

**Determinants of the use of bed nets for the prevention of malaria for children
under 5 years in the Democratic Republic of Congo.**

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DECLARATION

I, Ciza Silva Mukabaha declare that:

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ABSTRACT

This study was conducted to explore the determinants of bed net usage for the protection of children under the age of five against malaria in the Democratic Republic of Congo (DRC). The study aims to know the different socio-economic factors that affect child survival of malaria using bed nets and to determine the impact of these factors on bed net usage in preventing infection with the malaria parasite. The objectives are to determine child characteristics, mother or caregiver characteristic, and household characteristics associated with the use of bed net.

To determine the impact of these above-mentioned characteristics, data from the second Demographic and Health Survey in the DRC (EDS-RDC II) was used. Data collected from 2013 to 2014 was analyzed using STATA IC version 2013 to answer research questions such as; the association between participant demographics and bed net usage, maternal education, marital status and their association with child protection using bed net. The last this research answered are more related to the gender of household head, the location of the household where the child lived as well as the household wealth and their influence on child sleeping or not to sleep in the bed net.

Data was weighted to make the result nationally representative. The findings reveal that there is a relationship between most of the socioeconomic factors and the use of bed net for the protection of children under the age of five years in the DRC. Age of the child influences the use of bed net, this is so as the findings show that the younger a child is, the higher the chance of him/her sleeping under a bed net and vice-versa. The research findings also show that children who are under the care of a single mother have less chances of sleeping under the bed net as against children under the care of both parents who have higher chances of sleeping under bed nets. The importance of mother's education is justified by this study because the less educated a woman is, the lesser the chances of a child sleeping under the bed net. Household wealth also shows an impact on the child survival against malaria.

This study recommends narrowing the gap between rich and poor within the country as well as empowering women through education and other necessary knowledge to protect children against malaria through the use of bed net.

TABLE OF CONTENTS

DECLARATION.....	ii
ACKNOWLEDGEMENTS	iii
ABSTRACT.....	iv
TABLE OF CONTENTS	vi
LIST OF FIGURES	xi
LIST OF TABLES	xii
LIST OF ACRONYM.....	xiii
CHAPTER I: INTRODUCTION	1
1.1 Background of the Study.....	1
1.2. DRC progress on coverage / Impact indicators to date.....	6
1.3. Theoretical framework	6
1.4. Objectives of the study.....	8
1.5. Organization of the Dissertation	9
CHAPTER 2: LITERATURE REVIEW	11
2.1 Introduction	11
2.2. Definition of socio-economics status (SES).....	11
2.3. Child characteristics	12

2.3.1 Age of the child	12
2.3.2. Sex of the child	14
2.4. Mother Characteristics	14
2.4.1. The marital status of mother	14
2.4.2 Education level of mother/ guardian in the protection of the child.	16
2.5. Household Characteristics	18
2.5.1. Location (Urban vs rural area).....	18
2.5.2. Income level of household.....	20
2.5.3. Sex of the household head	23
2.6. Summary	23
CHAPTER 3: METHODOLOGY	25
3.1. Introduction	25
3.2. Location of the Study	25
3.3. Data source and study participants.....	26
3.3.1. Materials and Methods	27
3.3.2. Statistical Analysis	27
3.4. Anticipated Problems/Limitations.....	28
3.5. Validity, Reliability and Rigor	28
3.6. Target population	28

3.7. Study hypothesis testing.....	28
3.8. Variable analysis	29
3.8.1 Outcome variable.....	29
3.8.2. Associated variable.....	31
3.8.2.1. Gender or sex of the child.....	31
3.8.2.2. Age of the child.....	31
3.8.2.3. Higher education of the mother	32
3.8.2.4. marital status of the mother.....	32
3.8.2.5. Sex of household head	33
3.8.2.6. Location (Urban vs rural).....	33
3.8.2.7. Wealth of the household	34
3.8.2.8. Province	35
3.9. Summary	35
CHAPTER 4: RESULTS	37
4.1. Introduction	37
4.2. Demographic Distribution of the 9570 under five children in the sample.....	37
4.3. Univariate analysis of bed net use by children less than 5 years.	42
4.4. The unadjusted odd ratio for net use by children under five years.	46
4.4.1. Sex of child.....	46

4.4.2. Age of child	46
4.4.3. Marital status of mothers	46
4.4.4. Mothers' highest education level.....	47
4.4.5. Sex of household head	47
4.4.6. Household wealth	47
4.4.7. Location (Urban and Rural).....	48
4.4.8. Province	48
4.5. The adjusted odd ratio for net use by children under 5 years.	51
4.6. Conclusion.....	55
CHAPTER 5: DISCUSSION OF RESULTS AND CONCLUSION.....	57
5.1. Introduction	57
5.2. Discussion of the results.....	57
5.3. Theoretical Framework	61
5.4. Study limitations	62
5.5. Recommendations	62
5.5.1. Government	63
5.5.2 NGOs and other Donors	63
5.5.3 Mother, household heads and care takers	64
5.5.4 Community	64

5.6. Conclusion.....64

LIST OF FIGURES

Figure 1: Operation of the groups of proximate determinants on the health dynamics of a population.	7
Figure 2: Map of the Democratic Republic of Congo	26
Figure 3: Sex distribution among children.....	37
Figure 4: Children age distribution in percentage.....	38
Figure 5: Highest education of the mother.....	39
Figure 6: Marital status of mothers	39
Figure 7: Sex of household head.....	40
Figure 8: Geographic location of children in the sample.....	40
Figure 9: Wealth distribution of household	41
Figure 10: Child distribution by province.....	41

LIST OF TABLES

Table 1: Results of 2007 DHS, 2010 MICS, and 2013 DHS. Evolution of key malaria indicators in DRC for 2007 – 2014.....	6
Table 2: Descriptive statistic of the outcome variable	30
Table 3: Descriptive statistic of the outcome variable	30
Table 4: Univariate analysis of net use.	43
Table 5: Table of unadjusted Odd Ratio for net use.	49
Table 6: The table showing the adjusted odd ratio.....	54

LIST OF ACRONYM

CI: Confidence Interval

DHS: Demographic and Health Survey

DID: Department for International Development

DRC: Democratic Republic of Congo

IRS: Indoor Residual Spraying

IRS: Indoor Residual Spraying

ITN: Insecticide Treated Nets

LLINs: Long Lasting Insecticide Nets

MICS: Multiple Indicator Cluster Survey

PCR: Polymerase Chain Reaction

PMI: President Malaria Initiative

RBM: Roll Back Malaria

RDT: Rapid Diagnostic Test

SSA: Sub-Saharan Africa

WHO: World Health Organization

CHAPTER I: INTRODUCTION

1.1 Background of the Study

According to the Rollback Malaria (RBM) program, the malaria pandemic remains among one of the major public health challenges in Sub-Saharan Africa (Roll Back Malaria, 2015). Despite a decrease by 60 percent and 29 percent in mortality among children under 5 years at the year 2000 and 2010 respectively, the World Health Organization (WHO) estimated that around 92 percent of all malaria deaths mostly among young children under five years of age is in the African region (World Health Organization, 2016). This high mortality rate among children is a consequence of the fact that; at the early stage of life, children experience malaria infections before they acquire adequate clinical immunity. This often happen in the first or second year of life, which makes these early years particularly dangerous. Furthermore, in the context of general mortality among children, it was found that 20 percent of all deaths in children under five years are caused by malaria in Africa. The mortality rate for this disease is enormous as the pathogenesis of this disease is well known and is preventable and curable (Afolabi et al., 2009).

The WHO reported that malaria cases rose from 233 Million in 2000 to 244 million in 2005. This value decreased from 225 million in 2009 to 212 million in 2015. Mortality resulting from malaria parasite infection is estimated to have dropped from 985 000 in 2000 to 781 000 in 2009 and further decreased to 429 000 in 2015 (World Health Organization, 2016).

The vision of RBM in one sentence is to live in a world without the burden of malaria. To achieve this, set of progressive objectives backed by certain targets have been put in place. These includes reducing global malaria deaths rates and incidence 2020 with at least 40% compared with 2015. By 2030, death rate caused by malaria be reduced by at least 90% compares to 2015 and a minimum of 35 more countries be free of malaria (Roll Back Malaria, 2015).

To achieve the above-mentioned objectives, different methods to eradicate malaria have been put in place. Vector control is an essential component of malaria control program and consists of different strategies. The two principal strategies are; Long Lasting Insecticidal Nets (LLINs) as well as the Indoor Residual Spraying (IRS) but in some special cases, these two are helped by the larval source management as well as the personal protections measures (World Health Organization, 2017). Bed nets are the mainstay in malaria prevention, this is possible when used daily and effectively, and they prevent complications associated with malaria infection in a range of epidemiological settings. The World Health Organization recognises Insecticide Treated Nets (ITNs) in lowering overall transmission and protect all individuals within communities where there is high densities and infectivity of malaria vectors (World Health Organization, 2008). This is because bed net has been advocated as the most preventive tool against malaria especially in Sub-Saharan Africa (World Health Organization, 2008) however, its use has been faced with some challenges. These include reduced effectiveness or inappropriate use of Insecticide-Treated Nets (ITN). ITNs require periodic re-treatment to maintain effectiveness, but in recent years a type of ITNs, the Long-Lasting Insecticidal Net has been developed (Opiyo et al., 2007). In experimental settings, it has been effective after 20 washings over 3-4 years (Graham et.al, 2005).

Among other strategies to fight malaria in this age group, the increased utilization of bed net has been recommended (Eisele et al., 2009). The use of bed nets is a cost-effective intervention to reduce child mortality and maternal anemia where malaria imposes an important disease burden (Hanson et al., 2008). Thus, bed nets are a form of personal protection that has been shown to reduce malaria illness, severe disease and death due to malaria in endemic regions (Toé et al., 2009).

Research shows an increase in survival in children aged 1 month to 4years. This was made possible by the use of bed nets. However, this increase was a result of higher coverage in area with longer access to the programme. Which goes further in concluding that bed nets prevented 1 in 20 children from deaths at the time. Although bed nets are well known by some people as a practical malaria control tool with proven efficacy, some people still have

fears of a detrimental effect on immunity of long-term users (Trape et al. 1996 & Snow et al. 1997). This reflects the level of education or knowledge about malaria and ITN because it has been researched that insecticide treated net reduced overall child mortality by 19% (Schellenberg Joanna RM Armstrong et al. 2001).

