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Awareness, Use, Care of Insecticide-treated Bed Nets among Pregnant Women in Buea (Buea) and Bonassama (Douala)

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Abstract

Background: Malaria in pregnancy (MiP) remains a major health problem in Cameroon, with an unacceptably high annual maternal mortality rate pegged at 782 maternal deaths per 100,000 live births. Despite the gains made through the free distribution of Long Lasting Insecticide Treated Nets (LLITNs) during the antenatal visit and the mass campaign, there is a paucity of data about how pregnant women effectively care for LLITNs.

Methods: This was a hospital-based descriptive cross-sectional study conducted from June 2016 to September 2017 among consecutive consenting pregnant women attending antenatal clinics in Bonassama Health District (BHDa) and Buea Health Districts (BHD) located in Douala and Buea respectively using structured questionnaires.

Results: Seventy-eight point two (78.2%) of participants never used LLITNs in BHD compared to 7.0 % in BHDa. A greater proportion of participants in both health districts declared having acquired LLITNs during antenatal visits 502 (65.2%) and LLITNs acquisition were facilitated mostly by health workers (77.92 %) in BHD and (53.5%) BHDa. In BHD, 125 (32.5%) never washed their ITNs and the reasons cited were the difficulties to mount when removes 72 (18.7%) in BHD and 47 (12.2%) in BHDa. The majority of pregnant women do self-repaired 383(99.5%) their LLITNs when their damaged than taking them to the tailor 138(17.9%).

Conclusion: The high level of knowledge of LLITNs in protecting pregnant women against mosquito bites does not parallel the use of LLITNs in the study population. Forgetfulness and heat were the main reasons for not using the LLITNs in both Health Districts. Continuous health education and sensitization on the use of LLITNs as an effective preventive method for malaria during pregnancy should be accelerated especially during an antenatal visit.

Keywords: Malaria in pregnancy; LLITNs; BHD; BHDa; Antenatal visit; Forgetfulness

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Introduction

MiP is one of the main causes of miscarriage, intrauterine discharge, low-birth-weight neonates, neonatal death, and premature delivery [1]. Recent statistics of WHO [1] indicated that between 2012 and 2017, the proportion of children aged under 5 years who slept under an ITN increased from 36% to 61%, that of pregnant women rose from 26% to 61% and households ownership of at least one ITN moves from 47% to 72%, while households with at least one ITN for every two people from jumped from 20% to 40%. Unfortunately, nearly 40% of pregnant women did not sleep under an ITN in 2018 and two-thirds did not receive the recommended three doses of intermittent preventive treatment in pregnancy (IPTp) [2]. WHO estimated that, out of 25 million pregnancies in sub-Saharan Africa, some 11 million pregnant women were infected with malaria, resulting in nearly 872 000 children born with low birth weight [2]. Pregnant women are 3 times more likely than non-pregnant women to become infected with Plasmodium falciparum malaria [3] and, once infected, there is a propensity to develop severe malaria [4]. Pregnant women are considered a vulnerable group to malaria infection; consequently, the prevention of malarial bouts in

this group is imperative. MiP is a horrible despondency in sub-Saharan Africa

The WHO through The Roll Back Malaria (RBM) initiative recommended 80% utilization of LLITNs to achieve the target 3.3 for Sustainable Development Goal) [5] and that, to achieve the universal coverage, innovative campaign strategy to deliver LLINs to pregnant women and children under 5 years need to be accelerated [6]. LLITNs and the use of intermittent preventive treatment with anti-malarial medications have been the cornerstones of malaria prevention and control strategy targeting pregnant women [6]. Many factors do influence women's endorsement of LLITNs in Africa. Among others, are inaccessibility to information, distance to health facilities, local believes and traditions, heat, and misused (dry maize and egusi, store egusi against rodents, fishing because of good mesh size, fencing tomato/pepper farms with the idea of preventing animal invasion) education level [7]. Besides, women's parity, family size, marital status, social class, fear of suffocation, and place of residence were also mentioned as possible reasons for the non-used of LLITNs in Africa [8] Mounting body evidence suggests a strong correlation between the use, ownership of Insecticide Treated Neats (ITNs) and reduction of the prevalence of early pregnancy loss, anaemia in pregnancy, preterm births, intrauterine growth restriction, stillbirths, and perinatal mortality Eisele et al [6] According to WHO, ITNs reduced the prevalence rate of malaria, the death rate of pregnant women and their children, while women sleeping under ITNs every night produce 25% fewer underweight or premature babies during their fourth pregnancies [9].

