Cho *et al Pan African Journal of Life Sciences* (2020): 4(3): 112-120
DOI: 10.36108/pajols/0202/40(0320)

Publication of Faculty of Basic Medical Sciences,
Ladoke Akintola University of Technology, Ogbomoso

www.pajols.org
Online ISSN:2672-5924

RESEARCH **Open Access**

Predictors of Ownership/Utilisation Indicators of Long-lasting Insecticide Nets in the Bamendankwe Health Area of Cameroon: A Cross-Sectional Study

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Received 27th October 2020; Revised 20th November 2020; Accepted 22nd November 2020

Abstract

Background: Long-lasting Insecticide Nets (LLINs) are effective in the prevention of malaria, but universal utilisation continues to be declining in parts of Cameroon. This study aimed to explore the predictors and incidences of LLINs ownership/ utilisation in a semi-urban community in the Bamenda Health District (BHD). .

Methods: A cross-sectional survey involving 448 randomly selected household heads was conducted between March and April 2018 in the BHD. Data on LLINs ownership and utilisation were collected with structured questionnaires. Multivariate analysis was used to establish the predictors of LLINs utilisation and ownership.

Results: Household ownership of at least one LLINs and universal usage was 93.3% and 43.1% respectively.

Conclusion: The utilisation of LLINs was low and had no significant association with ownership. Continuous educational efforts and monitoring schemes with specific emphasis on vulnerable groups should be stepped up.

Keywords: Long-Lasting Insecticide Nets, Ownership of LLINs, Utilisation of LLINs, Predictors, Cameroon.

1.0 INTRODUCTION

Malaria remains one of the greatest killer disease and threat to public health in Africa, despite all control strategies invested in by the World Health Organisation (WHO) and stakeholders to reduce it. In Africa, it accounted for about 91% of cases during the 2014 indicator survey and a devastating disease threatening the productivity and economy of endemic countries [1]. It accounted for up to 40% of public health expenditures, 30 – 50% of inpatient hospitalisations and up to 60% of outpatient health clinic visits, with an enormous and long -lasting effect on economic growth and development [1-5]. It is the leading cause of mother and child morbidity and mortality, accounting for more than 81% of reported cases, about 91% of the deaths, and the third major cause of death (8.8%) in Cameroon [1, 6]. Although the scale-up of effective prevention tools had a major impact in the fight against malaria, the WHO recommended two prevention strategies: vector control measures and preventive treatment strategies for the most vulnerable groups to reduce malaria morbidity and mortality [4, 5, 7, 8]. Vector control is the main approach to malaria prevention and transmission, two forms which are effective in a lot of circumstances are: insecticide-treated mosquito nets (ITNs)/ Long Lasting Insecticide Nets (LLINs) and Indoor Residual Spraying of Insecticides [1, 4, 6]. There are individual, household, and environmental barriers to LLINs usage as well as the low perception of malaria resulting in inconsistent use of the LLINs [9].

In 2011, over eight million LLINs were distributed in Cameroon in an effort to reduce the burden of malaria [5, 10]. Increasing the coverage and use of LLINs is the most promoted vector control prevention strategy in malaria-endemic countries, in line with the WHO recommendations [1, 11-14]. The free mass distribution campaign (MDC) of 2011 and 2015 has scaled up the ownership of LLINs, but the universal utilisation of LLINs does not match ownership [7], as malaria rates are still on the rise [1].

So far, there is limited data on LLINs ownership and utilisation within the Cameroonian population. The objective of this study was to determine the predictive factors affecting the ownership and the utilisation indicators of LLINs in the Bamendankwe community.

2.0 METHODOLOGY

2.1 Study Design and Population

This was a community-based cross-sectional study, carried out to evaluate the ownership and utilisation indicators and associated factors. This study was conducted from March to May 2018, in a semi-urban community, with an undulating topography, located to the East of Bamenda metropolis. The Bamendankwe Health Area is one of the 17 health areas in the Bamenda Health District.

Eligible participants were single or married persons of either male or female gender aged ≥ 20 years who had resided in an household for at least the past 12 months.