In community-wide trials in several African settings, bed nets have been shown to reduce the death rate of children under 5 years from all causes by about 20% (Crawley, 2004). One of the major role that the bed nets play is that of separating mosquito from people sleeping under them. However, bed nets treated with an insecticide (ITNs) are more protective than untreated nets (Lengeler, 2004). In the case of ITN, adding to separating children from a mosquito, the insecticide used on the bed net kills mosquitoes. Thus, it protects in two ways. The insecticide also repels mosquitoes and by doing so, it reduces the number of mosquitoes entering the house to feed on people (Bekele et al., 2012). Therefore, if a large proportion of houses within a community regularly use ITNs, the number of mosquitoes, as well as their length of life, will be reduced (Killeen et al., 2007). However, the successfulness of this process will depend on the number of houses that regularly use ITN. All members of the community regardless of age, sex, financial condition and other socio-demographic factors may benefit (Killeen et al., 2007). For all members of the community to benefit from ITN protection, more than a half of the population in the community must use ITN on a regular basis (Yakob et al., 2010).

The equality in availability and usage of insecticide treated nets within different social classes and location may still be questioned due to the socioeconomics issues affecting developing regions especially the Sub-Saharan African (SSA) part (Nevill et al., 1996). Thus, due to the availability of effective means of prevention and treatment intervention against malaria and related mortality and morbidity caused as well as the economic loss due to the pandemic can be prevented if proper intervention is made universally accessible to everybody and particularly in the most endemic regions for those in need or most vulnerable to malaria (Breman et al., 2007).

RBM has identified two important indicators to monitor progress toward the set target; the proportion of households that own one or more nets as well as the proportion of under five

children who sleep under a net (Kilian et al., 2010). While it is important to evaluate the ownership of bed net in order to structure the proper and effective distribution channels, utilization of the bed net is the most important because it indicates how much influence prevention has on the epidemiological impact of the population (Macintyre et al., 2006).

According to the Department of International Development (DID), there are three different epidemiological zones in the DRC. Firstly, the equatorial forest zones with high morbidity in children under five. Secondly, the tropical zone where transmission increases during the long rainy season and which lasts between 5 – 8 months and where morbidity is highest for children under 10, lastly the mountainous areas of Kivu (North and South) and Katanga provinces in the east which are fringe areas, and prone to outbreaks. The majority of the population (97%) live in the equatorial forest and tropical zones where malaria transmission is highest while only 3% of the population live in mountainous, epidemic prone areas in the East; Kivu and Katanga (Taylor et al., 2011).

The President's Malaria Initiative (PMI) in the DRC has reported that malaria account for more than 40% of the total outpatients visit as well as of 40% of deaths among children under the age of five (PMI, 2015). Based on data collected in 2013-2014, the Demographic Health Survey supplemental malaria report showed the DRC national malaria prevalence in children of 6 to 59 months ranged from 23 to 34 percent depending on the different malaria measures used to test for the parasite in patient samples; Polymerase Chain Reaction (PCR) and Rapid Diagnostic Test (RDT) respectively (DHS, 2015). Furthermore, the report shows that; the prevalence increased by age and it is higher for those living in rural areas as compared to those living in urban areas (DHS, 2015). As such, the distribution of bed nets, identification of awareness gaps, monitoring of behavioral changes on malaria disease recognition and use of ITNs should be the priority area for the government of DRC with a special emphasis on increasing the coverage and use of ITNs under national malaria guidelines.

The country has catastrophic health indicators with child and maternal mortality rates being respectively the second and fourth highest in the World (Boschi-Pinto et al., 2010, Hogan

et al., 2010). Utilization of health services is extremely low; on average, one person consults health services every 6.7 years (Ministry of Planning DRC, 2006).

Despite difficulties in logistics and transportation that have hindered routine distribution, President's Malaria Initiative has managed to distribute ITNs in 138 PMI supported health zone, and distribution in the 43 additional health zone has recently begun. Furthermore, it has managed to distribute 567 831-bed nets to ANCs and childcare clinics in 138-health zone since 2011. Being among the poor countries in the world (HDI, 2014) DRC is ranking second to the bottom (186th out of 187 countries) in terms of the 2014 human development index worldwide. An estimate of 80% of the population lives on less than \$1 per day. Malaria is reported by the DRC Ministry of Health (2014) to be the principal cause of morbidity and mortality in the DRC. It is estimated that 97% of the population lives in zones with stable transmission lasting 8 to 12 months per year (DRC Ministry of Health, 2014).

This research seeks to describe contributing factors that hinder the utilization of bed nets among under five children in the Democratic Republic of Congo. Bed nets are highly effective in reducing malaria morbidity and mortality if properly use and maintained (Ministry of Health, 2014). Although ownership of nets in DRC has improved, the RBM target of 60 percent has not yet been achieved. According to the presidency report 2015, the DHS shows that the country is making progress with the malaria indicators vis-a-vis to the 2010 Multiple Indicator Cluster Survey (MICS) results. However, utilization has not reached the Abuja target level of 80 percent, and the use of bed nets remains very low in comparison to the ownership. Records of the policy and strategy for bed nets shows over 80 percent of people living in malaria endemic areas of DRC are supposed to sleep under the bed net. However, only a small number of this population sleep under the net. Among those who have the net, a significant number of them purchase their own bed nets from the commercial market.

1.2. DRC progress on coverage / Impact indicators to date.

According to the 2013-2014 DHS report, the DRC is making significant progress. A very promising trend in malaria indicators and all-cause mortality compared to the 2010 Multiple Indicators Cluster Survey (MICS) results. Some few highlights from the report include the increase in child use of bed nets by under 5 years from 38 percent to 56 percent. As well as the increase in households' ownership of ITN of at least one ITN, from 51 percent to 70 percent. Which lead to under-five-mortality decrease from 158/1000 live births in 2010 to 104/1000 live births in 2013.

Table 1: Results of 2007 DHS, 2010 MICS, and 2013 DHS. Evolution of key malaria indicators in DRC for 2007 – 2014

INDICATOR	2007	2010	2013	NMCP 2015
	DHS	MICS	DHS	target
Households with ≥ 1 ITN	9%	51%	70%	>80%
Children ≤ 5 sleeping under an ITN the previous night	6%	38%	55.9%	>80%

(Source: PMI 2015)

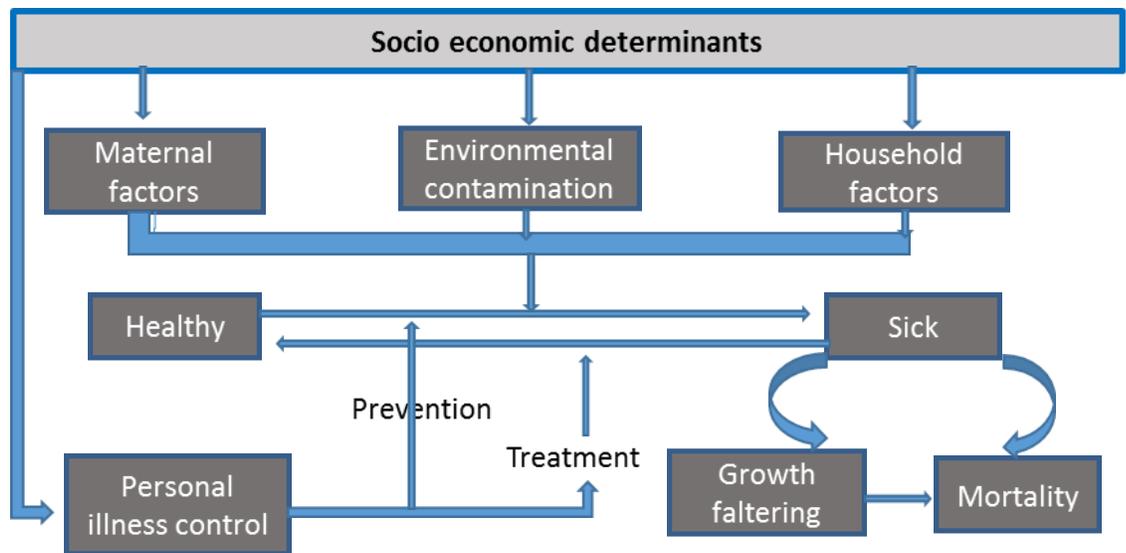
1.3. Theoretical framework

The theoretical model used for this research is the analytical framework for the study of child survival developed by Mosley and Chen in 1984. The intention of this framework is to promote research advancement on social policy with the objective to decrease child mortality particularly in the developing countries (Mosley and Chen, 1984). The framework outlines the relationship between child mortality and social and economic determinants of child mortality, which operates through a common set of biological

mechanisms, or proximate determinants, to exert an impact on mortality. Therefore, advancement of research on social policy to improve child survival is emphasized, the field intervention studies measures the effectiveness of personal preventive measures on levels of mortality and morbidity in a population.

The use of bed nets would fall under the prevention aspect of personal illness control and this is one of the five proposed proximate determinants, which immediately influences the risk of morbidity and mortality. Therefore, for the child survival to be affected, all social and economic determinants must be functioning through these variables. Maternal factors, which has been shown to exert an independent influence on pregnancy outcome and infant survival through its effects on maternal health. The environmental contamination refers to the transmission of infections agents to children. Here there are four different categories representing the main routes that infectious agents are transmitted to the human host. These include the routes for skin infections, and insect vectors, which transmit parasitic and viral diseases.

Figure 1: Operation of the groups of proximate determinants on the health dynamics of a population.



(Mosley and Chen, 1984)

Therefore, the three broad social determinants of levels that influence child mortality may be grouped into the categories; individual, household and community level variables. The individual level variables include parental resources in terms of levels of education have implications on child mortality (Agha, 2000). Household level variables such as household wealth, quality of housing, access to water, sanitation and availability of food influence child survival (Mosley and Chen, 1984). Community level variables involve differences in ecological setting, political economy and health system that influence parents' ability to provide health care for their children (ibid, 1984 and Agha, 2000).

Emphasizing on the above statement, research has shown for example that the father's education is much linked to occupation in urban setting and thus with the household income and that at certain extent influence attitudes toward the preference in child care services which may impact heavily on child survival when more educated fathers are married to less educated mothers. However, for the mother's side, it may be said that so many proximate determinants may directly influence the mother's education to radically alter chances for child survival.