Despite the considerable efforts made to control malaria, MiP remains a public health concern in Cameroon. For instance, in Mamfe in the South West and Ndop in the North West Regions, the prevalence of malaria in pregnancy was 39.6%% and 19.3% respectively [8,9]. In Cameroon, malaria transmission is stable. It is estimated that approximately 90% of the more than 20.000.000 million Cameroonian people are at risk of malaria. Malaria accounts for 49% of prenatal consultations, 59% of hospitalizations during pregnancy [10], 14% and 54% of deaths in pregnant women and children under five years respectively [11].

In 2011, as part of the National Malaria Control Program Strategy, Cameroon and its health partners distributed over eight million free long-lasting insecticides treated nets (LLINs) in an effort to reduce the significant morbidity and mortality burden of malaria in the country [12]. LLITN is a factory-treated net that does not require additional treatment. It is designed to maintain efficacy against mosquito vectors for at least 3 years. LLITNs utilization is the use of a standardized, properly hanged (mounted) net over the bed or the sleeping area. Appropriate use of LLITNs will not only provide a physical barrier preventing mosquito bites, but also conferring chemical barriers by killing or repelling mosquitoes that come into contact with the net fibers. LLITN's effectiveness is tributary to factors such as its integrity, the insecticides effect of the local mosquito and the proportion of people using a net [13] Achieving universal ITNs use coverage in pregnant women remains one of the greatest challenge facing many countries in sub-Saharan Africa [14]. The non-adherence of sleeping under the ITNs could jeopardize the attainment of 60% universal ITN use coverage set by the World Health Assembly in 2005 [15]. Universal coverage is achieved when all members of a household are protected by an ITN the previous night, at the optimal intra-household target of one ITN for every two members WHO 2004 [6].

The 2011 DHS-MICS in Cameroon indicated that in 2004, only 2% of the population owned at least one insecticide-treated net (ITN). However, in 2020, 80% of pregnant women in Foumbam (West Region Cameroon) [16] were reported to have slept under an ITN the night before the survey compared with 11.05% percent in forested and rural areas [17]. In recent surveys, discrepancies between ITN ownership and utilization were highlighted. Data from several settings of Cameroon has shown that 42.6% of ITNs available in the households in Mfou Health District [18] and 42.7% Foumban Subdivision [16] respectively, went unused. Despite the gains made through the free distribution of LLINs during the antenatal visit and mass campaign, the proportion still far below target 6 of the sustainable development goals There is a paucity of data regarding the use, care, and maintenance of ITNs during pregnancy in Cameroon [19]. The study aimed at assessing the awareness, use, care and repair of insecticide-treated bed nets among pregnant women in Buea (Buea) and Bonassama (Douala IV) Health Districts, Cameroon. Understanding factors that hindered the proper maintenance of ITNs could help in designing sustainable and innovative approaches to scale up the use of ITN among pregnant women.

Materials and Methods

Study areas

Buea health district

Buea is the capital of the South West Region of Cameroon. Buea Health District is made up of both rural and urban communities with a population of 133,092 inhabitants and an estimated 10,259 households Helen Kuokuo Kimbi et al [20]. The selected health facilities were classified as highlands (1.197 m above sea level). The climate of Buea is equatorial with temperatures that range from 25-29°C annually. The two main seasons are; the rainy season which starts from mid-March to mid-November and the dry season which spans from mid-November to March. BHD comprises seven health areas with a total of 21 recognized health facilities. Participants were drawn from the following health centres: Bonakanda IHC, Bokova IHC, Mount Mary hospital, Touch of faith, Molyko IHC, Solidarity clinic, Buea Town IHC, and Buea Road IHC, to have a geographical distribution of the health facilities

