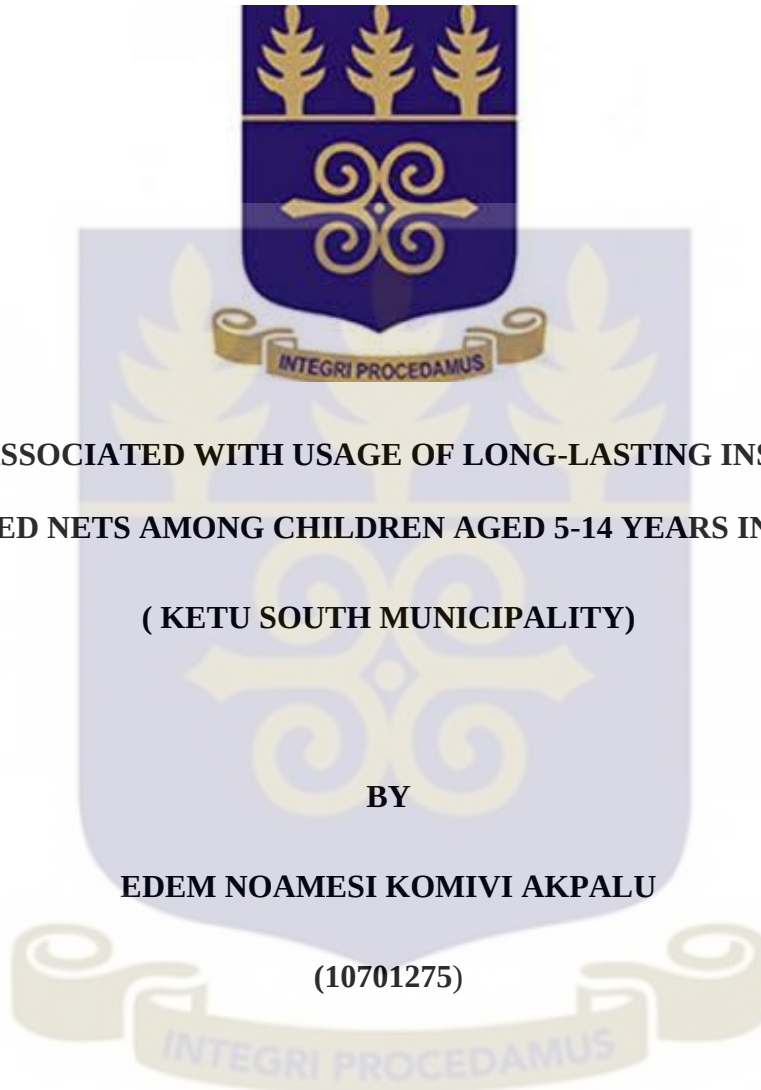


**SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA, LEGON**



**FACTORS ASSOCIATED WITH USAGE OF LONG-LASTING INSECTICIDES-
TREATED NETS AMONG CHILDREN AGED 5-14 YEARS IN AFLAO**

(KETU SOUTH MUNICIPALITY)

BY

EDEM NOAMESI KOMIVI AKPALU

(10701275)

**THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA,
LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
AWARD OF MASTERS OF PUBLIC HEALTH DEGREE**

JULY, 2019

DECLARATION

I, AKPALU Edem Noamesi Komivi, declare that except for reference to other people's research which have been duly cited, this thesis is the result of my own original research undertaken under supervision and that it has neither in whole nor in part been presented for another degree in this university or elsewhere.

_____ Date:_____

AKPALU Edem Noamesi Komivi

MPH Resident, School Of Public Health, College Of Health Sciences, University of Ghana, Legon

_____ Date:_____

DR. ADOLPHINA ADDO-LARTEY

Academic Supervisor

Department Of Epidemiology and Disease Control, School of Public Health, College Of Health Sciences, University Of Ghana, Legon

DEDICATION

I dedicate this work to God, for the blessings he granted me. He who sustained me throughout my studies, May The Glory be given to Him. I also dedicate this work to my son Edem and my beloved wife Apefa.

AKNOWLEDGEMENT

I wish to thank my supervisor Dr. Adolphina Addo-Lartey for her support and guidance to reach the accomplishment of this work.

I secondly express my sincere gratefulness to the Director of the Ketu South Health Municipality and his staff for the support given and the various action taken to facilitate data collection.

Sincere thanks to all lecturers at the School of Public Health.

Finally, I express my gratitude to WHO/TDR for its financial support during my training.

ABSTRACT

Background: Despite the existence of long lasting insecticide treated nets as a cost-effective tool of prevention of malaria, this disease still present as a serious public health burden in Ghana. Children aged 5 to 14 years account for the group that are less likely to utilize Long Lasting Insecticide Nets (LLINs).

Objectives: This study was conducted to explore factors associated with the use of LLINs among children aged 5-14 years in Aflao town in Ketu South Municipality.

Methods: A cross-sectional study was conducted in Aflao, the largest town in Ketu South municipality. The study population included households respondents with children aged 5-14 years resident in Aflao. Information about Household respondents socio-demographic characteristics, housing structure and characteristics of insecticide-treated nets in the household were gathered. Test of association was performed and logistic regression was used to determine factor associated with the usage of the net among the children age range.

Results: A total of 414 household respondents were interviewed (household head or designated representative). The mean age of the household respondent was 37.9 years and female represented the majority of household respondent interviewed (80.2%). About 71.3% of households owned at least one long-lasting insecticide treated net whilst 50.4% of children aged 5 to 14 years slept under the nets during the night preceding the interview. There was a significant association between the number of bed nets in the household and children aged 5 to 14 sleeping under the nets (OR=2.39, 95%CI (1.34-4.27); $p<0.01$). The usage of alternative methods in the household to avoid the bite of mosquito was associated with a reduction of up to 90% of the likelihood of the children sleeping under the nets (OR=0.1, 95%CI(0.06-0.22); $p<0.001$). This alternative method included most often the usage of spatial repellents (mosquito

coils) and insecticide sprays. Parental usage of bed net positively predicted the usage by the children aged 5 to 14 years.

Conclusion: Universal coverage of Aflao population is not yet reached. And poor usage of nets among children aged 5 to 14 years are associated with multiple factors. Even though a higher number of nets in the household does not translate necessarily in usage, parental habit represents a positive drive force for the usage of bed nets by the children and family

Keywords: children, long-lasting insecticide-treated nets, usage, malaria, Ketu South, Ghana

TABLE OF CONTENTS

DECLARATION	i
DEDICATION	ii
ACKNOWLEDGEMENT	iii
ABSTRACT	iv
LIST OF TABLES.....	ix
LIST OF FIGURES.....	x
LIST OF ABBREVIATIONS.....	xi
CHAPTER ONE	1
INTRODUCTION	1
1.1 Background.....	1
1.2 Problem statement.....	3
1.3 Justification.....	5
1.4 Conceptual framework	6
1.5 Narrative of the conceptual Framework	7
1.6 Objectives.....	8
CHAPTER TWO	9
LITERATURE REVIEW.....	9
2.1 Epidemiology of Malaria	9
2.2 Malaria in Ghana and Economic burden.....	10
2.3 Prevention	11
2.4 Long Lasting Insecticide Nets	12
2.5 Ownership, Usage LLIN	13
CHAPTER THREE	16
METHODS.....	16
3.1 Study area	16
3.2 Study design	17
3.3 Study population	17
3.4 Study variables	18
3.5 Sample size determination.....	19

3.6 Data collection	19
3.7 Data Processing and Analysis.....	19
3.8 Ethical considerations	20
3.9 Pre-testing of Study Tools.....	21
3.10 Data storage	21
3.11 Conflict of Interest	21
3.12 Dissemination of the findings	22
CHAPTER FOUR.....	23
RESULTS.....	23
4.1 Household respondents characteristics	23
4.2 Characteristics of interviewed children in households.....	26
4.3 Household structure	27
4.4 Knowledge of malaria and prevention	27
4.5 Long Lasting Insecticide Nets usage and measures of association	28
4.6 factors associated with non-usage of bed nets and multivariable analysis	29
CHAPTER FIVE	33
DISCUSSION.....	33
5.1 Ownership of LLINs	33
5.2 Sex and usage of LLINs	34
5.3 Number of bed nets and usage	34
5.4 Alternative methods and usage of LLINs.....	35
5.5 Usage and time since LLINs was acquired.....	35
5.6 Parental usage of LLINs	35
5.7 Multivariate analysis.....	36
5.8 Limitations of the study	36
CHAPTER SIX	38
CONCLUSION AND RECOMMENDATIONS	38
6.1 Conclusion.....	38
6.2 Recommendations	39
REFERENCES	40

APPENDICES	45
APPENDIX 1: PARTICIPANT INFORMATION SHEET	45
APPENDIX 2: CONSENT FORM	46
APPENDIX 3: QUESTIONNAIRE FORM	48

LIST OF TABLES

Table 1	Operational definitions of socio-demographics.....	18
Table 2	Socio-demographic characteristics of respondents.....	25
Table 3	Summary of association between usage of bed nets among children aged 5 to 14 years and dependant variables.....	29
Table 4	Multivariate analysis of usage of bed nets among children aged 5 to 14 years.....	32

LIST OF FIGURES

Figure 1	Conceptual framework of Factors associated with usage of Long Lasting Insecticide Nets among children aged 5 to 14 years.....	6
Figure 2	Ownership and usage of Long Lasting Insecticide Nets by household population in Ghana.....	15
Figure 3	Ketu South Municipality Map.....	16
Figure 4	Age distribution of household respondents.....	23
Figure 5	Age distribution of household respondents.....	24
Figure 6	Distribution of household members.....	27
Figure 7	Distribution of alternative methods used.....	31

LIST OF ABBREVIATIONS

CHW	Community Health Worker
GHC	Ghana Cedis
LLINs	Long Lasting Insecticide Nets
MOE	Margin Of Error
OPD	Out Patient Department
PMI	President's Malaria Initiative
TDR	Programme for Research and Training in Tropical Diseases
USAID	United States Agency for International Development
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

Malaria is an infectious condition due to a parasite transmitted to humans through the bite of an infected female mosquito called anopheles. Though it is preventable and curable, it largely represents a serious life-threatening condition (World Health Organization, 2018a).

In 2016, an equivalent of 8 times the Ghanaian population suffered from malaria across the world. In the same year, over 5 million additional cases of malaria were reported as compared to data from 2015 reports. WHO recorded 445,000 deaths related to malaria in 2016. The African region contributed to 9 out of 10 cases of malaria reported and over 9 out of 10 deaths equally occurred in the Africa (World Health Organization, 2018b).

Half of the world's population is at risk of malaria. Besides Sub-Saharan Africa, malaria is reported in other regions of the world such as South-East of Asia, the Mediterranean region, Americas, and the Pacific. Hence, over 90 countries and areas of current transmission of malaria are identified (World Health Organization, 2018b).

Infants, children under 5 years of age, pregnant women, HIV/AIDS infected patients, as well as non-immune migrants, mobile populations and travellers are considered to be at higher risk of getting this condition. Malaria also represents a huge economic burden. An estimated US\$ 2.7 billion was dedicated to malaria control and elimination in 2016 (World Health Organization, 2018b).

Cost-effective preventative measures and strategies exist. They include vector control, Preventive Intermittent Treatment during pregnancy and Seasonal Malaria Chemoprevention

(World Health Organization, 2017c). Vector control measures include the usage of Long Lasting Insecticide Nets (LLINs) and Indoor Residual Spraying (IRS). The LLINs are special types of bed nets which have gone through an industrial process in which specific chemicals are introduced into the net fibers or bound around them. This process confers a lifetime action of at least 3 years to the bed nets. LLINs is an important tool recommended by the World Health Organisation for preventing malaria transmission and has been proven to reduce malaria incidence rates by half (Pryce, Richardson, & Lengeler, 2018; World Health Organization, 2017b).

Ghana has implemented the use of the LLINs through universal coverage of LLINs strategies targeting all the population since 2011 (World Health Organization, 2016). In relation to 2012 figures on malaria, the strategic plan for malaria control in Ghana aims to achieve a 75% reduction of mortality and morbidity of malaria. And to achieve this goal, the first objective of the malaria control program is to protect at least 8 out of 10 people with intervention which provide effective prevention regarding malaria by 2020 (GHS/MOH/NMCP, 2014).

