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Utilization of insecticide treated nets among pregnant women in sodo zuria woreda Southern Ethiopia

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Background: The malaria control strategy has shown an improvement in providing services and allocating resources to enhance malaria elimination. The world malaria report indicated that there was a marked increment of insecticide treated net (ITNs) utilization among pregnant women. However, in Ethiopia, the number of households with possession and utilization of ITNs is still far behind the WHO recommendations. Hence, this study was aimed to measure the magnitude of ITN utilization and to identify factors associated with its utilization among pregnant women from April 4, 2021 to April 15, 2021 in Sodo Zuria Woreda, in Wolaita Zone, Southern Ethiopia.

Methods: A community based cross-sectional study was employed. Data were collected using interviewer administered pretested, structured questionnaires. Simple random sampling method was used to select 459 pregnant women. Data were entered into Epi Info version 7 and then exported to statistical package for the social sciences for further analysis. We used time period for data collection of current study. Binary's logistic regression was used to determine factors affecting insecticides treated net (ITN) utilization. Adjusted Odd Ratios (OR) with 95% CI was used to measures the strengths of associations.

Results: Of 435 surveyed households with pregnant women, 341(78.39%) with 95% Confidence Interval (CI) (74.5%, 82.3%) possessed at least one insecticide treated net. Among them, 194(56.89%) with 95% CI (51.6%, 61.7%) interviewees had self-reported as they slept under insecticide treated net on the night preceding the data collection day. Utilization of insecticide treated nets by other family members, AOR: 6.615(95% CI: 3.358, 13.032), knowledge that the use of insecticide treated nets can prevent malaria, AOR: 3.221(95% CI: 1.737, 5.974), sleeping under insecticide treated nets, AOR: 3.726(95% CI: 1.974, 7.034), and attending ANC follow up visits, AOR: 1.956(95% CI: 1.097), were found to be significantly associated factors with pregnant women's insecticide treated net utilization.

Conclusion: The number of households with pregnant women who had possession and utilization of ITNs was much lower than the recommendations set by WHO. Therefore, information dissemination to malaria high risk groups about insecticide treated net utilization and replacement of worn-out insecticide treated nets should be emphasized.

KEYWORDS

insecticide treated bed nets, malaria, pregnant women, sodo zuria woreda, ITNs

Background

In Ethiopia, malaria is a leading public health problem where approximately 68% of the population lives in malarious areas and three fourth of the total land mass is regarded as malarious (1). Malaria infection takes a heavy toll among pregnant women and young children (2). It is estimated that each year about 25 million pregnant women in sub-Saharan Africa (SSA) live at risk of malaria infection. Malaria infection during pregnancy carries substantial risks for pregnant woman, her fetus and the newborn child. It is frequently associated with the development of anemia, and complications like low birth weight and trans-placental parasitemia (3). Malaria transmission in Ethiopia is periodic, lasting for about three months usually from September to November (4).

The malaria control strategy has shown a progressive improvement to eliminate malaria through providing services and allocating resources (3). The two core globally accepted vector control interventions are long lasting insecticide treated net (LLITNs) and indoor residual spraying (IRS). The other ways of controlling malaria transmissions are keeping environmental hygiene and applying larvicides in mosquito breeding site (3). Ethiopia has been implementing national malaria strategic plans (NMSPs) phase III aiming to meet the ambitious goal of eliminating malaria in 50 districts by 2020 and entirely by 2030 (5)

The 2015 Ethiopian National Malaria Indicator (MIS) revealed that 65% of country's districts were malarious, and 53% had a risk of moderate to high transmission (6). However, according to malaria epidemiological and interventional study in Ethiopia, the nation-wide ITN ownership has been relatively low. In Ethiopia, the ITN ownership was 65% in 2007, 55% in 2011, and 64% in 2015. The National malaria indicator survey of 2015 also revealed that, the household level coverage of ITNs was 64% (7).

The Federal Ministry of Health (FMoH) of Ethiopia widely introduced LLITNs as a method of malaria prevention strategy targeting all age groups residing areas below 2000 meter altitude (4). However, utilization of ITN shows significant variations among region, residency, and house hold income (5). According to Ethiopia national MIS of 2016, ITN utilization is the highest among women living in urban areas and in the households with highest wealth quintiles. The survey also revealed that ITNs utilization is the highest in Afar and Amhara, lowest in Harari and Dire Dawa (8).

To best of our knowledge there was no previous study on ITNs utilization and factors affecting its utilization among pregnant women in study area. Therefore, the findings of study will be helpful for policy makers and the partners to recommend and redesign appropriate vector control interventions or used to improve ITNs utilization

Methods and materials

Study setting and period

This community based cross sectional study was conducted in Sodo Zuria Woreda of Wolaita Zone, Southern Ethiopia from April 4, 2021 to April 15, 2021. Sodo Zuria Woreda is one of 16 rural Woredas and 6 town administrations in Wolaita zone. The administrative seat of Sodo Zuria Woreda is Sodo town, which is located 383 km far from Addis Ababa (the capital city of Ethiopia),. Administratively, Sodo Zuria Woreda is divided in to 25 kebeles (five urban kebeles and twenty rural kebeles) (Figure 1). This study covered six rural kebeles (Shola Kodo, Kodo Gawulia, Waja Shoya, Waraza Lasho, Zala Shasha, and Shella Borkoshe) out of 20 rural kebeles in Sodo Zuria Woreda.