Therefore, Economic circumstances within the household play a huge role in the infant health and mortality. For less wealthy household, the child may be neglected or taken care of with less skilled sibling due to mother's outside work contrary to the rich household has the capability to hire a skilled and attentive nursemaid.

1.4. Objectives of the study

Many external organizations such as Global Fund, World Bank, USAID/PMI, WHO/UNICEF and to a lesser extent the government of the DRC have made a considerable effort in financing, procuring and distributing bed nets for malaria control in DRC (World malaria report 2015). Recently, the distribution of bed nets has been more frequent than in the past but discrepancy still exists between ownership and the use of mosquito nets within different dynamics. While emphasis has been put on ownership less attention has been paid to the utilization and factors that affect the utilization of bed nets despite low

utilization recorded. There has been no study investigating the socio demographic and economic factors that influence bed net utilization for children under five years in the DRC. The finding from this study will assist the government of DRC, policy makers and planners to intervene with the populations most at risk of low utilization of bed nets among children aged under five years.

The objectives of the study are as follows:

- ❖ To determine child characteristics associated with the use of bed net;
- ❖ To determine mother or caregiver characteristics associated with the use of bed net;
- ❖ To determine household characteristics associated with the use of bed net.

These objectives are linked to the following research questions:

- ❖ Are male children more likely to sleep under bed net than female children?
- ❖ Is the age of the child associated with sleeping under a bed net?
- ❖ Does maternal or caregiver education impact on sleeping under a bed net?
- ❖ Is maternal marital status associated with sleeping under a bed net?
- ❖ Are children in households with a male head more likely to sleep under a bed net?
- ❖ Are children resident in urban households more likely to sleep under a bed net than those in the rural household?
- ❖ Are children resident in wealthier households more likely to sleep under a bed net?

1.5. Organization of the Dissertation

This dissertation is divided into five (5) chapters. Chapter one (1) provides background information on motherhood and labour force participation. In addition, it addresses the objectives, research questions and theoretical framework of the study. Chapter two (2) presents a review of literature relevant to the undertaking of the research. Chapter (3)

focuses on the research methodology, the data set used, description of variables and analysis techniques employed. Limitations of the study are included. Chapter four (4) provides a discussion of the research findings. Chapter five (5) concludes by providing a summary of the research and possible future recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This section provides a background understanding of the socio-economic studies used in the analysis of individual choice patterns and research studies that have been carried out regarding insecticide treated nets use. It focuses mainly on the ownership and utilization of bed nets in households, factors affecting the usability and other effects in protecting children against malaria.

To understand elements contributing to the use of bed nets for children under five, socio-demographic and socio-economic patterns have to be studied as they form part of the distal determinants influencing the proximate determinants (Siri, 2014). Previous research conducted in other contexts has shown that socio-demographic factors such as gender, occupation of parents, place of residence, and relationship with head of household were significantly associated with sleeping under the net for children under five years (Goesch et al., 2008; Ng'ang'a et al., 2009; Ruyange et al., 2016; Wiseman et al., 2007). Therefore, because this study focuses on younger children aged less than 5 years, all responsibilities of a child at this level belong to parents or guardians.

The individual child characteristics, the mother/ caretaker characteristics and the household characteristics are likely to determine the use of mosquito nets for children under five years old. These characteristics include; firstly, the children characteristics such age and sex of the child. Secondly, on the mother or caregivers' characteristics including the marital status and the educational level of the mother/caregiver. Lastly, other household characteristics such as household head sex or gender, the wealth of the household, the location of the household such as rural or urban setting, as well as the province in which the household is located.

2.2. Definition of socio-economics status (SES)

Defining socio-economic and socio-demographic factors may be a good starting point in understanding the impacts that these factors have in relation to protecting children against

malaria. However according to Bollen et al., (2007), there is no common definition of socioeconomic status. Thus, Bollen et al 2007 argue that; socioeconomic status depend on the layers or strata that are defined by the society founded on particular dimensions deemed significant in the society such as income, wealth, education, place of residence, occupation, household ownership of goods and items and household dwelling characteristics (Bollen et al., 2007). Furthermore, Wolfe (2014) posits that these educational, occupational, and wealth resources empower a person, household or society with an advantage over others with respect to getting something that is socially valued. The common understanding is that SES situates individuals, households and families in different status in a particular society (Wolfe, 2014).

2.3. Child characteristics

Child characteristics in this study focus on two major aspects namely age and sex of the child. Child under five years is the most vulnerable to child mortality due to malaria. Child mortality rate determines the level of development in the country. In most cases, under-five mortalities is higher in female than male children (Abdul-Aziz, A.R., Harris, E., Munyakazi, L. 2012). Thus, these two-sociodemographic determinants of child survival against malaria are studied.

2.3.1 Age of the child

Age differences have been shown to have an implication in distribution and use of ITN. According to Noor et al., (2009) when conducting an analysis of national household survey data from between 2005 and 2009 for 18 malaria endemic countries in Africa, found that a number of children under the age 5 sleep under bed nets in comparison to other age groups (Noor et al., 2009b). The researcher outlined two different reasons; the first reason being that RBM campaign focuses on children under five as the most vulnerable group of people during the distribution of bed net campaign. The second relates to the distribution of ITN to pregnant women during antenatal care or through mass-catch-up immunization campaigns (Noor et al., 2009b).

In addition, it has been argued that children were also more likely to sleep under the net because of sharing beds with their mothers or both parents (Gobena et al., 2012, Noor et al., 2009b, Tchinda et al., 2012). Paradoxically, other researchers have found that despite the free distribution of ITN, children under five years are still more vulnerable to sleeping unprotected by an ITN. The vulnerability of children has been caused partly by the inconsistent sleeping under the bed net (Toe et al., 2009). Depending on the mood of the mother or the weather conditions, some mothers/ parent choose not to sleep under the net and this, in turn, affects the child not sleeping inside the net. Therefore, the discrepancy or gap in using and not using bed net for children is not much helpful in terms of protection against malaria (Toe et al., 2009).

Age differences among those young children between zeros to five years' influences the level of vulnerability to the disease, as the immunity of a one-week child and that of a four-year-old child will not be the same in terms of resisting malaria infection, and consequently, the decision on which children to put under the ITN. Thus, research from Nigeria and Ghana found that the use of the ITN is typically given to the youngest in the case when there is more than one child under the age of five and insufficient ITN to cover all children (Oresanya, 2008; Zurudam 2012).

Sufficient access to Long-lasting treated mosquito nets (LLNs) was defined as having one bed net per two people within a household, Wanzira et al. (2013) have noted an improvement from 8.5 % of households in central Uganda meeting this definition in 2009 to 25.9% in 2011. (Wanzira et al., 2013). This is supported by the results of a study conducted in the central region of Uganda study which found there was an increase in targeted community ownership of bed nets with 22% of households owning at least one ITN in 2008 compared to 69% in 2013 (Bennett et al., 2012, Sexton, 2011, Thwing et al., 2008). However, the greatest of this distribution tend to cover the equity gap that existed between bed net ownership and use in the previous campaigns.

2.3.2. Sex of the child

The pattern of ITNs use viewed by sex shows that in the age group <5 years, a higher proportion of male children sleep under ITNs compared to female in Kenya, Tanzania, Zambia, Mali, Benin, Senegal, Angola, Djibouti and Sudan. However, for Rwanda, Uganda, Namibia, Niger, Zimbabwe, Ethiopia, DRC, Guinea and Swaziland, being a male or female child does not influence ITNs use (Noor et al., 2009a). A different study on the intra-household net use study conducted in six African countries namely; Ethiopia, Ghana, Mali, Nigeria, Senegal and Zambia reveals equal protection of children under five years despite gender of a child. One of the important findings was that within a household where there are more children under five and less ITNs, the priority is given to the youngest child in this case, children under two years have highest rates of net use regardless of the gender (Baume and Marin, 2007).

2.4. Mother Characteristics

More often, young children spend more time with mothers than fathers do. Therefore, mothers' characteristics are more influential for the child survival. The following literature study mothers' marital status as well as the mother's education in determining the use of bed net for children under five years.

2.4.1. The marital status of mother

The status of a child's parents in the household may play a huge role in child survival or health. Due to different support that may come to their side in different ways such as financially and other means that give advantages to a couple which has gone through a civil or even traditional marriage engagement. Therefore, a child born to unmarried parents and not living with both parents may seem to be more disadvantaged than their counterparts born living with both married parents. This part will evaluate how the marital status of child's parents' impacts on their health in term of using or not using the insecticide treated net in protection against mosquito bite which spread malaria.

As a socio-demographic determinant, studying the marital status of the mother of a child in the DRC is important. It is important to understand the relationship between the status of the mother to the father, because at this young age, the child is fully dependent on the parents and mostly the mother who spend more time with. The mother's relationship with the child is important in influencing the state of a child's health.

The Ghana Demographic and Health Survey 2008 determined the marital status of a mother and the impact it has on the malaria infection of under five children. The research by Nyarko et al. 2014 found that mothers' marital status has some impacts on malaria. A high proportion of children infected with malaria is from families where mothers are divorced. Unexpectedly, the proportion of children from mothers who are married is in between those divorced and never married. These proportions may reflect the rate of bed net usage within the different marital status of mothers (Nyarko and Cobblah, 2014).

However, the study conducted by Mugisha et al., (2003), using the Uganda Demographic and Health Survey to investigate the sleeping arrangements and use of bed net. The result shows that children of those mothers who are married and those who live together with their partners are four times more likely to use mosquito nets than children whose mothers never got married (Mugisha and Arinaitwe, 2003; Noor et al., 2009b). Considering these results, one may tend to associate the marital status of the mother with the use of bed nets or lack of bed net use by children under the age of five. Furthermore, the presence of both parents in the house may explain these findings because of idea exchange and sharing of knowledge on malaria protection and mostly the importance of protecting the young children.

Although mothers of under five children have knowledge the symptoms of malaria, research shows that many of mothers are ignorant of the vulnerability of children under the age of five. The non-availability of shops around the area where bed net can be purchased plus the distance between the time the insecticide expired on the net and the time to retreating the net has been long enough to let mosquitos feed on children in the household (Osero et al., 2005).

