Determinants of Long-Lasting Insecticide-Treated Bed Net Utilization Among Pregnant Women in Gechi District, Buno Bedele Zone South West Ethiopia: A Community-Based Cross-Sectional Study

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Abstract

Background: Long-lasting insecticide-treated bed nets (LLITNs) are a key malaria prevention method, but their consistent use in Ethiopia, particularly among rural mothers, remains challenging. Information on LLITN usage among pregnant women in resource-limited settings is especially scarce. This study investigated LLITN utilization and the factors influencing its use among pregnant women in the Gechi district, Southwest Ethiopia, in 2024.

Methods: A community-based cross-sectional study was conducted from June to July 2024, including 422 randomly selected pregnant women. Data collection employed a pretested questionnaire, and logistic regression analysis was utilized to identify factors influencing LLITN usage. Variables with a *P*-value $< .25$ in univariable analysis were incorporated into the multivariable logistic regression model. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were computed, and statistical significance was set at $P \leqslant .05$. The model's performance was assessed using the Hosmer-Lemeshow goodness-of-fit test.

Results: The finding of this study revealed that 93.9% of the respondents had LLITN, and the current utilization status of pregnant women was 46.5% [41.7%-51.3%]. The low level of utilization was significantly associated with women' education, parity, antenatal care (ANC) attendance, and family size. Accordingly, women without formal education were 52% less likely [AOR: 0.48, 95% CI: 0.28-0.81]; those with primipara were 1.98 times more likely [AOR: 1.98, 95% CI: 1.30-3.03]; a family size of less than 5 was 2.53 times [AOR: 2.53, 95% CI: 1.61-3.87] more likely, and women who attended at least 1 ANC visit were 2.08 times more likely [AOR: 2.08, 95% CI: 1.21-2.58] to use LLITN.

Conclusion: The pregnant women's LITN utilization in settings was low, associated with women's education, parity, antenatal care attendance, and family size. Key players should focus on awareness creation and ANC follow-up to reduce illness during pregnancy, particularly in rural, hard-to-reach settings.

Plain Language Summary

Insecticide-treated bed nets (ITNs) are a key malaria prevention method, but their consistent use in Ethiopia, particularly among rural mothers, remains challenging. Information on ITN usage among pregnant women in resource-limited settings is especially scarce. This study investigated ITN utilization and the factors influencing its use among pregnant women (PW) in the Gechi district, Southwest Ethiopia, in 2024. A community-based cross-sectional study was conducted from June to July 2024, including 422 randomly selected PW. Data collection employed a pretested questionnaire, and logistic regression analysis was utilized to identify factors influencing insecticide-treated net (ITN) usage. Variables with a p-value < 0.25 in univariable analysis were incorporated into the multivariate logistic regression model. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were computed, and statistical significance was set at p $\leqslant 0.05$. The model's performance was assessed using the Hosmer-Lemeshow goodness-of-fit test. The finding of this study revealed that

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93.9% of the respondents had ITN, and the current utilization status of PW was 46.5% [41.7%-51.3%]. The low level of utilization was significantly associated with women' education, parity, antenatal care (ANC) attendance, and family size. Accordingly, women without formal education were 52% less likely [AOR: 0.48, 95% CI: 0.28-0.81]; those with primipara were 1.98 times more likely [AOR: 1.98, 95% CI: 1.30-3.03]; a family size of less than five was 2.53 times [AOR: 2.53, 95% CI: 1.61-3.87] more likely, and women who attended at least one ANC visit were 2.08 times more likely [AOR: 2.08, 95% CI: 1.21-2.58] to use ITN. The pregnant women's ITN utilization in settings was low, associated with women's education, parity, antenatal care attendance, and family size. Key players should focus on awareness creation and ANC follow-up to reduce illness during pregnancy.