2.2 Sample Size Determination

This study comprised household heads from eight localities of the community, with a minimum sample size of 356, calculated with the CDC- Epi-Info version 7.2.2.6 (Centre for Disease Control, Georgia USA) with the following characteristics; an average population of 307,620 in 2009 with an annual increase rate of 2% (6152.4) to 369,144 in 2018 [15] for the health district, an estimated proportion of households owning LLINs of 63.5% [2], an accepted error margin of 5%, design effect of 1.0 and one cluster. Given the possibility of missing out on some of the households, the sample size was adjusted by a 10% loss to 392. A total of 448 households were finally sampled.

2.3 Variables and Definition of Concepts

A household was defined as a wife with her direct dependents, and a compound was divided into several households depending on the number of wives, where the husband was assigned to the first wife's household [16, 17].

The ownership of LLINs was defined as the proportion of households with at least one LLIN, where the numerator comprises the number of households surveyed with at least one LLIN and the denominator, the total number of households surveyed. Coverage was the proportion of households with at least an LLIN for every two people, where the numerator comprises all households where the ratio between the number of LLINs owned and the number of de-jure members of that household, that is, usual members excluding visitors, is 0.5 or higher and the denominator is the total number of sampled households [18-20].

Table 1. Socio-demographic Characteristics of Study Participants

			Coverage (n = 387)			Universal utilisation (n = 192)		
Variable	**Subclass**	**n (%)**	**No**	**Yes**	**χ^2/ F (p-value)**	**No**	**Yes**	**χ^2/ F (p-value)**
Age groups (in years)	≤ 20	9 (2.2)	3 (9.7)	6 (1.6)	10.82 ($4.48x10^{-3}$*)	5 (2.5)	4 (2.1)	3.23 (0.19)
	21 – 40	282 (67.5)	16 (51.6)	266 (68.7)		144 (63.7)	138 (71.9)	
	41 – 60	127 (30.4)	12 (38.7)	115 (29.7)		77 (34.1)	50 (26.0)	
	Mean age (±SEM)	35.89±0.48	35.32±2.07	35.94±0.49	10.87 (0.738)	36.73±10.06	34.91±9.48	341.67 (0.06)
Sex	Females	258 (61.7)	2 (6.5)	256 (66.1)	43.29 ($4.71x10^{-11}$*)	135 (59.7)	123 (64.1)	0.82 (0.36)
	Males	160 (38.3)	29 (93.5)	131 (33.9)		91 (40.3)	69 (35.9)	
Marital status	Unmarried	162 (38.8)	17 (54.8)	145 (37.5)	3.65 ($5.61x10^{-2}$)	91 (40.3)	71 (37.0)	0.47 (0.49)
	Married	256 (61.2)	14 (45.2)	242 (62.5)		135 (59.7)	121 (63.0)	
Education	Primary	138 (33.0)	9 (29.0)	129 (33.3)	0.42 (0.81)	72 (31.9)	66 (34.4)	2.07 (0.36)
	Secondary	141 (33.7)	12 (38.7)	129 (33.3)		72 (31.9)	69 (35.9)	
	Tertiary	139 (33.3)	10 (32.3)	129 (33.3)		82 (36.3)	57 (29.7)	
Occupation	Agricultural	147 (35.2)	12 (38.7)	135 (34.9)	8.67 ($3.4x10^{-2}$*)	85 (37.6)	62 (32.3)	11.45 (0.01*)
	Unskilled	118 (28.2)	3 (9.7)	115 (29.7)		55 (24.3)	63 (32.8)	
	State/ Parastatal	29 (6.9)	5 (16.1)	24 (6.2)		23 (10.2)	6 (3.1)	
	Professional	124 (29.7)	11 (35.5)	113 (29.2)		63 (27.9)	61 (31.8)	
House type	Caraboat/ Temporal	16 (3.8)	0 (0.0)	16 (4.1)	1.33 (0.25)	7 (3.1)	9 (4.7)	0.71 (0.39)
	Mud/ Cement Block	402 (96.2)	31 (100.0)	371 (95.9)		219 (96.9)	183 (95.3)	
N° of bedrooms	1 – 3	382 (91.4)	28 (90.3)	354 (91.5)	0.05 (0.83)	209 (92.5)	173 (90.1)	0.73 (0.39)
	4 – 7	36 (8.6)	3 (9.7)	33 (8.5)		17 (7.5)	19 (9.9)	
	Mean N° of bedrooms (± SEM)	2.01±0.05	2.07±0.06	1.94±0.07	1.70 (0.19)	2.07±0.06	1.94±0.07	1.70 (0.19)
Household Composition	Mean N° of children < 5	1.07±0.05	1.33±0.07	0.76±0.06	37.80 ($1.84x10^{-9}$*)	1.25±0.07	0.76±0.06	26.54 ($4.04x10^{-7}$*)
	Mean N° of children 6 – 17	1.71±0.05	1.96±0.07	1.41±0.07	28.69 ($1.41x10^{-7}$*)	1.17±0.08	1.41±0.07	4.80 ($2.90x10^{-2}$*)
	Mean N° of persons ≥ 18	1.90±0.03	2.0±0.04	1.78±0.04	15.18 ($1.14x10^{-4}$*)	0.76±0.06	1.74±0.04	146.61 ($4.10x10^{-29}$*)
	Expectant women surveyed	0.11±0.01	0.11±0.02	0.10±0.02	0.04 (0.833)	0.07±0.02	0.08±0.02	0.23 ($6.32x10^{-1}$)
	Mean household size (± SEM)	4.78±0.10	5.41±0.14	4.05±0.13	48.52 ($1.28x10^{-11}$*)	3.25±0.14	3.99±0.13	15.15 ($1.15x10^{-4}$*)
	Population surveyed	2000	107	1893	14.02 ($2.06x10^{-4}$*)	1222	778	48.52 ($1.28x10^{-11}$*)
Net Ownership	Mean N° of nets/ household	2.69±0.06	1.06±0.06	2.82±0.06	68.74 ($1.57x10^{-15}$*)	3.05±0.08	2.28±0.08	45.64 ($4.81x10^{-11}$*)
	LLINs : Person ratio	1126/2000	33/107	1093/1893		689/1222	437/778	