Bonassama health district

Bonassama Health District is located in Douala IV Subdivision in the Littoral Region of Cameroon. BHDa is made up of 11 health areas serving a total population size of 337,337 inhabitants. The climate of Douala is equatorial with temperatures that range from 30-35°C and with approximatively 1274 hours of sunshine per year on average. Participants were drawn from the following health centres: CS Medico social, Bonassama Health District, CS Christ the king, CS Espoir, CS Help Medical, CS La Mere, CMA

Sodiko, and Mount Zion.

Study design

This was a hospital-based descriptive cross-sectional study conducted from June 2016 to September 2017 among consecutive consenting pregnant women attending antenatal clinics in BHDa and BHD located in Douala and Buea respectively using structured questionnaires.

Sample size estimation and sampling technique:

The sample size was determined using the formula Bryan [21]

N=Z2pq/e2

Sample size calculation was based on the prevalence of 42.6% of households slept under the ITNs the previous night recorded in Mfou Health District [18] where n is the sample size required, z=1.96 is confidence level test statistic at the desired level of significance, p=95% confidence level and considering a 5% marginal error. The required sample size was 376. A total of 770 pregnant women were finally approached and consisting of 385 participants from each of the health district.

A multistage random sampling technique was used to select the health centres. In the first stage, four health facilities were randomly selected form the lists of recognized health facilities in the district. In the second stage, then two health centres again selected randomly from each of these health facilities. A systematic sampling technique was used to select every nth registered pregnant woman from the antenatal registers at each of the health facilities visited on antenatal clinic days until the required number of subjects was attained. The selected women were interviewed in the health centres.

Questionnaire administration

A total of 800 questionnaires were prepared in French and English, pre-tested in a non-survey health centre to determine its clarity and comprehension. The questionnaire was administered through face to face interview by the research team with the assistance of the Nurses at the Antenatal Department of the health centres. However, those that could not express themselves in those languages were interviewed in Pidgin (Local English). Respondents included in the study were pregnant women at their first antenatal visit and have acquired long lasting insecticide-treated nets (LLINs). Participants that were excluded comprised pregnant women in their subsequent visit and those admitted in the Emergency Unit. The questionnaire assessed the sociodemographic characteristics of study subjects and patterns of utilization of LLINs.

Statistical analysis

Data were entered into Excel (Microsoft) and exported to SPSS 20.0 (SPSS Inc., Chicago, IL, USA) for analysis. A descriptive statistical analysis was carried out on the use and care of LLINs. Results were presented in frequency tables, charts.

Ethical considerations

Before the commencement of the study, an ethical clearance was obtained from the Ethical Review Board (ERB) of the University of Douala. Informed written consent was obtained from the study population before the administration of the questionnaire. The consenting process involved the explanation of the content of the information sheets to pregnant women by Nurses in charge of the Antenatal clinic in the language (English, French or Pidgin) she best understood and opportunities were given for questions/ clarifications. Emphasis was laid on the voluntary nature of participation and that they could withdraw at any time without any explanation.

Results

Characteristics of study participants

A total of 770 pregnant women were enrolled among which 385 (50%) were from BHD and 385 (50%) from BHDa. In BHD most of the participants were within the aged bracket of 26- and 30, while in BHDa their ages ranged between 31 and 35. Most of the participants were married 163 (42.34%) in BHD and aged 187 (48.57%) in BHDa, secondary education 134 (34.81%) in BHD and primary education 157 (40.78%) in BHDa as their highest educational qualification. The greater numbers of the participants were in their 5-6 pregnancies in BHD and 1-2 pregnancies in BHDa **(Table 1).**