Introduction

Malaria remains one of the most significant global health challenges, disproportionately affecting tropical and subtropical regions, with sub-Saharan Africa bearing the highest burden.[1,2] It is a parasitic disease caused by *Plasmodium species*, transmitted through the bites of infected female *Anopheles* mosquitoes.[3] Globally, malaria continues to pose severe health, social, and economic challenges. It is particularly devastating in sub-Saharan Africa, where the disease contributes to approximately 25% of all maternal deaths in endemic areas.[4] The effects of malaria extend beyond health, significantly impacting economies by reducing workforce productivity, increasing healthcare costs, and perpetuating cycles of poverty in affected communities.[5]

Pregnant women are among the most vulnerable groups affected by malaria, as pregnancy suppresses immune function, making them more susceptible to infections.[6] This vulnerability is most pronounced in women during their first pregnancies and those of younger maternal age, who exhibit less acquired immunity than older, multiparous women.[7] Studies estimate that approximately 25 million pregnancies annually are at risk of malaria infection in sub-Saharan Africa alone, with dire consequences for both maternal and fetal health.[8-10]

Malaria during pregnancy is associated with a range of adverse outcomes, including maternal anemia, placental malaria, intrauterine growth restriction, and increased risks of miscarriage, stillbirth, and neonatal mortality.[11,12] Placental malaria, caused by the sequestration of P. falciparum-infected erythrocytes in the placenta, leads to placental insufficiency. This compromises the transfer of oxygen and nutrients to the fetus, often resulting in low birth weight (LBW) deliveries, which are a leading cause of neonatal death and long-term developmental issues.[12] Infants born with low birth weight are at higher risk of delayed social and cognitive development, neonatal sepsis, and mortality in the first year of life.[12]

The burden of malaria in pregnancy is particularly high in Ethiopia, where approximately 65% of the population resides in malaria-endemic regions, and 75% of the land area is conducive to malaria transmission.[13] These alarming statistics underscore the urgent need for effective preventive strategies to protect pregnant women and their unborn children from this devastating disease. One of the most effective strategies for malaria prevention is the use of insecticide-treated bed nets (ITNs). ITNs create a physical barrier between individuals and mosquitoes while also killing mosquitoes that come into contact with the net.[14] Consistent and proper use of ITNs has been shown to reduce malaria-related deaths by approximately 20% in endemic areas[15] and lower malaria episodes by 48% to 50%.[15] For pregnant women, ITN use is particularly crucial as it significantly reduces the risk of adverse pregnancy outcomes. Studies indicate that ITN usage can reduce malaria transmission by up to 90%, miscarriages by 33%, and stillbirths by 25%.[8,9,16] Recognizing the critical importance of ITNs, the World Health Organization (WHO) recommends that all pregnant women sleep under an ITN as early as possible during pregnancy, ideally before conception.[17,18]

Despite their proven effectiveness, the utilization of ITNs among pregnant women in sub-Saharan Africa, including Ethiopia, remains alarmingly low. Studies have identified several barriers to ITN usage, including limited access to ITNs, lack of awareness about their benefits, and sociocultural factors.[19] Educational status, occupation, rural residence, ownership of a television or radio (a proxy for health information exposure), religion, ethnicity, and family income are significant determinants of ITN utilization among pregnant women.[20,21] Furthermore, misconceptions about ITN safety during pregnancy and discomfort associated with sleeping under nets contribute to low usage rates.[13,22]

In Ethiopia, the Federal Ministry of Health has made substantial efforts to improve ITN access, distributing large quantities of long-lasting insecticidal nets (LLINs) to address the population at risk.[23] However, this distribution effort has not fully translated into widespread ITN usage, particularly among vulnerable populations such as pregnant women. Research shows that knowledge gaps about ITN use, coupled with logistical challenges in distribution, have hindered the success of malaria prevention programs in rural and underserved areas.[24-26] In the Gechi district, more than 3000 cases were reported annually in the area, and to control the disease, more than 17,000 LLINs were distributed recently for more than 6000 households living

in risk areas (unpublished report of the Gechi district health office 2024). Despite massive distribution of the nets, the level of utilization among pregnant women in the setting is limited information that enhances the prevention intervention. Therefore, this study aimed to assess the utilization and associated factors of insecticide-treated nets among PW in Gechi Woreda, which helps the policymakers and concerned bodies to emphasize the utilization of ITNs by pregnant women.

