

# Ownership and Utilization of Long Lasting Insecticide Treated Nets (LLIN) and Factors Associated to Non-utilization Among Pregnant Women in Ho Municipality of Ghana

Wisdom Kudzo Axame<sup>1</sup>, Margaret Kweku<sup>1</sup>, Sedoafia Amelor<sup>1</sup>, Gideon Kye-Duodu<sup>1</sup>, Eric Agboli<sup>1</sup>, Isaac Agbemafle<sup>2</sup>, Wisdom Takramah<sup>1</sup>, Elvis Tarkang<sup>3,\*</sup>, Fred Newton Binka<sup>4</sup>

<sup>1</sup>Department of Epidemiology and Biostatistics, School of Public Health, University of Health and Allied Sciences, Ho, Ghana

<sup>2</sup>Department of Family and Community Health, School of Public Health, University of Health and Allied Sciences, Ho, Ghana

<sup>3</sup>Department of Population and Behavioural Sciences, School of Public Health, University of Health and Allied Sciences, Ho, Ghana

<sup>4</sup>Office of the Vice Chancellor, University of Health and Allied Sciences, Ho, Ghana

## Email address:

ebeyang1@yahoo.com (E. Tarkang)

\*Corresponding author

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**Abstract:** *Background:* Malaria is a mosquito-borne infectious disease affecting millions of people across the world especially children under five years and pregnant women. As part of the preventive strategies to combat malaria in pregnant women, free Long Lasting Insecticide Nets (LLINs) are given to them at Antenatal Care (ANC) clinics. This study assessed the ownership and utilization of LLINs and association between knowledge and utilization of LLINs among pregnant women in the Ho Municipality. *Methods:* In March 2016, a cross-sectional survey was carried out in six ANC clinics in Ho the municipal and regional capital of Volta Region. All six ANC clinics in the regional capital were included. Proportionate sampling was used to determine subjects needed from each facility. All eligible pregnant women present at the time of visit to the facility were conveniently used. Data was collected using interviews and questionnaire. Descriptive statistics was used to describe the categorical data whilst t test was used for the quantitative variables. Chi-square and logistic regression were used to determine the relationships and associations between the dependent and independent variables. *Results:* A total of 355 pregnant women with mean age  $27.8 \pm 5.5$  years were interviewed. Ownership of LLIN was 81.4% while usage was 42.5%. Level of education significantly influenced LLIN ownership ( $p=0.003$ ) and utilization (0.020). The main barriers to LLIN utilization were inconvenience due to heat (77.7%), lack of ownership of LLIN (12.9%) and absence of mosquitoes (4.3%). Knowledge on LLINs was high (73%). *Conclusion:* Ownership of LLIN was high but utilization was very low. Over a quarter (27%) of the pregnant women had moderate knowledge on LLINs. This if left unchecked can have negative consequences on the health of these women and their unborn babies. *Recommendations:* Behaviour change communication strategies on LLIN use should be further targeted to improve LLIN utilization among pregnant women.

**Keywords:** Malaria Prevention, Pregnant Women, Antenatal Clinics, LLIN Ownership, LLIN Utilization, Knowledge, Ho Municipality

## 1. Background

Malaria is the world's most important parasitic infection. It

is ranked among the major health and developmental problems for the poor countries in the world [1]. According to the World Health Organization (WHO), there were 214 million cases of malaria in 2015 and 438 000 deaths. Sub-

Saharan Africa (SSA) continues to carry a disproportionately high share of the global malaria burden, with 88% of malaria cases and 90% of malaria deaths [2].

Malaria in pregnancy is a common medico-social problem requiring a multi-disciplinary and multi-dimensional solution [3]. It was estimated that 125 million pregnancies around the world every year were at risk of malaria infection [4].

Ghana subscribed to the “Abuja Accord of 2000”, by African heads of states that sought to achieve 60% coverage of malaria interventions by 2010 [5]. This was to focus particularly on pregnant women and children under five years. As part of the millennium declaration, various countries enjoined to halt and reduce the incidence of malaria and other diseases by 2015 [6].