When linking the practice of purchasing bed net from the market, marital status is associated with the ownership and utilization. In a research done when studying the socio-demographic factors that influence the utilization and ownership of ITNs among malaria vulnerable groups in Buea health district in Cameroon, married female respondents were 3.66 times more likely to buy a mosquito bed nets from the market than single women. This is viewed in the context that married women received financial support from husbands contrary to single women who personally struggle to support all family on their own and the expenses of the entire family are on their shoulder. This situation forces the women to compromise on mosquito net to get primary necessities such as food for the household (Kimbi et al., 2014).

In general, an effective malaria control and prevention strategies including bed net use have been much linked to the financial or socio-economic status of individual concerned because they are directly associated with accessibility and affordability of the preventive measures (Tonga et al., 2013).

2.4.2 Education level of mother/ guardian in the protection of the child.

It has been shown that the level of education has been positively correlated with the health status as well as life expectancy (Sanchez-vaznaugh et al., 2009). Education helps a person to improve the world around him/her thorough reading, listening and self-documenting. Therefore, the more an individual is educated, the more he/she is exposed to the world and challenges of health as well as understanding the importance of preventing the burden of malaria disease through a bed net. Furthermore, education is much related to the determinants of health including health behaviours, preventive service use and risky contexts (Feinstein et al., 2006). Parent education especially the mother of the under-five child in the African context, may be crucial to determining the level of the child's protection (Noor et al., 2009). The research finding by Gobena in the Kersa district in the eastern Ethiopia prove that women's education (low level of education or non-education) was positively associated with the reasons for not using the ITN in the household even though the net may be available in the house. Instead of covering children with the net,

mothers prefer using the net to cover other objects in the house and in some cases, the bed nets are used as curtains (Gobena et al., 2014).

Progressive education about malaria transmission and benefits of the regular and proper use of bed nets should eliminate misconceptions about bed net usage. According to Legesse, (2007) in general, an educated community have better access to multiple bed nets information source such as television, radio, magazines etc. Therefore, parents or guardians with a higher level of education are advantaged and use bed nets more than their counterparts use with little or no education. Furthermore, it may be argued with the support of a previous research done in Kinshasa which reported that women who have secondary school or higher educational qualifications were 3.4 times more likely to own and 2.8 times more likely to use a bed net compared with women with less education (Pettifor et al., 2008).

All findings above have been confirmed by the findings of Ndjinga et al. (2010), where education level of the household head shows an association with bed net use among household family in the surveyed village outside Kinshasa in DRC (Ndjinga et al., 2010). However, a more recent study by Adebayo et al. (2014) found that when assessing the ownership and utilisation of ITN among care givers of children under five, in rural community in Southern Nigeria, the research found that the level of education of the child's caregivers does not necessarily translate to utilisation of ITN since caregivers with low or no education are more likely to use the bed net according to this research finding (Adebayo et al., 2014). Furthermore, this work is reinforced by the study Kimbi et al. (2014) who associated education with a good knowledge on malaria preventive measures (Kimbi et al., 2014).

Furthermore, the finding by Deaton (2002), emphasize that level of education improves the utilization of bed nets because educated people, according to the author; obtain more scientific knowledge and information related malaria in school such as the mode of transmission, prevention methods as well as the consequence of not been protected against the disease. So in this regards, educated people are more exposed to knowledge of the disease than uneducated who are less aware of health problems that may occur and may

not benefit from health services (Deaton, 2002). Adding to this, in the African context, education is more associated with economic resources in the sense that without resources, it is almost impossible for an individual to go further in education due to costs of school and tuition fees. However once acquired, education boosts the individual psychology, social life as well as economic resources (Winkelby, 1992).

2.5. Household Characteristics

On the household level, different aspects influence the child survival in areas of endemic malaria zone. Therefore, aspects such as income, location of the household as well as the sex of household head are researched below to get knowledge on the existing literature about characteristics influencing child survival against malaria through bed net use.

2.5.1. Location (Urban vs rural area)

Rural dwellers may have less access to health facilities for important malaria prevention tools such as ITNs in comparison to urban areas that have a greater density of health facilities for resource distribution. Data from DHS 2007 DRC shows that the coverage and proper utilization of the malaria prevention measures in the country may be limited by the lack of sustainable distribution and issues related to replacement of nets, seasonality of malaria, and poor knowledge of the community about the link between mosquitoes and malaria (Stanton et al., 2013). In the tropical regions like the DRC and other similar countries, the area where the household is located may influence breeding of mosquitoes and expose household members to the bites. In Cameroon, a research was done by Oyekale prove that 40.54 % versus 23.12% of children were tested positive for malaria when comparing rural to urban area respectively (Oyekale et al., 2015). Various reasons have been discovered as being the causes of these divergences, such as poorly maintained drainage, a bushy environment, the presence of stagnant water and an unclean environment search as biotic (vegetation and fauna) as well as an abiotic (chemical and physical) factors were reported (Tadesse et al., 2011). These are breeding grounds for mosquitoes and mostly associated with the rural setting (Oyekale, 2015). However, within urban settings, those urban children living in the poor areas are more likely to be infected with malaria as

a result of the inequality in planned urbanization resulting in poor housing, inadequate sanitation as well as poorly managed drainage systems in poor sections of towns and cities (Opiyo et al., 2007).

According to Graves et al. (2007) when conducting the research on the use of net by individuals in households owning nets in Ethiopia, using the Malaria Indicator Survey (MIS) 2007; there is a higher bed net usage in the urban compare to a rural area. The authors, noted that these results were surprising as lower usage was expected in urban areas since the urban dwellers might associate bed net use with villagers and rural life (Graves et al., 2011). It may be said that these results may reflect the higher level of education within urban compared to a rural area, it may also be due to a huge and more diverse social networks or a more progressive attitude among urban dwellers leading to earlier adoptions of unfamiliar strategies (Baume et al., 2009). Lengeler (2004) also noted that the better financial situation of urban residents and a higher level of education for urban dwellers in Cameroon was associated with a greater likelihood of urban residents purchasing a bed net from the market than those in rural communities (Lengeler, 2004).

Furthermore, in studying mothers' socio-economic status that influences malaria morbidity among children under the age of five in Cameroon the relationship between the severity of anaemia and the incidence of malaria among children, shows a 63.4 and 64.95 percent in rural and urban areas respectively of rural children whose households had mosquito nets. However, the proportion of household children who slept under the bed nets was 29.05% in urban while only 19.04% was recorded for the rural area (Oyekale, 2015).

The lack of proper infrastructure or poor state of infrastructure in rural areas compared to urban areas across the African continent means that benefits and privileges gained by urban dwellers are not always equally shared by rural dwellers. These findings are paradoxically opposed to the findings from Nigeria where rural children dwellers have a very high utilization rate of ITN than that of their counterpart from the urban dwellers (Oresanya et al., 2008). The researchers noted that this was also influenced by the regional location in Nigeria as those people living in the Southern part of the country had a reported higher

utilization rate of the bed net in comparison to those on the northern side of the country. (Oresanya et al., 2008).

The relationship between the severity of anaemia and the incidence of malaria among children, 63.4 and 64.95 in rural and urban areas respectively but the proportion of household children who slept under the bed nets was 29.05% in urban while only 19.04% was recorded for the in a rural area (Oyekale, 2015).

2.5.2. Income level of household

Malaria has been frequently referred to as a disease of the poor or disease of poverty (Ezzati et al., 2002). However, studies examining malaria incidence by socio-economic status on the small scale compared to the data on macro level have not been able to provide enough evidence to support this assertion, because those studies examining macroeconomic data have shown that the burden of malaria is greatest among the world poorest countries (Worrall et al., 2003). Moreover, this study is backed by the findings of Kimby et al. (2014) who found that economic status is associated with good knowledge of malaria prevention measures (Kimbi et al., 2014).

Although there are different dimensions of the potential vulnerability of malaria that include social, demographic and geographic elements, this part focuses on the socioeconomic status of the household and the financial aspect involved in the process of securing a bed net for use within a household.

Poor people are thought to be at higher risk of becoming infected with malaria, and to become more frequently infected by malaria. It has been recorded that a child from a poor household is likely to die from malaria compared to that of a rich. Still for the high coverage and to achieve the Abuja Summit target, mass distribution of insecticide treated nets has been recommended (Teklehaimanot et al., 2007), and in order for all of a region or area to be equally covered, free distribution has been encouraged (Thwing et al., 2008), though argument favoring a 'for-profit' approach also exists (Webster et al., 2005). When insecticidal bed nets are distributed free of cost instead of cost recovery or (heavily)

subsidized cost approach, evidence from 40 malaria-endemic African countries shows that the coverage became more equitable as well as rapidly scalable (Noor et al., 2007).

In Zambia, a national survey found a high prevalence of malaria infection among the poorest population groups, the prevalence is higher in under-fives children from poorer families in 10 districts (Chizema-Kawesha et al., 2010). This may be because poor families live in dwellings that have poor protection against mosquitoes and this category of the population can hardly afford to purchase an ITN or even to afford to pay for a proper and effective malaria treatment once infected (Samba, 1997). The direct and indirect costs associated with the accessing prevention against malaria burden, represent an obstacle for poor households. A research in Ghana found that although the cost of malaria care was just 1% of the income of the rich, it was 34% of the income of poor households (Akazili, 2002).

In terms of societal classification, when characterizing poor and rich people, household socioeconomic status represents a very important area of consideration. The income level is important not only for the households but also for its distribution among household members (Chaudhry et al., 2009). Income became very complex to define due to its different components including monetary, farms, and other assets (Chaudhry et al., 2009). Examining the predictors of treated net ownership and utilization among children aged under five years in Nigeria, Oresanya et al., 2008 highlight that many socio-economic variables including education, wealth, income and region of residence proven significant in predicting bed net utilization. In contrary to the finding of the research by Goesch et al., 2008, which prove the strong inverse relationship between socio-economic factors such as highest income among others on one side and the bed net use on the other. The author justifies this inverse relationship in the hypothesis that bed net may be used to avoid the excessive noise created by the mosquito and not necessarily for preventing the bites from the insect. Thus, the author mentions that this hypothesis may be explained in that the richer households may be less prone to the insect and nuisance relative to poor households who often do not have nets in their windows as the first step of prevention. Other studies have shown that lower income household may have lower or insignificant willingness to pay for

bed nets (Nketiah-Amponsah, 2010). These and others such as lack of cash money at hand and not having access to credit may have caused the non-accessibility to an ITN for malaria prevention.