To fulfill this objective, mass distribution campaigns of LLINs are organised nationwide. In addition, continuous distribution of LLIN is preformed through services offered during Antenatal Care visits (ANC) and Child Welfare Clinics (CWC). School-based distribution of LLIN also accounts for strategies to improve the protection of the population against malaria. The other strategies include IRS in some selected health districts and larviciding (GHS/MOH/NMCP, 2014).

1.2 Problem statement

Over the past decade, there has been a significant increase in ownership of LLINs in Ghana, rising from 31% to 73% between 2008 and 2016. The high level of ownership does not necessarily translate into effective use of the bed nets. The effective usage of this preventive tool is still less than 50% (GHS/MOH/NMCP, 2014; GSS/GHS/ICF, 2017). The Volta region represents one of the highest malaria prevalence settings (Mba & Aboh, 2007; World Health Organization, 2016) in which usage of LLINs is very poor (46%) compared to ownership (76%). Ketu South accounts for one of the Volta Region municipalities with a high prevalence of malaria (Mba & Aboh, 2007).

Multiple factors have been found responsible for the use or non-use of LLINs in Ghana. Perceived mosquito density, heat, poor state of bed nets, knowledge malaria symptoms and the vector, past experience of malaria, and the level of education of household heads/caregivers have been cited as factors influencing usage of bed nets (Nyavor et al., 2017; Thompson, 2014; Zuradam, 2012). Many predictors including the number of bed nets available in households, socio-economical level, rural setting, and colour of bed nets, have been associated to the use of the bed nets (Baume & Franca-Koh, 2011). Perceived density of mosquito in households, excess of nets in household or heat have been cited as factors of non-usage of bed nets rather than their size or shape (Koenker & Yukich, 2017).

The poor usage of bed nets can have life long and deadly consequences for children. Malaria is a leading cause of anemia in sub-Saharan Africa (Kassebaum et al, 2014) and can alter cognitive functions (Vitor-Silva, Reyes-Lecca, Pinheiro, & Lacerda, 2009). Reports estimate about 70000 to 110000 deaths due to malaria are annually recorded in the 5-14 years (Nankabirwa et al., 2014). It has been proven that malaria control intervention can increase the

mean Hemoglobin level in children (Korenromp, Armstrong-Schellenberg, Williams, Nahlen, & Snow, 2004).

Numerous research on usage of bed nets have focused on women in gestation and children under five (Axame et al., 2016; Deladem, 2013; Dzata, 2015; Nyavor et al., 2017). While a relatively high proportion of children who are aged 59 months and less sleep under mosquito nets, a sharp decrease of the usage of the bed nets is noted among children between the age of 5 to 14 years. This age group were not sufficiently protected by sleeping under insecticide treated nets; hence they represented a high proportion of unprotected population even though they represent the greatest reservoir of infection (Baume & Marin, 2007; GSS/GHS/ICF, 2017; Noor, Kirui, Brooker, & Snow, 2009). Studies in Ethiopia, the Democratic Republic of the Congo, Uganda, Kenya, Zambia have shown the consistent low proportion of LLINs usage in this child age group (Ntuku et al., 2017; Kepha et al., 2016; Birhanu et al., 2015; Wanzira, Katamba, & Rubahika, 2016). It is important to better understand the factors associated with low usage of LLINs in this specific age group in order to ensure the achievement of the objectives of the Strategic Plan elaborated at national level regarding malaria control in Ghana.

1.3 Justification

Children and adolescents between 5 and 14 years have been identified in several studies as a population with less probability to sleep under mosquito bed nets (Birhanu et al., 2015; Kepha et al., 2016; Ntuku et al., 2017; Wanzira et al., 2018). Since several years, the focus has been put on gestating women and children less than 60 months of. This sub-groups are universally acknowledged as the vulnerable groups regarding malaria (World Health Organization, 2018b). The malaria burden in the 5-14 years old children has become importantly rising challenge (Nankabirwa et al., 2014; Pinchoff et al., 2015).

To our knowledge, detailed information on factors influencing the usage and non-usage of LLINs in this age group are rare in Ghana. Ketu South Municipality is one of the areas where malaria prevalence is consistently high over the past decade in the Volta Region. Aflao is the most populated area of the Municipality. This study will help understand the level of usage of LLINs among children aged 5-14 years. The study will also help uncover factors associated with the gaps between ownership and effective usage of LLINs.

1.4 Conceptual framework

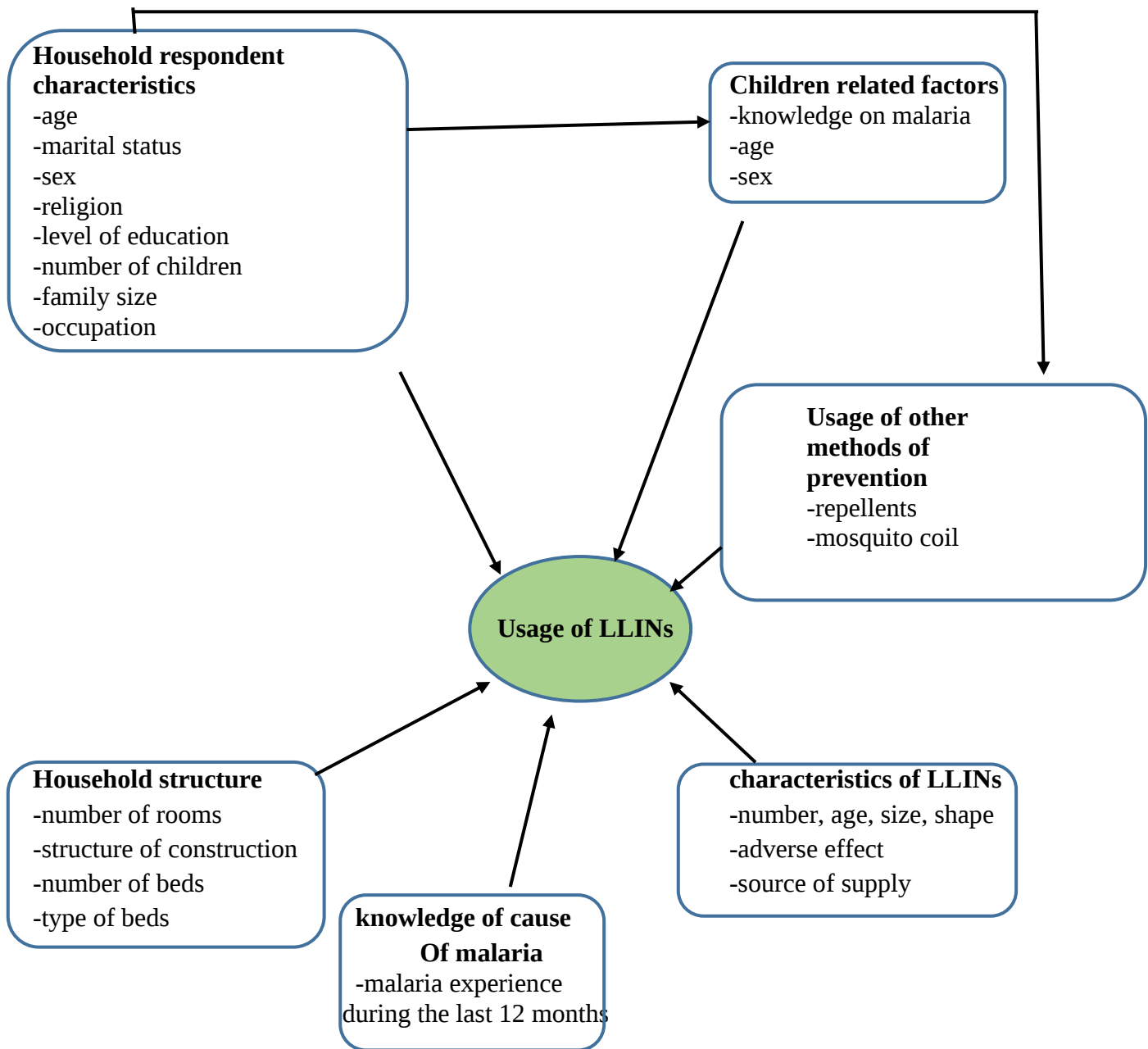


Figure 1: Conceptual framework of Factors associated with usage of Long Lasting Insecticide Nets among children aged 5 to 14 years

1.5 Narrative of the conceptual Framework

Household respondents or head characteristics and/or primary caregiver in the household is an important component in usage or non-usage of LLINs in children. The study community belongs primarily to a patrilineal ethnic group. Hierarchy is an important component of its governance and authority is centralised. Head of families is often the oldest male. Ownership of property is passed on by patrilineal inheritances and decisions are merely taken by men (Ghana Statistical Service, 2014). Hence sex can be an important factor in the use of bed nets in households. Socio-economic status can play an important role in the usage of mosquito nets in a household (Baume & Franca-Koh, 2011; Thompson, 2014). The socio-economic status can be associated with the highest level of education, other socio-demographic characteristics and also housing characteristics. Hence, Marital status and size of the family can also influence the usage of mosquito nets (Sena, Deressa, & Ali, 2013; Thompson, 2014). The household structure is also a factor that can be associated with non-usage of mosquito nets. A number of rooms, size of rooms, type of construction, type of beds on which children sleep, the possibility of having adequate space and device to enable the hanging of the nets can determine the usage of LLINs. The LLIN usage can also be determined by individual factors at the children level such as their age, sex and compliance to sleep under mosquito nets. Usage of alternative preventative methods can influence the usage of mosquito nets. The availability of LLINs, their current state, the knowledge of the link between a mosquito bite and the occurrence of malaria, the eventual adverse effect related to sleeping under the bed nets can be other factors which influence the use of LLINs.

1.6 Objectives

1.6.1 General Objective

To assess the use of Long Lasting Insecticide Nets (LLINs) among children aged 5-14 years in Aflao town in Ketu South Municipality

1.6.2 Specific objectives

1. Determine ownership of LLINs by household respondents in Aflao town in Ketu South Municipality
2. Determine usage of LLINs among children aged 5-14 years in Aflao town in Ketu South District
3. Determine factors associated with usage / non-usage of LLINs among children aged 5-14 years in Aflao town in Ketu South District

CHAPTER TWO

LITTERATURE REVIEW

2.1 Epidemiology of Malaria

In 2016, about 445,000 death were recorded out of 216 million malaria cases which occurred worldwide. African remains the most important zone in which the burden of malaria continues to be serious. Out of ten malaria cases reported worldwide, nine occurred in Africa; and the continent counts more than 9 deaths out of 10 deaths. *Plasmodium* protozoan parasite is responsible for the occurrence of this condition and it is transmitted through the bite of infected female *Anopheles* mosquitoes. Four major species of *Plasmodium* account for Human malaria: *P. falciparum*, *P. ovale*, *P. vivax*, and *P. malariae*. A fifth species, normally present in animals, *P. knowlesi* has been identified in recent years in humans (World Health Organization, 2018b). Though everybody is at risk of malaria infection, key populations including infants, children under five, non-immune migrants, mobile populations, pregnant women, , travellers, as well as people living with HIV/AIDS have a higher risk of being infected by the parasite and develop severe complications (World Health Organization, 2018b). People who reside in areas characterised by a high transmission of malaria acquire some level of protection through their immune system with time. From birth to about 6 months after birth, children are partially protected by antibodies acquired from the mother during pregnancy. This level of protection reduces with time while the child develops his own immunity. Children less than 60 months of age have not totally developed their acquired immunity hence are at risk of malaria and its severe complications (Doolan, Dobaño, & Baird, 2009).

In Ghana, malaria is still endemic and represents a major public health issue. Malaria is the number one cause of sickness and death recorded among children less 60 months. Despite the effort done to control malaria, there has been a subsequent increase in a number of suspected

cases of malaria between 2015 and 2016. In 2017, over 10 million cases of suspected malaria were reported. This represented about one-third of all Out Patient Department (OPD) cases. About One out of five admissions were attributable to malaria and 2% of total deaths registered in Ghana were attributable to malaria (Ghana Health Service, 2018). *P. falciparum* is the most important species responsible for malaria. *P. malariae* accounts for around 20% of malaria cases. *P. ovale* is responsible for a negligible proportion of malaria cases. Malaria coinfection by *P. falciparum* and *P. malariae* is possible. Finally, *P. vivax* infection is not present in Ghana.