Sodo Zuria Woreda is located at an altitude between 1500 meters at Tando village in Zala Shasha kebele and 2,950 meters at tip of mount Damot above sea level. The Woreda has 21 degree cilices annual temperature on average, maximum of 28 degree cilices and minimum of 18 degree cilices. In addition, the study area has average annual rain fall of 800 mm and it ranges from maximum of 1,300 mm and minimum of 600 mm. Major rainy season start from June and extend to October. Water bodies such as streams and rivers commonly exist in all kebeles of the Woreda. There are also small scale irrigation canals which

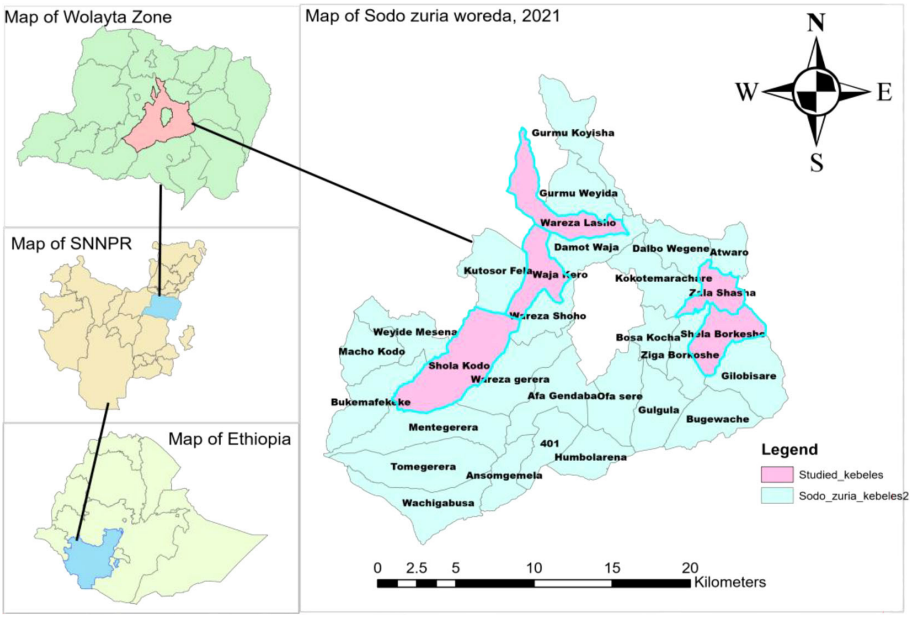

FIGURE 1
Map of Sodo Zuria Woreda showing study area, Wolaita zone, SNNPR, 2021.

surround five kebeles of the district. Around 84 permanent mosquito breeding sites were identified in the district which covers 5.04 KM^2 areas.

NB: Waja Shoya kebele was separated from Waja Kero Kebele and Kodo Gawulia kebele was separated from Shola Kodo kebele. So these newly structured kebeles are not available in shape file.

Study design

A community based cross-sectional study supplemented with observation of current physical status of ITNs, caring practices done by the owners of ITNs (mending if torn, washing of ITNs, proper hanging of ITNs over sleeping spaces, and the like) was employed

Source Population

All pregnant women residences of rural kebeles of Sodo Zuria Woreda were source population of the study.

Study population

All pregnant women who were systematically selected from study households of Sodo Zuria Woreda.

Inclusion criteria

Pregnant women who resided for six months or more prior to data collection period in rural kebeles of Sodo Zuria Woreda and registered by rural HEWs of study area for identification of pregnant women for ANC follow up and other obstetric services were included in the study.

Exclusion criteria

Pregnant women who are severely sick and mentally ill during data collection period were excluded from the study.

Sample size determination and sampling technique

The sample size for the first objective was calculated using single population proportion formula with the following assumptions using EPI info version 7. The proportion of ITNs utilization among pregnant women in the previous night of data collection date was 72.5% (i.e., P = 0.725), taken from study conducted at Damot Pulasa district, Wolaita Zone, Southern Ethiopia, 95% confidence interval, 5% margin of error, design effect of 1.5, power of 80% (9) (Table 1).

$$N = Z^2 \quad P \quad (1 - p) = 1.96^2(0.725)0.275/0.05^2$$

TABLE 1 Sample size calculation for the utilization of insecticide treated nets and associated factor among pregnant women, 2021.

Variable (factor)	Adjusted odds Ratio (AOR)	Power in 95% confidence interval (CI)	% outcome innon-exposed	Ratio Unexposed: exposed	Sample size	References
Interviewee's knowledge on malaria	6.9	80%	69.4%	0.441	98	(9)
Maternal Education	3.4	80%	14.5%	0.170	289	(9)
Rural Residence	2.49	80%	50%	1	182	(10)

$$d^2$$

The calculated sample size is 306.

Since, the sample size calculated for the first objective is greater than that of the rest two objectives; the first objective was used to calculate the final sample size. After considering design effect of 1.5 the final calculated sample size for this study was 306*1.5 = 459 (9, 10).

Sampling procedure

Multi stage sampling method was used to select the participants. Firstly, Sodo Zuria Woreda was selected out of 16 rural Woreda in Wolaita Zone by simple random sampling (SRS) method. Then, 6 kebeles were selected from 20 rural kebeles in Sodo Zuria Woreda by SRS technique. The number of study participants in each kebele was obtained by dividing estimated population of PW in the kebele by total number of PW in six sampled kebeles and then multiplying by sample size (459). Data registered at health posts or family folder of respective kebele was used to identify sampling frame of households with PW. This data contains health information of pregnant woman and house number. Finally, systematic random sampling technique was used to select the study participants from the family folder at respective health post. After that, data collectors took the house number of study participants and went to the identified household to interview PW. In each household, only one pregnant woman was interviewed (Table 2).

Adapted from different literatures with a few modification (9, 10).

Data collection

Data were collected using a pretested, structured interviewer-administered questionnaire prepared after reviewing the relevant literatures. The questionnaire was developed in English and then translated to Amharic, and then back translated to English by another public health officer to ensure its consistency in meaning and rationality. It was the Amharic version of the questionnaire that was used for data collection. Face-to-face interview was conducted by four degree holder nurses.

Operational definitions

ITN was defined as any LLIN designed to kill, repel, or block mosquitoes physically, that has been planned to remain effective for more than three years without retreatment (11).

ITN possession: proportion of households with at least one ITN.