Patterns of acquisition of LLINs

A greater proportion of participants in both health districts declared having acquired bed nets during antenatal visits 502 (65.2%) and those LLITNs were arranged mostly by health workers (77.92%) in BHD and BHDa (53.5%). When asked about the reasons for their happiness using LLITNs, most of the respondents mentioned that they have made them learn a lot about mosquito net through sensitization 128 (44.4%) in BHD while in BHDa, it has contributed to better health 131 (46.2%). A considerable proportion of pregnant women were ready to collect additional ITNs, if it's given free of charge 120 (31.2%) in BHD while in BHDa, it is because 174 (45.2%) just discovered the importance of using it **(Table 2).**

Patterns of LLITNs maintenance

In BHD 106(27.5%) of participants washed LLITNs weekly, while 111(28.8%) in BHDa washed LLITNs twice a year. In BHD, 125(32.5%) never washed their ITNs while in BHDa 85(22.1%) of participants affirmed done the same. The main reason for no washing the ITNSs mentioned by the participants was difficulty to mount when removes 72 (18.7%) in BHD and 47 (12.2%) in BHDa. The majority of pregnant women do self-repaired 383(99.5) the ITNs when is torn than taking them to the tailor 138(17.9%) **(Table 3).**

Practices towards LLITNs utilization

Nearly half of participating women in BHD were aware that LLITNs prevent the bite of mosquitoes 188 (48.8%), while in BHDa the proportion falls to 164 (42.6%). Seventy eight point two (78.2%) of participants never used LLITNs in BHD compared to 7.0% in BHDa. Patterns of LLITNs hanging varied among respondents as shown in **Table 4**. Out of the 835 respondents of BHD, 75 (19.5%) said they hang the LLITNs All year round, 80 (27.8%) when

Table 1 Socio-demographic characteristics of participants.

Parameters	Buea Health District n (%)	Bonassama Health District n(%)	Total n (%)
Age			
16-20	30 (7.79)	68 (17.66)	98 (12.73)
21-25	58 (15.06)	83 (21.56)	141 (18.31)
26-30	112 (29.09)	83 (21.56)	195 (25.32)
31-35	97 (25.19)	87 (22.60)	184 (23.90)
35>	88 (22.87)	64 (16.62)	152 (19.74)
Total	385 (100)	385 (100)	770 (100)
Marital status			
Married	163 (42.34)	187 (48.57)	350 (45.45)
Single	106 (27.53)	94 (24.42)	200 (25.97)
Divorced	72 (18.70)	58 (15.06)	130 (16.88)
Withdraw	44 (11.43)	46 (11.95)	90 (11.69)
Total	385 (100)	385 (100)	770 (100)
Number of pregnancy			
1-2	78 (20.26)	150 (38.96)	228 (29.61)
3-4	88 (22.89)	131 (34.03)	219 (28.44)
5-6	129 (33.51)	72 (18.70)	201 (26.10)
7 >	90 (23.38)	32 (8.31)	122 (15.84)
Total	385 (100)	385 (100)	770 (100)
Education Level			
None	37 (9.61)	32 (8.31)	69 (8.96)
Primary	112 (29.09)	157 (40.78)	269 (34.94)
Secondary	134 (34.81)	133 (34.55)	267 (34.68)
Tertiary	102 (26.49)	63 (16.36)	165 (21.43)
Total	385 (100)	385 (100)	770 (100)
Occupation			
Civil servant	67 (17.40)	46 (11.95)	113 (14.68)
House wife	117 (30.39)	109 (28.31)	226 (29.35)
Health personnel	35 (9.09)	60 (15.58)	95 (12.34)
Teacher	88 (22.85)	64 (16.62)	152 (19.74)
Farmers or business	78 (20.26)	106 (27.53)	184 (23.90)
Total	385 (100)	385 (100)	770 (100)
Religion			
Christian	222 (57.66)	180 (46.75)	402 (52.21)
Muslim	102 (26.49)	100 (25.97)	202 (26.23)
Unreligious	61 (15.84)	105 (27.27)	166 (21.56)
Total	385 (100)	385 (100)	770 (100)
Health centres			
Buea Road⁄ Bonassama	94 (24.42)	168 (43.63)	262 (34.03)
Molyko/Mambanda	104 (27.01)	69 (17.92)	173 (22.47)
Bova/Nkomba	92 (23.90)	104 (27.01)	196 (25.45)
Buea Town/Sodiko	95 (24.68)	44 (11.43)	139 (18.05)
Total	385 (100)	385 (100)	770 (100)

there is no heat and shockingly, 175 (45.6%) never use LLITNs. The major difficulty preventing the routine used of LLITNs was its mounting 327 (42.5%). The reported reasons for not using a mosquito net slightly differed in both Health District. In BHD the main reason was forgetfulness 49(12.7%) while in BHDa the discomfort generated by heat 55(14.3%) predominates.