Malaria is associated with education and level of wealth . In Ghana, Children from low wealth quintile are more likely to contract malaria. This condition among children is associated with the education level of their mothers. Finally, living in rural settings and urban slums increases the risk of getting malaria (GHS/MOH/NMCP, 2014)

2.2 Malaria in Ghana and Economic burden

Malaria poses an important economic burden on households and health systems. Between 2006 and 2011, financing of malaria has multiplied; rising from a little more than US\$20 to US\$100. Since 2014, the financing has stabilised around US\$ 80 (World Health Organization, 2018a). Along with the government, The Global Fund, WHO, USAID/PMI are the main contributors to financing the battle against malaria. In 2016, The Global Fund contributed the major part of the financing (World Health Organization, 2016). Individuals contribute to malaria control through the direct payment of hospital fees and purchasing of drugs for the treatment of malaria (GHS/MOH/NMCP, 2014). Between US\$8 and 230 US\$ is spent per malaria episode management. The health systems cost, the direct household cost, and indirect household cost constitute the various parts of this expenditure (Sicuri, Vieta, Lindner, Constenla, & Sauboin, 2013). In 2003, the cost of drugs accounted for 36% of the total cost of treatment in health

facilities (Ankomah Asante & Asenso-Okyere, 2003). In 2014, more than US\$ 6.5 million was lost by businesses, of which 90% was by direct costs, and attributed to malaria (Nonvignon et al., 2016).

2.3 Prevention

Four key interventions are used in prevention of malaria occurrence: Insecticide treated nets, IRS, larva control, Preventive intermittent Treatment during pregnancy (World Health Organization, 2017c). Vector control is a major component of prevention and reduction of malaria transmission. It comprises usage of mosquito nets treated by insecticides and residual spraying in houses. A high coverage of vector control intervention can confer a level of protection to the entire community (World Health Organization, 2018b). A large reduction in malaria burden in Africa depends on the higher coverage of all the population. And it will be beneficial also to the most vulnerable groups at higher likelihood of malaria (Killeen et al., 2007).

Half of the reduction in malaria incidence rate is linked to usage of mosquito bed nets as compared to no use of the nets. Comparing usage of treated nets to untreated nets, research shows a reduction by 1/3 of the incidence of uncomplicated malaria (Lengeler, 2009; World Health Organization, 2017b). The treated nets have the potential, through the chemicals imbedded in them, to kill or repel the mosquitoes which come into contact with them. They act as chemical barriers as well as physical barriers to mosquitoes (World Health Organization, 2018c).

To achieve a high coverage of population in insecticide treated nets, WHO recommends mass distribution of the bed nets through nationwide campaigns. The mass campaigns aims to distribute one bed net for each two people exposed to malaria. Also, the campaign has to be repeated every three years ideally. Aside the campaigns, continuous distribution of the bed

nets through ANC visits, EPI and school based distribution (World Health Organization, 2017a). In Ghana, insecticide-treated nets distribution was implemented since 2004, concerning population at greater risk. It has been extended to all age group since 2010 with mass distribution campaigns (World Health Organization, 2016).

2.4 Long Lasting Insecticide Nets

LLINs are special types of bed nets which underwent an industrial process in which specific chemicals are introduced into the net fibers or bound around them. Thus, these nets remain effective in laboratory condition after at least 20 WHO standard washes. And in field conditions, the nets remain effective for 3 to 5 years. The main advantage of the LLINs is the fact that there is no need for additional treatments with insecticides during the three years of optimal usage. LLINs represent the first choice recommended net by the World Health Organization (World Health Organization, 2018c).

The LLINs represent the most important proportion of Insecticide Treated Nets distributed in countries. Three major chemicals have got approval by WHO to be used as insecticide product used in the treatment and production of the nets: Permethrin, Deltamethrin, and Alpha-cypermethrin (World Health Organization, 2017b). There has been a consistent expansion of the proportion of the population that sleep under treated nets in sub-Saharan Africa. From 30% in 2010 it has risen to 54% in 2016. The household ownership of LLINs has also risen from 50% in 2010 to 80% in 2016.

LLIN ownership is defined by Households that have at least one LLIN while the proportion of households with at least one LLIN for every two people defines the coverage. Use is defined by the proportion of people having slept under an LLIN the night before the survey (GSS/GHS/ICF, 2017). Ownership and usage of LLINs are unequally distributed in Africa (World Health Organization, 2017c).

The aim of the National Malaria Control Program through the strategic plan elaborated for the period 2014-2020 in view to control malaria is to achieve a reduction of malaria morbidity and mortality burden by three quarters by 2020 as compared to 2012 data. And to achieve this goal, at least 8 out of 10 Ghanaian population must have intervention for prevention of malaria by 2020 (GHS/MOH/NMCP, 2014). Free distribution of LLINs for children less than five years old and mothers was adopted as a policy in Ghana in 2004 and extended to all age groups of people in 2010 (World Health Organization, 2016). Thus, LLINs are routinely distributed at no cost to women in gestation during their antenatal care visit and to children under one year age who have completed successfully the Penta 3 of the Expanded Immunisation Programme. Strategies implemented to achieve universal coverage of the population include distribution through mass campaigns and antenatal clinic regular distributions. During child welfare clinics, strategies are elaborated to ensure distribution of the nets to eligible people. Finally, primary schools based distribution of the nets also contributes to the achievement of the goals. These strategies led to a marked increase in ownership of LLINs. For example; in 2010-2012, mass distribution of LLINs was undertaken by a door-to-door, leading to a coverage of over 96% of the population (GHS/MOH/NMCP, 2014). The nets can also be purchased on the markets or in shops (GSS/GHS/ICF, 2017).

2.5 Ownership, Usage LLIN

Over the last five years, Ghana has implemented two LLIN distribution mass campaigns. Between 2010 and 2012, an LLIN coverage of 96.7% was achieved through mass distribution campaigns in which almost 12.5 million bed nets were given out in various regions in Ghana. It was an important increase compared to the proportion of 48.9% recorded in 2011 (GHS/MOH/NMCP, 2014, Smith Paintain et al., 2014). Northern region, Greater Accra, Upper East and West experienced the most recent distribution campaigns. In 2014, the campaigns was

implemented Eastern and Volta regions while in 2015, Ashanti, Central and Western Region as well as Brong Ahafo benefited. These various interventions contributed to an increase in ownership of LLINs from 31% in 2008 to 73% in 2016 (GSS/GHS/ICF, 2009, GSS/GHS/ICF, 2014, GSS/GHS/ICF, 2017).

At the regional level, Greater Accra has the lowest level of ownership of LLINs. With more than 9 out of 10 household ownership, the Upper East constitutes the region with the highest proportion of households with at least one LLIN. The Volta Region is ranked 5th.

For the past two years, mass distribution campaigns represent the major channel of acquisition of nets in households (85%), followed by procurement through ANC visits, immunisation distribution and purchasing in shops or markets (GSS/GHS/ICF, 2017).

Despite the relatively high level of ownership of LLINs in Ghana, the main challenge remains the usage. At the country level, less than half of the household population sleep under insecticide-treated nets. However, 66% of the households had access to the LLINs. This could suggest that behavioural factors could explain the lack of usage of available LLINs. At the regional level, half of the regions including the Volta region achieved less than 50% use of LLINs.

It is worth noting that the characteristics of LLINs ownership and usage are not peculiar to Ghana alone. Between 2000 and 2004, an extensive household study led in six African countries revealed a consistent increase in ownership during the period but also showed the gap between ownership and use (Baume & Marin, 2007).

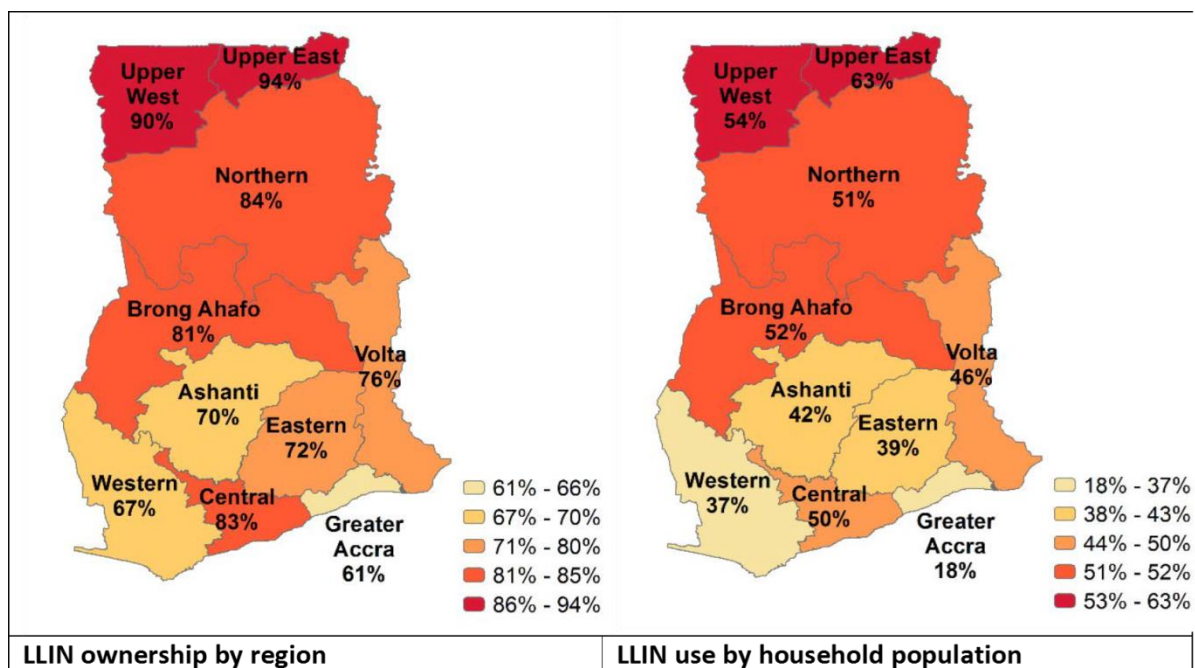


Figure 2: Ownership and usage of Long Lasting Insecticide Nets by household population in Ghana (GSS/GHS/ICF, 2017)

CHAPTER THREE

METHODS

3.1 Study area

Ketu South Municipality is situated in the Volta Region. It constitutes one of the 25 Municipalities of the region. It shares boundaries with Ketu North District, in the Atlantic Ocean, and Keta Municipality respectively at the North, South and West. Aflao is the biggest town of the Municipality and is located at the extreme East of the Municipality representing the principal entry point with the capital city of Togo republic.