ITN utilization- was defined as when study subjects responded positively as having slept under the ITN in the night preceding data collection day (12, 13). ITN utilization was measured based on respondents' self-report together with direct observation. Accordingly, ITN utilization was recorded to be "yes" if a pregnant women and/or a child slept under ITN during the night prior to the survey date and ITN was observed to be hanged (mounted) over the bed/the sleeping area during the observation day. On the other hand, ITN utilization was labeled to be "no" if a pregnant women and/or a child slept under ITN during the night prior to the survey date or if the ITN

TABLE 2 Sample size allocation by kebele for the utilization of IINs and associated factors among pregnant women in Sodo Zuria Woreda of Wolaita Zone, SNNPR, 2021.

S/No	Kebele name	Kebele Population	Number of *PW (3.46%)	Sample size per selected kebele (46.72% of *PW)
1	Solla Kodo	3,854	133	66
2	Kodo Gawulia	3,902	135	66
3	Waja Shoya	2,657	92	45
4	Shella Borkoshe	5,087	176	87
5	Zala Shasha	5,376	186	92
6	Waraza Lasho	6070	210	103
	Total	26,946	932	459

*PW = Pregnant Women.

was not observed to be hanged (mounted) over the bed/the sleeping area during the observation day despite a positive participant's report [9].

Proper hanging of ITN: Hanging and putting net under all around mattress properly in a way that it doesn't allow the entry of mosquitoes.

Proper care of ITN: Washing ITN by using mild soaps and not using detergents like Berekina at a quarterly (three months) interval and drying it under shadow.

Improper care of ITN: Washing of ITN by using detergents like sodium hypochlorite (bleach) and drying it by exposing to direct sun light and washing it more than expected frequently (every 2 to 3 months).

Pregnant woman: is a human female who was registered for ANC follow up by HEWs or a woman self-reported herself as pregnant during the study period.

Data management and analysis

Before the actual data collection, the questionnaires were pre-tested on similar setting but outside selected rural kebeles. The data collectors and supervisors were trained for three consecutive days on principles, ethical considerations, procedures, and details of the questionnaire. The principal investigator closely monitored the data collection process. Completed questionnaires were checked for their consistency and completeness every day and then entered into Epi-Info version 7 statistical software. Finally, the data were exported to SPSS for further cleaning and analyses. To avoid excessive number of variables and unstable estimates in the subsequent model, only variables reached a P value < 0.25 by bivariate analysis were kept in multivariable analysis. We performed logistic regression model using backward stepwise method for the predictors of ITN utilization. Backward stepwise regression approach was preferred because it reduces the number of predictors to reduce the multicollinearity problem and it is one of the ways to resolve the over fitting Statistical significance was set at P value < 0.05 in multivariable logistic regression with their 95% level of confidence interval and adjusted odds ratio.

Ethical considerations

Prior to data collection, ethical clearance was obtained from the Institutional Review Board (IRB) of Hawassa University, college of medicine and health sciences, school of public health under the reference number of Ref.No IRB/060/13. Written permission was obtained from Wolaita zone health department and Sodo Zuria Woreda health office. Informed written consent was attained from each study participant prior to data collection. The purpose of the study was explained to each respondent. During data collection, all study participants were communicated that their participation would be voluntary, and also they were told that they can quit participation at any time, even after the interview is ongoing. Address of the principal investigator was disclosed for participants to use it whenever they have any doubt. Data were collected by using codes. Name and other personal identifiers were not asked and all the confidentiality and private information were kept secret.

Results

Socio demographic characteristics of study participants

Of sampled 459 HHs with pregnant women, 435 were participated in this study making the response rate of 94.77%. The total population of the studied households was 1,908 with an average (± SD) family size of 4.39 (± 1.733). Of the total population identified, 435 (22.80%) were pregnant women. Mean age of respondents was 28.69 (SD ±5.48). Of the total respondents, 55 (12.64%), 425 (97.70%), and 314(72.18%) were with no formal education, married (leaving together), and housewife, respectively (Table 3).

Household assets and characteristics of housing

Almost all, 430 (98.97) of the roof of houses of study participants were covered with corrugated sheets of iron. Only 51 (11.72%) households possess television. Three hundred sixty two (83.22%) of study participants reported that they use kitchen to cook food. A total of 876 separate sleeping places were identified, thus, making the average number of separate sleeping places per HH was 2.01 (SD ± 0.56) (Table 4).

Obstetric health characteristics of the study participants

Mean age at first pregnancy was 20.31 (SD ±2.22). Two hundred seventy four (63.99%) pregnancies were occurred by intention (plan). Concerning ANC follow up, 226 (51.59%) pregnant women were started ANC visit during current pregnancy. However, only 83 (36.73%) of them showed ANC follow up appointment cards for data collectors. Children under age five were 384 (20.13%) with mean of 0.88 (SD ± 0.60) (Table 5).

TABLE 3 Socio-demographic background of the respondents, Sodo Zuria District in Wolaita zone, Southern Ethiopia, 2021.

Variables	Category	Number	Percent (%)
Age of pregnant woman (years) (N = 435)	16-20	51	11.49
	21-25	70	15.86
	26-30	165	38.39
	30-35	99	22.53
	36-39	50	11.72
Sex of head of HH (N = 435)	Male	425	97.70
	Female	10	2.30
Religion of respondent (N = 435)	Orthodox	160	36.78
	Protestant	244	56.09
	Catholic	31	3.99
Educational status of the respondent (N = 433)	Unable to read and write	55	12.64
	Primary (1-8)	315	72.41
	Secondary and above	65	14.94
Educational status of Husband (N = 433)	Unable to read and write	24	5.52
	Primary (1-8)	227	52.18
	Secondary and above	182	41.64
Occupation of the respondent (N = 433)	House wife	314	72.18
	Other jobs	23	5.29
Occupation of the Husband (N = 433)	Farmer	309	71.36
	Other jobs	124	28.64
Marital status of the respondent (N = 435)	Married (living together)	425	97.70
	Others	10	2.30
Family Size (N = 435)	¾ 5	319	73.33
	> 5	116	26.66

*HH = House Hold.