Despite the 39 African country signatories to eliminate taxes and tariffs on ITNs, as of the year 2007, more than half (62 percent) of the Abuja signatories continue to impose taxes and tariffs on this life-saving instrument. This increases the price of ITN, reduces affordability and discourages the import of ITNs (Alilio et al., 2007). As of 2007, The DRC government did not yet show a significant step forward in reducing tax and tariff on ITNs as did its counterpart of Ghana, Uganda and others although the country through the ministry of health has been actively involved in the global effort against malaria under the RBM initiative. According to Simons et al. 2002, the reducing or waiving the taxes and tariffs on ITNs, could increase the affordability across less income groups and significantly increase influence the ITNs use (Simons et al., 2000).

A study conducted in Mozambique by Chase et al. (2009) found that after controlling for other covariance that there is no discernible empirical evidence that poor households are less likely to own bed nets. Conversely, the results indicate that education and market knowledge are associated with high willingness to pay for bed net, however, the use of alternative means of protection such as Indoor Residual Spraying (IRS) are found to decrease demand for bed net use.

Within certain settings, factors such as income as a socio-economic environment have been shown by many researchers as one of the main determinants of health in communities where by higher income and social status is generally associated with better quality of life, therefore better health. Thus, it's viewed as the bigger the difference between poor and rich people, the greater is the difference in their health condition (AFRICA)

The World Health Organization (WHO) elaborated a new guidance for the use of insecticide treated mosquito nets to protect people from malaria. Lack of income and the cost of ITN have been among the factors within the household that hinder the use of ITNs (Bashinyora, 2010).

A study conducted using the household having at least one child of less than five years in the zone of Mumbunda in Lubumbashi (DRC) found that among all respondents having nets, 13.1 percent declares using the net on children under the age of five and the 80.2 percent declares using it for everybody else in the household. The main reason for those without a net has been linked to not having money. Therefore, it is evident that income constraint (Poverty) is one of the major barriers for not using the net in the health zone of Mumbunda in DRC (Mulenga et al., 2016). This finding reflects that of Rwanda demographic surveys where the use of ITNs are higher in the middle and higher income index community (Ruyange, 2016). It has to be membered that; in Gambia where the communal net treatment was distributed free of charge, by regional health team led to improved child survival. However, people were unwilling to pay for services that had once been free and mortality rate returned to their previous values after the introduction of a cost recovery program.

2.5.3. Sex of the household head

In general, a household is defined as a unit headed by a male or female with her or his dependants and spouse, and who are sharing cooking pots and or eating at commonplace as well as sleeping under the same roof. According to (Adjah and Panayiotou, 2014) from the household survey conducted in Ghana, within a household headed by a male, there is more likely that a child sleeps under the bed net the previous night before the interview. Health outcomes, also depend upon social and economic factors that in turn are influenced by cultural and political conditions in society to understand health and illness, both sexes must be taken into account. Social factors, such as the degree to which women are excluded from schooling or from participation in public life, affect their knowledge about health problems and how to prevent and to treat them (Vlassoff, 2007).

2.6. Summary

This chapter points out the literatures that have been used in determining the use of bed nets in protecting children under five against mosquito bite. Socio-demographic and socio-economic positions show greater implications. Among them, it highlights three principal

areas, mainly the child characteristics, the mothers' characteristics as well as the household characteristics that influence child's protection. Researches prove that age differences give under five years old an advantage over other age groups (five and above) in terms of sleeping under the bed net. Mostly, in recent years, an increase in bed nets for this age group have been recorded and this is due to the high vulnerability of child for malaria. Gender or sex perspective of a child in most cases does not have an influence on the protection of the child in some countries. Therefore, this cannot be generalized any more.

On the other side, the level of mother's education may determine how much the child will be protected as it exposes a person to the knowledge and information on how to live well. Therefore, most literature agrees that education (high) gives a woman the advantage of using bed net for her child unlike the counterpart without or with a low level of education. In addition, mothers who live alone and the one who is married in terms of child protection may not have the same impact. The literature proves that for the mother who is married or living with the partner, their child has more chances of sleeping in the bed net vis-à-vis of the other categories.

The household characteristics also have a huge influence in the use or not using of the net since the household may be affected by the geographic location being in rural or in an urban area within different provinces, the implications of household head gender, the wealth index of the household. The inequality between rural and urban area tend to give an advantage to urban children in using bed net due to many socio-economics factors such as infrastructure (physical and chemical), education inequality as well as the environment search as vegetation and fauna.

CHAPTER 3: METHODOLOGY

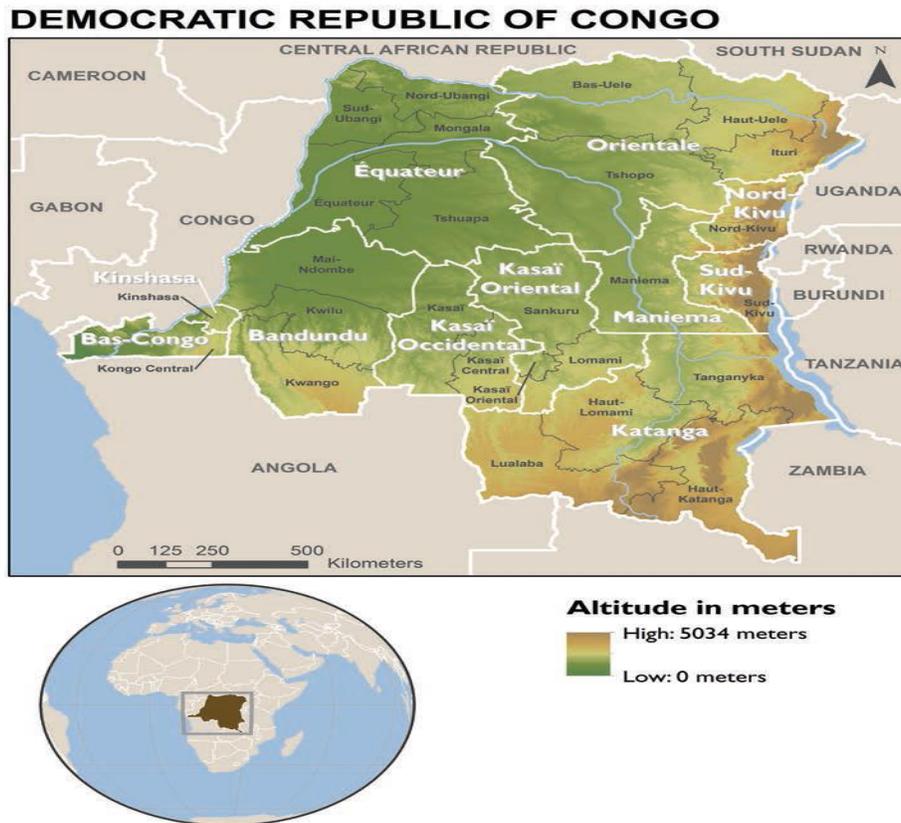
3.1. Introduction

This chapter outlines the method, sample size, and the procedures of sampling for the 2013-2014 DHS in the DRC used for this study. In addition, it details the variables used in the analysis and the statistical tests applied.

3.2. Location of the Study

Data for the study was collected in the Democratic Republic of Congo (DRC). The third largest country in Sub-Saharan Africa with a population of 65.8 million people. The country is rich in human and natural resources and with the second largest rain forest in the world (Human Development Index 2015). Precipitation is ample; raining for approximately six to eight months of the year. The failing economy that used to produce 56.3% of the GDP from agriculture produces currently generate only 15%. The country is rich in a variety of minerals such as copper, cobalt, diamond, gold, Zinc, Oil, Uranium, columbite/tantalite, and other rare metals. Despite the abundant resources that the country possessed, DRC remain one of the poorest countries in the world. Its official economy has collapsed in the last few decades due to hyperinflation, mismanagement, corruption, war, conflict, general instability, political crisis and economic dislocation (Beya, 2012).

Figure 2: Map of the Democratic Republic of Congo



(DRC DHS, 2013)

DRC lies on the Equator, with one-third of the country to the north and two-thirds to the south. South of the Equator, the rainy season lasts from October to May and north of the equator, the rains are experienced from April to November. Along the equator, rainfall is regular throughout the year. During the wet season, thunderstorms often are violent but seldom last more than a few hours. The DRC is located in central Africa bordered by nine countries namely; Angola, Burundi, Central African Republic, Republic of the Congo, Rwanda, South Soudan, Tanzania, Uganda and Zambia.

3.3. Data source and study participants

The data used for this study was obtained from the second Demographic and Health Survey (DHS) in DRC (EDS-RDC II). The DHS is designed to provide data for monitoring the

population and health situation in DRC, therefore it provides reliable data on many aspects including malaria and the use of bed nets including the treated and untreated net for the prevention of mosquito bite which transmits malaria in the human body. Fieldwork for EDS-RDC II took place from November 2013 to February 2014. During the survey, 18 716 household interviews took place including 18 827 women aged 15-49 in all selected household and Therefore, data for 9570 children 0-59 months was gathered. The majority of indicators are representative at the national level, for urban and rural areas and for each of the 11 provinces. Additionally, most of the indicators are also representative for the 26 new provinces. It is worth to mention that all the data used for this research has been published before through the DHS.

3.3.1. Materials and Methods

Ethics statement, all survey responds provided verbal informed consent for the collection of information in one of the five main languages (French, Kiluba, Lingala, Swahili and Tshiluba) spoken in the DRC as per DHS protocol. In cases of limited literacy levels in rural area provinces, consent was verbally acquired. Immediately at the conclusion of the interview, DHS does the de-identification of all data to ensure the confidentiality of the publicly accessible survey datasets. The Ethics Committees of Macro International and the School of Public Health of the University of Kinshasa approved Consent procedures, survey administration and blood sample (where necessary) for data collection.

3.3.2. Statistical Analysis

The data is analyzed using STATA IC version 2013. Descriptive summaries statistics tools such as (frequencies) and sample percentages will be used for analysis and presentation of results.

The inferential statistics namely the logistic regression analysis will be used to predict the effect of socio-economic variables including gender, location, education and occupation of the parents/caretakers, on the use of insecticide treated nets. Therefore, this regression will be used to determine the utilization of ITN as the main outcome variable.