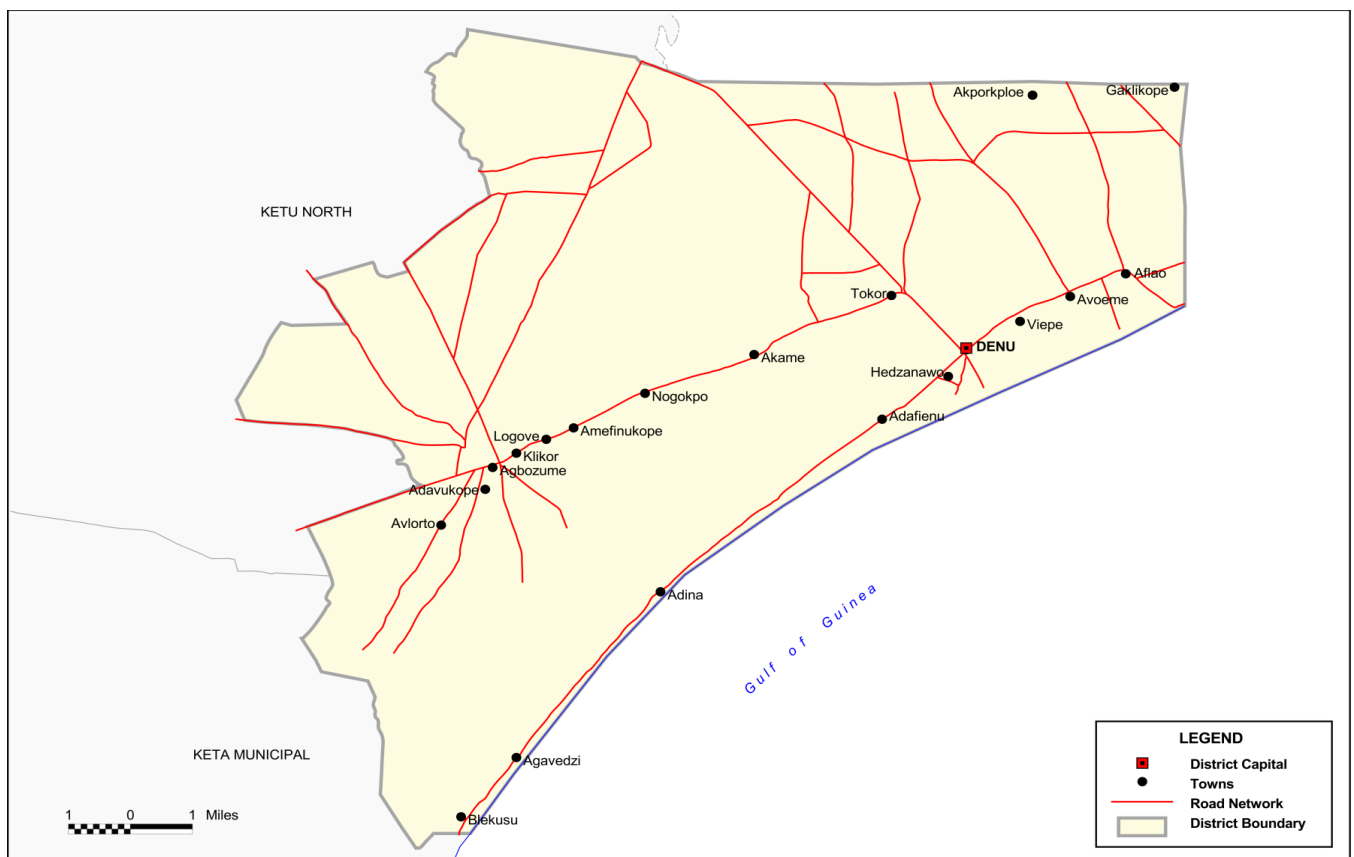


Figure 3: Ketu South Municipality Map

Out of a total population of 160,756 in the Municipality, Aflao recorded a population of 37,350 during the 2010 population Census. Almost 9000 households are established in Aflao. Between April and June and from September to November, rainy season is experienced in the Municipality. The people living in the area are mainly petty traders, fishermen, fishmongers and Kente weavers with a few government workers interspersed between them.

3.2 Study design

It was a descriptive and analytic cross-sectional study conducted in Aflao, the biggest population town in Ketu South Municipality in the Volta Region. Consecutive Simple random sampling methods were used to identify the minimum of 420 households necessary for the study (see the sample size determination section for details).

Every household respondent (household head or mother / reliable representative) who has lived for at least 6 months in the locality ; has at least one child aged between 5 and 14 years is eligible to be interviewed using the structured questionnaire. Demographic information such as marital status, age, sex, and level of education, children in a household, occupation and religion were collected. Other information collected include house structure (type of rooms, bed), characteristics of children, and LLINs ownership and usage.

3.3 Study population

households respondents with children aged 5-14 years resident in Aflao were the study population. Children aged 5 to 14 years were also interviewed.

3.4 Study variables

The outcome was the usage of LLIN among children aged 5 to 14 years. **Use** is defined by the proportion of people having slept under a LLIN the night before the survey. The explanatory factors were organized into three majors groups: the household respondents background characteristics (sex, marital status, age, family size, number of children aged 5-14 years, socio-economic status, level of education, occupation), Housing structure (number of rooms, number of beds), characteristics of LLINs (size, numbers, adverse effects, source of supply, age).

Table 1: Operational definitions of socio-demographic characteristics of household respondents

Variables	Operational definition	Scale of measurement	Source of data
Age	Age at the last birthday	years	Interview
Sex	Biological sex	Binary (male/female)	Interview
Religion	Belief	Nominal (Christian/Muslim/Traditional)	Interview
Marital status	Marital status of the respondent	Nominal (Married/ divorced/Single/widow / Cohabitant)	Interview
Education level	Highest formal education attainted by the respondent	Ordinal (None/primary/JSH/SHS/Tertiary)	Interview
Occupation	Current work of household respondent	Nominal (farmer/petty trader/public worker/unemployed/businessman)	Interview
Family size	what number of people are living in the household respondent include	Discrete numbers	Interview
Number of children aged 5 to 14 years	Number of children aged 5 to 14 years (inclusive) in the household	Discrete numbers	Interview

3.5 Sample size determination

We used the following formula to estimate the minimum sample size of the study.

$$n = \frac{Z_{1-\frac{\alpha}{2}}^2 P(1 - P)}{MOE^2}$$

We used the proportion of usage of LLIN in the Volta region (46%) as a proxy for the usage among children aged 5 to 14 years.

P=proportion of LLIN usage of households (46%) MOE=5% Z=1.96

The minimum number of the household to be interviewed is 380 that we increase it by to achieve a number of 420 households to be interviewed.

3.6 Data collection

We used a structured questionnaire to gather the various informations needed.. Research assistant were recruited and trained for the purpose and divided into the two sub-areas of Aflao (Aflao East and Aflao West). Four pairs of research assistants were deployed in the town. Households were selected randomly and a pair of assistant led each interview. Data were collected in Aflao during in June 2019. At the end of each day, the data collected was reviewed with the groups, discussed and eventual problems were sorted out.

3.7 Processing of data and Analysis

Information gathered through the questionnaire were entered into an Excel spreadsheet. Three spreadsheets were created for data collection and were named: household's characteristics, children characteristics, usage of LLINs. Variables of interest were listed in the spreadsheet and data entered as categorical or continuous where it applies. Set up of limits to the type and value of data that can be entered was performed to avoid data entry errors. Data were checked

and cleaned for validation. The spreadsheets were merged and imported to Stata version 15 (Stata Corporation, Texas, USA) for the statistical analysis. In Stata, households' respondent's ages and children age were categorized respectively into four groups and two groups. Simple descriptive statistics were performed on household's respondents' and households characteristics: mean age, sex, age category distribution of respondents, size of households and number of bed nets available. The usage of bed nets among children aged 5 to 14 years was explored.

The association of each applicable household categorical variable with the dependent variable (LLIN use during the prior night in children aged 5 to 14 years) will be tested by Chi-square. Bivariate and Multiple variate analysis was performed with an independent variable which were found significant. Based on the literature revue, variables not found significant in the bivariate analysis our analysis but with a $p < 0.5$ were also fitted into the logistic regression model to explore the relationship between the outcome and the various independent variables found significant.

All tests were conducted with 95% of confidence and the difference will be statistically significant if $p < 0.05$. Tables and figures were used to summarize the results.

3.8 Ethics considerations

Approval of the study was sought and obtained from the Ghana Health Service Committee in charge under the Reference Number **GHS-ERC 018/03/19** of the 1st April 2019. Permission was obtained from the Director of Ketu South Health Municipality. The study participants were household respondents (heads or their representatives) and children aged 5 to 14 years. An informed consent was provided to adult study participants to testify their free choice to take part in the study. Regarding the children, assent was obtained.

The potential risks of the project were the respondents' time, privacy and eventual psychological threats that some questions might revive. The study would be beneficial to the participants since the information from them will help to improve on health intervention and promotion activities in the area of utilisation of LLINs and also add to existing knowledge. We believe the benefits exceeded the risks.

Participation of the household respondents was highly appreciated. Their concerns and advice will be taken into account but no incentives were provided to them in exchange for the information requested for during the interviews.

3.9 Testing of Study Tools

Questionnaire for data collection were tested in 10 households in Keta for reliability. Observations on clarity and a good understanding of the questions were taken into account to improve on the quality of the questionnaire. Data obtained from this pre-testing study were stored in confidentiality. No data analysis was performed on this sample.

3.10 Data storage

Confidentiality of data was maintained. No name of respondents was incorporated in the data. Backup for the data was saved and kept in a secured place. Only the principal investigator has access to the stored data. The Principal Investigator (PI) will keep all data collected during the study for 5 years after which they will be destroyed.

3.11 Conflict of Interest

This research is funded by TDR/WHO, implementation research on diseases of poverty. The Principal Investigator does not have any particular conflict of interest in this study other than for its academic and public health importance.

3.12 Dissemination of the findings

The results of this research will be submitted to the School of Public Health as part of research work for obtention of Master of Public Health Degree. The key points will be made available to the study population as feedback of the research undertaken. Finally, an article will be derived from the findings for publication in a reputable peer-reviewed journal.

CHAPTER FOUR

RESULTS

4.1 Household respondents characteristics

A total of 434 households in Aflao were interviewed. Twenty (20) were excluded for lack of accuracy of information provided. Out of the 414 household included, female household respondents represented 80.2%. The age of household respondents varied widely from 20 to 85 years. Majority (40.1%) of household respondent interviewed age was situated between 35 and 44 years. The mean age of household respondents was 37.9 ± 9.69 years. By sex category, the age group of 35 to 44 years represents more than 1/3 of people who were interviewed.

Figure 1 shows the age distribution of household respondents by age categories.

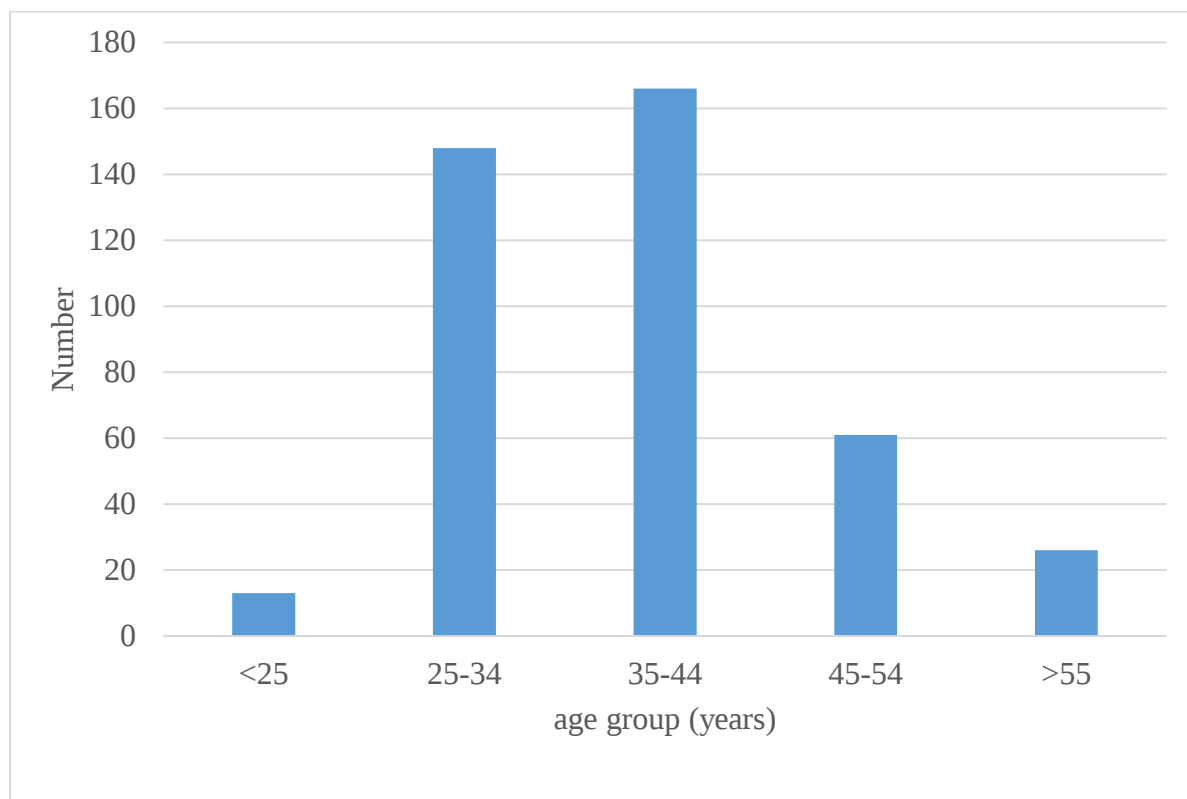


Figure 4: Age distribution of household respondents

More than half (53.4%) of the household respondents had a secondary school education as their highest level of education. Equally, almost 3 out of 4 partners of married household respondents attended secondary school (71.7%). Majority of household respondent were married (80.9%) and less than 1 out of 4 respondent was not a Christian. The principal occupation of the respondent was petty trading (53.9%). Other activities including hairdresser, tailor, painte, and seamstress represented 13% of occupations. The household size varied from a minimum of two members to a maximum of 15 members. The mean household size was 5.02 with a median of 5.0 persons per households. Figure 2 summarises the distribution of household by a number of members.