In order to achieve this target, the strategies to be used included prevention through the use of insecticide treated nets (ITNs), use of long lasting insecticides nets (LLINs), early detection and appropriate prompt treatment with Artemisinin-based combination therapies (ACTs). The other strategies included the use of effective chemoprophylaxis or intermittent preventive treatment in pregnancy (IPTp) and indoor residual spraying (IRS) [7].

Ghana implemented a malaria control strategy that involved multi and inter-sectoral partnerships, working together to reduce illness and death due to malaria by 50%, increase ITN ownership to 80% and usage to 60% by 2010 [6]. Though Ghana has made progress implementing its National Malaria Control Programme (NMCP), gaps still existed in achieving set targets. The May 2006 Abuja declaration entreated countries to put in place new measures to reduce malaria burden by 75% by the year 2015 [6&8]. These strategies implemented to achieve these goals included, preventive measures through the use of insecticide treated bed-nets (ITNs), long lasting insecticide nets (LLINs) and intermittent preventive treatment (IPT) in pregnancy (IPTp), in infants (IPTi), Seasonal Malaria Chemoprevention (SMC) in children and indoor residual spraying (IRS). Other curative measures were the early detection and appropriate prompt treatment with Arthemisinin-based combination therapies (ACTs) and tracking of cases through a surveillance system also known as the Test, Treat and Track (T3) strategy [8-9].

The objective was to increase ITN ownership to 100% and usage to 80% in the general population by 2015 (GDHS, 2008) and increase the number of children under-five and pregnant women sleeping under treated nets to 85% [10]. Insecticide treated nets (ITNs) were distributed at no cost to children under five years in households in Ghana as part of the National Immunization Days (NIDs) campaign in December, EPI growth monitoring clinics and in schools. Distribution of LLINs to pregnant women was done at antenatal care clinics (ANC) free of charge.

Insecticide treated nets (ITNs) have become one of the most viable tools used to prevent malaria transmission in Ghana. For their effectiveness, these mosquito nets have to be treated by dipping them in appropriate insecticides at least once in a year by the users or with the help of health workers.

However, less than 5% of the mosquito nets presently used in Africa are properly treated or even re-treated [11]. To solve this problem, ITNs were replaced by Long Lasting Insecticide-treated Nets (LLINs) for public health programs. These LLINs are manufactured using state-of-the-art bioactive fabric technologies and are treated only once during their production. The major point of interest about these LLINs is their efficacy should last as long as the average lifespan of the net which is usually 4 to 5 years [11].

Correct use of LLINs has been proven to reduce malaria cases by about 50%, and effectively reducing all causes of child mortality by 20% [12]. In most settings, WHO recommends LLIN coverage for all people at risk of being infected with malaria [13]. The most cost-effective way to achieve this is by providing LLINs free of charge, and to ensure equal access for all. Also, effective behaviour change communication strategies are required to ensure that all people at risk of malaria sleep under a LLIN every night [2]. According to WHO, during the past 10 years, coverage with vector control interventions increased substantially in Africa. In 2013, almost half of the population at risk in Africa (49%) had access to an insecticide-treated mosquito net, compared to 3% in 2004. In 2014, an estimated 214 million long-lasting insecticidal nets (LLINs) were delivered to malaria-endemic countries in Africa, bringing the total number of LLINs delivered to that region since 2012 to 427 million [14].

Studies have revealed that LLIN use among those who own them is commonly interrupted by forgetfulness, unavailability of net due to washing or dirtiness, extreme fatigue, labour pains and illness [15], heat [16] and not being bothered about mosquito bites [17].

In Ghana, pregnant women are given LLINs either on the first or second ANC visit free of charge. The Ghana Demographic health survey (GDHS) reported that in 2008, 27% of pregnant women slept under an ITN the night before the survey. Those living in rural areas were 41% more likely to have slept under a mosquito net than urban pregnant women (18%) [6]. In 2010, Ghana Millennium Development Goals (GMDG) Report indicated that 34.0% of pregnant women slept under ITN/ LLIN [18].