In addition, the confidence intervals (CI) will be evaluated to examine the strength of the association, as well as p-value and R² as the coefficient of determination, will be applied to measure how close the data are fitting the regression line.

3.4. Anticipated Problems/Limitations

In order to study the determinants of the use of insecticide treated nets for the prevention of malaria for children under 5 years of age in the DRC, secondary data collected by DHS was used. Therefore, the researcher has not anticipated any major problem or limitation due to the high level of professionalism as well as organization (logistically, ethically and financially) of DHS. However, the author recognizes the fact that; the data used for this research come from the 2013-2014 data collection (the most recent in DRC) therefore some slight change may have happened in between the period of the data collection and the analysis of the findings of this research.

3.5. Validity, Reliability and Rigor

The DRC Demographic and health survey provide a very reliable dataset with the survey that is statistically representative therefore the quantitative results of this study on the socio-demographic and socioeconomic factors that impacts the use of insecticide treated net for children under five years may be generalized to the entire population of the country. Again, this is also supported by the data collected by DHS as well as the statistical software (STATA IC version 2013) that will be used for the analysis of this research.

3.6. Target population

The study focus on young children aged 0 to 4 years of age. The DRC Demographic and Health Survey (DR DHS) 2013-2014 collected this data for the current study.

3.7. Study hypothesis testing

The aim of this study is to find out if there is a relationship between socio-demographic, socio-economic status and the use of insecticide treated nets in protecting young children below the age of five years against malaria.

- The null hypothesis (H0) state that there is no significant relationship between the socioeconomic factors (age and sex of child, marital status, mother education, sex of household head, household wealth, province and lastly location emphasizing here rural versus urban area) and the utilization of bed nets among children under the age of five in the Democratic Republic of Congo.
- The alternative (H1) states that there is a significant relationship between socio-economic factors (age, gender...) and the utilization of bed net among children under the age of five in the Democratic Republic of Congo.

The key answers to the main questions of this study are answered using the analysis of the independent variables vis-à-vis of the dependent variable. These variables will be rearranged or cleaned as followed;

3.8. Variable analysis

3.8.1 Outcome variable

This thesis uses the outcome variable originally coded as ML0: type of mosquito bed net(s) child slept under last night. For this variable, tree different options were selected namely; the category of children who did not sleep in the bed net the night of the interview, the other category of children who slept only in the treated nets and lastly the category of those who slept only in an untreated net. Therefore, when tabulating this variable, it was found that only 1.17% of the children slept under an untreated net.

Table 2: Descriptive statistic of the outcome variable

Descriptive statistic of the outcome variable			
Type of mosquito bed nets (Child slept under last night)	Frequency	Percent	Cumulative percentage
No net	7 206	38.5	38.5
Only treated net	9150	48.89	87.39
Only untreated nets	219	1.17	88.56
	2141	11.44	100
Total	18716	100	

Due to the lower number of children who slept in the only untreated net category or case making this category not enough to conduct a valid analysis, therefore, a dummy variable is created as follow;

0 = no net

1 = bed net usage

Therefore, a new descriptive statistic of outcome variable will appear as follow;

Table 3: Descriptive statistic of the outcome variable

Descriptive statistic of the outcome variable			
Type of mosquito bed nets (Child slept under last night)	Frequency	Percent	Cumulative percentage
(0) No net	7 206	38.5	38.5
(1) Any kind of net	9369	50.06	61.5
	2141	11.44	100
Total	18716	100	

3.8.2. Associated variable

3.8.2.1. Gender or sex of the child

This study uses gender and sex interchangeably, therefore this variable is measured into two categories which are male and female the variable is recorded as “*sexofchild*” meanwhile in the original DHS dataset it is recorded as “*b4*” and labeled as follow;

1= male

2= female

3.8.2.2. Age of the child

The variable age of a child is divided into categories. The original code for this variable was *B8* but for the purpose this research, it was recorded as *Chldage* it is categorized into child age ranging from 0, 1, 2, 3, and 4 years old. For the purpose of clarity, note the following explanation about the age categorizations.

Age 0 (0 – 11 months) represent children who were born from the day before the interview until the day before their first annual birth day.

Age 1 (12 – 23 months) represent children who were born from the day before their first annual birth day until the day before their second annual birthday.

Age 2 (24 – 35 months) represent children who were born from the day before their second annual birth day until the day before their third annual birthday.

Age 3 (36 – 47 months) represent children who were born from the day before their third annual birth day until the day before their fourth annual birthday.

Age 4 (48 – 58 months) represent children who were born from the day before the fourth birth day until the day before their fifth annual birthday.

3.8.2.3. *Higher education of the mother*

“Education is the most powerful weapon that we can use to change the world” Nelson Mandela.

The variable *v106* highest education level attended (in the original data set) is used as a standardized variable providing level of education. The level of education is divided into the following categories; No education, primary, secondary and higher (representing any level of education above secondary school). This variable is also measured into categories and labeled as follow:

0 = No education

1 = Primary

2 = Secondary

3 = Higher

3.8.2.4. *marital status of the mother*

The variable marital status of the mother is represented as *v501* in the original data and it is divided into six different categories namely;

1 = Never in Union

2 = Married

3 = Living together with partner

4 = Widowed

5 = Divorced

6 = Separated

However, for the purpose of this study, the variable is recorded as a *maristat* and the categories are brought down to two mainly due to the research question as well as the very low percentages of women who are divorced (1%), widowed (2%), never in union (4%) and those separated (6%). The new two categories are coded as follow;

1 = Married (including those living with partner) and

2 = Others (including; never in a union, widowed, divorced and those separated).

3.8.2.5. *Sex of household head*

The variable *v151* represent the “*sex of the household head*” in the original dataset, for this study purpose, the variable is recorded as *hhsex* and the labeling is as follow;

1 = male

2 = Female

3.8.2.6. *Location (Urban vs rural)*

The variable *v102* de facto type of place of residence is the type of place of residence where the respondent interviewed as either urban or rural. Note that, this is not the respondent’s own categorization but was created based on whether the cluster or sample point number defined as urban or rural. Location in this study refers to the areas where the child under five years lives. It may be among two sides either in urban or rural areas; there is no universally accepted definition of what is known as urban and what is considered as a city. However, according to the United Nations International Children’s Emergency Fund (WHO, 2010), “Urban Zone” differs from one country to another and is constantly revised.

Urban area is characterized by one or more of the following components; administrative criterion, political frontiers, population density, economic function and the presence of specific urban features (roads, pavement, electric lighting, and sewage systems) while rural zones include the entire population, territory and other resources of the countryside, in other words, the areas located outside of the large, urbanized centers. Children who live in

rural zones often find themselves in a precarious situation. Due to the extreme poverty, they can hardly satisfy fundamental needs such as access to healthcare, education and they are often exposed to danger (Ba, no date).

Most research findings have shown a greater association between place of residence and the socioeconomic issues such as resources, live conditions. This comes to the situation where most urban areas are associated with proper infrastructure, better facility to health care services and good quality education, in general, compares to the rural counterparts (Kuate-Defo, 2006).

3.8.2.7. Wealth of the household

The EDS-DRC II constructed the wealth of the household using the household assets such as television, radio, car as well as other household characteristics such as availability of electricity, type of drinking water, water supply, type of toilet, type of fuel used to cook etc. the following five steps were considered in the process;

a) Each of the asset or characteristics a weight (score or coefficient) generated from a principal component analysis. b) The score of the resulting goods is standardized according to a standard normal distribution 1, of average 0 and standard deviation 1. C) Each household is assigned a score for each property and the sum of all scores per household. d) Households are ranked in ascending order of total score and divided into five categories of equal quintiles. Thus the scale ranging from 1 (the lowest quintile) to 5 the (highest quintile). e) The score of each household is allocated to the individuals composing it. The individuals are thus divided into five different categories; the poorest, poorer, middle, the richer and the richest. Thus, for better understanding and interpretation, the author create a new variable wealth with only 3 categories 1 category of poor which combine both the poorest and the poorer, another category of the middle and the last category of rich which combine the richer and the richest.

Poor = 1

Middle = 2

Rich = 3

3.8.2.8. Province

The variable *v101* is the “*province*” in the dataset as well as in this study. It represents all the 11 provinces that form the country. The following numbers represent the provinces:

1 = Kinshasa

2 = Bandundu

3 = Bas-Congo

4 = Equateur

5 = Kasai Occidental

6 = Kasai Oriental

7 = Katanga

8 = Maniema

9 = Nord-Kivu

10 = Oriental

11 = Sud-Kivu

Just for reminding purpose noted that; in 2015 the 11 provinces were divided into 26 new provinces as per DRC constitution. Therefore, currently, the country has 26 provinces.

3.9. Summary

The purpose of this chapter is to describe the methodology used in analyzing different variables with the objective of giving answers to the research questions. The chapter went further to clarify details of the variables and the procedures used in analyzing the secondary

data. All the variables are from the Demographic and Health Survey (DHS) in DRC (EDS-RDC II). They are analyzed in the finding the determining of the use bed net in protecting children under five years in DRC. Therefore, in the following chapter, these variables are divided into three categories namely the category in the relation to child characteristics such as sex and age of the child. For the mother characteristics, the variables such as education and marital status of the mother. Lastly, in household characteristics, variables such as household head sex, location, wealth index and the province are analyzed.

CHAPTER 4: RESULTS

4.1. Introduction

The chapter presents the findings of the study investigating the factors associated with insecticide treated net usage for children aged less than five years in the Democratic Republic of Congo. Numerous studies have been conducted to document the use of bed net in Sub-Saharan Africa, however, not many focused on the socio-economic and socio-demographic application of bed net in protecting children's health against malaria. Therefore, this study aims to examine the association of socio-economic characteristics of the mother and the household and their impact on the use of bed nets.