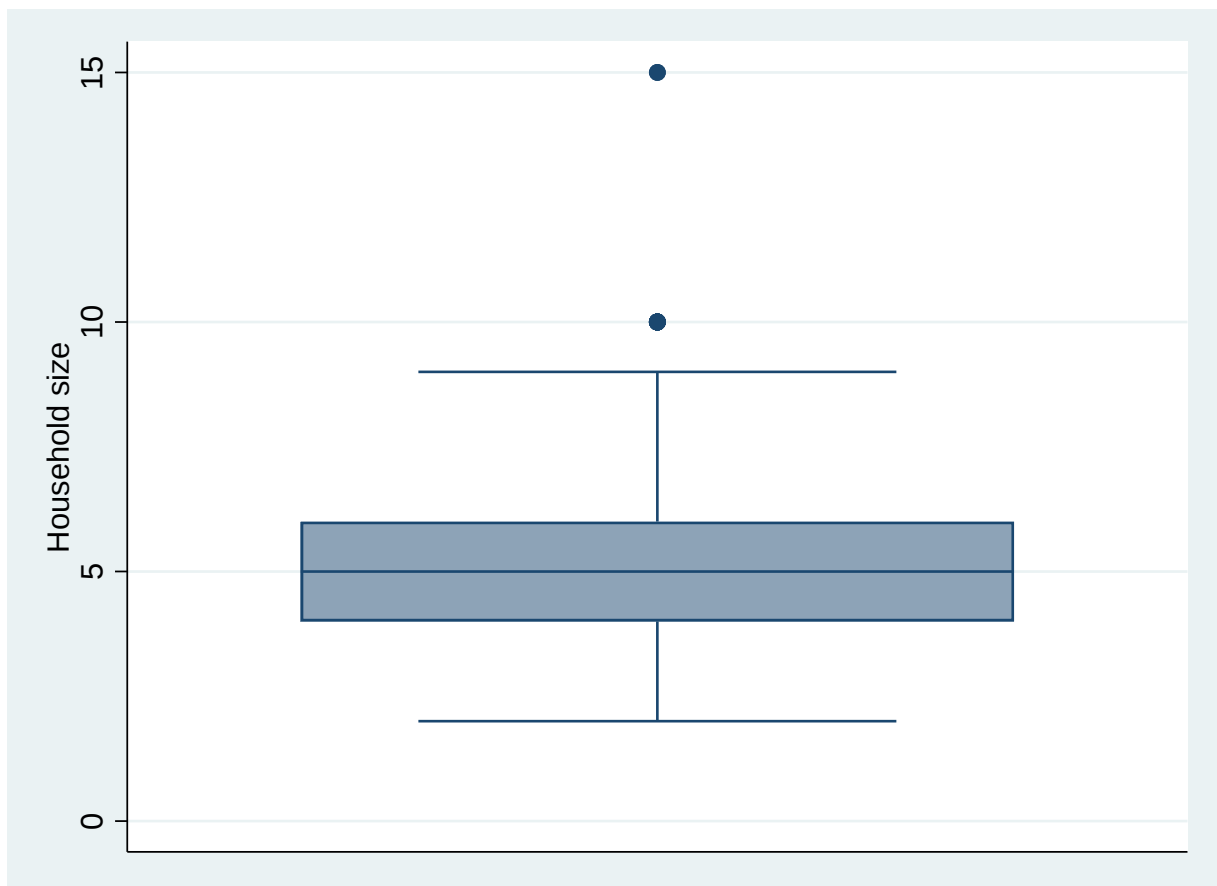


Figure 5: Distribution of household members

The below table shows the socio-demographic characteristic of the household respondents

Table 2: socio-demographic characteristics of household respondents

Characteristics	n	%	Mean	SD	Min	Max
Sex						
Male	82	19.8				
Female	332	80.2				
Age						
			37.9	9.69	20	85
<25	13	3.1				
25-34	148	35.8				
35-44	166	40.1				
45-55	61	14.7				
>55	26	6.3				
Marital status						
Married	335	80.9				
Single	35	8.5				
Widow	29	6.8				
Divorced	8	1.9				
Co-habitant	6	1.4				
Not specified	2	0.5				
Highest level of education						
No education	76	18.4				
Primary	99	23.9				
Junior High School	158	38.2				
Senior High School	63	15.2				
Tertiary	12	2.9				
Not specified	6	1.4				
Highest Level of education of partner						
No education	38	11.5				
Primary	35	10.5				
Junior High School	130	39.2				
Senior High School	108	32.5				
Tertiary	21	6.3				

Table 2 Continued

Characteristics	n	%	Mean	SD	Min	Max
Religion						
Christian	318	76.8				
Muslem	37	8.9				
Traditional	52	12.6				
Others	7	1.7				
Occupation						
Farmer/fisherman	13	3.1				
Petty trader	223	53.9				
Civil servant	17	4.1				
Unemployed	10	2.4				
Business woman/man	81	19.6				
Housewife	16	3.9				
Others	54	13.0				
Household members			5.02	1.85	2	15
Children in households			3.05	1.58	1	13
Children aged 5-14 years in households			1.95	1.14	1	8
Less than 2 children	180	43.5				
2-4 children	221	53.4				
More than 5 children	13	3.1				

4.2 Characteristics of interviewed children in households

A total number of 1301 children were in the 414 household interviewed out of which 809 were aged 5 to 14 years. Among the 414 children interviewed, the female was slightly predominant (51.9%).

4.3 Household structure

Only 19 households had an external aspect of their living place made of muddy materials. Almost 60% of the household respondents reported having two or more rooms in their house. The respondent who possessed only one bed represented 21% of the interviewed. Half of the children sleeping in the households indicated sleeping on the mat during the night.

4.4 Knowledge of malaria and prevention

High body temperature, shivering, headache and weakness were the major symptoms cited by the respondents to be related to malaria according to them. The following bar chart shows the proportion of the major's symptoms cited.

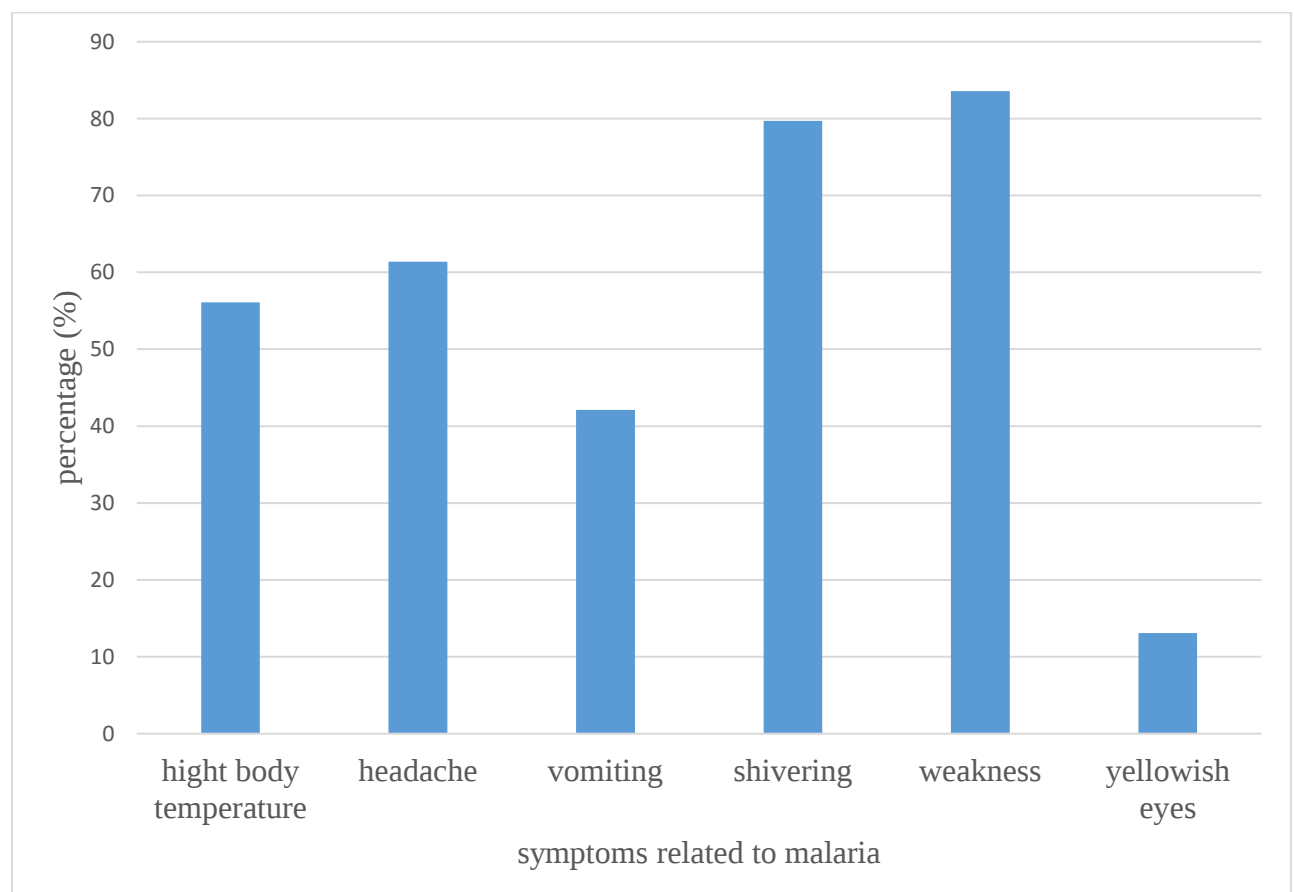


Figure 6: Distribution of symptoms related to malaria

Most of the respondents knew of a mosquito as a vector of malaria; 94.4% of them could identify mosquito as the causing agent of malaria but only 62.4% could recognised this illness can be transmitted from a sick person to a healthy person through mosquito bite . In addition, about 25% of respondents did not cite bed nets as an effective tool to prevent malaria. Only 44.7% of respondent revealed experience of at least one person contracting malaria in their household during the last 12 months before the interview. Coil was mostly used as a mean of prevention of malaria among the respondents.

4.5 Long Lasting Insecticide Nets usage and measures of association

Ownership of bed nets represented 71.3%. About 54.7% of the bed nets were acquired less than one year ago and 84.3% of bed nets owned were acquired during the last three years. The majority (62.7%) of bed nets were acquired through bed nets distribution campaigns. Only 50.4% of children aged 5 to 14 years slept under treated nets the previous night.

Forty percent of respondents who possessed a bed net were in the age group of 35 to 45 years. In addition, forty percent of children who slept under bed nets had their parents aged 35 to 45 years. The boys represented 51.4% of children aged 5 to 14 years who slept under bed nets. The following table 3 shows that The non-usage of alternative methods to prevent mosquito bite was strongly associated with sleeping under a bed net ($\chi^2 = 47.79$; $p < 0.001$). The number of rooms or sleeping space available in the household was not statistically associated with the usage of bed nets by children. However, the number of bed net in the household influences the usage of this bed nets by the children ($\chi^2 = 12.0$; $p = 0.007$). Parental usage of insecticide-treated net is also associated with children sleeping under the nets. Furthermore, the association exist and still statistically significant regardless of the sex category of the household respondent (male: $\chi^2 = 22.06$; $p < 0.001$ | female: $\chi^2 = 166.3$; $p < 0.001$)

Table 3: summary of the association between usage of bed nets among children aged 5 to 14 years and dependant variables

Usage of bed nets among children	Chi2	p-value
Number of bed nets in the household	12.00	0.007
Age of bed nets used	6.1	0.04
Household size	1.49	0.47
Marital status of parents	4.47	0.35
Parental age group	0.41	0.98
Level of education	4.68	0.32
Parents sleeping under bed nets	194.95	<0.001
Usage of alternative methods	47.79	<0.001
Child age group	1.12	0.29
Child sex	0.13	0.73

Finally, there was no significant difference in the usage of bed nets by sex of the children ($\chi^2 = 0.12$; $p = 0.73$). Children aged 5 to 9 years were not found more likely to sleep under bed net as compared to those aged 10 to 14 years ($\chi^2 = 1.13$; $p = 0.29$).