In 2014, 43.3% of pregnant women slept under an ITN the night before the Ghana Demographic and Health survey. Those living in rural areas were 55.2% more likely to have slept under a mosquito net the night before the survey than urban women 31.2%. It was found that in the Volta Region 68.6% pregnant slept under ITN the night before the survey [19].

Data from the District Health Information Management System 2 (DHIMS 2) database from 2012 to 2014 showed low utilization of LLINs by pregnant women. In 2012, out of 4266 ANC registrants who received LLINs during their first visit, 16.0% had used LLIN by their second ANC visit. The situation improved in 2013 when out of 4395 ANC registrants, 33.6% of the pregnant women had used the LLIN by their second visit.

This study reports on ownership and utilization of the LLINs among pregnant women. It also identified factors that

influence the utilization of LLINs in Ho urban, the regional capital of Volta Region as well as the capital of the Ho municipality.

## 2. Methods

### 2.1. Study Design and Setting

This study was a cross-sectional study involving pregnant women of all ages irrespective of the gestational age of the pregnancy, attending six ANC in Ho urban during the survey period. Ho Municipality is one of the twenty-five (25) administrative districts in the Volta Region. It has a population of 177,281 representing a percentage of 8.4% of the region's total population. The Municipality lies between latitudes 6° 20'N and 6° 55' N and longitude 0° 12' E and 0° 53' E. It shares boundaries with Adaklu and Agotime-Ziope Districts to the south, and to the north respectively, with Ho West District and Republic of Togo to the East. It occupies a total land of 23,611 square kilometres representing 11.5% of the region's total land. The general relief of the municipality is composed of both mountainous and lowland areas. Akwapim-Togo Ranges form part of the mountainous areas to the north and northeast. The vegetation is of two types: the forest and semi deciduous savannah. The climate is tropical with temperatures varying between 22°C and 37°C. The rainfall pattern is characterized by two rainy seasons referred to as major and minor seasons. The major rainy season begins from March to June while the minor season is from July to November and high malaria transmission coincides with the rainy seasons. The highest rainfall occurs in June and has a mean value of 201mm while the lowest rainfall occurs in November with a mean value of 2mm [20]. The municipality has 21 health facilities. These included one (1) Regional hospital, 1 Municipal hospital, 1 Polyclinic, 6 Health centers and 8 CHPS compounds and 4 Private clinics. There are 15 ANC clinics in the Municipality.

### 2.2. Sample Size Determination and Sampling

The sample size of the study was determined using the formula:  $N = \frac{(Z_{\alpha/2})^2 P (1-P)}{e^2}$  [21]. Where n = sample size to be determined,  $Z_{\alpha/2}$  = Z-score of 1.96 at 95% Confidence Interval (CI), p = prevalence of 50% or 0.5 as the exact prevalence was not known and e=margin of error of 5% = 0.05. A sample size of 355 was obtained.

A probability (simple random) sampling technique was used for the selection of ANC clinics and respondents in each facility. Six out of ten ANC clinics in the Ho Central sub-municipal were selected by ballot. Proportionate sampling was used to determine subjects needed from each facility.

The lottery method was used and it was the non-replacement type. In doing that, the expected number of respondents for each facility was estimated. This was done by counting the number of pregnant women who reported at the facility in the same period of data collection of the previous year (2015) for each facility. The assumption was

that the same number (sample frame or potential respondents) will visit the facility. Once the sampling frame for each facility was obtained and the number of respondents to be interviewed for each facility was known, 'yes' and 'no' was written on pieces of papers and folded. All eligible pregnant women attending clinic at the time of the survey balloted and those who picked yes and consented to participated were enrolled into the study.

