13] Malaria is recognized as the leading cause of morbidity and mortality in Ethiopia, accounting for 16.6% of outpatient visits, 15% of hospitalizations, and 28.9% of inpatient deaths.[13] Approximately three-quarters of the country's land area is prone to malaria, with an estimated 48 million people-about 68% of the population, residing in malaria-risk zones.[14,15]

The World Health Organization (WHO) recommends the use of long-lasting insecticide-treated nets (LLINs) as one of the measures to mitigate the harmful effects of malaria during pregnancy.[16] One of the most prevalent and cost-effective vector control strategies for malaria prevention is using long lasting insecticide-treated nets.[17]

LLINs are also effective in malaria prevention in high-endemic areas.[3,18] As a result, the distribution and usage of LLINs are key interventions for malaria infection prevention control in developing countries such as Ethiopia. Long lasting insecticide-treated nets have been proven to significantly reduce malaria morbidity, particularly among pregnant women and children under the age of 5.[19,20] Because of its effectiveness in reducing the burden of malaria sickness, the WHO roll back malaria program emphasizes the use of LLINs as one of the major malaria control tools in hollo-endemic countries.[21] The results of a survey on long-lasting insecticidal net (LLIN) coverage and usage in Ethiopia indicated that 64.8% of households owned at least one LLIN. The proportion of households with at least 1 LLIN per 2 people and the proportion of individuals who slept under a net the previous night were 39.1% and 42.6%, respectively.[22]

Although Ethiopia recognizes the value of LLINs for preventing malaria transmission and is actively working to increase their distribution and use, the goal of reaching 60% of pregnant women in high-risk malaria areas has not yet been fully achieved.[22] This shortfall highlights the need for enhanced efforts and resource allocation from donors and government bodies. However, despite these efforts, the proper use coverage of LLINs among priority and high-risk groups remains disappointingly low. For example, a survey conducted in Ethiopia showed that only 1.2% of pregnant women had slept under an LLIN.[23]

Malaria infection during pregnancy can have negative effects on fetal health, including stillbirth and low birth weight. In Ethiopia, the application of long lasting insecticide-treated nets (LLINs) is limited due to issues such as inadequate distribution, a lack of understanding of the relationship between mosquitoes and malaria, and difficulties in hanging and replacing nets.[24] Several factors contribute to low LLIN utilization, including discomfort, a lack of experience in hanging nets, inefficient education about LLINs, and a scarcity of LLINs.[25]

The World Health Organization (WHO) recommends LLINs as the primary malaria control strategy, particularly for pregnant women. The Roll Back Malaria Coalition also views increasing the use of mosquito nets among pregnant women as a vital strategy. In Ethiopia, possession and use of LLINs do not always go hand in hand, as many individuals who receive them do not sleep beneath them or care for them properly.[26] Therefore, this study aimed at assessing long lasting insecticide-treated nets utilization and associated factors among pregnant women in Shebel Berenta District, Northwest Ethiopia.

Methods and Materials

Study area and periods

The study was conducted in Shebel Berenta District in Northwest Ethiopia. Shebel Berenta is situated 108 km from Debre Markos, the main town of East Gojjam Zone, 372 km from Bahirdar, the capital city of the Amhara Region, and 283 km from Addis Ababa, the capital city of Ethiopia. According to the 2007 census projections, the total population of the district is 135 512, with an estimated 27 414 (20.23%) women of reproductive age and 4567 pregnant women, spread across 4 urban and 20 rural sub-districts.[27] This study was conducted from March 15, 2023 up to April 30, 2023.

Study design: Community based cross-sectional study design was used.

Source population

Pregnant women living in Shebel Berenta District.

Study population

All pregnant women, who had LLIN and were living in selected kebeles of Shebel Berenta District, were the sources of data for this study. All pregnant women residing in the selected kebeles who were ⩾6 months period after pregnancy were included, while pregnant women who were severely or critically ill during the study periods were excluded.