*Indicate significant p-values, **SEM:** Standard Error of Mean

The household universal LLINs utilisation was defined as the proportion of the population that slept under LLINs the previous night [18-20]. The utilisation of LLINs last night was defined as, the proportion of household heads who used LLINs the night before the survey, where the numerator comprises the number of household heads who used LLINs last night, and the denominator, the total number of household heads surveyed.

2.4 Ethical Statement

This study was approved by the Regional Delegation of Public Health for the Southwest region and the Faculty of Health Science Institutional Review Board, University of Buea, Cameroon (FHS-UB No: 624-05). Verbal permission was obtained from the local authorities of the localities where the study took place.

2.5 Data Collection and Statistical Analysis

Data were collected from heads of households in eight quarters of the community. The quarters were selected by simple random sampling, followed by the systematic sampling of households. Semi-structured questionnaires were used for data collection from each household head. The questionnaires were structured into the following sections: identification, ownership of LLINs, utilisation of LLINs and socio-demographic data. Statistical analysis was performed with Statistical Package for the Social Sciences version 25 (IBM-SPSS, Inc, Chicago, IL, USA). Associations between predictive factors and LLINs ownership/ utilisation were explored with Pearson Chi-square (χ^2) and logistic regression analyses. Statistical significance was set at $p \leq 0.05$.

3.0 RESULTS

3.1 Characteristics of Study Participants

A total of 448 household heads [282 (62.9%) females and 166 (37.1) males] aged 36.18 ± 9.86 years (range 20 – 58 years) were surveyed. The ownership and utilisation of LLINs from the 448 heads of households are presented in Figure 1. Four hundred and eighteen (93.3%) of the 448 household heads sampled, had at least one LLIN and were thus included in this analysis. All 418 were from eight quarters of the BHA and comprised of 38.3% males and 61.7% females. The mean (± SEM) age of participants was 35.89 ± 0.48 years. Of the 2,000 residents who slept home last night, 447 (22.3%) were children less than five years old and 45 (2.2%) were expectant mothers.

The majority (61.2%) of the participants were married, 35.2% were engaged in farming, educational distribution amongst the three educational strata were almost the same, while a huge majority lived in one – three bedroom houses [mean bedroom (± SEM) of 2.01 ± 0.05], as well a mean (± SEM) family size of 4.78 ± 0.10 (Table 1).