### 2.3. Data Collection

Information on pregnant woman's background characteristics (e.g. age, level of education, marital status and occupation) was obtained using a pretested semi-structured questionnaire. Respondents were asked questions to ascertain their knowledge about ownership and utilization LLINs as well as reasons for not using LLIN.

### 2.4. Data Analysis

After data was collected from the participants, it was entered using EPI DATA 3.1 software and then exported to STATA version 12.0 software for analysis. Descriptive statistics as well as cross tabulations were used to analyze the data. Chi-square and logistic regression were used to determine the relationships and associations between the dependent variable and independent variables. All results were confined at 0.05 level of significance. Respondents' knowledge about LLINs was ranked by giving one mark (1) to a correct answer and no mark (0) for a wrong answer. The knowledge score of respondents ranged from 0 to 7 with a mean of 6.01(SD=0.79). The knowledge scores were further divided into three levels; low, moderate and high knowledge. Low knowledge was assigned to respondents who scored 0 to 3 marks, moderate to those who scored 4 to 5 marks and high knowledge level was for those who scored 6 to 7.

### 2.5. Ethical Consideration

Ethical clearance was obtained from the Ministry of Health/ Ghana Health Service Ethics Review Committee (GHS-ERC) with clearance ID NO: GHS-ERC: 30/02/16. Before the commencement of the study permission was sought from the Municipal Health Directorate (MHD). A written informed consent was obtained from the participants.

## 3. Results

### 3.1. Background Characteristics of Respondents

A total of 355 pregnant women were surveyed in March 2016. Their mean age was 27.84±5.51 ranging from 16 to 43 years. Most (52.1%) were aged between 26-35 years. Majority (87.6%) of the respondents were Christians, and 286 (80.6%) of the respondents were married. In terms of educational status, majority of the respondents (83.7%) had varying forms of education ranging from primary to tertiary education while 58 (16.3%) had no formal education. More than half (57.2%) of the respondents were self-employed, 91

(25.6%) were civil servants, 43 (12.1%) were students and 18 (5.1%) were unemployed (Table 1).

**Table 1.** Background characteristics of respondents.

Characteristic	Number (%)
Number enrolled	355
Mean Age (SD)	27.84 (5.51)
Age (years)	
15-25	132 (37.2)
26-35	185 (52.1)
36-45	38 (10.7)
Level of education	
No education	58 (16.3)
Primary education	85 (23.9)
Secondary education	122 (34.4)
Tertiary	90 (25.4)
Occupation	
Trading	90 (25.3)
Farming	13 (3.7)
Civil servant	91 (25.6)
Others	161 (45.4)
Marital status	
Married	286 (80.6)
Single	66 (18.6)
Divorced	3 (0.8)
36-45	38(10.7)
Religion	
Christianity	311 (87.6)
Islam	44 (12.4)
Tribe	
n	60 (16.9)
Ewe	246 (69.3)
Hausa	20 (5.6)
Ga	2 (0.6)
Others	27 (7.6)

### 3.2. Ownership and Utilization of LLIN

Table 2 shows that out of the 355 respondents, 289 (81.4%) said they owned a LLIN and 151 (42.5%) said they used LLIN, while majority of the pregnant women 57.5% did not use LLIN the night before the survey (Table 3). Among

respondents who own a LLIN, more than half 151/289 (52.2%) of them used it. The rest (47.8%) did not sleep under LLIN (Table 3).

**Table 2.** Ownership of LLIN among respondents.

Have a LLIN	Frequency	Percentage (%)
Yes	289	81.4
No	66	18.6
Total	355	100
Utilization of LLIN among respondents		
Used LLIN	All respondents N=355	Only Respondents with LLIN N=289
	Frequency (%)	Frequency (%)
Yes	151 (42.5)	151 (52.2)
No	204 (57.5)	138 (47.8)
Total	355	289

### 3.3. Comparison of LLIN Ownership with Demographic Characteristics

Table 3 shows that 146 (50.5%) of respondents aged between 26-35 own a LLINs followed by those aged between 15-25 years 112 (38.8%) and the least were those aged between 36-45 31(10.7%) The difference between LLINs ownership and age categories was not statistically significant ( $\chi^2=1.79$ ;  $p=0.409$ ).