Methods and Materials

Study Area and Period

The study was conducted in Gechi Woreda, in the Oromia Region, from June 2024 to July 2024. The woreda is located in the Bunno Bedelle Zone and has 33 kebeles, with a total population of 108 133 (52 985 males and 55 147 females). In 2015, the population was 22 393 households, with an estimated 23 930 child-bearing-age women (15-49) in the woreda. The woreda has 4 governmental health centers and 8 private health institutions. The health centers are Gechi Health Center, Chara Health Center, Hurufa Health Center, and Sekecha Health Center.

$$n_f = \frac{p(1-p)(Z_{\alpha/2})2}{d^2} = n_f = \frac{0.51(1-0.51)(1.96)2}{0.05^2} = n_f = 384.$$

The study calculated a final sample size of 422, including a 10% non-response rate. The samples for the factors related to ITN utilization were calculated using Epi Info software. Considering the factors reported from previous studies, such as maternal education[28] and ANC attendance,[29] were analyzed. For maternal education, with a 95% confidence level, 80% power, and a 1:1 ratio, the calculated sample size for maternal education was 132, while for ANC attendance it was 118. To ensure sufficient power, the largest sample size of 422 PW was selected.

Sampling Procedures. The sample size for each pregnant women were allocated proportionally to each selected kebeles and each participant were selected using simple random sampling from the sampling frame taking community health information registers as sampling frame (Figure 1).

A questionnaire was developed after a thorough review of literatures.[4,13,30-32] The data collection tools contain (socio-demographic characteristics, individual factors, ITN-related factors, and obstetric-related factors). The validity and reliability of data collection tools was done on 21 of the total study participants at Borecha woredas. Based on the information, the data collection tools were modified for the final data collection. The principal investigator was chosen by 2 supervisors and 4 data collectors from Borecha Woreda with health-related backgrounds, knowledge of the languages of the community in the study area, and data collection experience. A structured questionnaire administered by an interviewer in person was used.

Study Design and Population

The study used a community-based cross-sectional design, focusing on PW (pregnant women) in Gechi Woreda. The population consisted of randomly selected PW from selected kebeles. The study included all currently PW and households who volunteered, while exclusion criteria excluded women who were unable to respond or were absent after 2 round home visits.

Sample Size and Sampling Techniques

Sample Size. The sample size was calculated using a single population proportion formula assuming a 95% confidence interval and 51% prevalence (P) from the study conducted on Insecticide Treated Net utilization among PW in Ethiopia, 2023, and a precision of 5% between the sample and the 10% non-response rate was taken.[27]

$$n_i = \frac{(Z\alpha/2)^2(p)\times(1-p)}{d^2}$$ where: n_i was the initial

sample size, $Z_{\alpha/2}$ = was the standard score value for a 95% confidence level for 2 sides of normal distribution = 1.96, p = was the prevalence = 0.51, d = was margin of error = 0.05.

Study Variables

The study analyzed ITN utilization as a dependent variable, while independent variables included socio-demographic characteristics, behavioral factors, obstetric factors, and ITN-related factors such as availability, accessibility, affordability, possession of ITNs, and sleeping patterns.