Sample size calculation and sampling procedure

The sample size was calculated using single population proportion formula by assuming that 72.5% population proportion of LLINs utilization was made.[28] The sample size had 95%

confidence interval, 5% (0.05) marginal error, (1.5) design effect and 10% non-response rate.

$$n = \frac{(z\,\alpha/2)^2\ p\ (1-p)}{(d)^2}$$

Where: n = the required sample size, p = 72.5% (proportion of pregnant women using LLINs) d = Margin of error, Zα/2 = 1.69 (Z = score corresponds to 95% confidence interval.

$$\frac{(1.96)^2\ 0.725(1-0.725)}{(0.05)^2} = 306$$

$$306 * 1.5\ (\text{Design Effect}) = 459$$

The total sample size with 10% non-response rate was = 505.

The study units were identified by a two-stage sampling technique. Primarily 12 (2 urban and 10 rural) sub-districts were selected from 24 total sub-districts by simple random sampling. The number of pregnant women selected from each randomly selected sub-district was determined by the proportional allocation. The total number of pregnant women registered in 12 sub-districts was 985. Then to select the study participants (pregnant women), a systematic random sampling method was used. The sampling interval k has been determined by dividing the study population by the calculated sample size (985/505 = 2). To select the initial study participant, lottery method was used, followed by a systematic selection of study participants every K until the right numbers of participants were taken from each randomly selected kebele. Revisits were performed in the instance where eligible respondents were not available at the time of data collection.

Variables

Dependent variables. LLIN utilization among pregnant women (information about utilization of LLIN was asked the night before the survey)

Independent variables. Socio-demographic characteristics of pregnant women (such as age, educational status, marital status, religion, occupation, monthly income, residence); health information, personal factors, such as knowledge and practice; housing condition, such as number of rooms and number of bed; reproductive history (age of pregnancy, ANC follow up, gravidity, family size).

Data collection tools. Following the survey of the relevant literature,[2,12] an interviewer-administered questionnaire was developed for gathering data. The dispatched questionnaire, which was prepared in Amharic, asked about socio-demographic data, knowledge about utilization of LLIN, health information, and other associated areas. Data collectors were selected based on their willingness to participate in the survey, their ability to understand the local languages, and their manners of communication.

Data quality management

To ensure valid information, the questionnaire was first developed in English, and then it was translated into the local language (Amharic), and for interpretation it was translated back to English. Before actual data collection, the questionnaire was pretested in Shebel Berenta District, on those sub-districts, which were not included in the main study. The pretest was made on 5% of the total sample size to ensure the clarity, ordering, consistency and acceptability of the questionnaire. A 1-day training for 6 data collectors and 2 supervisors was given to ensure the quality of data. The training focused on the survey's aims, the significance of each question, interview techniques, data confidentiality, informed consent, and the roles and responsibilities of data collectors and supervisors. The collected data were reviewed by data collectors and supervisors for completeness and logical consistency. Additionally, the collected data were also checked by the principal investigator every day. Finally, data cleaning was made at the end of data entry.

Data processing and analysis

The collected data were entered, cleaned, checked, and coded using EpiData version 3.1. Finally, the data were exported to SPSS version 25 for analysis. Descriptive statistics was used to describe the variables that were presented using text, tables, and graphs. Binary logistic regression was employed to identify factors associated with insecticide-treated nets.

First, bivariable logistic regression was conducted, and all variables with a p-value less than 0.25 were considered candidates for multivariable analysis, and they were included in the multivariable analysis. Subsequently, multivariable analysis was performed, and variables that showed a significant association at $P < .05$ with a 95% confidence interval (CI) were declared to have a statistically significant association with the dependent variable (LLIN utilization). The Hosmer-Lemeshow test was used to check the model's goodness-of-fit, and the maximum likelihood ratio test was conducted to verify the assumption (P-value = .56).