Ownership of LLIN with regard to the respondents' level of education indicated that respondents who had secondary education had the highest 98 (33.9%) ownership of LLIN, followed by Primary education 80 (27.7%), tertiary education 69 (23.9) and the least was no formal education 42 (14.5%). The difference between LLINs ownership and level of education was statistically significant ( $\chi^2=13.6$ ;  $p=0.003$ ). There was no significant difference between marital status and LLIN ownership ( $\chi^2=0.84$ ;  $p=0.657$ ) (Table 3).

**Table 3.** Comparison of ownership and utilization of LLIN with some demographic characteristics of respondents.

Characteristic	LLIN ownership N=289 Number (%)	Chi-Square	P-value	LLIN utilization N=151 Number (%)	Chi-square	P-value
Age categorisation (years)						
15-25	112(38.8)	1.79	0.409	68(45.0)	5.51	0.063
26-35	146(50.5)			67(44.4)		
36-45	31(10.7)			16(10.6)		
Level of Education						
No education	42(14.5)	13.60	0.003	23(15.2)	9.84	0.020
Primary education	80(27.7)			54(35.8)		
Secondary education	98(33.9)			48(31.8)		
Tertiary education	69(23.9)			26(17.2)		
Marital Status						
Married	235(81.3)	0.84	0.657	124(82.1)	1.47	0.479
Single	52(18.0)			26(17.2)		
Divorced	2(0.7)			1(0.7)		

### 3.4. Comparison of LLIN Utilization with Demographic Characteristics

Table 3 shows that 68 (45.0%) of respondents aged 15-25 years used LLIN, followed by those aged 26-35 years 67

(44.4%) and the least was pregnant women aged 36-45 years 16 (10.6%). Though not statistically significant, pregnant women aged between 26 and 35 years were more likely to own LLIN compared to those aged 15-25 years. However, pregnant women aged 15-25 year were more likely to use

LLINs compared to the older age group ( $\chi^2 = 5.51$ ;  $p = 0.063$ ) (Table 4).

With regard to respondents' level of education, 54 (35.8%) of respondents who had Primary education, 48 (31.8%) with secondary education and 26 (17.2%) with Tertiary education were more likely to use LLIN compared to 23 (15.2%) of those without formal education ( $\chi^2 = 9.84$ ;  $p = 0.020$ ).

### 3.5. Knowledge on LLINs

All respondents knew that use of LLIN helps to prevent the burden of malaria. Out of the 355 respondents, majority (99.7%) knew that LLINs are used to prevent mosquito bites and (99.1%) agreed that pregnant women should sleep under LLINs. Surprisingly, only 169 (47.6%) of the respondents knew that LLINs were manufactured with insecticides to last 4 to 5 years and 219 (61.7%) said LLINs should not be washed frequently (Figure 1).

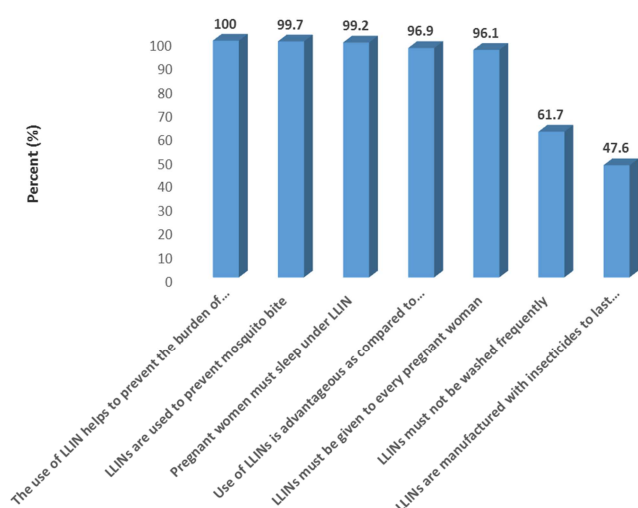


Figure 1. Respondent's knowledge on Long lasting Insecticide Nets (LLINs).