Operational Definition

Knowledge about malaria and IT: Respondents were considered as having adequate knowledge (knowledgeable) about malaria if they respond correctly to half of the questions regarding the transmission and prevention methods including the use of ITN and good knowledge (ie, a score ⩾ mean score) and poor knowledge (ie, a score of < the median score).[33]

Attitude toward malaria and ITN: assessment of the predisposition to respond favorably or unfavorably toward malaria. Eight items of 5 5-point Likert scale (ranges from strongly agree to strongly disagree) will be used to evaluate the respondents' attitude toward malaria preventive measures including ITNs. The respondents will be evaluated for the whole items to say low, moderate, and high attitude toward malaria and if the individual gets less than the whole item mean score classified as low attitude, if it is between 50% and 80% considered as moderate attitude and above 80% as high attitude toward malaria.

ITN utilization: was measured based on respondents' reports and approved by observation check list. Accordingly, ITN utilization will be recorded to be "yes" if a pregnant
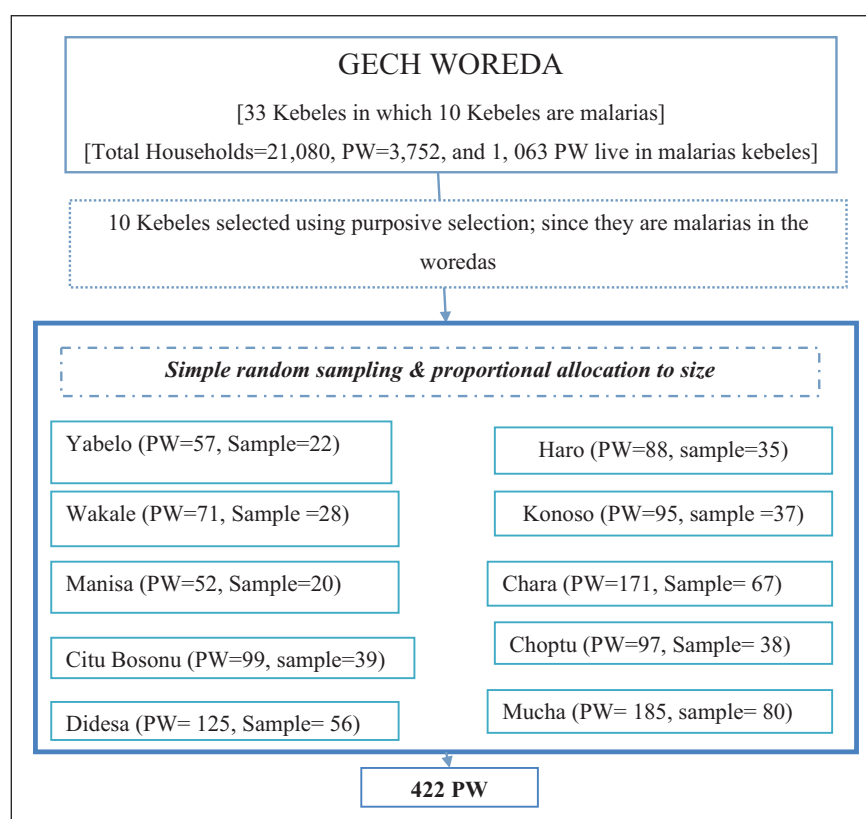
Figure 1. Schematic presentation of sampling procedures.

woman and/or a child reported that they slept under ITN, and Hanging and putting ITN under an all-around.

Data Management and Analysis

Data was collected using structured questionnaires, entered into Epi-data version 4.4.1.0, and exported to SPSS version 20 for analysis. Descriptive statistics (mean, standard deviations, and percentages) were computed to present the data and describe the study participants. The bivariable and multivariable logistic regression analyses were carried out to identify variables that are significantly associated with ITN utilization. Variables in bivariable analysis whose p-value is less than 0.25 were included in multivariable analysis, and then multivariable analyses were performed for those candidate variables in bivariable analysis to investigate independent predictors by controlling for possible confounders. A multivariable logistic regression model was used to identify factors associated with ITN utilization. Hosmer-Lemeshow's goodness of fit test was used to assess whether the necessary assumptions for the application of multivariable logistic regression were fulfilled. Multicollinearity was assessed using standard error, and the variables were entered into the multivariate model without multicollinearity. Adjusted odds ratios (AOR) were calculated with 95% CIs, and statistical significance was declared at $P \leqslant .05$.