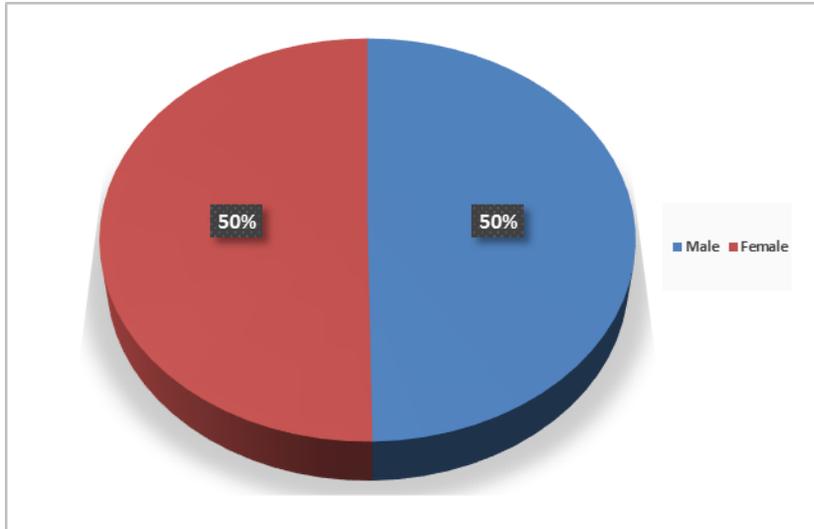
This chapter starts with a brief overview of the demographic distribution of the sample thereafter, a cross-tabulation showing the relationship between the dependent and the independent variables are examined. The rest of the chapter provides a detailed presentation of the results obtained by the bivariate and the multivariate analysis of the bed net use for children under five years in order to answer the study questions.

4.2. Demographic Distribution of the 9570 under five children in the sample.

The selected variables included the age of a child, gender of the child, place of residence or location, the provinces (11 provinces), the highest educational level of the mother, wealth index of household, the marital status of the mother, as well as the gender of the household head.

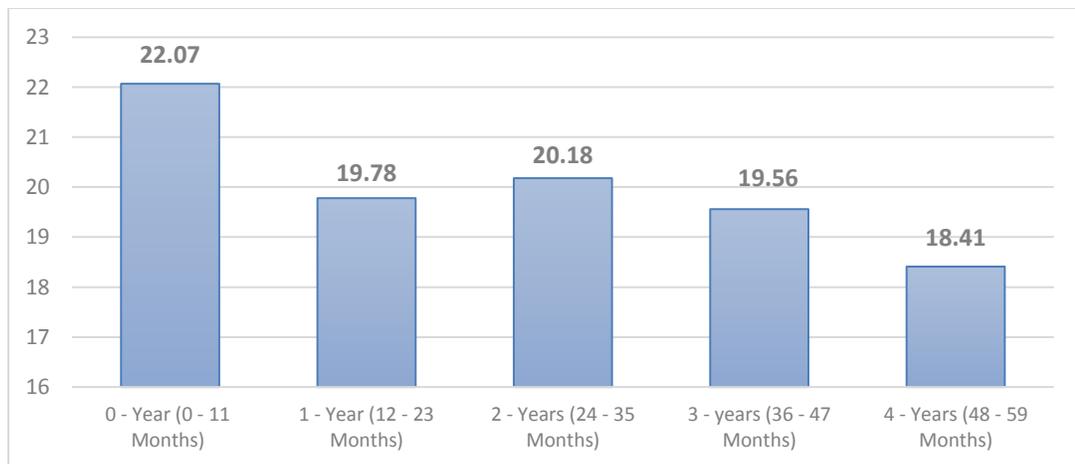
Figure 3: Sex distribution among children

The sex representation of children in the sample is almost equal with 49.7% male children and 50.3% female children respectively as shown in figure 3 below.



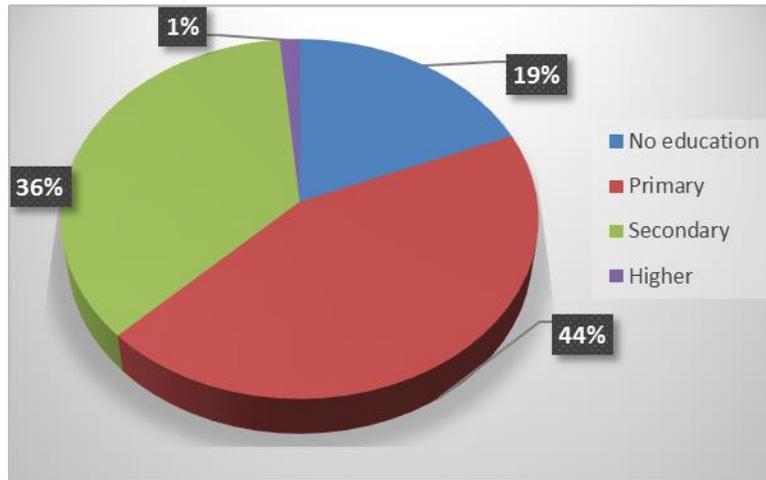
Regarding the age distribution of the sample, as presented in the figure4 below, approximately 22.1% of the children are less than one year, 19.8% are one-year-old, and 20.2% are two years old. Almost a fifth (19.6%) are three years old 18.4% are four years.

Figure 4: Children age distribution in percentage



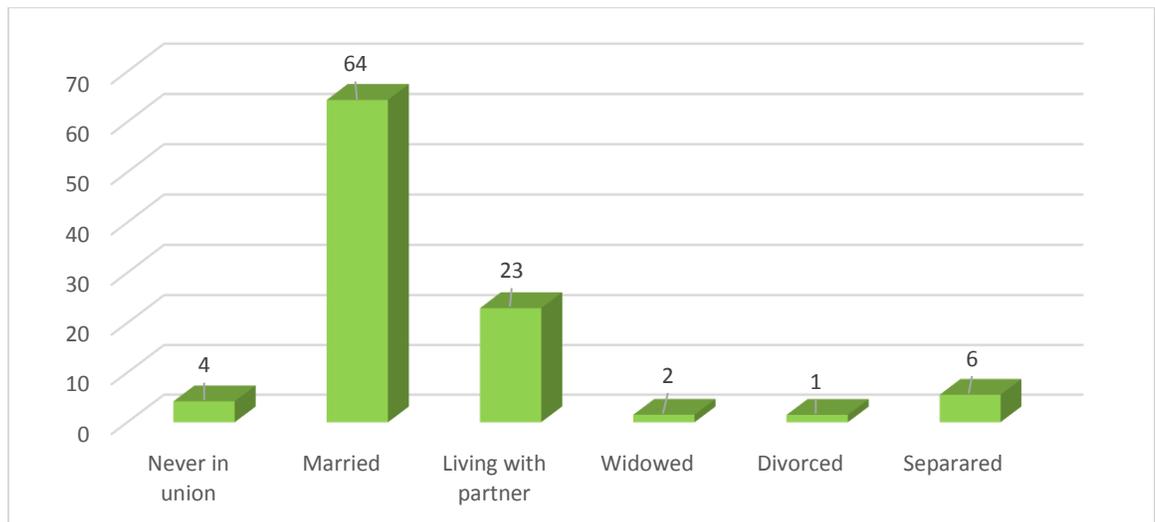
The variable education in the figure below shows that the majority (44%) of mothers have primary education level followed by those with secondary school level (36%), then with 19% of non-educated mothers and only 1% have higher education level. This is seen as a large difference between mothers who have a secondary school level and those who have a higher education (36% versus only 1%).

Figure 5: Highest education of the mother



Focusing on the marital status of the mother, the majority (64%) of mothers are married which is the largest number in this sub-category followed by those who live with their partners with a total of 23% while those who have never been in union and those separated are respectively 4% and 6%. Widowed and the divorced are the lowest with a percent of almost 2% and 1% respectively.

Figure 6: Marital status of mothers



Furthermore, household head composition reveals a huge difference between the numbers of male versus female household head 80% and 20% respectively.

Figure 7: Sex of household head

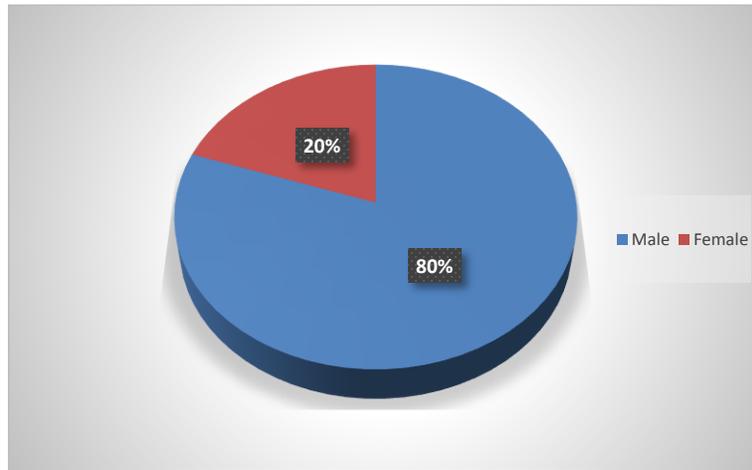
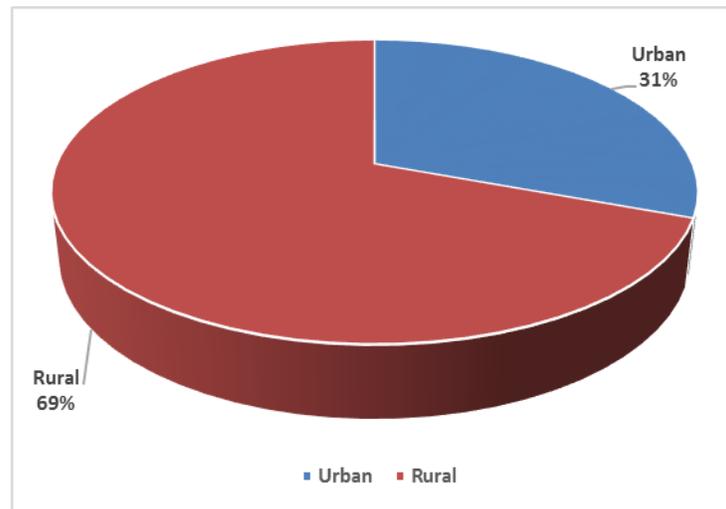


Figure 8 below shows the geographic composition of children who are less than 5 years according to the sample collected.