3.2 Household LLINs Ownership Indicators and Sources

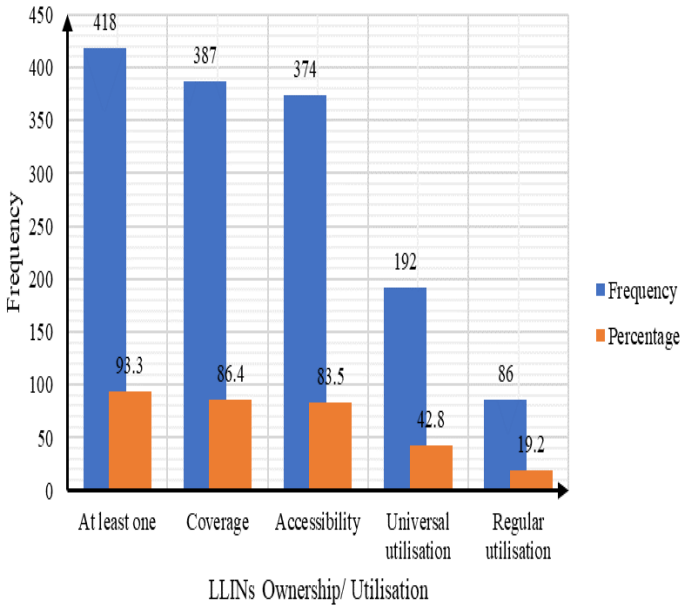

Figure 1. Household LLINs Ownership/ Utilisation Indicators

There were 1,126 LLINs, LLINs density (mean ± SEM) of 2.69 ± 0.06, with overall household ownership of at least one LLINs and coverage proportions of 93.3% and 86.4% (LLIN: Person ratio of 0.56) respectively. Household accessibility to LLINs was 83.5% (Figure 1).

Long-lasting insecticidal nets were obtained from a variety of sources; 54.5% (228/418) from the free mass distribution campaigns, 22.5% (94/418) from the ante-natal clinic, 14.1% (59/418) from relatives, and 3.8% (16/418) bought.

Household coverage (Table 1) was significantly associated with age, sex, marital status, occupation of the household head, and household size ($p < 0.05$). Multivariate regression analysis (Table 2) revealed that marital and occupational statutes were independent predictors of household accessibility to LLINs and coverage. Households which were headed by unmarried persons were

respectively about two and four folds more likely to have accessibility [O.R; 2.3, 95% C.I; (1.1 – 4.8), $p = 3.45x10^{-2}$] and coverage [O.R; 3.9, 95% C.I; (1.5 – 10.5), $p = 6.53x10^{-3}$] compared with those headed by married persons. For occupational status, households headed by state/parastatal workers were respectively about three and 5.5 folds more likely to have accessibility [O.R; 2.8, 95% C.I; (0.7 – 11.1), $p = 0.14$] and coverage [O.R; 5.5, 95% C.I; (1.1 – 27.7), $p = 3.73x10^{-2}$] with LLINs when compared with the other occupations.

3.3 Household Utilisation of LLINs

One hundred and ninety-two [192 (42.8%)] and 86 (19.2%) of the 448 households sampled, slept under LLINs last night, and regularly used LLINs respectively (Figure 1).

The universal utilisation of LLINs (Table 1) was associated with the age and occupational status of the household head ($p < 0.05$). Multivariate analysis (Table 2) showed that households whose heads were unmarried and state/parastatal employees were more likely to effectively [O.R; 1.5, 95% C.I; (0.9 – 2.2), $p = 8.80x10^{-2}$] and regularly [O.R; 2.0, 95% C.I; (1.1 – 3.8), $p = 1.44x10^{-2}$] use LLINs when compared with their counterparts.