4.6 factors associated with non-usage of bed nets and multivariable analysis

Using a simple logistic regression, the number of bed nets in the household is associated with the use of a mosquito bed net. The overall strength of the association is significant ($p = 0.0076$). In households with two-bed nets, the odds of children sleeping under bed nets is 2.39 times as compared to households with only one-bed net. This association is significant (95%CI (1.34-4.27); $p < 0.01$). Equally having three or four-bed nets in the household is strongly associated with children aged 5 to 14 years sleeping under the nets. The odds of sleeping under bed nets

in households with 3 or 4-bed nets is 1.9 times as compared to households with one bed net (95%CI (1.01-3.56); $p=0.04$). For a household with more than 4-bed nets, the strength of the association is no more significant.

Alternative methods to prevent mosquito bite is inversely associated with the usage of bed nets among the children aged 5 to 14 years. The odds of sleeping under bed nets is 90% reduced among children in the household using alternative methods of prevention of mosquito bites as compared to the households which do not use alternative methods (95%CI(0.06-0.22); $p<0.001$). Related to the usage of alternative methods to avoid mosquito bite, three major factors were reported in the interview: the usage of the coil, the usage of insecticide spray and the usage of the fan to prevent the heat in the sleeping rooms.

Also, the fact that it rained the previous night also contributed to the non-usage of mosquito net among the children. The occurrence of rain during the previous night and perceived absence of mosquito accounted for 8%. Other reasons were represented by the feeling of uncomfortableness, laziness and skin reaction at the contact of the nets.

The figure below shows the major factors related to the usage of alternative methods.

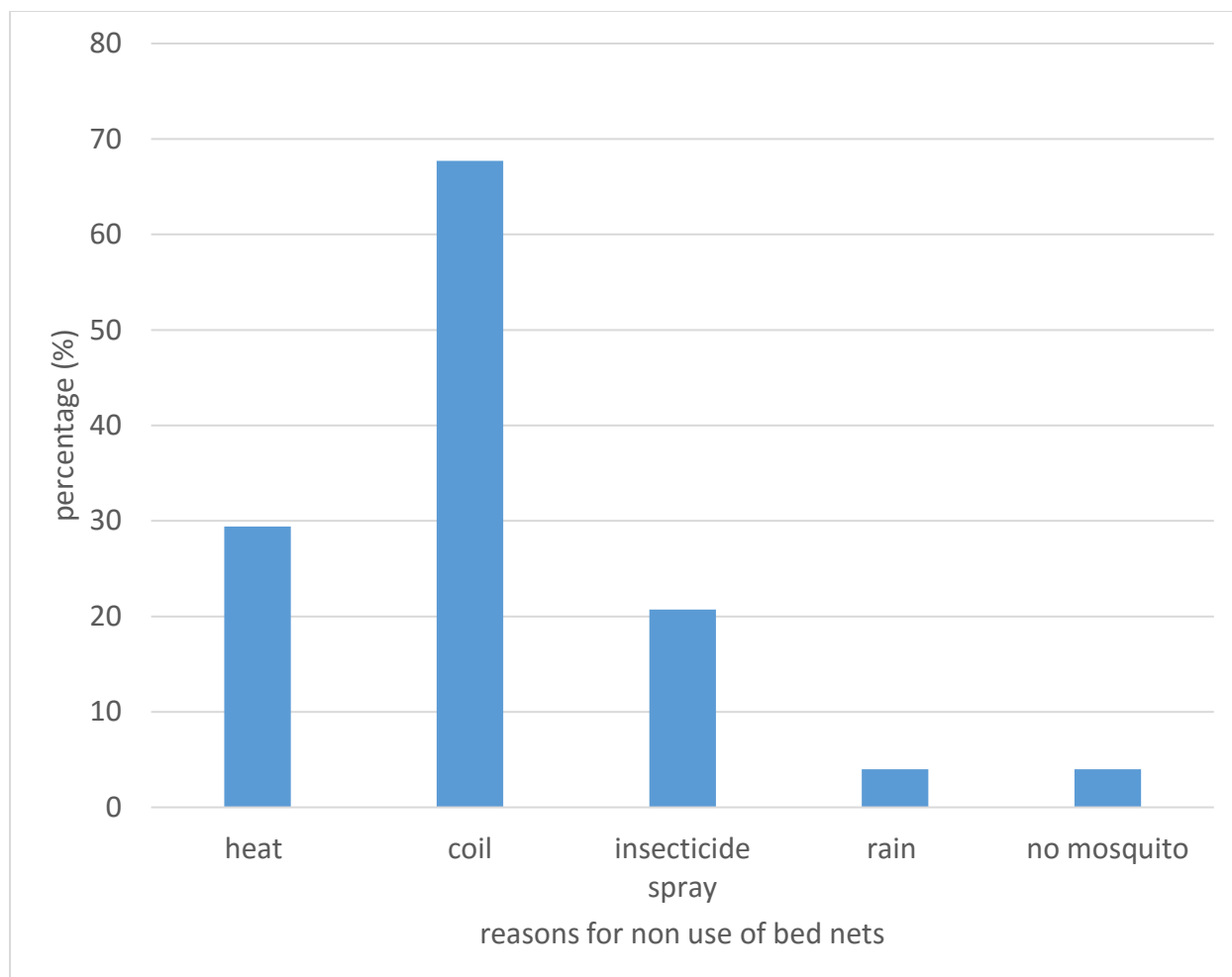


Figure 7: Distribution of alternative methods used

After adjusting for age group, sex, marital status, usage of alternative methods and education, the number of bed nets in the household influence the usage of the bed nets by children aged 5 to 14 years. The following table shows the strength of the association between the various dependent variables

Table 4: A multivariate analysis of usage of bed nets among children aged 5 to 14 years

	uOdds ratio	aOdds ratio	Standard Error	p-value	95%CI
Alternative methods	0.11	0.33	0.19	0.05	0.1-1.0
Parental sleep	38.6	7.0	34.4	<0.001	26.8-169.2
Sex	1.38	2.1	1.08	0.18	0.7-5.7
Marital status					
Married		Ref			
Single		1.02	0.82	0.97	0.2-5.0
Widow		0.87	0.67	0.85	0.1-3.9
Divorced		14.76	19.56	0.04	1.1-198.0
Co-habitant		0.21	0.47	0.48	0.0-15.9
Highest level of education					
No education		Ref			
Primary		1.24	0.74	0.72	0.3-4.0
JHS		2.70	1.57	0.08	0.8-8.4
SHS		4.44	3.25	0.04	1.0-18.6
Tertiary		4.26	5.40	0.25	0.3-51.2
Number of bednets					
One		Ref			
Two		3.01	1.52	0.02	1.1-8.1
Three		2.88	1.56	0.05	0.9-8.3
≥4		0.68	0.59	0.66	0.1-3.7

RR=0.517 p<0.01

CHAPTER FIVE

DISCUSSION

5.1 Ownership of LLINs

In our study, over 84.3% of bed nets which were used were acquired during the last three years. We can hypothesise that the bed nets are relatively new and still conserve their capacity to destroy the mosquito when used. Insecticide-treated nets do not require additional treatment along the years as they remain effective in field condition for a duration of three years (World Health Organization, 2018c). This relatively high proportion of insecticide-treated bed nets still effective can be explained by the fact that distribution campaigns occurred during last year.

The majority of the bed nets were acquired during the distribution campaigns. Mass distribution of LLINs has been proven to be one essential tool in increasing ownership of the bed nets. Free distribution of the bed net helps curve the barriers that socio-economic status can represent towards purchasing this nets (Finlay et al., 2017; Moscibrodzki et al., 2018).

In addition, our study has shown relatively low ownership of the insecticide-treated nets. Less than 3 respondents out of 4 owned at least one-bed nets despite the distribution campaign of the year before. This proportion is less than the Volta Region level (76%) of ownership of the bed nets (GSS/GHS/ICF, 2017). Various other studies in Ghana reported a diversity of proportion in ownership. The ownership of LLINs varies with the type of study and the design. Nyavor (2017) and Axame (2016) reported ownership of over 80% in respectively Hohoe and Ho municipality (Volta Region) whilst Dzata (2015) reported 93.3% ownership. A high proportion of ownership in sub-Saharan Africa has been reported in various countries (Baume, Reithinger, & Woldehanna, 2009; Watiro, Akliku Habte & Awoke, 2016). And to effectively

fight against malaria in Ghana, population protection of at least 80% has to be acquired (Ghana Health Service, 2018).

5.2 Sex and usage of LLINs

In our study, 80.2% of respondents were female and 72.9% of females had at least one-bed nets. However, at the univariate level, the association between sex category and usage of bed nets among children aged 5 to 14 years was not found significant. As opposed to our findings, the various study found a strong association between the usage of insecticides bed nets usage and the female sex (Graves et al., 2011). Other authors reported the positive impact of males on the utilization of bed nets in their household (Fokam, Kindzeka, Ngimuh, Dzi, & Wanji, 2017). We could possibly explain the lack of the association by the small number of males interviewed in our study group. Our analyses did not provide sufficient evidence of an association between respondents' age group and the usage of the insecticide-treated nets ($p=0.98$).

5.3 Number of bed nets and usage

A number of insecticide-treated bed nets in the household is an important factor in the usage of bed nets in our study ($p=0.007$). Furthermore, the odds of sleeping under bed nets in households with two insecticide-treated nets is 2.39 times as compared to the households with one-bed nets. But owning more than four-bed nets does not increase the likelihood of children aged 5 to 14 years to sleep under them. In Ethiopia, ownership of two and three-bed net increased the likelihood of them being used (Watiro, Akliku Habte & Awoke, 2016). Possession of fewer net, in particular not more than two nets has been reported as one of the ten factors predicting usage of bed nets in Ghana (Baume & Franca-Koh, 2011).

5.4 Alternative methods and usage of LLINs

Usage of alternative methods to prevent mosquito bites was associated with non-usage of bed nets. The usage of the coil was the most reported as alternative methods. Coils are readily available countrywide in Ghana; hence a great proportion of the population utilize them (Hogarh, Agyei, & Danso, 2016). A systematic review of literature has shown insufficient evidence of spatial repellents (coils) in the prevention of malaria (Maia, Kliner, Richardson, Lengeler, & Moore, 2018). Equally, there is a very low certainty of the protective effect of insecticide spraying on the occurrence of malaria (Pryce, Choi, Richardson, & Malone, 2018). Hence, the accurate information on preventative methods in relation to malaria has to be reinforced to curb dissemination of misinformation in the population. Mosquito nuisance might be a factor associated with the usage of insecticide-treated nets (Pinchoff et al., 2015).

5.5 Usage and time since LLINs was acquired

An association between the number of years since the bed nets were acquired and the usage was found in our study this can be explained by the fact that people are more likely to sleep under insecticides treated nets when they are relatively new in addition, with time, the bed nets will most likely be damaged and no more suitable for usage. The same findings were underlined in the predictors of usage of bed nets in Ghana. This study included households with pregnant women or caretaker of at least one child under five years of age and was conducted in six regions including the Volta Region (Baume & Franca-Koh, 2011).

5.6 Parental usage of LLINs

There was a strong association between parental usage of the bed nets and children sleeping under the bed nets the night before our interview. Though some study reported that households men tend to keep the mosquito nets for themselves alone (Okrah, Traoré, Palé, Sommerfeld, &

Müller, 2002), we believe this is more likely to be explained by the good habit that is translated into the whole households. As a consequence, as parents sleep under bed nets, children also sleep under bed nets.

5.7 Multivariate analysis

In the multiple regression model, 51.7% of the outcome could be explained by the dependant's variables. The overall model was statistically significant. The number of bed nets in the households and the parental habit of using mosquito bed nets during the night were positive predictors of the fact that children will sleep under the bed nets. In this model, the marital status was also a predictive factor of usage of the nets. In a household headed by a divorced person, the likelihood of the child sleeping under mosquito treated net was 14 times as compared to a married couple. This can possibly be explained by the reduced size of the family and the fact that the child might sleep along with the mother. On the other hand, the level of education also showed a level of significance in this model. In a household with the respondent highest level of education at high school, the odds of children sleeping under bed nets is 4.4 times as compared to no education. The level of education has been associated to the usage of bed nets in other studies (Axame et al., 2016; Baume et al., 2009).