### 3.6. Factors Associated with Utilization of LLIN

Considering age as a factor in the adjusted logistic regression model, the 15-25 age group was the reference to which other age groups were compared (Table 4). There was an association between aged 26-36 years and utilization of LLIN compared to those aged 15-25 years [OR=0.45 (95% CI: 0.23-0.90;  $p=0.023$ ]. With respect to education and utilization of LLIN, there was no association between groups when compared to no education. There was no association between occupation, marital, status religion and LLIN utilization (Table 5).

Table 5 shows the unadjusted Logistic Regression between Utilization of LLIN and demographic information. Considering age as a factor in the unadjusted logistic regression model, the 15-25 age group was the reference to which other age groups were compared. The 26-36 age group was associated with LLIN utilisation than those aged 15-25 years [OR=0.51 (95% CI: 0.29-0.90);  $p: 0.020$ ]. The other demographic characteristics did not have any association with LLIN utilization as observed in the adjusted logistic

model.

Table 4. Adjusted Logistic Regression between Utilization of LLIN and demographic information.

Variable	Odds ratio (95% CI)	P-value
Age groups		
15-25		
26-35	0.45 (0.23-0.90)	0.023
36-45	0.44 (0.16-1.21)	0.114
Education		
No education		
Primary	1.37 (0.48-3.94)	0.554
Secondary	0.41 (0.14-1.24)	0.117
Tertiary	0.42 (0.10-1.76)	0.238
Occupation		
Trading		
Farming	1.10 (0.17-7.06)	0.917
Civil servant	1.24 (0.38-4.05)	0.724
Others	1.22 (0.56-2.67)	0.623
Marital status		
Married		
Single	0.87 (0.35-2.16)	0.759
Divorced	1	
Religion		
Christianity		
Islam	2.02 (0.25-16.13)	0.508
Tribe		
Akan		
Ewe	0.65 (0.30-1.42)	0.281
Hausa	0.24 (0.02-2.54)	0.238
Ga	1	
Others	0.69 (0.11-4.37)	0.691

Table 5. Unadjusted Logistic Regression between Utilization of LLIN and demographic information.

Variable	Odds ratio (95% CI)	P-value
Age groups		
15-25		
26-35	0.51 (0.29-0.90)	0.020
36-45	0.60 (0.25-1.45)	0.256
Education		
No education		
Primary	1.79 (0.75-4.29)	0.188
Secondary	0.69 (0.31-1.55)	0.374
Tertiary	0.61 (0.25-1.47)	0.273
Occupation		
Trading		
Farming	0.71 (0.15-3.42)	0.669
Civil servant	0.62 (0.30-1.27)	0.190
Others	0.94 (0.51-1.76)	0.856
Marital status		
Married		
Single	1.41 (0.68-3.00)	0.357
Divorced	1	
Religion		
Christianity		
Islam	1.26 (0.52-3.07)	0.612
Tribe		
Akan		
Ewe	0.81 (0.40-1.66)	0.576
Hausa	0.60 (0.17-2.15)	0.437
Ga	1	
Others	1.04 (0.30-3.63)	0.955



### 3.7. Barriers to the Utilization of LLINs

Figure 2 shows barriers associated with LLIN utilization among those who did not use it the night before the survey. Out of the 355 pregnant women, 204 (57.5%) did not use LLIN the night before the survey. Reasons given for not using LLIN included too much heat (18.9%), did not own a LLIN (18.6%) and used mosquito coil/spray (3.4%). Other reasons given were use fan instead of LLIN (2.0%), don't like LLIN (2.0%), feel uncomfortable sleeping under LLIN (2.0%), there were no mosquitoes in their area (2.0%) and the rest (8.5%) did not give any reason for not using the LLIN.