3.4 The rationale for the ineffective utilisation of LLINs

Table 3 shows 10 reasons for irregular utilisation of LLINs by study participants. Of these, only three (it gives heat, it is dirty and "no mosquitoes) were significantly associated with the regular utilisation of LLINs in the binary regression analysis. Those who said LLINs were allergic, that they lacked interest and that they usually forget, were 2.7, 1.6, and 2.5 times more likely to ineffec-

Table 2. Multinomial Logistic Analysis Showing the Association Between Predictors and LLINs Ownership/Utilisation Indicators

	Ownership of LLINs				Utilization of LLINs			
DV→	**Accessibility (*n* = 374)**		**Coverage (*n* = 387)**		**Universal (*n* = 192)**		**Regular (*n* = 86)**	
IV¯	*p*-value	O.R (95% C.I.)	p-value	O.R (95% C.I.)	p-value	O.R (95% C.I.)	p-value	O.R (95% C.I.)
Age groups (in years)								
≤ 20	0.17	3.4 (0.6 – 20.3)†	0.22	3.4 (0.5 – 24.4)†	0.78	0.8 (0.2 – 3.4)	-	-
21 – 40	0.56	1.3 (0.6 – 2.8)†	0.49	0.7 (0.3 – 1.9)	$6.34x10^{-2}$	0.6 (0.4 – 1.0)	-	-
41 – 60	Ref	1.0	Ref	1.0	Ref	1.0	-	-
Sex								
Females	$3.11x10^{-6}$*	0.2 (0.1 – 0.3)	$1.89x10^{-5}$*	0.04 (0.01 – 0.2)	0.87	1.0 (0.6 – 1.5)	0.25	0.7 (0.4 – 1.2)
Males	Ref	1.0	Ref	1.0	Ref	1.0	Ref	1.0
Marital status								
Unmarried	$3.45x10^{-2}$*	2.3 (1.1 – 4.8)†	$6.53x10^{-3}$*	3.9 (1.5 – 10.5)†	$8.80x10^{-2}$	1.5 (0.9 – 2.2)†	$1.44x10^{-2}$*	2.0 (1.1 – 3.8)†
Married	Ref	1.0	Ref	1.0	Ref	1.0	Ref	1.0
Education								
Primary	0.86	1.1 (0.4 – 2.9)†	0.63	1.4 (0.4 – 4.7)†	0.81	0.9 (0.5 – 1.6)	0.81	1.1 (0.5 – 2.2)†
Secondary	0.48	1.4 (0.6 – 3.4)†	0.45	1.6 (0.5 – 5.1)†	0.80	0.9 (0.6 – 1.6)	0.20	0.7 (0.4 – 1.2)
Tertiary	Ref	1.0	Ref	1.0	Ref	1.0	Ref	1.0
Occupation								
Agricultural	0.24	1.6 (0.7 – 3.8)†	0.22	1.9 (0.7 – 5.3)†	0.18	1.4 (0.8 – 2.4)†	0.98	1.0 (0.5 – 1.8)
Unskilled	0.44	0.6 (0.2 – 2.0)	0.41	0.5 (0.1 – 2.4)	0.60	0.9 (0.5 – 1.5)	0.33	1.4 (0.7 – 2.9)†
State/ Parastatal	0.14	2.8 (0.7 – 11.1)†	$3.73x10^{-2}$*	5.5 (1.1 – 27.7)†	$1.12x10^{-2}$*	3.7 (1.4 – 10.4)†	0.34	1.8 (0.5 – 6.0)†
Professional	Ref	1.0	Ref	1.0	Ref	1.0	Ref	1.0
Nº of bedrooms								
1 – 3	0.15	0.5 (0.2 – 1.3)	0.70	0.8 (0.2 – 3.1)	0.28	1.5 (0.7 – 3.0)†	0.49	1.3 (0.6 – 3.0)
4 – 7	Ref	1.0	Ref	1.0	Ref	1.0	Ref	1.0

O.R: Odds ratio, **Ref:** Reference, **DV:** Dependent variable, **IV:** Independent variable, *Indicates significant *p* – value, † Indicates likely groups, SEM: Standard Error of Mean