Discussion

Insecticide-treated net is one of the Key components of WHO recommendations for malaria prevention and control initiatives in MiP [6]. The Massive and impressive body of evidence supports the ITNs efficacy in reducing the burden of malaria in MiP. However, LLITNs utilization in sub-Saharan Africa (54%) by the population at risk is far below universal LLITNs coverage set at 80%. The present study assessed the use, care and maintenance of ITN among pregnant women in the BHD and BHDa. Our findings revealed that pregnant women's overall knowledge of ITNs in BHD and BHDa was relatively poor. Overall, only 48.8%

Table 2 Patterns of acquisition and perception of LLITNs.

	Buea Health District n (%)	Bonassama Health District n (%)	Total n (%)
Source of collection of LLITNs			
During antenatal visits	279 (72.47)	223 (57.92)	502 (65.2)
At the distribution sites	57 (14.81)	94 (24.42)	151 (19.6)
Through mass campaign	49 (12.77)	68(17.66)	117 (15.2)
Total	385 (100)	385 (100)	770 (100)
Who arrange for the LLITNs			
Spouse	25 (6.49)	68(17.66)	93(12.1)
Health worker	300 (77.92)	206 (53.51)	506 (65.7)
Friend	41 (10.65)	74 (19.22)	115 (14.9)
Children	19 (4.93)	37 (9.61)	56 (7.3)
Total	385 (100)	385(100)	770 (100)
Happiness for using LLITNs			
It has contributed for a better health	88 (30.56)	131(46.13)	219 (28.4)
It has made me to change mosquitoes net as I wish	72 (25.00)	92 (32.39)	164 (21.3)
It has made me to learn lots about mosquitoes net through sensitization	128 (44.44)	61 (21.48)	189 (24.5)
Total	288 (74.8)	284 (73.7)	572 (74.3)
Are you unhappy for using LLITNs			
I don't like using mosquitoes net	47 (48.5)	56 (55.5)	103 (13.4)
I prefer other alternative rather than using mosquito net	34 (35.05)	28 (27.72)	62 (8.1)
I was already aware of the importance and see no need for net	16 (16.49)	17 (16.83)	33 (4.3)
Total	97 (25.2)	101 (26.2)	198 (25.7)
Are you ready to collect LLITNs again? If yes			
Because I just discovered the importance of using mosquito net	73 (19.0)	174 (45.2)	247 (32.0)
It's free of charge so why shouldn't I	194 (50.4)	94 (24.4)	288 (37.4)
Total	267 (69.4)	268 (69.6)	535 (69.1)
Are you ready to collect LLITNs again? If no			
I got more than enough mosquito nets taken from previous campaign	32 (27.12)	76 (64.96)	108 (14.0)
Mosquito nets has never convenient me	47 (39.83)	23 (19.66)	70 (9.1)
I am already satisfied with what I have	39 (33.05)	18 (15.38)	57 (7.4)
Total	118 (30.6)	117 (30.4)	235 (30.5)