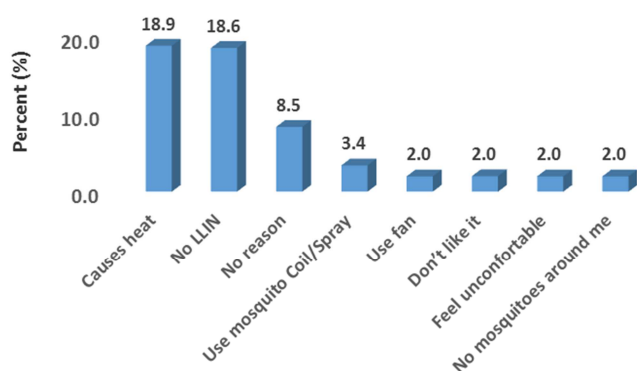


Figure 2. Barriers to LLIN Utilization.

## 4. Discussion

In order to achieve universal coverage in Ghana, one specific objective of NMPC was to scale up the distribution of LLINs such that, 100% of all households own at least one LLIN, 80% of the general population, 85% children under five and pregnant women sleep under LLINs by 2015 [6&18]. These objectives are still far from being reached in Ghana. This study was set out to find out the ownership and utilization level of LLINs among pregnant women in the Ho Municipality after 2015.

### 4.1. Ownership of LLIN

Ownership of LLIN among the respondents was impressive (289) 81.4%, although this study did not achieve the target of 100% set for 2015 [6 & 18]. However, results from this study show an impressive improvement in the ownership of LLIN as compared to the 2014 Ghana Demographic Health Survey (GDHS) where the overall ownership was 54% among pregnant women of which the Volta Region had the highest of 72% while, the Greater Accra Region had the lowest of 27% [19].

### 4.2. LLIN Utilization

In determining LLIN utilization in this study, only persons who reported to have slept under a LLIN the night before the survey were considered as users of LLINs. Out of the 289 respondents that alluded to owning a LLIN, 151 (42.5%) slept under it the night before the survey. Findings from the study indicate that the 85% utilization target set by the

NMCP was not met [10]. Studies have shown that there is variation in the utilization of LLIN between rural and urban settings. Reports by the GDHS showed that in 2008, overall, 27% of pregnant women slept under net and 41% were from rural areas while 18% were from urban areas [6]. In 2014, 49.6% pregnant women slept under LLIN, with 64.5% of them from rural and 35.5 from urban areas. This study reported 42.5% LLIN utilization, which is higher than what was reported by GDHS in 2014, (31.2%). It was also found that in the Volta Region, 68.6% of the pregnant women slept under ITN the night before the survey [19], but no information was given on pregnant women who slept under LLIN in urban areas in the region. Analysis of data from DHIMS 2 also shows that in 2013, 42.4% of the pregnant women used the LLIN on their first visit and 33.6% on their second visit in the Ho municipality [20]. Findings from this study (42.5%) may be a true reflection of LLIN utilization in an urban setting in the Volta Region.

It is clear that in Ghana, utilization of LLIN in rural areas is higher than urban areas. Findings reported by GDHS in 2014 show that utilization of LLIN in the Volta Region was high (68.6%) and this is comparable to what was reported in Mali, 78.5% [22] and in Sierra Leone, 76.5% [23].

This study did not report on performance of pregnant women in the rural settings. This clearly shows that with a great deal of effort, even more that 80% utilization of LLIN among pregnant women can be achieved.

### 4.3. Knowledge on LLIN

All respondents had some form of knowledge on LLIN. Most, (73%) had high knowledge on LLIN while 96 (27%) had moderate knowledge on LLIN. Furthermore, most (99.7%) of the respondents knew LLINs are used to protect oneself from mosquito bites. The high knowledge of respondents could be as a result of the level of information and education they had prior to and during LLIN distribution campaigns and at ANCs.