Table 3. Association of LLINs Utilisation With Reasons for Irregular Utilisation

					Universal use		Regular use
Variable	**n (%)**	**No**	**Yes**	**p-value**	**O.R (95% C.I.)**	**p-value**	**O.R (95% C.I.)**
Gives heat	360 (86.1)	198 (87.6)	162 (84.4)	0.40	0.5 (0.1 – 2.7)	0.04*	0.04 (0.0 – 0.8)
Allergy	357 (85.4)	197 (87.2)	160 (83.3)	0.24	2.7 (0.5 – 14.5)†	0.72	1.6 (0.1 – 18.8)†
Breathing difficulties	191 (45.7)	107 (47.3)	84 (43.8)	0.41	1.2 (0.8 – 1.8)†	0.18	1.5 (0.8 – 2.5)†
Difficult to hang	124 (29.7)	70 (31.0)	54 (28.1)	0.38	0.7 (0.4 – 1.5)	0.68	1.2 (0.5 – 3.1)†
Lack interest	95 (22.7)	57 (25.2)	38 (19.8)	0.19	1.6 (0.8 – 3.3)†	0.15	2.2 (0.7 – 6.7)†
Tiredness	72 (17.2)	36 (15.9)	36 (18.8)	0.68	0.9 (0.5 – 1.5)	0.40	1.4 (0.7 – 2.7)†
Dirty	24 (5.7)	15 (6.6)	9 (4.7)	0.41	1.4 (0.6 – 3.4)†	0.04*	0.4 (0.2 – 0.9)
Forgot	19 (4.5)	14 (6.2)	5 (2.6)	0.09	2.5 (0.9 – 7.2)†	-	-
No mosquitoes	15 (3.6)	8 (3.5)	7 (3.6)	0.80	1.1 (0.4 – 3.3)†	0.02*	0.2 (0.1 – 0.7)
Used repellent	15 (3.6)	7 (3.1)	8 (4.2)	0.80	0.9 (0.3 – 2.5)	0.65	0.7 (0.2 – 2.9))
	418	226	192				

O.R: Odds Ratio; **C.I:** Confidence Interval

tively use LLINs compared to their counterparts. Meanwhile those allergic to LLINs, those with breathing difficulties, those with lack of interest and tiredness were more likely to use the LLINs irregularly when compared with their counterparts.

3.5 Association of Ownership With Utilisation

Only coverage had a significant association with the regular utilisation of LLINs (Table 4).

Table 4. Association of LLINs Ownership Indicators With Utilisation Indicators

		Universal utilisation				
Ownership		**No**	**Yes**	**Total**	χ^2	**p-value**
Coverage	No	14 (6.2)	17 (8.9)	31 (7.4)	1.07	0.30
	Yes	212 (93.8)	175 (91.1)	387 (92.6)		
Accessibility	No	27 (11.9)	17 (8.9)	44 (10.5)	1.05	0.30
	Yes	199 (88.1)	175 (91.1)	374 (89.5)		
	Total	226	192	418		
		Regular utilisation				
		No	Yes			
Coverage	No	29 (8.7)	2 (2.3)	31 (7.4)	4.08	0.04*
	Yes	303 (91.3)	84 (97.7)	387 (92.6)		
Accessibility	No	36 (10.8)	8 (9.3)	44 (10.5)	0.17	0.68
	Yes	296 (89.2)	78 (90.7)	374 (89.5)		
	Total	332	86	418		
		Used LLINs last night				
		No	Yes			
Coverage	No	19 (6.9)	12 (8.3)	31 (7.4)	0.269	0.604
	Yes	255 (93.1)	132 (91.7)	387 (92.6)		
Accessibility	No	27 (9.9)	17 (11.8)	44 (10.5)	0.382	0.537
	Yes	247 (90.1)	127 (88.2)	374 (89.5)		
	Total	274	144	418		

4.0 DISCUSSION

4.1 Indicators of Household LLINs Ownership

The aim of this study was to determine the LLINs ownership indicators, LLINs utilisation indicators and associated predictors of LLINs ownership/utilisation amongst household heads in the Bamendankwe Health area. LLINs ownership of 93.3% in this study was higher than the 47 – 89.9% reported elsewhere in Cameroon [2, 4, 16, 21-23], the 33.3 - 85% in Africa [24-28], and the 15.5 – 48% in in Asia [29, 30]. It was, however, lower than the 99.7% reported in Myanmar [31] and in line with the 93.5% reported in Madagascar [27].