Ethical approval and consent

Ethical approval was obtained from Debre Markos University's Health Sciences College Ethical Review Committee (ERC) that is identified with protocol number CMHS/PGC/114/11/2022. Participants were informed about the purpose of the study and their full right not to be interviewed, if they don't want, at all or at any time while the interview is going on. Informed verbal consent from every participant was obtained before conducting the interview. The names of the respondents were not included for the sake of confidentiality. The participants' privacy was ensured by

Table 1. Socio-demographic characteristics of the respondents in Shebel Berenta District, Northwest Ethiopia, 2023 (n = 486).

CHARACTERISTICS	CATEGORIES	N (%)
Age group	15-24 y	87 (17.90)
	25-34 y	227 (46.70)
	35-49	172 (35.40)
Residence	Urban	101 (20.80)
	Rural	385 (79.20)
Religion	Orthodox	391 (80.50)
	Muslim	95 (19.50)
Marital status	Married	446 (91.80)
	Single	13 (2.70)
	Divorced	20 (4.10)
	Widowed	-
Education status	Can't read and write	202 (41.60)
	Can read and write (had not formal education)	92 (18.9)
	Elementary education	115 (23.70)
	Secondary education	51 (10.5)
	College and above	26 (5.3)
Occupation	House wife	382 (78.60)
	Merchant	59 (12.10)
	Government employee	28 (5.80)
	Student	6 (1.20)
	Others	-
Family size	1-3	239 (49.20)
	4-5	223 (45.90)
	>5	-
Monthly income in USD ($)	<9.3	80 (16.50)
	9.3-18.6	43 (8.80)
	>18.6	363 (74.70)

interviewing them where there was no flow of people. Problem identified during data collection, if pregnant women or family who had febrile by history, was referred to the health post or health center.

Results

Socio-demographic characteristics of the respondents

A total of 486 pregnant women participated in the study, resulting in a response rate of 96.20%. The median age of the respondents was 30.50 years with a standard deviation (SD) of ±6.69. Approximately 446 (91.8%) were married, and 385 (79.2%) were rural dwellers. Regarding religion, 391 (80.5%) were Orthodox. 202 (41.6%) of the respondents were illiterate, and 262 (53.9%) were farmers. The mean income of the respondents was 3184.48 Ethiopian Birr with a standard deviation of ±2235.14 (Table 1).

Obstetric and reproductive related characteristics of pregnant women. About 168 (34.6%) and 221 (45.5%) of the pregnant women were in the third and second trimesters of gestation, respectively. Three hundred seventy-seven (77.6%) of the pregnant women were multigravida, and 365 (75.1%) of them attended ANC follow-up (Table 2).

Table 2. Obstetric and reproductive related characteristics of pregnant women in Shebel Berenta District, Northwest Ethiopia, 2023.

VARIABLE	CATEGORIES	N (%)
ANC Contact	Yes	365 (75.10)
	No	121 (24.90)
Gravidity	Primigravida	109 (22.40)
	Multigravida	377 (7 7.60)
Age of pregnancy	First trimester	97 (20.00)
	Second trimester	221 (45.50)
	Third trimester	168 (34.60)

Magnitude of long lasting insecticide-treated nets utilization

LLINs were distributed to 485 (99.80%) households in the study area, with 51.90% of the households having 1 LLIN. About 373 (76.70%) of the respondents received information about LLINs and their benefits, with health workers being the main source of information (62.60%). Approximately 291 (59.90%) of pregnant women utilized an LLIN the night before data collection, and 278 (57.20%) of the respondents had properly mounted LLINs over their sleeping areas during data collection. About 281 (57.8%) of the LLINs being used were less than 3 years old, 126 (26.3%) were between 3 and 5 years old, and the remaining were over 5 years old (Table 3).

The overall 219 (45.1%) [95% CI: 40.5%-49.2%] pregnant women slept under a properly mounted LLIN the night before the survey (Figure 1).