Pregnant women's knowledge towards malaria prevention and control

When we investigate study participants' accessibility for information focusing on malaria prevention and control, 385 (88.51%) have ever heard about malaria. Most frequent 226 (51.95%) source of information responded by study participants was friends/family (Figure 2).

One hundred thirteen (25.98%) of study participants' home was visited by health workers or HEWs within the last 12 months prior to data collection period. Time elapsed from the last home visit was < 3 months, 3 to 6 months, and > 6 months with proportion of 38.94% (44), 38.94% (44), and 22.12% (25) respectively.

Two hundred eighty two (64.82%) respondents replied that malaria can transmit from infected person to not infected individual and 136 (31.26%) of them recognized bite of mosquito as means of malaria transmission. Two hundred sixty nine (61 83%) interviewees cited that sleeping under ITNs prevents malaria; whereas, 202 (46.44%) study participants mentioned fever as major symptom of malaria.

Wrong perceptions responded by study participants as cause of malaria transmission include physical contact with malaria patients, exposure to bad odor, drinking unsafe water, eating sweet food items such as stalk of maize and sorghum. Two hundred sixty nine (61.84%) of interviewees mentioned sleeping under ITNs as main method of malaria prevention. Other replies include environmental control measures, treating febrile cases within 24 hrs of fever initiation, spray of house with insecticidal chemicals, and taking preventive medication.

Insecticide treated nets possession and utilization

Of the 435 households surveyed, 341(78.39%) with 95% CI (74.5%, 82.3%) possessed at least one ITN. Similarly, coverage of at least two ITNs was 256(58.85%). The number of ITNs identified per household fluctuates from 1 to 4 with an average ownership per HH of 1.89 (± SD) 0.628). Three hundred thirty six (98.54) respondents freely obtained ITNs from health institution/HP (Table 6). Of 341 pregnant women who reside in households with at least one ITN, 194 (56.89%) with 95% CI (51.6%, 61.7%) self reportedly slept under ITN on preceding night of data collection day. Among those who slept under ITNs, 78 (40.21%) and 116 (59.79%) used their ITNs consistently (throughout the year) and intermittently respectively.

TABLE 4 Household assets and characteristics of surveyed households in Sodo Zuria Woreda, Wolaita zone, Southern Ethiopia, 2021.

Variables (N = 435)		Category	Number	Percent (%)
Monthly Family level of income/ETB (N = 435)		< = 1500	171	39.2
		>1500	264	60.6
Land ownership per hectare (N = 435)		None	21	4.83
		< 1	273	62.76
		1-3	141	32.41
Availability mobile phone in the HH (N = 435)		Yes	390	89.65
		No	45	10.35
Availability of television in the HH (N = 435)		Yes	51	11.72
		No	384	88.28
Availability of radio in the HH (N = 435)		Yes	319	73.33
		No	116	26.67
Availability of domestic animals (N = 435)		Yes	387	88.96
		No	48	11.04
Shelter of domestic animals separated from residence (n =387)		Yes	186	48.06
		No	201	51.93
Main material of	Roof(435)	Corrugated iron	430	98.85
		Others	5	1.15
	Floor(435)	Earth or dung	395	90.80
		Cement	40	9.20
	Wall(435)	Wood plastered with mud	424	97.47
		Others	11	2,53
Wall of the residence painted		Yes	260	59.77
		No	175	40.23
Number of rooms used for sleeping		1	350	80.46
		2	85	19.54
Number of separated spaces used for sleeping		1	74	17.01
		2	281	64.6
		3	80	18.39
Cooking usually done in (N = 435)		Kitchen	362	83.22
		Residence	59	13.56
		Out door	14	3.22
Kitchen is in separated building from residence (n = 362)		Yes	181	50.00
		No	181	50.00

*HH = House Hold, ETB = Ethiopian Birr.

As witnessed by data collectors, among 341 ITNs possessor HHs, 273 (80.06%) hanged at least one ITN over sleeping spaces. Even if the availability of 645 ITNs was confirmed by data collectors, only 325 (50%) of available ITNs were hanged over sleeping spaces with mean of 0.95 (SD ± 0.592) (Figure 3).

Among a total of 645 ITNs available in surveyed households, 336 (52.09%) ITNs were damaged. Even if it was not time to be worn out to ITNs in relation to mass distribution time (16 months prior to data collection period), more than half of visually inspected ITNs {97 (15.03%) and 239 (37.05%)} were out of use and torn (need repairment) respectively (Figure 4).

We attempted to assess whether pregnant women care for their ITNs or not. As a result, 282 (82.69%) respondents didn't have experience of sewing (mending) an ITN when it gets damaged (torn). As well, only 104 (28.03%) respondents have positive attitude towards effectiveness of ITNs after washing (Table 6).

Of 116 study participants who use their ITNs intermittently, 67 (57.76%) replied that they use ITNs when they hear mosquito buzzing. Others who use their ITNs occasionally responded as they use ITNS after rainy season, during rainy season, and during dry season, 29 (25%), 14 (12.07%), and 6(5.17%) respectively. Among 341 at least one ITN owner interviewees, 147 (43.12%) didn't sleep under ITN on preceding night of data collection day. Main reasons specified by them were shown in Figure 5.

TABLE 5 Obstetric health information of study participants in Sodo Zuria Woreda, Wolaita zone, Southern Ethiopia, 2021.