The 86.4% coverage (LLIN: Person ratio of 0.55) was higher compared to a similar study with 58.5% coverage in the Mount Cameroon area [23] and studies elsewhere around the world [13, 19, 27, 32] and lower compared to the Ministry of Public Health's ambition to achieve 100% coverage by 2015 [33] and another study in Myanmar [31]. Household LLINs accessibility of 83.5% observed in this study was higher compared to studies elsewhere in Africa [19, 27, 28, 34]. The differences could be attributed to the continuous efforts by the national malaria control programme to foster the ownership and utilisation of LLINs, study designs; hospital-based and community-based as well as study areas; in and out of Cameroon. The independent predictors of the ownership of at least one LLIN as well as coverage were marital status and occupation. Marital status was earlier reported in a similar study in the Bamenda Health area [2] wherein households headed by married individuals had a positive impact on LLINs ownership but differed from the findings of studies elsewhere in South-Eastern Nigeria, Ethiopia, Myanmar, and China [24, 25, 29, 31, 35] where it had no significant impact on ownership.

4.2 Indicators of Household LLINs Utilisation

The universal household utilisation of LLINs in the study of 43.1% was lower compared to reports elsewhere in Cameroon [2, 16, 23] and in some places across the world [24, 27, 31, 32, 35] and higher when compared to the 21.5% reported in Ethiopia [25], 6.9 – 15.3% in urban and rural Myanmar [30] and the 9.5 – 32.8% in Tanzania [28]. The 19.4% proportion of households regularly using LLINs in this study was very low compared to 48.0% reported in China [29] and 52.3% in Ethiopia [26]. The low rate of LLINs utilisation in this study was also attributed to; heat (86.6%), allergy (85.9%), breathing difficulties (46.7%), difficulties to install the nets (29.7%), lack of interest (22.5%) and tiredness (17%). Compared to studies in Cameroon, these were higher: heat discomfort (26.7 - 52.2%), difficulties hanging up nets (12.1 – 25.3%) tiredness and laziness (18.9%) [2, 4, 23] as well as negligence (29.3%) [2] and environmental factor [36] accounting for non-usage of bed nets. Out of Cameroon, the rationale for the irregular and ineffective utilisation of LLINs was attributed to; the nets were too hot, difficulties in the installation, inconveniences, and lack of space [9, 29]. These differences could be attributed to different study populations and study areas as well as different study seasons.

The independent determinants of the utilisation of LLINs were marital status, and occupation of the household head. Age, sex, education house type/number of bedrooms, environmental factor and ownership of LLINs had no significant association with the utilisation of LLINs. Occupation as observed in this study was in line with studies reported in Myanmar and China [29, 31].

Strengths of the study; field data were obtained by well-trained field surveyors and health personnel, with a mastery of the study area. The quality of data collected was assured through the pretesting of questionnaires in a pilot study to minimize bias.

Limitations of the study; this was a cross-sectional study, representing the snapshot of the population within the study period and does not show cause and effect since the predictor and outcome variables were measured at the same time. Data was collected through self-reporting and thus there is a possibility of bias where the respondent provides socially acceptable answers. Recall bias can also affect some of the responses and subsequently the results of the study. Also, the design of this study could not capture data on behaviour change communication and other malaria control measures. The study could not also capture data on the undulating nature of the different localities.

Although the free Mass Distribution Campaign, MDC has improved LLINs ownership and coverage, the universal utilisation of 43.1% is still very low. Factors that were significantly associated with the utilisation of LLINs were: the occupation of household head, household composition, and ownership of LLINs. Marital status and occupation were observed to be the independent predictors of ownership and utilisation of LLINs. Continuous educational efforts and monitoring schemes with specific emphasis on vulnerable groups should be stepped up.

Conflict of Interest

The authors declare that there is no conflict of interest.

Acknowledgements

We are thankful to the heads of households who participated in this survey, the community health workers and to the field assistants who worked under challenging field conditions

Authors Contribution

NFC conceived and designed the study, performed data collection, analysed data and drafted the manuscript; **NPF** contributed to study design, data collection and manuscript writing ; **FSM, MBC** contributed to data collection and manuscript writing; **KPJ** contributed to data analysis and writing of the manuscript; **NCF** contributed to manuscript draft; **NPF** contributed to study design. All authors approved the final version of the manuscript

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