Data Quality Management

The data collection tool was developed in English and translated into Afan Oromo, ensuring consistency and accuracy. Two days of training were provided to data collectors and supervisors, covering the study's purpose, data collection tools, procedures, interview techniques, and confidentiality. A pretest involving 5% of the total study participants was conducted at Borecha Woreda Health Center to assess the reliability and validity of the instruments, with necessary adjustments made before the final data collection.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of the College of Health Science, Mattu University. Subsequently, a formal letter from the Department of Public Health was submitted to the Gechi Woreda Health Office, which in turn issued similar letters to respective health centers. Written Informed consent was secured from all participants, ensuring their right to withdraw from the interview at any time and guaranteeing the confidentiality of their responses.

Results

Socio-Demographic Characteristics of Study Participants

In this study, a total of 413 PW were involved, resulting in a response rate of 97.87%. From the total participants, 90.3% of them were from rural communities, 97.7% were married, more than half (68%) of them attended primary education, 73.1% work as housewives in their role in the

Table 1. Sociodemographic characteristics of study participants among PW in Gechi woreda of Buno Bedele Zone, 2024 [N=413].

Variables	Category	Frequency (%)
Residence	Semi-urban	40 (9.7)
	Rural	373 (90.3)
Religion	Orthodox	14 (3.4)
	Muslim	380 (92.0)
	Protestant	19 (4.6)
Marital status (Where: 5 widowed, 6 separated)	Married	402 (97.3)
	Divorced /separated	11 (2.7)
Women education	No formal education	101 (24.5)
	Primary (1-8)	284 (68.8)
	Secondary (9-12)	21 (5.1)
	College and above	7 (1.7)
Husband education	No formal education	35 (8.5)
	Primary (1-8)	306 (74.1)
	Secondary (9-12)	67 (16.2)
Women occupation	House wife	302 (73.1)
	Merchant	87 (21.1)
	Day laborer	14 (3.4)
	Government employed	10 (2.4)
Husband occupation (N=408)	Farmer	359 (86.9)
	Merchant	10 (2.4)
	Day laborer	10 (2.4)
	Government employed	29 (7)
Family size	Less five member	165 (40)
	Five and above	248 (60)
Monthly income	500-1000 (4\$-8\$)	86 (20.8)
	1001-1500 (8.01\$-12\$)	131 (31.7)
	1501-2000 (12.01-16\$)	139 (33.7)
	2001-3000 (16.01\$-24\$)	57 (13.8)

Table 2. Maternal characteristics of study participants among PW in Gechi woreda of Buno Bedele Zone, 2024 [N=413].

Variables	Category	Frequency (%)
Parity	Primipara	185 (44.8)
	Multipara	228 (55.2)
Gravidity	Prim-gravida	232 (56.2)
	Multigravida	181 (43.8)
Stage of current pregnancy	First trimester	62 (15.0)
	Second trimester	232 (56.2)
	Third trimester	119 (28.8)
History of abortion	Yes	8 (1.9)
	No	405 (98.1)
ANC attended	Yes	331 (80.1)
	No	82 (19.9)
ANC visit rounds (N=331)	First visit	195 (58.9)
	Second visit	106 (32.0)
	Third visit or more	30 (9.1)

household, and about half (60%) of the respondents have 5 or more family members (Table 1).

Maternal Characteristics

Of the total participants (413 PW), 44.8% of them were primipara, 55.2% were multipara, 56.2% were prim-gravda, 43.8% were multigravida, and about 1.9% had a history of abortion. The current prevalence is 80.1% following antenatal care (ANC), in which 58.9% visited once, 32% visited twice, and 9.1% visited 3 times or more. The stage of the current pregnancy shows that 15% were in the in the first trimester, 56.2% were in the second trimester, and 28.8% were in the in the third trimester (Table 2).