This study has shown that the pregnant women did not know that LLIN are impregnated with insecticides and also did not know that LLIN should not be washed frequently. Lack of knowledge can result into frequent washing of the LLIN which could reduce the effectiveness.

The study has also shown that information given by health workers does not include nor stress on the fact that LLIN are impregnated with insecticides therefore should not be washed frequently. This might be a contributory factor to not using LLINs.

### 4.4. Barriers to LLIN Utilization

Among those who owned LLINs but utilized them irregularly, though knowledgeable about LLINs, many factors influenced their utilization, most of them were associated with the environment. Commonly stated barriers included: inconveniences due to the heat the LLIN causes (18.9%), lack of ownership 18.6%, use of mosquito coil and spray (3.4%), use of fan (2.0%), no mosquitoes in place of

residence (2.0%) and no reason for using LLIN 4 (8.5%).

This study found that the main reasons for not using LLINs were inconveniences due to heat, no LLIN and LLIN is washed or torn. This is similar to what was reported by other studies; Graves and colleagues reported forgetfulness, unavailability of nets, net washed, fatigue, illness and in labour as reasons for not using LLIN [15]. Pulford and colleagues also reported heat as a major factor preventing pregnant women from using LLIN [16].

## 5. Limitations

Findings from this study were based on self-reported ownership and utilization. Although 10% of the respondent's homes were visited, not all respondents allowed field workers to enter their sleeping areas to observe if they actually had the LLINs and whether they were hung or not.

## 6. Conclusion

From the study, it has been established that ownership of LLIN was high (81.4%) but did not meet the target of 100% by 2015. Utilization of LLIN was lower (42.5%) than the 85% target for 2015. However, 42.5% achievement in this study appears to be high compared to coverage of LLIN utilization in urban settings in Ghana, (18%) in 2008 and 31.2% in 2014 (GDHS, 2014). Pregnant women with some educational level were more likely to acquire LLIN compared to those with no Education. The younger age group of pregnant women were more likely to use LLIN when they acquire them compared to older age groups. The study has also shown that information given to pregnant women on LLIN by health workers lack key messages such as LLIN are impregnated with insecticides and therefore should not be washed frequently. In conclusion, although the target of the NMCP of 100% coverage and 85% utilization of LLIN was not met, the continuous free distribution of LLINs to pregnant women at ANC and improvement on the education on LLIN can result in higher coverage and utilization.

## Recommendations

There is the need therefore to improve on the health education by the Ministry of Health/GHS to ensure that pregnant women understand what is in the net and how it works. This can be done by repackaging the message and re-training the health workers.

Studies need to be carried out to determine why utilization of LLIN is low among urban than rural pregnant women.

Free distribution of LLINs at ANC by health workers and through other campaign strategies should continue in order to replace worn out nets and reach those who do not have.

## Abbreviations

ANC: Antenatal Clinic, CHAG: Christian Health Association of Ghana, DHIMS2: District Health Information

Management System 2, GDHS: Ghana Demographic Health Survey, GMDG: Ghana Millennium Development Goals, FP: Family Planning, GHS-ERC: Ghana Health Service-Ethics Review Committee, GHS: Ghana Health Service, IPTp: Intermittent Preventive Treatment of malaria in pregnancy, ITNs: Insecticide Treated Nets, LLINs: Long Lasting Insecticide Nets, MoH: Ministry of Health, NMCP: National Malaria Control Program, RCH: Reproductive and Child Health, SP: Sulphadoxine Pyrimethamine, SMC: Seasonal Malaria Chemoprevention, UNICEF: United Nations International Children's Emergency Fund, WHO: World Health Organization.

Availability of data and material

Available upon request

## Competing Interests

The authors declare that they have no competing interests

## Authors' Contributions

WA, GKD and MK conceived the study, MK, WT, IA and WA did the data analysis and wrote the methods section. MK, WA, IA, EA, ET and SA were responsible for the initial draft of the manuscript. All authors reviewed and approved the final version of the manuscript.

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