Variables	Category	Frequency	Percent (%)
Number of pregnancies (N = 435) (gravidity)	Primigravidae	75	17.24
	Multigravidae	360	82.76
Number of deliveries (n=360) (Parity)	Primiparae	72	20.00
	Multiparae	288	80.00
Is current pregnancy intended (Parity) (N = 435)	Yes	274	63.99
	No	161	37.01
Respondent started ANC follow up (N = 435)	Yes	226	51.95
	No	209	48.05
Place of ANC-1 follow up (n = 226)	Health post	29	12.8
	Health center/hospital	171	75.66
	Private clinic	26	12.83
Number of ANC visits (n = 226)	1	103	45.58
	2	109	48.23
	3 and more	14	6.19
Availability of appointment card (n = 226)	Yes	83	36.73
	No	143	63.27
Gestational age (N = 435)	First Trimester	129	29.66
	Second Trimester	167	38.39
	Third Trimester	139	31.94
Number of children under age five (N = 435)	None	107	24.60
	one	272	62.53
	Two	56	12.87
Infected by malaria in previous pregnancy? (n=360)	Yes	190	52.77
	No	170	47.22
Place of treatment for malaria in previous pregnancy (n = 190)	Home remedy	42	22.11
	Health post	8	4.21
	Health center/hospital	98	51.58
	Private clinic	42	22.11
Time interval between treatment initiation and onset of fever? (n = 190)	within 24 hours	9	6.08
	> 24 hours	132	89.19
	I don't recall	7	4.73

Factors associated with insecticide treated nets possession

Categorical independent variables with P-value < 0.25 in bivariate logistic regression analysis were entered in multivariable stepwise backward logistic regression analysis to determine statistical associations between dependent and independent variables. These include husband's occupation, time taken to reach health facility, age of respondent, attending ANC follow up, identifying mosquito bite as mode of malaria transmission, knowledge that the use of ITNs can prevent malaria, access to information on schedule of ITNs distribution, ITNs shape preference. On the other hand, respondent ever educated, Husband ever educated, respondent's occupation, home visit by HEWs, family size, radio available and television available were not associated on bivariable analysis. Therefore, these variables were excluded from multivariable analysis.

After controlling for the effects of potentially confounding variables using multivariable stepwise backward logistic regression, independent variables with P-value < 0.05 with their 95% CI and AOR were identified to be statistically significant predictors of ITNs possession. These include occupation of husband (farmer), AOR = 1.940(95% CI: 1.143, 3.293), knowledge that the use of ITNs can prevent malaria AOR = 1.692(95% CI: 1.007, 2.845), access to information on schedule of ITNs mass distribution, AOR = 3.034(95% CI: 1.724, 5.341) and ITNs shape preference, AOR = 3.150(95% CI: 1.908, 5.200) (Table 7).

Factors associated with utilization of ITNs by pregnant women

Categorical independent variables with P-value less than 0.25 in bivariable logistic regression analysis were entered in

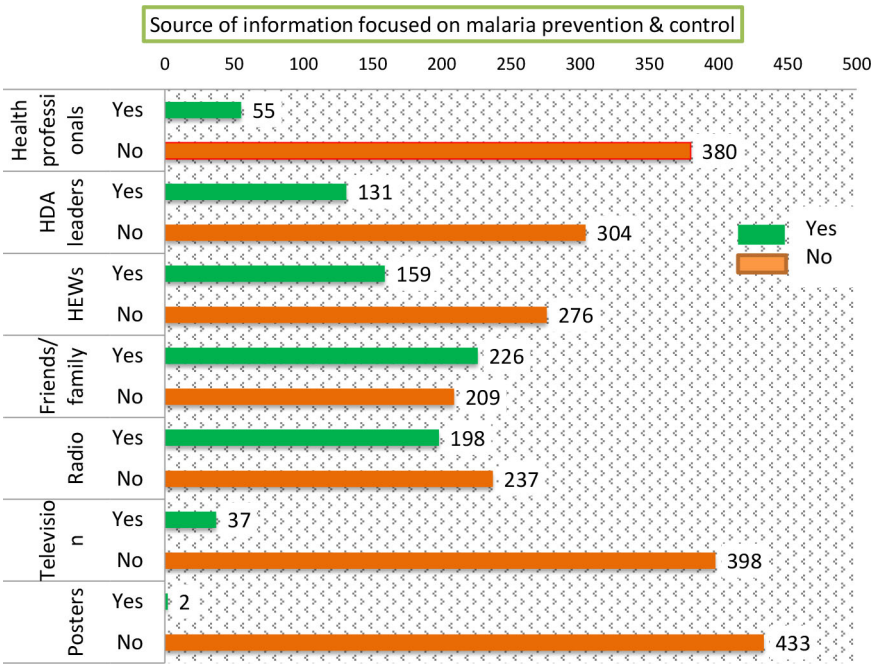

FIGURE 2
Source of health information provided at household level for pregnant women.

multivariable stepwise backward logistic regression analysis. These include attending ANC follow up, utilization of ITNs by other family members, home visit by HWs/HEWs, knowledge that the use of insecticide treated nets can prevent malaria, identifying mosquito bite as mode of malaria transmission, washing material of ITNs, the area cooking usually done, mending practice of torn ITNs, age of pregnant women, Prioritized family members to use ITNs in case of shortage, HEWs as source of information, wall of residential house painted, and access to information on mass ITNs distribution schedule. The investigation yielded eight dichotomized variables at P-value < 0.05 with their 95% CI and AOR to be significantly associated with ITNs utilization by pregnant women. These include utilization of ITNs by other family members, AOR: 6.615(95% CI: 3.358, 13.032), access to information on ITNs mass distribution schedule, AOR: 2.857(95% CI: 1.197, 6.818), knowledge that the use of insecticide treated nets can prevent malaria, AOR: 3.221 (95% CI: 1.737, 5.974), identifying mosquito bite as mode of malaria transmission, AOR: 1.929(95% CI: 1.004, 3.706), giving priority to high risk groups (under five children and pregnant women) to sleep under ITNs, AOR: 3.726(95% CI: 1.974, 7.034), HEWs as source of information, AOR: 2.409 (95% CI: 1.313, 4.420), Attending ANC follow up visits, AOR: 1.956(95% CI: 1.097, 3.487), and Age of PW, AOR: 0.527 (95% CI: 0.288, 0.965) (Table 8).