Knowledge of pregnant women about malaria and long lasting insecticide-treated nets s

Approximately 295 respondents (60.70%) acknowledged that malaria transmission is caused by mosquito bites. Half of the respondents (50%) mentioned children under the age of five as a priority category for malaria prevention in their families. Moreover, half (54.90%) identified pregnant women as a high-risk group for malaria prevention at home. Furthermore, 298 respondents (61.30%) identified long-lasting insecticidal nets (LLIN) as an important malaria preventive tool at the home level.

From the symptoms of malaria, chilliness was mentioned by 308 (63.40%) of the respondents; fever by 202 (41.40%); headache by 115 (23.70%); vomiting by 38 (7.80%); loss of appetite by 38 (7.80%); and the remaining one reported nothing known. Concerning the knowledge of the respondents about LLIN prevention mechanisms, 283(58.20%) of the

respondents reported LLIN to prevent mosquito bite (as a physical barrier). More than half (67.50%) of the respondents have identified that LLINs should be used every night. Majority (87.7%) of the respondents believed that the use of LLIN did not have any problem (Table 4).

Table 3. LLIN utilization and related condition in Shebel Berenta district, Northwest Ethiopia, 2023.

CHARACTERISTICS	CATEGORIES	N (%)Y
Received information about LLINs and their benefits	Yes No	373 (76.70) 113 (23.30)
From whom you received information	Media Health worker WDA Others	56 (11.50) 304 (62.60) 11 (2.30) 2 (0.40)
Accesses to LLINs	Yes No	485 (99.80) 1 (0.20)
Pregnant women used LLIN previous night	Yes No	291 (59.90) 195 (40.10)
LLIN properly mounted over sleeping area	Yes No	278 (57.20) 208 (42.80)
LLIN tear (hole)	Yes No	51 (10.50) 435 (89.50)
Number of beds or places of sleep	One two Three & above	227 (46.70) 209 (43.00) 50 (10.70)
Number of bed nets observed in household	One Two Three & above	252 (51.90) 178 (36.60) 55 (11.50)
Number of beds (places) observed with bed nets	One Two Three & above	368 (75.70) 109 (22.40) 8 (1.60)
The age of LLINs present in the household	<3y 3-5y >5y	281 (57.80) 128 (26.30) 8 (2.50)

From the total participants, 252 (51.9%) respondents had good knowledge about LLIN and malaria, while 234 (48.1%) of them had poor knowledge. Among those respondents who had good knowledge, 156 (58.4%) were properly utilized the LLINs, while among respondents who had poor knowledge regarding utilization of LLINs, 111(41.6%) properly utilized the LLINs (Table 5).

Reasons for not using LLIN by pregnant women

Regarding the reasons mentioned for not using LLIN, 64 (13.20%) of the respondents reported absent of mosquito seen in the house, and 92 (18.90%) of them forgotten to mount the bed nets (Figure 2).

Factors associated with LLIN utilization among pregnant women

Variables, such as age, residence, educational status, monthly income, antenatal follow-up, gestational age, gravidity, having information about LLINs and their benefits, and knowledge were found to be associated with LLIN utilization (*P*-value < .25), and they were considered for further analysis. In a multivariate logistic regression analysis, ANC follow up, having information about LLINs and their benefits, and educational status had a significant association with LLIN utilization among pregnant women (*P*-value < .05).

The odds of LLINs utilization among pregnant women were 3.36 times higher than those who had ANC visit during pregnancy (AOR = 3.36; 95% CI: 1.83, 6.17). This study also showed that the odds of LLINs utilization were 8.1 times higher for pregnant women who had information about LLINs and their benefits when compared to their counterparts (AOR = 8.10; 95% CI: 3.94, 16.65). Furthermore, this study found out that pregnant women who were unable to read and write had 80.4% less likely to utilize LLINs when compared to