Attitude Towards ITN Utilization

The study participant's attitude toward ITN utilization was assessed using 8 questions, as explained in the following table. After analysis of the total 413 participants, more than half (65.86%) of women had a positive attitude toward ITN utilization, and only 34.14% reported having a negative attitude toward ITN utilization (Table 3).

Knowledge of PW on Malaria and ITN

Of the total respondents, 90.3% know that malaria is a communicable disease, and 83.9 of them reported it is transmitted by mosquito bite, 2.7% by airborne, 10.7% by contact, and 2.7% by other means such as through contaminated food. On risk groups, only 49.6% know the risk groups (children and PW), and 63.2% know the possibility of prevention, of which only 26.8% thought ITN was an alternative prevention method. Concerning knowledge of the ITN, 90.5% of them heard about it, and of those who heard the massage, 75.6% were from health workers. In the last 6 months, about 44.6% experienced malaria at least once, and of those who got the disease, 77.7% visited health facilities (Table 4).

Sleeping Patterns and ITN Utilization

The majority (93.9%) of the respondents reported owning ITN, of which 90.5% received it from health facilities for free, and about 70.9% of the households owned 1 ITN per household, and 33% of the ITN were in good condition as per field observation in this study. Concerning the ITN utilization, 67.8% of the ITNs were hanged over the beds during the home visit, 62.6% of the women reported they slept under the ITN preceding night of the survey day, and the overall utilization status as per WHO recommendation was only 46.5% utilization in the setting (Table 5).

Factors Associated With ITN Utilization Among PW

In the analysis of factors associated with ITN utilization, different factors were included in the binary logistic regression, including socio-demographic factors, maternal factors, knowledge-related factors, attitudes toward utilization, and ITN-related factors. Accordingly, marital status, women' education, husband education, parity, ANC attendance, and family size were associated with maternal ITN utilization in crude analysis at a *P*-value less than .25 and

Table 3. The study participant's attitude toward ITN utilization among PW in the Gechi District of Buno Bedele, 2024 [N = 413].

Statements	Level of agreement	Frequency (%)	SD, mean
Malaria is the most serious health problem in the community	Strongly disagree	81 (19.6)	(1.52, 3.49)
	Disagree	42 (10.2)	
	Neutral	28 (6.8)	
	Agree	119 (28.8)	
	Strongly agree	143 (34.6)	
Malaria can cause a serious health problem for the fetus in the womb	Strongly disagree	70 (16.9)	(1.44, 3.61)
	Disagree	30 (7.3)	
	Neutral	31 (7.5)	
	Agree	142 (34.4)	
	Strongly agree	140 (33.9)	
Malaria can lead to death if not treated	Strongly disagree	71 (17.2)	(1.35, 3.46)
	Disagree	20 (4.8)	
	Neutral	60 (14.5)	
	Agree	171 (41.4)	
	Strongly agree	91 (22.0)	
Malaria can be transmitted without mosquito bite	Strongly disagree	31 (7.5)	(1.26, 3.69)
	Disagree	51 (12.3)	
	Neutral	76 (18.4)	
	Agree	112 (27.1)	
	Strongly agree	143 (34.6)	
Stagnant water and marsh areas can facilitate mosquito breeding	Strongly disagree	51 (12.3)	(1.43, 3.68)
	Disagree	60 (14.5)	
	Neutral	20 (4.8)	
	Agree	121 (29.3)	
	Strongly agree	161 (39.0)	
It is possible to prevent malaria	Strongly disagree	41 (9.9)	(1.33, 3.73)
	Disagree	50 (12.1)	
	Neutral	40 (9.7)	
	Agree	132 (32.0)	
	Strongly agree	150 (36.3)	
Utilization of ITNs is one of the best methods of malaria prevention	Strongly disagree	51 (12.3)	(1.45, 3.58)
	Disagree	70 (16.9)	
	Neutral	40 (9.7)	
	Agree	91 (22)	
	Strongly agree	161 (39)	
I am interested to use ITNs regularly and to prevent malaria	Strongly disagree	51 (12.3)	(1.26, 3.69)
	Disagree	60 (14.5)	
	Neutral	60 (14.5)	
	Agree	132 (31.0)	
	Strongly agree	110 (26.0)	
Attitude	Positive	272 (65.9)	(1.21, 3.58)
	Negative	141 (34.1)	