Discussion

The aim of this study was to determine the coverage of ITNs, its utilization rate, and factors associated with ITN possession and utilization among pregnant women in rural kebeles of Sodo Zuria Woreda, Southern Ethiopia, 2021. Despite mass distribution of ITNs in January, 2020 in which the Woreda attained universal (100%) coverage of at least one ITN per household, its ownership was low among pregnant women participated in current study. Sixteen months after mass ITNs distribution campaign, only 194 (78.39%) of surveyed households possessed at least one ITN. Similarly, the coverage of at least two ITNs was 256 (58.85%). Thus, in reference to PMI (President's Malaria Initiative) Ethiopia Malaria Operational Plan/2020 that aims to achieve 100% coverage in malaria endemic areas to own at least one ITN per two persons and to achieve and maintain utilization above 80% by all age and sex groups, the possession coverage of ITNs in the study area was low. As stated in 2017 National Malaria Guidelines, FMoH Ethiopia aims to achieve universal (100%) coverage with one ITN per sleeping space on average to households in malaria endemic areas (14, 15).

Other previous studies carried out in Ethiopia and Sudan also found that maternal knowledge on malaria, maternal educational level, bed room condition, and time taken to reach the health facility and ITNs condition negatively affects ITNs

TABLE 6 ITNs possession and utilization among pregnant women in Sodo Zuria Woreda of Wolaita zone, Southern Ethiopia, 2021.

Variables		Category	Frequency	%
Availability of ITNs (N = 435)		Yes	341	78.39
		No	94	21.61
ITNs shape preference (N = 435)		Yes	302	69.43
		No	133	30.57
ITNs shape most preferred by respondent(n = 302)		Conical/circular	238	78.81
		Rectangular	64	21.19
Number of ITNs in HH (n = 341)		One	85	24.93
		Two	209	61.29
		Three and above	47	13.78
ITNs hanged over sleeping space (n = 341)		Yes	273	80.06
		No	68	19.94
Number of ITNs in hanged over sleeping space (observation) (n = 273)		One ITN in use	221	80.95
		Two ITNs in use	52	19.04
Pregnant woman slept under ITN last night (n = 341)		Yes	194	56.89
		No	147	43.11
How often do you sleep under ITN? (n=194)		Consistently	78	40.21
		Intermittently	116	59.79
Who (other than PW) slept under ITNs last night? (n = 341)		Under five children	115	33.72
		Other members of the family	136	39.88
		No body	90	26.39
Who gets priority to sleep under ITNs (n = 341)		Pregnant woman	152	44.75
		children under age five	97	28.46
		Head of household	85	24.93
		Elderly people	7	2.05
Caring for ITNs (n = 341)	Mending (sewing if torn) ITNs if torn	Yes	59	17.31
		No	282	82.69
	Frequency of washing ITNs	Quarterly (2 -3 months)	32	9.38
		Other schedules	309	90.62
	Washing material used	Ordinary soap/Detergent	315	92.37
		Water only	26	7.63
	Places used to dry ITNs	Direct sunlight	223	65.39
		Under shadow	118	34.60
Current status of ITNs (observation) (N = 645)		Good (functional)	268	41.55
		Torn (need repairmen)	239	37.05
		Out of use (Worn out)	97	15.04
		Saved for future use	41	6.35

utilization (16–19). Study conducted in Arbaminch town, southern Ethiopia, shown that, education of head of household and rural residence of the household were found to be significant determinant factors of ITNs utilization (10).

In this study, ITNs coverage with one ITN per sleeping space was 62.56%. Our study finding for ITNs utilization by pregnant women was in accordance with a previous report of Halaba Kulito town 54.16% (17). In contrast, the coverage report of our study to possess at least one ITN at household level was higher than the ownership report of previous studies conducted in southern and northern Ethiopia (10, 20). Possible explanation for the difference might be variation in study period which may indicate the impact of interventions done on vector control strategies, especially ITNs distribution. In this study, out of 341 pregnant women who reside in at least one ITN owner households, 194 (56.89%) were self-reported that they slept under ITN the night preceding data collection day. This finding was lower than ITNs utilization reports of Damot Pulasa, and Raya Azebo 72.5%, and 74.3% respectively (9, 19). It was also lower than WHO recommendation (80%) for ITNs utilization by high risk groups and Ethiopia national MIS 2015 (74%) (8, 14).

The present study also showed that the proportion between possession and utilization was 78.4% and 56.9% respectively. Possible reason for the disparity between ITNs possession and utilization is failure to supply ITNs in routine service delivery

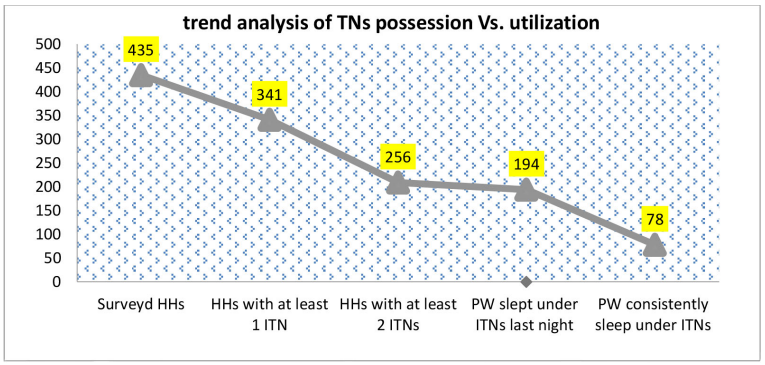

FIGURE 3
Trend analysis of ITNs possession Vs. utilization pregnant women.

points including ANC follow up visits and EPI services (21–23). The finding of this study was higher than the finding of the study reported in Halaba Kulito (77.4% versus 54%) (9, 17), in Arbaminch district (35%), and National Malaria Indicator Survey of 2015 (44%) (8, 10, 24). This might be due to the progresses in ITNs coverage and improvement in health information dissemination strategies in current health systems. The difference between the report done by the national MIS 2015 and current study might be because the 2015 national indicator survey was carried out across the countrywide where there is low risk and high risk of malaria prevalence.