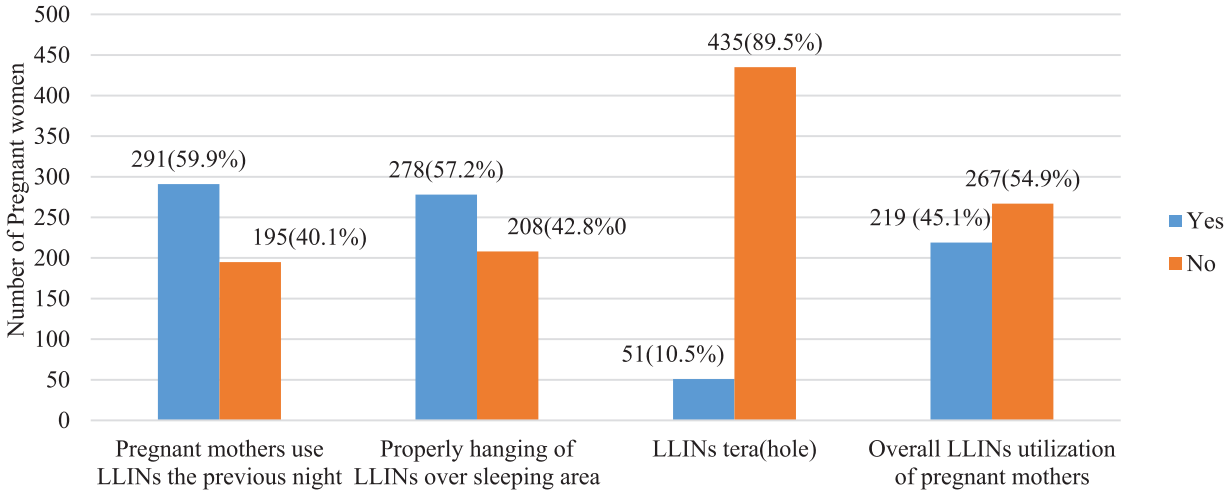

Figure 1. Proportion of LLINs utilization among pregnant women in Shebel Bernta District, Northwest Ethiopia, 2023.

Table 4. Knowledge of pregnant women about malaria and long lasting insecticide-treated nets in Shebel Berenta District, Northwest Ethiopia, 2023 (n = 486).

CHARACTERISTICS	CATEGORIES	N (%)
Transmission of malaria	Mosquito bite	295 (60.70)
	By flies	24 (4.90)
	Due to water	30 (6.20)
	Not known	34 (7.20)
Priority given for malaria prevention within the household	<5 children	243 (50.00)
	Mothers	267 (54.90)
	Adult	16 (3,30)
	Old age	11 (2.30)
Malaria prevention mechanism	Chemical spray	117 (24.10)
	Draining stagnant water	129 (26.50)
	Environment management	110 (22.60)
	LLIN utilization	298 (61.30)
	Not known	15 (1.10)
Symptom of malaria	Fever	202 (41.40)
	Headache	115 (23.70)
	Chills	308 (63.40)
	Loss of appetite	38 (7.80)
	Vomiting	38 (7.80)
	Not known	11 (2.30)
LLIN mechanism of action	Physical barriers	283 (58.20)
	Kills mosquito	157 (32.30)
	Not known	23 (4.70)
When to utilize LLIN	Every night	328 (67.50)
	Sometimes	41 (8.40)
	Seasonally	94 (20.00)
	Not known	20 (4.10)
Any problem if LLIN utilized	Yes	60 (12.30)
	No	426 (87.70)
List of problems if LLIN utilized	No comfort	20 (4.10)
	Cause heat	34 (7.20)
	Air hanger	4 (0.80)
	Not known	2 (0.40)

Table 5. The distribution of LLINs utilization on knowledge status toward LLINs utilization nets in Shebel Berenta District, Northwest Ethiopia, 2023.