were candidates for multivariable analysis. In the final model, women' education [AOR: 0.48, 95% CI: 0.28-0.81], parity [AOR: 1.98, 95% CI: 1.30-3.03], ANC attendance [AOR: 2.08, 95% CI: 1.21-2.58], and family size [AOR: 2.53, 95% CI: 1.61-3.87] were significantly associated with ITN utilization at a *P*-value less than .05 after controlling for confounders (Table 6).

Discussion

This community-based cross-sectional survey was conducted among randomly selected PW in the Gechi district of Buno Bedele zone in south-west Ethiopia. The study involved 413 PW to identify LLITN utilization and factors associated with utilization in the setting. The findings of the study showed that the majority (93.9%) of the respondents reported owning LLITN. About 70.9% of the households owned 1 LLITN per household. The level of utilization, 67.8% of the LLITNs were hanged over the beds during the home visit, 62.6% of the women reported they slept under the LLITN preceding night of the survey day, and the overall utilization status as per WHO recommendation was only 46.5% [41.7%-51.3%] utilization in the setting. This level of utilization was consistent with the finding from other parts of Ethiopia. For instance, study from Miesso Woreda Eastern,[29] and from East African Countries 47.05%.[34] However, this finding shows lower utilization when compared with meta-analysis results in

Table 4. Knowledge of the study participants on malaria and ITN utilization among PW in the Gechi District of Buno Bedele, 2024 [N = 413].

Variables	Category	Frequency (%)
Malaria transmitted from person to person	Yes	373 (90.3)
	No	40 (9.7)
Way malaria transmission	Mosquito	313 (83.9)
	Air born	10 (2.7)
	Contact with infected person	40 (10.7)
	Other	10 (2.7)
Knowledge of high risk group	Yes	205 (49.6)
	No	208 (50.4)
Malaria preventable	Yes	261 (63.2)
	No	152 (36.8)
Methods malaria prevention	IRS	140 (53.6)
	ITN	70 (26.8)
	Herb spray	21 (5.1)
	Taking antimalarial medication	30 (7.3)
Knowledge of benefit of ITN	Yes	155 (37.5)
	No	258 (62.5)
Heard about ITN	Yes	373 (90.3)
	No	40 (9.7)
Source of Information about ITN	Radio	10 (2.7)
	Partner or friends	71 (19.0)
	Health workers	282 (75.6)
	School	10 (2.7)
Infected by malaria in the last 6 mo	Yes	184 (44.6)
	No	229 (55.4)
Health seeking during illness (N = 165)	Home with modern medicine	28 (15.2)
	Home with traditional	13 (7.1)
	Health facility	143 (77.7)

Table 5. Sleeping patterns and ITN utilization among PW in the Gechi District of Buno Bedele, 2024 [N = 413].

Variables	Category	Frequency (%)
Own ITN	Yes	388 (93.9)
	No	25 (6.1)
Source of ITN [N = 388]	Received from health facility	351 (90.5)
	Bought from market	37 (9.5)
Reason for not having	Unable to buy	10 (40)
	Waiting for free supply	10 (40)
	Damaged and old	5 (20)
Number of ITN households owned	One	275 (70.9)
	Two or more	113 (29.1)
Condition of ITN (observed)	Good (no holes)	128 (33)
	Poor (1-4 holes)	260 (67)
Hanged over bed (observed)	Yes	263 (67.8)
	No	125 (32.2)
Reported slept under ITN preceding night	Yes	243 (62.6)
	No	145 (37.4)
ITN utilization	Yes	192 (46.5)
	No	221 (53.5)

Ethiopia that shows 59.42%,[4] Ruwanda that shows 75%,[35] and from Nigeria that shows 71.8%.[36] The difference may be due to the nature of the study that the current study was community based study while most of the studies were institution based studies.