5.8 Limitations of the study

This study was a cross sectional study. It gives a snapshot of the situation at a time point. The cross sectional nature of the study can be a limitation of the study as the usage of insecticide treated bed net can differ, depending on the period of the year at which the study has been done. The fact that the study was done in the rainy season could have biased the outcome in favour

of overestimating the usage or underestimating the usage of insecticide bed nets depending on the households

In addition, this study was mainly based on responses given to the questions asked. All respondents could not allow for observation of the effectiveness of the use or not of the insecticide-treated nets. This could lead to biased responses although this eventuality was factored into the design of the questionnaire to allow a check of the answers. The other limitation of the study was that the interviews took place either in the morning or in the evening to be able to meet the parents and the children at the same time. Hence, information were not collected in the same condition in all the households.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

This was a cross-sectional study which aimed to explore factors associated with the usage and non-usage of LLINs among children of age between 5 and 14 years in the Aflao Town.

6.1 Conclusion

Even though distribution campaigns occurred less than one year before the study and continuous distribution strategies are been implemented in the Ketu South Health Municipality, less than $\frac{3}{4}$ of the household respondents had at least one insecticide-treated net.

This study also revealed that just little more than half (50.4%) of the children aged 5 to 14 years slept under the bed nets the night prior to our interview.

In this study, there was no statistically significant association between the household respondents age or sex and the usage of insecticide-treated nets usage among the children age group.

Preventative methods to fight against malaria were relatively well known by the study participants but the usage of alternative methods to avoid the mosquito bite such as coils or insecticide spray in the households reduced the likelihood of children of the age group of sleeping under the bed nets by almost 90%.

In this study, the number of bed nets in households influenced their usage. Having two or three nets in the households was associated with their usage as compared to having one. But having four or more does not add any benefits. Also, this study revealed the positive influence of parental usage of the bed nets on the usage of their children.

6.2 Recommendations

In view of the result of this study, we can formulate the following recommendations. It is important that the distribution of bed nets campaigns should be maintained and even intensified with special focus on the households which did not benefit from previous campaigns. This specifically targeted campaign will help increase considerably the ownership of the insecticide treated nets in the town. The fact to have a mosquito treated bed nets being the preliminary condition for the possibility of using them; the probability of sleeping under this nets will be increased especially for those having two, three or four mosquito bed nets in their households as compared to those with one in their household. Secondly, education and continuous sensitization has to be sustained. Parents have showed the positive drive force that they represent for the usage of insecticides treated nets. Finally, emphasis needs to be put on various actions toward reduction of usage of alternative methods to avoid bite of mosquito. The easy availability of the coils and insecticides sprays in the country contributes to maintain the perceived effect of their efficiency in the population. This will lead to the LLINs becoming the default option for all households and children.

REFERENCES

- Ankomah Asante, F., & Asenso-Okyere, K. (2003). *Economic Burden of Malaria in Ghana A Technical Report Submitted to the World Health Organisation (WHO), African Regional Office (AFRO)*. Consulté à l'adresse http://www.who.int/countries/gha/publications/Economic_Burden_of_Malaria_in_Ghana_Final_Report_Nov03.pdf
- Axame, W. K., Kweku, M., Amelor, S., Kye-Duodu, G., Agboli, E., Agbemafle, I., ... Binka, F. N. (2016). Ownership and Utilization of Long Lasting Insecticide Treated Nets (LLIN) and Factors Associated to Non-utilization Among Pregnant Women in Ho Municipality of Ghana. *Central Journ of Public Heal*, 2(1), 35-42. <https://doi.org/10.11648/J.CAJPH.20160201.16>
- Baume, C. A., & Franca-Koh, A. C. (2011). Predictors of mosquito net use in Ghana. *Malaria Journal*, 10(1), 265-271. <https://doi.org/10.1186/1475-2875-10-265>
- Baume, C. A., & Marin, M. C. (2007). Intra-household mosquito net use in Ethiopia, Ghana, Mali, Nigeria, Senegal, and Zambia: Are nets being used? Who in the household uses them? *American Journal of Tropical Medicine and Hygiene*, 77(5), 963-971. <https://doi.org/77/5/963> [pii]
- Baume, C. A., Reithinger, R., & Woldehanna, S. (2009). Factors associated with use and non-use of mosquito nets owned in Oromia and Amhara Regional States, Ethiopia. *Malaria Journal*, 8, 264-274. <https://doi.org/10.1186/1475-2875-8-264>
- Birhanu, Z., Abebe, L., Sudhakar, M., Dissanayake, G., Yihdego, Y., Alemayehu, G., & Yewhalaw, D. (2015). Access to and use gaps of insecticide-treated nets among communities in Jimma Zone, southwestern Ethiopia: Baseline results from malaria education interventions Infectious Disease epidemiology. *BMC Public Health*, 15(1), 1-11. <https://doi.org/10.1186/s12889-015-2677-2>
- Deladem, S. P. (2013). *Use of Long Lasting Insecticide Bed Net Among Pregnant Women in Ga East Municipality of the Greater Accra Region*. UNIVERSITY OF GHANA, LEGON.
- Doolan, D. L., Dobaño, C., & Baird, J. K. (2009). Acquired immunity to Malaria. *Clinical Microbiology Reviews*, 22(1), 13-36. <https://doi.org/10.1128/CMR.00025-08>
- Dzata, S. T. (2015). *Assessing the Coverage and Use of Long Lasting Insecticide Treated Nets in the Kpone-On-Sea Township of the Greater Accra Region of Ghana*. UNIVERSITY OF GHANA LEGON. <https://doi.org/10.1038/253004b0>
- Finlay, A. M., Butts, J., Ranaivoharimina, H., Cotte, A. H., Ramarosandratana, B., Rabarijaona, H., & Tuseo, L. (2017). Free mass distribution of long lasting insecticidal nets lead to high levels of LLIN access and use in Madagascar, 2010: A cross-sectional observational study. *PLoS ONE*, 12(8), 1-25. <https://doi.org/10.1371/journal.pone.0183936>
- Fokam, E. B., Kindzeka, G. F., Ngimuh, L., Dzi, K. T. J., & Wanji, S. (2017). Determination of the predictive factors of long-lasting insecticide-treated net ownership and utilisation

- in the Bamenda Health District of Cameroon. *BMC Public Health*, 17(1), 1-10.
<https://doi.org/10.1186/s12889-017-4155-5>
- Ghana Health Service. (2018). *2017 Annual Report National Malaria Control Programme*.
- Ghana Statistical Service. (2014). *2010 population & housing census. District analytical report. Ketu South Municipality*.
- GHS/MOH/NMCP. (2014). *Strategic Plan for Malaria Control in Ghana 2014-2020*.
- Graves, P. M., Ngondi, J. M., Hwang, J., Getachew, A., Gebre, T., Mosher, A. W., ... Jr, F. O. R. (2011). Factors associated with mosquito net use by individuals in households owning nets in Ethiopia. *Malaria Journal*, 10(1), 354. <https://doi.org/10.1186/1475-2875-10-354>
- GSS/GHS/ICF. (2009). *Ghana Demographic and Health Survey 2008*.
<https://doi.org/10.15171/ijhpm.2016.42>
- GSS/GHS/ICF. (2014). *Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF International. 2015. Ghana Demographic and Health Survey 2014. Rockville, Maryland, USA: GSS, GHS, and ICF International*.
<https://doi.org/10.15171/ijhpm.2016.42>
- GSS/GHS/ICF. (2017). *GHANA Malaria Indicator Survey 2016 Ghana Statistical Service Accra, Ghana National Malaria Control Programme*. Consulté à l'adresse <http://www.statsghana.gov.gh/docfiles/publications/MIS26.pdf>
- Hogarh, J. N., Agyei, P. A., & Danso, K. O. (2016). Application of mosquito repellent coils and associated self - reported health issues in Ghana. *Malaria Journal*, 15, 61-68.
<https://doi.org/10.1186/s12936-016-1126-8>
- Kassebaum et al. (2014). A systematic analysis of global Anemia burden from 1990 to 2010. *Blood*, 123(5), 615-625. <https://doi.org/10.1182/blood-2013-06-508325>.The
- Kepha, S., Nikolay, B., Nuwaha, F., Mwandawiro, C. S., Nankabirwa, J., Ndibazza, J., ... Brooker, S. J. (2016). Plasmodium falciparum parasitaemia and clinical malaria among school children living in a high transmission setting in western Kenya. *Malaria Journal*, 15(1), 1-13. <https://doi.org/10.1186/s12936-016-1176-y>
- Killeen, G. F., Smith, T. A., Ferguson, H. M., Mshinda, H., Abdulla, S., Lengeler, C., & Kachur, S. P. (2007). Preventing childhood malaria in Africa by protecting adults from mosquitoes with insecticide-treated nets. *PLoS Medicine*, 4(7), 1246-1258.
<https://doi.org/10.1371/journal.pmed.0040229>
- Koenker, H., & Yukich, J. O. (2017). Effect of user preferences on ITN use: a review of literature and data. *Malaria Journal*, 16(1), 1-18. <https://doi.org/10.1186/s12936-017-1879-8>
- Korenromp, E. L., Armstrong-Schellenberg, J. R. M., Williams, B. G., Nahlen, B. L., & Snow, R. W. (2004). Impact of malaria control on childhood anaemia in Africa - A quantitative review. *Tropical Medicine and International Health*, 9(10), 1050-1065.
<https://doi.org/10.1111/j.1365-3156.2004.01317.x>

- Lengeler, C. (2009). Insecticide-treated bed nets and curtains for preventing malaria (Review), 17(4), 423-426. <https://doi.org/10.1021/ie50184a030>
- Maia, M. F., Kliner, M., Richardson, M., Lengeler, C., & Moore, J. (2018). Mosquito repellents for malaria prevention (Review). *Clinical Microbiology Reviews*, (2), 1-73. <https://doi.org/10.1002/14651858.CD011595.pub2.www.cochranelibrary.com>
- Mba, C. J., & Aboh, I. K. (2007). Prevalence and management of malaria in Ghana: A case study of Volta Region. *Etude de la Population Africaine*, 22(1), 137-165. <https://doi.org/10.1371/journal.pone.0020257>
- Moscibrodzki, P., Dobelle, M., Stone, J., Kalumuna, C., Chiu, Y.-H. M., & Hennig, N. (2018). Free versus purchased mosquito net ownership and use in Budondo sub-county, Uganda. *Malaria Journal*, 17(1), 1-12. <https://doi.org/10.1186/s12936-018-2515-y>
- Nankabirwa, J., Brooker, S. J., Clarke, S. E., Fernando, D., Gitonga, C. W., Schellenberg, D., & Greenwood, B. (2014). Malaria in school-age children in Africa: An increasingly important challenge. *Tropical Medicine and International Health*, 19(11), 1294-1309. <https://doi.org/10.1111/tmi.12374>
- Nonvignon, J., Aryeetey, G. C., Malm, K. L., Agyemang, S. A., Aubyn, V. N. A., Peprah, N. Y., & Bart-Plange, C. N. (2016). Economic burden of malaria on businesses in Ghana: A case for private sector investment in malaria control. *Malaria Journal*, 15, 454. <https://doi.org/10.1186/s12936-016-1506-0>
- Noor, A. M., Kirui, V. C., Brooker, S. J., & Snow, R. W. (2009). The use of insecticide treated nets by age : implications for universal coverage in Africa. *BMC Public Health*, 9, 369-377. <https://doi.org/10.1186/1471-2458-9-369>
- Ntuku, H. M., Ruckstuhl, L., Julo-Réminiac, J. E., Umesumbu, S. E., Bokota, A., Tshefu, A., & Lengeler, C. (2017). Long-lasting insecticidal net (LLIN) ownership, use and cost of implementation after a mass distribution campaign in Kasai Occidental Province, Democratic Republic of Congo. *Malaria Journal*, 16(1), 1-14. <https://doi.org/10.1186/s12936-016-1671-1>
- Nyavor, K. D., Kweku, M., Agbemaflé, I., Takramah, W., Norman, I., Tarkang, E., & Binka, F. (2017). Assessing the ownership, usage and knowledge of insecticide treated nets (ITNs) in malaria prevention in the hohoe municipality, Ghana. *Pan African Medical Journal*, 28, 1-8. <https://doi.org/10.11604/pamj.2017.28.67.9934>
- Okrah, J., Traoré, C., Palé, A., Sommerfeld, J., & Müller, O. (2002). Community factors associated with malaria prevention by mosquito nets : an exploratory study in rural Burkina Faso. *Tropical Medicine and International Health*, 7(3), 240-248.
- Pinchoff, J., Hamapumbu, H., Kobayashi, T., Simubali, L., Stevenson, J. C., Norris, D. E., & Colantuoni, E. (2015). Factors associated with sustained use of long-lasting insecticide-treated nets following a reduction in malaria transmission in southern Zambia. *American Journal of Tropical Medicine and Hygiene*, 93(5), 954-960. <https://doi.org/10.4269/ajtmh.15-0093>
- Pryce, J., Choi, L., Richardson, M., & Malone, D. (2018). Insecticide space spraying for