Our study also revealed that usage of ITNs by other family members encouraged the current utilization of ITNs. Pregnant women whose family members use ITNs are about 6 times more likely to use ITNs than those their family members didn't use ITNs in previous night of data collection date. This finding was also reported by previous study in Sudan (16). The possible explanation for this result could be ITNs user family members act as role model for pregnant women and motivate their family members to use ITNs. Study participants who prefer ITNs shape were 3 times more likely to possess ITNs than their counterparts. This finding agrees with the finding of the study conducted on Long lasting insecticidal net use and its associated factors in Limmu Seka District, South West Ethiopia, in which the conical shaped ITN was more preferable due to the fact that conical ITNs are convenient for hanging (25).

Study participants who know how malaria transmits were 4 times more likely to utilize ITNs when compared to those who do not know about malaria transmission through mosquito bite. Similarly, a study conducted in Limmu Seka District in South Western Ethiopia reported that study participants who do not know how malaria is transmits were less likely utilize ITNs when compared to those who know about malaria transmission by mosquito bite (25). This study also revealed that respondents who have knowledge that the use of ITNs prevents malaria were 3 folds more likely use ITNs than their counterparts. This finding was consistent with previous report conducted in

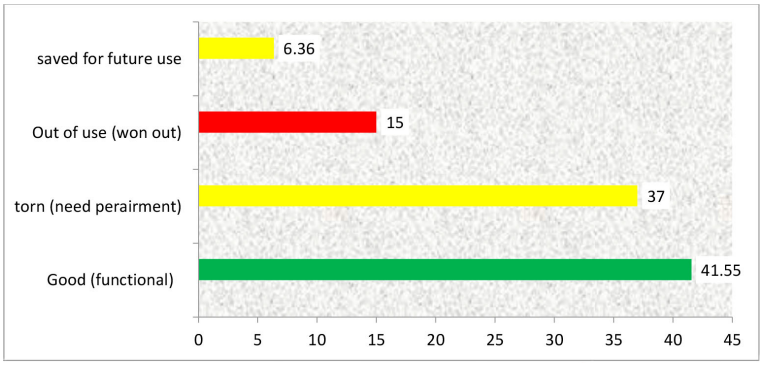

FIGURE 4
Status of ITNs during data collection period.

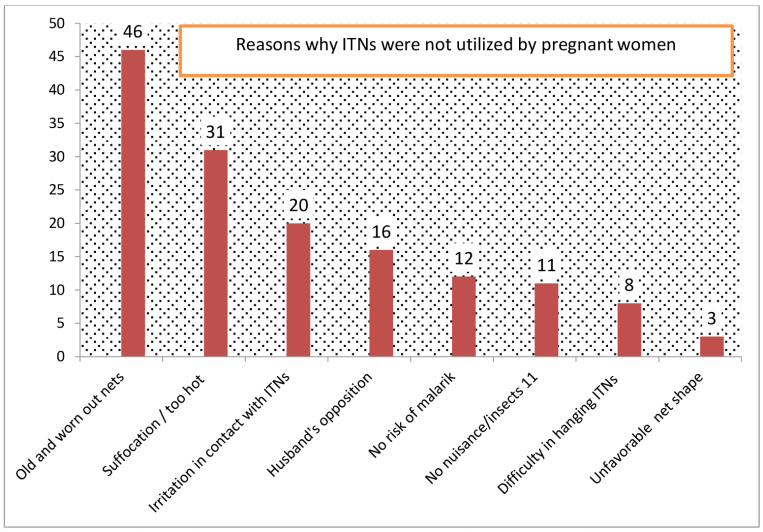

FIGURE 5
Reasons why pregnant women not using ITNs in rural kebeles of Sodo Zuria Woreda, Southern Ethiopia, 2021.

Uganda (2017) in which 98.1% of the respondents considered ITNs a key malaria prevention strategy (26).

The study participants' knowledge that sleeping under ITN prevents the transmission of malaria was significantly associated with both ownership and utilization of ITNs. The respondents who know that ITNs prevents malaria by preventing mosquito bites were 1.7 times more likely to possess ITNs whereas, the respondents who know that TTNs prevents malaria were 3 times more likely to utilize

TABLE 7 Factors associated with Insecticide Treated Nets possession among pregnant women in Sodo Zuria Woreda, Southern Ethiopia, 2021.

Variables	Category	Possession of at least one ITN by surveyed HHs (N= 435)				
		Yes	No	COR (95% CI)	AOR (95% CI)	P-value
	Other occupations	88	33	1		
Occupation of husband	Farmer	250	59	1.630(1.006, 2.639) *	1.940(1.143, 3.293)	0.014*
	Other occupations	91	35	1	1	
Time taken to reach health facility	< 1 Hr.	98	16	1.966(1.093, 3.535)	1.278(0.674, 2.424)	0.452
	> 1 Hr.	243	78	1	1	
	Yes	94	18	1.607(0.912, 2.830)	NA	
	No	247	76	1		
Can ITNs prevent malaria?	Yes	225	42	2.401(1.510, 3.820) *	1.692(1.007, 2.845)	0.047*
	No	116	52	1	1	
Mode of transmission	Mosquito bite	116	20	1.908(1.109, 3.281)	1.188(0.638. 2.210)	0.587
	Others	225	74	1	1	
	> 5	95	21	1		
HEWs as information source	Yes	133	26	1.672(1.013, 2.762)	1.296(0.753, 2.232)	0.349
	No	208	68	1		
Started ANC follow up	Yes	185	40	1.611(1.016, 2.556)	1.383(0.838, 2.280)	0.204
	No	155	54	1	1	
Access to information during ITNs distribution	Yes	292	56	4.044(2.426, 6.742) *	3.034(1.724, 5.341)	0.000*
	No	49	38	1	1	
ITNs shape preference	Yes	259	43	3.746(2.328, 6.028)	3.150(1.908, 5.200)	0.000*
	No	83	51	1		

*Statistically significant variables in multivariable logistic regression at P-value < 0.05.