		LLINS UTILIZATION		
		PROPERLY UTILIZED	NOT PROPERLY UTILIZED	TOTAL
Knowledge about LLINs utilization	Good	156 (58.4%)	96 (43.8%)	252 (51.9%)
	Poor	111 (41.6%)	123 (56.2%)	234 (48.1%)

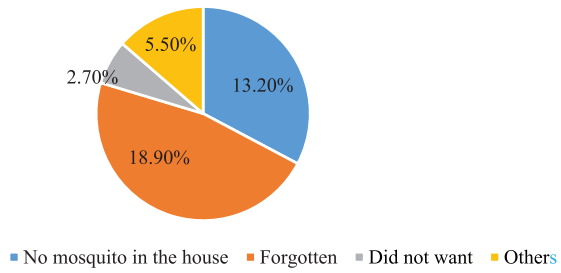

Figure 2. Reasons for not using LLIN by the pregnant woman in Shebelle Berenta, district, northwest, Ethiopia, 2023.

women whose educational status was at a college and above (AOR = 0.196; 95% CI: 0.064, 0.60; Table 6).

Discussion

This study was designed to assess the magnitude and associated factors of LLIN utilization among pregnant women in Shebel Berenta District, Northwest Ethiopia. Additionally, the study aimed at evaluating the utilization of LLINs. Almost 99.80% of the pregnant women had access to a LLIN. However, only 45.1% [95% CI; 40.5%–49.2%] of the pregnant women utilize LLIN properly the night before the survey. This finding goes in line with the studies conducted in southern Ethiopia (48%),[18] Halaba Kulito Town (42.4%),[23] Ghana (43.3%),[29] and with the study conducted in Namibia (47%).[30] But the current study finding was lower than the study conducted in northern Ethiopia (58.4%, 63.1%, and 70.80) %),[31-33] Southern Ethiopia (55.5%-72.5%)[23,34-36] and no Northeast Ethiopia (54%-79.1%),[31,32,37] Congo (71.4%)[38] and from WHO recommendation of LLIN utilization to be in Ethiopia (80%).[12] But, the study is higher than the studies conducted in Northwest Ethiopia (33.6%),[37] Raya Azebo (34.5%),[39] Adama Woreda, Oromia Regional State, Ethiopia (14.7%),[40] Nigeria (7.5%),[41] Miesso Woreda, Eastern Ethiopia (39.9%)[42] and northern Uganda (35%).[43] This could be due to differences in study periods, study areas, socioeconomic status of participants, and seasonal variation in data collection times. It might also be due to information variation, since in this study, knowledge regarding the use of LLINs during pregnancy was found low (Table 5). Another possible explanation for the lowered observation of LLIN utilization in the current study may be seasonal variation at the time of the study conducted. The current study was conducted during the dry season, when participants tended to be careless in using LLIN because they perceived a low risk of malaria in the dry season.

The odds of pregnant women properly utilized LLINs were 80.4% times lower among women who did not have any education when compared to those who had education status of college diploma and above. This finding is in line with study conducted in Addis Zemen Hospital, Northwest Ethiopia[44] and Damot Pulasa District, Southern Ethiopia.[45] This might be due to educated pregnant women may know the consequences of malaria in pregnancy if they did not use LLINs.[46] Another possible explanation might be due to the fact that educated women can easily get convinced and also have information and understand the information related to the prevention mechanisms malaria including LLINs.

Pregnant women who received information about LLINs and their benefits had 8 times higher in odds of utilizing a LLIN than their counter parts. This finding was consistent with study conducted in Fogera, Northwest Ethiopia.[33] This could be due to the fact that pregnant women who received health education about long-lasting insecticide-treated nets were more aware of the importance of LLINs in preventing malaria, which enables them to use the LLINs effectively.[47]

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In this study, pregnant women who had antenatal care follow-up had 3 times higher odds of utilizing LLINs than who had no ANC follow-up. This finding in line with the studies conducted in Awabel woreda, Northwest Ethiopia and Miesso Woreda, Eastern Ethiopia.[42,48] This could be due to the possibility that pregnant women who attended antenatal care visits received relevant health information regarding the use of long-lasting insecticidal nets since it is one of the routine health service activities during ANC services in Ethiopia. They also have been made aware of the risks associated with malaria during pregnancy if LLINs were not utilized. Therefore, ANC visits can be a vital opportunity to educate pregnant women on the proper use of LLINs.[49]

Strengths of This Study and Limitation of the Present Study

The strengths of this study included its use of direct observation to confirm participants' self-reported information regarding ITN utilization, check whether the nets were hung (mounted) over the sleeping places, and assess the physical condition of the nets. This study has a limitation in that its

Table 6. Bivariable and Multivariable analysis factors associated with LLIN utilization in Shebel Berenta District Northwest Ethiopia, 2023 (n = 486).