and 42.6% of pregnant women interviewed knew that ITNs protects against mosquito bites in BHD and BHDa respectively. These data are similar to that of Adeneye [22], but lower than that of Grace [23] in a qualitative study conducted in Ghana and another study in Nigeria [24]. In another study in North West Region Cameroon, Ngum Helen Ntonifor 2016 [10] found out that 79.3% of the respondents were of the opinion that LLITNs can help to prevent malaria. However, our data indicated that only 27.8% of respondents mentioned that ITNs is used to prevent malaria. The difference might be attributed to the fact the vast majority of the participants in the North West Cameroon have attended tertiary education level. We found out that 157 (40.8%) of participants in BHDa hang LLITNs over the beds permanently all year round which are inconsistent with the study by Ntonifor and Veyufambom [25] which indicated that only 59 (11.4%) study participants put them permanently over their beds. The main difficulty encountered by respondents using LLITNs was the strain to mount it every evening 327 (42.5%). However, (87.9%) of the respondents said it was easy putting on LLITNs. The difference could be attributed to the fact that the North West Region of Cameroon is still received LLITNs and maintaining sensitization on effective utilization of ITNs from other partners, such as PLAN Cameroon (a non- governmental organization). The proportion of pregnant women 175 (45.6%) that ascertained to have never used ITNs was abysmally high considering the sensitization carried out in the BHD by Government organizations and its partners. This is consistent with a study by Ukibe [26] who found out that (56%) of pregnant women attending antenatal clinics never used ITNs in Anambra State.

The most common reason given for not using a LLITN was forgetfulness to it pull down in the evening in BHD. This contradicts several other studies [24-27] that reported that heat was the major factor hindering the effective use of LLITNs. This is might be accredited to the fact that some of the respondents live at 1100 meters above sea level where the prevailing temperature is relatively low compared to other areas of the health centres. However, at BHDa at situated at 1 meter above sea level, with warmer weather, thus heat was mentioned as the major obstacle for the effective use of LLITNs. This is in agreement with studies

Table 3 Patterns of ITNs maintenance.

	Buea Health District n (%)	Bonassama Health District n (%)	Total n (%)
How often do you wash LLITNs?			
Weekly	106 (40.7)	34 (11.3)	140 (26.0)
Monthly	83 (32.0)	66 (22.0)	149 (27.0)
Twice in a year	29 (11.2)	111(37.0)	140 (24.1)
Four times a year	42 (16.2)	89 (29.7)	131(23.0)
Never wash the net	125 (32.5)	85 (22.1)	210 (27.3)
Total	260	300	
Why you do not you wash it?			
it's difficult to mount when removes	72 (57.6)	47 (55.3)	119 (56.7)
Net have no effect on the body when dirty. The main thing is for protection	29 (23.2)	27 (31.7)	56 (26.7)
I feel lazy washing mosquito net	24 (19.2)	11(13.0)	35(16.7)
	385	385	
How do you Repair the ITNs			
Saw it myself	184 (47.8)	199 (51.7)	383 (49.7)
Take it to the clinic	1 (0.2)	1(0.2)	2 (0.3)
Take it to tailor	76 (19.7)	62 (16.1)	138 (17.9)
Why you do not Repair ITNs			
I change if torn	74 (19.2)	60 (18.6)	134 (17.4)
I prefer leaving it like that	8 (2.1)	31 (8.1)	39 (5.1)
Take it to tailor	42 (11.0)	32 (8.3)	74(9.6)
	385	385	

Table 4 Practices towards LLITNs utilization.

	Buea Health District n (%)	Bonassama Health District n(%)	Total n(%)
Importance of using LLITNs			
Protect against mosquito bites	188 (48.8)	164 (42.6)	352(45.7)
prevent malaria	107 (27.8)	154 (40.0)	261(33.9)
Protect us from other infections	90 (23.4)	67 (17.4)	157 (20.4)
Patterns of ITNs hanging			
All year round	75 (19.5)	157 (40.8)	232 (30.1)
When there is no heat	80 (27.8)	116 (30.2)	196 (25.5)
I choose some days not to use	55 (14.3)	85 (22.1)	137 (17.8)
I never use ITNs	175 (45.6)	27 (7.0)	202 (26.2)
What are the difficulties?			
Difficult to mount":P	152 (39.5)	175 (45.5)	327 (42.5)
Lack of a place to sun the ITNs	40 (10.3)	56 (14.5)	96 (12.5)
Difficult to understand messages about ITNs	39 (10.1)	38 (9.9)	96 (12.5)
Problem face when not use?			
No option	55 (14.3)	73 (20.5)	128 (16.6)
Mosquito bites	99 (25.7)	64 (16.6)	163 (21.2)
Will suffer from malaria and spend much money	79 (20.5)	64 (16.6)	143 (18.6)
will get sick	41 (10.6)	46 (11.9)	87 (11.3)
Reasons for not using net?			
Heat	30 (7.8)	55 (14.3)	85 (11.0)
Forgetfulness	49 (12.7)	16 (4.2)	65 (8.4)
Disruption of sleeping arrangements	23 (6.0)	13 (3.4)	36 (4.7)
I have other alternatives to prevent mosquito bites	36 (9.4)	17 (4.4)	53 (6.9)