TABLE 8 Factors associated with ITNs utilization among pregnant women in Sodo Zuria Woreda, Southern Ethiopia, 2021.

Variables	Category	ITN use by pregnant women (n = 341)				
		Yes	No	COR (95% CI)	AOR (95% CI)	P-value
Other family members used ITN last night	Yes	174	70	7.909(4.496,13.912)	6.615(3.358, 13.032)	0.000*
	No	77	20	1	1	
Home visit by HWs/HEWs	Yes	69	125	2.694(1.600, 4.536)	.0.580(0.251, 1.339)	0.202
	No	25	122	1	1	
Can ITNs prevent malaria?	Yes	159	35	5.575(3.418, 9.096)	3.221(1.737, 5.974)	0.000*
	No	66	81	1	1	
Mode of malaria transmission	Mosquito bite	90	104	4.027(2.421, 6.700)	1.929(1.004, 3.706)	0.049*
	Others	26	121	1	1	
Cooking usually done in	Kitchen	173	21	1.854(1.001, 3.432)	1.150(0.499, 2.650)	0.743
	Residence	120	27	1	1	
Mending ITNs when it gets torn	Yes	45	14	2.869(1.507, 5.462)	1.334(0.547, 3.255)	0.526
	No	149	133	1	1	
Age of PW	<=30	177	105	0.608(0.384, 0.962)	0.527(0.288, 0.965)	0.038*
	> 30	77	42	1	1	
Prioritized group to sleep under ITNs	PW/Children < age 5	164	30	3.987(2.398, 6.631)	3.726(1.974, 7.034)	0.000*
	Other family members	85	62	1	1	
HEWs as source of information	Yes	97	97	3.083(1.928, 4.931)	2.409(1.313, 4.420)	0.005*
	No	36	111	1	1	
Started ANC follow up	Yes	119	75	1.923(1.244, 2.973)	1.956(1.097, 3.487)	0.023*
	No	66	80	1	1	
Access to messages on malaria	Yes	181	13	3.133(1.555, 6.313)	0.865(0.312, 2.393)	0.779
	No	120	27	1	1	
Wall of residence painted	Yes	127	78	1.677(1.081, 2.600)	1.296(0.699, 2.402)	0.410
	No	67	69	1	1	
Access to information on schedule of ITNs distribution	Yes	181	13	4.516(2.295, 8.885)	2.857(1.197, 6.818)	0.018*
	No	111	36	1	1	

*Statistically significant variables in multivariable logistic regression at P-value < 0.05.

ITNs when compared to those who do not know malaria preventive effect of ITNs. Similar finding was also reported in previous study (27).

As identified by current study, about 98.5% of surveyed households freely obtained ITNs from health institution. The report was slightly higher than the finding of the study reported in Arbaminch (10). The finding of the current study also showed that those who receive information about ITNs utilization from health extension are 2.5 folds more likely to use ITNs than their counterparts. Similar findings was reported by the study conducted in Limmu Seka District in South West Ethiopia (25).

Pregnant women whose husband's occupation was farmer were about 2 times more likely to use ITNs than pregnant women whose husband were engaged in other occupation. However, this finding was negatively associated with ITNs utilization by pregnant women in previous study conducted on determinants of ownership and utilization of insecticide-treated bed nets for malaria control in Eastern Ethiopia (28, 29). Possible explanation for positive association between ITN utilization and partner's occupation is that agricultural development team (organized by 30 to 40 household heads) and health development army (organized by averagely 30 house wives) work together in various health related issues including promotion of ITNs possession and its proper utilization.

Strengths and limitations of the study

Strengths of our study include data collectors verified the presence or absence of ITNs, its being hanged (mounted) over sleeping space or not, and physical status of the nets (pretense of hole or tear, washing material and drying place, if the net is used for other unintended purposes) by home to home survey. Data collection period was coinciding with the minor malaria transmission period of the year in other parts of the country, but as mentioned in methods and materials section, this period (April to June) seems major malaria transmission period in Wolaita Zone which needs further investigation. Because of the cross-sectional nature of the study design we failed to show trends of ITNs possession as well as its utilization over time. Likewise, the utilization of ITNs by pregnant women was measured by self-report of usage of only one night prior to survey date which may be affected by social desirability bias.

Conclusion

Despite the efforts made to scale up ITN distribution, ITN possession and regular utilization was much lower than recommendation set by WHO. Knowledge that the use of insecticide treated nets can prevent malaria, utilization of insecticide treated nets by other family members, giving priority to high risk groups to sleep under insecticide treated nets, and antenatal follow up visits were found to be significantly associated with ITN by pregnant women. Likewise, having information on schedule of ITNs distribution, and husband's occupation (being farmer) and net shape preference are significantly associated with ITNs ownership by pregnant women. Premature attrition rate of ITNs was found to be major reason for an observed low ITN ownership and utilization.

Recommendations

Attention should be given to information dissemination and replacement of worn-out ITNs in special schedules such as antenatal follow up visits in addition to three yearly based mass distribution campaigns. There is also a need for implementation of sustainable behavioral change communication (BCC) focusing on caring practices and regular utilization of ITNs after ITN distribution coordinated with prioritizing most vulnerable groups such as Children less than age of 5 years and pregnant women. Furthermore, ITN shape should be considered before procurement to agree with the preference of the commonly.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics Statement

Prior to data collection, ethical clearance was obtained from the Institutional Review Board (IRB) of Hawassa University, college of medicine and health sciences, school of public health. Written permission was obtained from Wolaita zone health department and Sodo Zuria Woreda health office. Informed written consent was attained from each study participant prior to data collection.

Author contributions

JN and YH was involved in the conception, study design, execution, acquisition of data, analysis and interpretation of data, took part in drafting the article or revising it critically for important intellectual content. AA and MO were involved in study design, execution, acquisition of data, analysis, interpretation, drafted and final manuscript writing. All authors reviewed and agreed on all versions of the manuscript before submission, agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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