VARIABLES	LLIN UTILIZATION		OR (95%CI)	AOR (95%CI)	*P*-VALUE
	YES	NO			
Age group					
15-24	40	47	1.334 (0.792-2.246)	0.857 (0.389 1.887)	.701
25-34	112	115	1.526 (1.021-2.282)	0.882 (0.499-1.558)	.665
34-49	67	105	1	1	
Residence					
Urban	59	42	1.975 (1.266, 3.081)	1.092 (0.635-1.879)	.751
Rural	160	225	1	1	
Educational status					
No education	55	147	**0.112 (0.043, 0.29)***	**0.196 (0.064, 0.60)****	.004
No formal education with able to read and write	52	40	0.39 (0.143, 1.06)	0.476 (0.155, 1.465)	.196
Elementary education	60	55	0.33 (0.122, 0.875)	0.424 (0.140, 1.282)	.129
Secondary education	32	19	0.505 (0.173, 1.48)	0.559 (0.171, 1.828)	.336
College and above	20	6	1	1	
Monthly income					
＜500	31	49	0.68 (0.414,1.115)	1.271 (0.694,2.329)	.437
500-1000	13	30	0.466 (0.235,0.921)	0.663 (0.2971.480)	.316
⩾1000	175	188	1	1	
ANC follow up					
Yes	199	166	**6.054 (3.59, 10.20)***	**3.36 (1.83, 6.166)****	.000
No	20	101	1	1	
Gestational age					
First trimester	33	64	0.528 (0.315, 0.886)	0.918 (0.487, 1.730)	.791
Second trimester	103	118	0.894 (0.598, 1.336)	1.061 (0.664,1.697)	.804
Third trimester	83	85	1	1	
Gravidity					
Primigravida	166	183	1.438 (0.961, 2.151)	0.922 (0.494, 1.721)	.799
Multigravi	53	84	1	1	
Having information about LLINs and its benefits					
Yes	209	164	**13.126 (6.65,25.93)***	**8.10 (3.94-16.65)****	.000
No	10	103	1	1	
Knowledge of the respondents					
Good	123	111	1.801 (1.255, 2.584)	1.160 (0.757-1.779)	.496
Poor	96	156	1	1	

cross-sectional study design captures data at a single point in time, which restricts the ability to assess changes or impacts over time.

Conclusion

Utilization of long lasting insecticide-treated nets among pregnant women in Shebel Berenta district was low when compared to the national recommendation. Antenatal care follows up, having information about LLINs and its benefits and educational status were significant factors for LLINs utilization. Mothers who had routine ANC follow up and who got information about LLINs and its benefit have positive effect on increasing utilization of LLINs, while women who had no education decreases the LLINs utilization during pregnancy. Therefore, the government at different levels should focus on strengthening ANC follow up services with integrated malaria prevention and information dissemination. In addition, health education should be given to strengthen primary health care service levels so that the LLINs utilization during pregnancy could be increased. Other non-governmental organizations should also focus on the above issue. Women should be educated in order to utilize LLINs and practice malaria prevention mechanisms.

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Authors' Contributions

YG, AT, MW, and HT developed the study design, literature review, quality assessment, data extraction, statistical analysis, and interpretation of the data. HM, SS, ZA, and BT developed drafts of the manuscript. All authors approved the final manuscript.

Availability of data and material

The data sets analyzed during the current study are available from the corresponding author upon reasonable request.

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