- preventing malaria transmission (Review). *Cochrane Database of Systematic Reviews*, (11), 1-48.
<https://doi.org/10.1002/14651858.CD012689.pub2>. www.cochranelibrary.com
- Pryce, J., Richardson, M., & Lengeler, C. (2018). *Insecticide-treated nets for preventing malaria (Review) SUMMARY OF FINDINGS FOR THE MAIN COMPARISON. Cochrane Database of Systematic Reviews*.
<https://doi.org/10.1002/14651858.CD000363.pub3>. www.cochranelibrary.com
- Sena, L. D., Deressa, W. A., & Ali, A. A. (2013). Predictors of long-lasting insecticide-treated bed net ownership and utilization: Evidence from community-based cross-sectional comparative study, Southwest Ethiopia. *Malaria Journal*, 12(1), 1.
<https://doi.org/10.1186/1475-2875-12-406>
- Sicuri, E., Vieta, A., Lindner, L., Constenla, D., & Sauboin, C. (2013). The economic costs of malaria in children in three sub-Saharan countries: Ghana, Tanzania and Kenya. *Malaria Journal*, 12(1), 1. <https://doi.org/10.1186/1475-2875-12-307>
- Smith Paintain, L., Awini, E., Addei, S., Kukula, V., Nikoi, C., & Sarpong. (2014). Evaluation of a universal long-lasting insecticidal net (LLIN) distribution campaign in Ghana: Cost effectiveness of distribution and hang-up activities. *Malaria Journal*, 13(1), 1-13. <https://doi.org/10.1186/1475-2875-13-71>
- Thompson, L. H. (2014). *Head of Household Characteristics Influencing Insecticide Treated Net Use in Ghana*. San Diego State University.
- Vitor-Silva, S., Reyes-Lecca, R. C., Pinheiro, T. R. A., & Lacerda, M. V. G. (2009). Malaria is associated with poor school performance in an endemic area of the Brazilian Amazon. *Malaria journal*, 8, 230. <https://doi.org/10.1186/1475-2875-8-230>
- Wanzira, H., Eganyu, T., Mulebeke, R., Bukenya, F., Echodu, D., & Adoke, Y. (2018). Long lasting insecticidal bed nets ownership, access and use in a high malaria transmission setting before and after a mass distribution campaign in Uganda. *PLoS ONE*, 13(1), 1-14. <https://doi.org/10.1371/journal.pone.0191191>
- Wanzira, H., Katamba, H., & Rubahika, D. (2016). Use of long-lasting insecticide-treated bed nets in a population with universal coverage following a mass distribution campaign in Uganda. *Malaria Journal*, 15(1), 1-8. <https://doi.org/10.1186/s12936-016-1360-0>
- Watiro, Akliku Habte & Awoke, W. (2016). Insecticide-treated net ownership and utilization and factors that influence their use in Itang , Gambella region , Ethiopia : cross-sectional study. *Risk management and Healthcare Policyanagement and Healthcare Policy*, 9, 101-112.
- World Health Organization. (2016). Malaria Fact Sheet for Ghana. Consulté à l'adresse http://www.who.int/malaria/publications/country-profiles/profile_gha_en.pdf?ua=1
- World Health Organization. (2017a). *Achieving and maintaining universal coverage with long-lasting insecticidal nets for malaria control*.
- World Health Organization. (2017b). *Report of the twentieth WHOPES working group meeting, WHO/HQ, Geneva, 20–24 March 2017: review of Interceptor G2LN*,

DawaPlus 3.0 LN, DawaPlus 4.0 LN, SumiLarv 2 MR, Chlorfenapyr 240 SC.
Who/Htm/Ntd/Whopes/2017.04. <https://doi.org/Licence>: CC BY-NC-SA 3.0 IGO.

World Health Organization. (2017c). *World malaria report 2017*. Geneva: World Health Organization. Accessed September. <https://doi.org/10.1071/EC12504>

World Health Organization. (2018a). Key facts. Consulté 12 septembre 2018, à l'adresse <http://www.who.int/news-room/fact-sheets/detail/malaria>

World Health Organization. (2018b). Malaria. Consulté à l'adresse <http://www.who.int/news-room/fact-sheets/detail/malaria>

World Health Organization. (2018c). *WHO malaria terminology*.
<https://doi.org/www.who.int/malaria/publications/atoz/malaria-terminology/en/>

Zuradam, S. F. (2012). *Factors associated with use and non-use of mosquito nets for children less than 5 years of age in the Mfantseman Municipality, Ghana*. University of Eastern Finland. Consulté à l'adresse http://epublications.uef.fi/pub/urn_nbn_fi_uef-20121116/urn_nbn_fi_uef-20121116.pdf

APPENDICES

APPENDIX 1: PARTICIPANT INFORMATION SHEET

I am a Public Health Student at University of Ghana and my name is Edem Noamesi Komivi AKPALU. I am undertaking a study as part of my research work for obtention of the Degree of Master in Public Health. The objective of the study is to determine factors associated to the use of mosquito nets among children aged 5 to 14 years.

The study which is purely academic work involves answering questions. With your permission, we would like to collect background information concerning you and your children aged 5 to 14 years as well as information concerning mosquito nets in your household and their usage.

It does not involve any invasive procedure on you for samples. The risks involved with study participation, mainly discomfort with the above mentioned topics, will be minimized by the researcher and interpreter, by explaining each item on the questionnaire to your understanding as a respondent. Time taken may pose minimum discomfort to you since it will take 30 minutes or less to complete.

Kindly note that the information collected will be kept secret and analysis of the data will be done in such a way that your anonymity will be preserved. It is also important to note that you are free to withdraw from the study at any moment and it will not involve any consequences for you.

If you have any problem or question about this study, you can contact

1. The principal investigator Edem N.K. AKPALU (Tel: +233558223069) in the Department of Epidemiology, School of Public Health, and University of Ghana.
2. Hannah Frimpong - Administrator, GHS-ERC (Tel 0244516482)

APPENDIX 2: CONSENT FORM

CONSENT FORM (HOUSEHOLDSRESPONDENTS)

PARTICIPANTS' STATEMENT

I acknowledge that I have read or have had the purpose and content of the participant information sheet read and satisfactorily explained to me in a language English ☐ or Ewe ☐. I understand and I fully understand the contents and any potential implications as well as the right to withdraw even after I have signed this form. I voluntarily agree to be part of this study.

Do I have your permission to record your interview? Yes ☐ No ☐

Participant initials or participant code:

Participants' Signature:or thumb print

Date:

INTERPRETATOR'S STATEMENT

I interpreted the purpose and contents of the Participant's information Sheet to the participant to the best of my ability in the language English ☐ Ewe ☐ to his/her proper understanding.

All questions, appropriate clarifications sort by the participant and answers that were also provided were duly interpreted to his/her satisfaction.

Name:

Date:

Signature:

WITNESS STATEMENT.

I was present when the purpose and content of the participant information sheet was read and explained satisfactorily to the participants in the language English ☐ Ewe ☐ his/she understood.

I confirm that the participant was given opportunity to ask questions/seek clarification and same were duly answered to his/her satisfaction before voluntarily agreeing to be part of the research.

Name: Date:

Signature:

INVESTIGATORS STATEMENT

I certify that the participant has given ample time to read and learn about the study. All questions and clarifications raised by the participant have been addressed.

Researcher's name

Signature:..... Date:

Name:

ASSENT FORM FOR CHILDREN

The study going on has been fully explained to me. I have also read the information sheet. Opportunity has been given to me to ask questions and discuss unclear aspect regarding the study. I understand the goals of this study and various risk and positive aspects of the study. I fully acknowledge that I can pull out this study at any moment without any consequences. Finally, a copy of the information document has been provided to me. Hence, I give my assent.

Participant's Signature: Date Signed.....

Investigator's Signature..... Date Signed.....

If volunteers cannot read the form themselves, a witness /interpreter must sign here:

I hereby testify that I witness when the study was explained to the participants and all question related to the study answered. I also witnessed the approval of the participant to take part in the study.

Date Signature of witness.....

APPENDIX 3: QUESTIONNAIRE FORM

ID.....

Date.....

Dear Participant,

This questionnaire is designed to solicit your contribution to the study on factors associated with usage of Long Lasting Insecticide Bed Net (LLIN) among children aged 5 to 14 years Ketu South District (Aflao), you have been identified and your assistance is being sought to participate in this exercise by completing this questionnaire as objectively as possible. Note that information obtain will contribute immensely to the purpose of the study. Your responses will be treated with utmost confidentiality. Thank you very much for your support and cooperation.

Head of Household Characteristics

1. Sex [1] Male [2] Female
2. What is your age ____ (years)
3. What is your marital status? [1] Married [1] single [3] widow [4] divorced [5] co-habiting [6] others, please specify.....
4. What level of education have you achieved? [0] no education [1] primary [2] JHS/ middle school [3] SHS [4] tertiary
If married or cohabiting, what is the highest level of education of your partner?
[0] no education [1] primary [2] JHS/ middle school [3] SHS
[4] tertiary
5. Which religious obedience do you practice [1] Christianity [2] Islam [3] Traditional [4] Others (please specify).....
6. What is your occupation [1] unemployed [2] petty trader [3] public worker [4] businessman/woman [5] housewife [6] others
(please specify).....
7. How many are you in the household.....(number)
8. How many children are in the household.....(number)
9. How many children between 5 and 14 years are in the household.....(number)

Knowledge about malaria, vector and prevention

10. During the last 12 months has any of your children experienced malaria?

[1] Yes [2] No

11. How do you know if someone has malaria?

.....
.....
.....

12. According to you what is (are) the cause(s) of malaria?

.....
.....
.....

13. Can malaria mosquito bite transmits malaria from a person to another?

[1] Yes [2] No [3] don't know

14. can you list how malaria can be prevented?

.....
.....
.....
.....
.....
.....

Characteristics of House

15. External aspect of the house [1] Mud house [2] wooden structure
[3] cement building [4] glass house [5] others (please
specify).....

16. How many rooms are in the household.....

17. How many beds are in the household.....

18. Under which type of bed do the children sleep?

19. By what means do you have drinking water for the household

[1] pipe water [2] protected well [3] unprotected well [4] rain water
collection [5] other (please specify).....

LLIN and usage of alternative methods to avoid mosquito bite

20. Do you possess mosquito nets in your household? [1] Yes [2] No

21. How many LLIN do you have.....(number)

22. How did you obtain the LLIN
 [1] Distribution campaign [2] ANC [3] Child Welfare Clinic
 [4] purchased [5] others (please specify).....
23. Since how long (years) do you have the LLIN.....
24. Do you use LLIN you have? [1] Yes [2] No
25. How many LLIN do you use.....(numbers)
26. Which period do you use LLIN [1] All Along the year [2] rainy
 season [3] dry season [4] Others
 (specify).....
27. Did you sleep under LLIN last night? [1] Yes [2] No
28. If No,
 Why.....

29. Did your children aged 5 to 14 years sleep under LLIN last night?
 [1] Yes [2] No
30. Did you use any alternative methods to avoid mosquito last night? [1] natural
 repellents [2] coils [3] insecticide spray [4] others (please
 specify).....

Characteristics of children aged 5 to 14 years

31. Age..... date of birth____/____/____/ (dd/mm/yy)
32. sex [1] Male [2] Female
33. Did you sleep under mosquito net last night? [1] Yes
34. At which time do you go to sleep? [1] 7:00 pm – 8:00pm [2] 8:00- 9:00pm
 [3] 9:00pm –10:00pm [4] others (please specify).....
35. what is malaria?.....
36. According to you what is (are) the cause(s) of malaria?
 [1] Overwork [2] witchcraft [3] mosquito bite
 [4] Exposure to sun [6] others (please specify).....
37. Can mosquito bite transmit malaria from one person to another?
 [1] Yes [2] No [3] don't know