conducted elsewhere [28]. Likewise, Among practices hindering the use of bed nets in the cities of Douala and Yaoundé were the sensations of discomfort when sleeping under bed net as expressed by respondents living in densely populated BHDa, with poorly constructed house with nearly no aeration for air to circulate and suffering from erratic power supply [29]. Previous studies have investigated the barriers to use and reasons for non-use of bed nets, identifying such factors as knowledge

about the causes of malaria, type and condition of nets, socio-economic indicators including education, and perceptions of heat/discomfort under a net.

The early plugging of small holes in the LLITNs is not only recommended effective barter against mosquito bites, but also increase its durability [30]. The major methods used by respondents to maintain the integrity of their ITNs was sewing/stitching the LLITNs themselves when torn. Nearly half of the respondents acknowledge to repair the torn LLITNs themselves, highlighting the importance of maintaining the integrity of LLITNs for effective protection against mosquito bites.

Recommended LLITN care practices include hanging nets up while not in use, washing gently and infrequently with no soap or mild soap, drying indoors or in the shade, and repairing holes [31], LLITNs in the BHD (highlands) were frequently washed (40.7%) weekly than the lowlands BHDa (11.3%) weekly; which are contradiction to study conducted in western Kenya [32]. In BHDa 111(37.0%)) of respondents admitted washing their net twice yearly which is in line with the manufacturer's instruction for washing LLINs is once in 6 months [33], as frequent net washing is not recommended,. The practice of LLITN washing as recommended was poor in BHD. One thirds of participants in BHD said they have never wash their LLITNs. This is in agreement with a study by [34]. The main reason given for not washing the nets was the difficulties to mount when remove. This low practice of washing and drying LLITNs in BHD raised the need to properly educated pregnant women on the maintenance of the LLITNs during antenatal clinic.

In the present study, antenatal visit remains the main platform to acquire a LLITN in the selected Health Districts. This finding contradict the observation recorded in the study carried out in BHD [35], they found out that most of the pregnant women obtained their LLITNs during mass distribution campaign. The slight difference could have been attributed to the fact that the study was conducted a couple of years after mass distribution. In a study in Ghana, health workers usually provided comprehensive information on LLITNs to pregnant women attending antennal clinic before issuing LLITNs. The information provided consist of how to treat the LLIN before use, such as drying it in the shade for 24 h to prevent itchy body and eyes resulting from the chemicals used to treat it, the importance of LLINs in fighting malaria in pregnancy; and pregnant women needed to wear long sleeved dresses, to prevent mosquito bites, if they had to stay outside for long periods during the evening [36,37].

Limitations

The scope of study was limited to eight randomly selected health centres in each of the Health Districts and thus, did not cover the whole health districts. The study also failed to use qualitative methods to assess the utilization and maintenance of LLITNs.

Conclusions

The high level of knowledge of LLITNs in protecting pregnant women against mosquito bites does not parallel the effective use of LLITNs in the study population. These data suggest very low usage of LLITNs in BHD. Forgetfulness and heat were the main reasons of no using the ILLNs in BHD and Health Districts respectively. Continuous health education and sensitization on the effective use of ILLTNs as a preventive method for MiP should be accelerated especially during antenatal visits.

Competing interests

The authors declare no competing interest.

Authors' contributions

HN and BT participated in the conception and design of the study. JF-C and HN analysed the data and coordinated the data collection. BT drafted the first manuscript. All authors read and approved the final manuscript.

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