The low level utilization was significantly associated with women' education, parity, Antenatal care (ANC) visit, and previous malaria infection in the last 6 months. The current study revealed that sociodemographic factors mother education and family size were significantly associated with utilization. Accordingly, women who had no formal education were 52% less likely to utilize than those who attended at least primary education. Similarly, women who had family size less than 5 members was 2.53 times more likely to utilize. Similar studies also documented the importance of maternal education in the improvement of health behaviors including LLITN utilization during pregnancy.[13,34,35] This is due the fact that education enhances the knowledge of the women and shapes their practice. On the other hand large family size may have additional constraints than small size.[34] Mother those had large family size may be buzzy to feed child and low consideration for their own health.

The factors that contribute for the lower utilization were maternal factors ANC attendance and parity. Accordingly, PW who attended at least 1 ANC visit were 2.08 times more likely to utilize LLITN. Similarly, PW those with primipara were 1.98 times more likely to utilize than their counterparts. This finding was consistent with similar studies from Malawi[37] and Rwanda.[35] The study highlights the disparity between ownership and effective utilization of long-lasting insecticide-treated nets (LLITNs), urging community health workers to implement educational programs to address social and cultural barriers. It also suggests prioritizing interventions for large families and women without formal education and promoting health education to improve access to antenatal care. Misuse of LLITNs, such as repurposing them for non-health-related purposes, is attributed to knowledge gaps and cultural practices. The cross-sectional nature of the study limits causal inference due to temporal relationships. Therefore, future research should focus on longitudinal interventional studies with robust validation methods and innovative approaches.

Conclusion

The study found that despite good ownership of LLITNs among women, their utilization is very low when compared with the national malaria elimination target. The low LLITN utilization among PW underscores the need for action to save life-giving women. Factors such as education, gravidity, antenatal care attendance, and previous malaria infection in the last 6 months significantly influenced LLITN utilization. Key players in maternal care

Table 6. Multivariable analysis of factors associated with ITN Utilization among PW in the Gechi District of Buno Bedele, 2024 [N = 413].

Variables		Yes	No	COR			AOR		
				COR	95% CI	P value	AOR	95% CI	P-value
Marital status	Married	190	212	4.033	0.86-18.90	.077	1.64	0.174-15.47	.66
	Separated/ divorced	2	9	1			1		
Women education	NFE	30	71	0.391	0.242-0.633	<.001	0.479	0.28-0.81	.006*
	At least Primary	162	150	1			1		
Husband education	NFE	10	25	0.424	0.198-0.908	.027	0.60	0.26-1.39	.239
	At least Primary	181	192	1			1		
Parity	Primipara	105	80	2.127	1.433-3.157	<.001	1.98	1.30-3.03	.001*
	Multipara	87	141	1			1		
ANC attendance	Yes	166	165	2.167	1.298-3.618	.003	2.08	1.21-3.58	.008*
	Less five member	98	67	1			1		
Family size	Five and above	94	154	2.396	1.602-3.585	<.001	2.53	1.65-3.87	<.001*
	No	119	154	1			1		

*Significant at *P*-value less than .01.

should focus on awareness creation and ANC follow-up to reduce malaria during pregnancy.

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Author Contributions

DOD: methodology, formal analysis, visualization, original draft writing, and reviewing the manuscript. SKT: methodology, formal analysis, visualization, writing review, editing. BM: methodology, formal analysis, visualization, writing, review editing. Finally, all the authors proofread and approved the final version.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Data Availability Statement

The data sets analyzed during the current study are available in the supporting information.

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