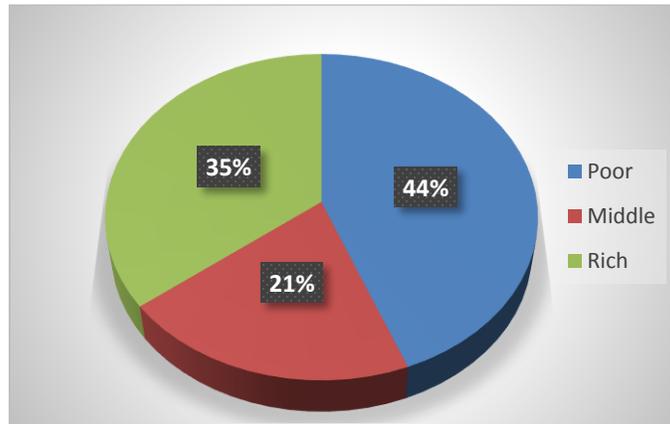
Figure 8: Geographic location of children in the sample.



The majority of children under five included in the DHS were living in households in the rural areas (69%) compared to 31% in the urban areas (31%).

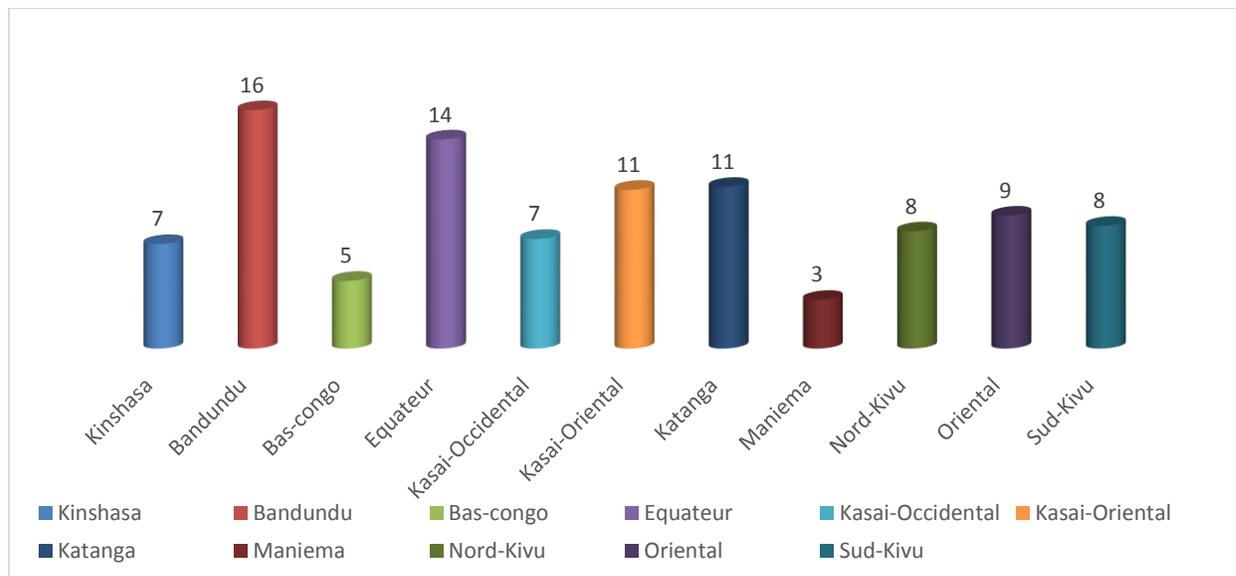
The statistics show a 44% of poor household followed by a 35% of wealthier households with 21% in the middle household wealth band. As shown in figure 9 below.

Figure 9: Wealth distribution of household



On the provincial level, all 11 provinces are representative, with the province of Bandundu having the highest percentage (16%) followed by Equateur with 14 %, then the Kasai-Oriental and the Katanga which both have an equal percentage of 11%. The Oriental province has 9 percent and approximately 8 % in the Sud-Kivu as well as the province of North-Kivu with 8%. The province of Kasai-Occidental has 7% approximately while Kinshasa the capital city of DRC has 7% and the two last provinces are Bas-Congo and Maniema with the lowest percentage estimated to 5% and 3% respectively.

Figure 10: Child distribution by province



4.3. Univariate analysis of bed net use by children less than 5 years.

Table 4 below present the relationship between socio-economic factors and the utilization of bed net among children under the age of five in DRC. Figures in the table show that, among the 4740 male children, 58.2% slept under a bed net while among the 4830 female children, 58.6 % slept under a bed net. With the p-value = 0.7283, this indicates that at 5% confidence interval, there is no significant relationship between sex of the child and the use of bed net.

The age of the child with a p-value = 0.000, shows that there is a strong significant relationship between age of a child and the use of bed net. Among children age groups of 2364 children of 0 – 11 months, 63.2% of children in this category slept under a bed net. Similarly, for the 2098 children age 12 – 23 months 63.1% children in this age category slept under a bed net. For children age 24 - 35 months, approximately 57.3% sleep under a bed net. The table shows also children age 36 – 47 months that use bed net to be 55.3% in this age category and lastly, children age 48 – 58 months, 51.7% sleep under the bed net. Therefore, we can see that, although there is no huge difference between children age 0 – 11 months and those age 12 -23 months generally, the younger a child is, the more he/she is privileged to sleep in the net.

The marital status of the mothers shows that after combining married women and those living together with their partners like husband and wife, the table shows that of the 8639 women in this category, 59.9 % cover their children with the bed net. Of the 931 women who have never been in a union or who are separated, divorced, or widowed, 47.6% of them use bed net for their children. The p-value of 0.000 shows that there is a strong significant relationship between the marital status of women and the use of bed net to protect their children. Married/living together women are more likely to cover their children in the bed net than others.

Education shows the p-value = 0.000 meaning that there is a strong statistically significant relationship between education of the mother and the use of bed net in protecting the child against malaria. The table shows furthermore that; 50.2% of the 1557 mothers without any level of education use the bed net to cover their children and 57.6 % of 4113 mothers with primary school level use bed net to cover their children against malaria. Of the 3707 women with secondary education, 63.1% used a bed net to cover their children. Lastly, among the mothers with higher

education, 75.7% of them cover their children under the age five with bed net against malaria. The higher the level of education the more bed net are used by mothers to their children.

Furthermore, the table shows that men compared to the number headed by women, 7846 and 1724 respectively head most households. In addition, it is clear that among the household headed by a male, 59.3 % of them use bed net to protect their children against malaria while among the household headed by females, and only 54.6% cover their children with the bed net. This may be due to the high level of illiteracy among females in DRC compared to males (EDS-DRC, 2014).

Household wealth variable shows a higher number of poor households (4014) than all others middle and rich class households followed by rich household (3480) then middle class household (2076). Interestingly, it is clear that middle-class households mostly use the net. As the figures in the table indicate, a 62.1% of middle class household use bed net followed by a rich household with a 59.9% of the use of net then lastly among poor people it is only 55.5% of household in this category that covers children with bed net. The p-value = 0.0338 emphasize that there is a significant relationship between bed net use and the household wealth at 5% significance level.

Location compares urban households to the rural areas, the table shows that most households are located in rural areas compared to urban areas, 6654 and 2916 respectively. However, when comparing the bed net use within each location, we notice that there is a significant difference in bed net use by household location since there is 58.6% of rural household use a bed net and 58.1% of those households from an urban location. The p-value of 0.8351 indicates that at 5% significance level, there is no statistically significant association between household location and the use of bed net.

Lastly, there was a strong statistically significant relationship between provinces and the use of bed net in DRC ($p = 0.000$). The province of Kasai-Occidental with 36.6% of net usage was the lowest countrywide. Kasai-Oriental has 51.2% of net use. The province of Bandundu with 80.2% has the highest usage of bed than all other provinces followed by the province of Bas-Congo with approximately 70% of net use for their children.

Table 4: Univariate analysis of % using bed net by different socio-economic factors.

Variable	N (count)	% (95% CI)	p-value
	9570		
Child characteristics			
Sex of child (n=9570)			
Male	4740	58.2 (55.4 – 61.0)	0.7282
Female	4830	58.6 (55.9 – 61.2)	
Age of child (n=9569)			
0 (0-11 months)	2364	63.2 (60.3 – 66.0)	0.0000
1 (12-23 months)	2098	63.1 (59.9 – 66.2)	
2 (24-35 months)	1890	57.3 (54.2 – 60.3)	
3 (36-47 months)	1727	55.3 (52.0 – 58.5)	
4 (48-58 months)	1490	51.7 (48.3 – 55.1)	
Maternal characteristics			
Marital status (n=9570)			
Married & living with partner	8639	59.9 (57.2 – 62.6)	0.0000
Single, separated, divorced	931	47.6 (43.4 – 51.8)	
Mother Education (n=9570)			
No education	1557	50.2 (45.5 – 54.9)	0.0000
Primary	4113	57.6 (54.4 – 60.7)	
Secondary	3707	63.1 (65.3 – 66.1)	
Higher	193	75.7 (65.3 – 83.7)	
Household head sex (n=9570)			

Male	7846	59.3 (56.7 – 61.9)	0.0023
Female	1724	54.6 (51.1 – 58.1)	
Household wealth (n=9570)			
Poor	4014	55.5 (51.6 – 59.4)	0.0338
Middle	2076	62.1 (58.7 – 65.4)	
Rich	3480	59.9 (56.1 – 63.7)	
Location (Urban/ Rural) (n=9570)			
Urban	2916	58.1 (54.3 – 61.7)	0.8351
Rural	6654	58.6 (55.3 – 61.8)	
Province (n=9570)			
Kinshasa	661	56.8 (48.4 – 64.8)	0.0000
Bandundu	2218	80.2 (76.8 – 83.1)	
Bas-Congo	508	69.6 (59.4 – 78.2)	
Equateur	1526	67.0 (62.0 – 71.8)	
Kasai-Occidental	448	36.6 (30.9 – 42.7)	
Kasai-Oriental	903	51.2 (44.1 – 58.2)	
Katanga	1123	62.9 (58.6 – 67.0)	
Maniema	251	46.5 (39.8 – 53.4)	
Nord-Kivu	548	40.5 (28.9 – 53.3)	
Oriental	567	40.1 (32.7 – 48.0)	
Sud-Kivu	817	60.3 (50.4 – 69.4)	

4.4. The unadjusted odd ratio for net use by children under five years.

4.4.1. Sex of child

Gender or sex of the child does not have an impact on the use or lack of bed net use. As comparing the odds ratios for female children in relation to the category of reference (male), it is clear that there is no significant relation between the two categories. Therefore, it does not matter if the child is a male or female, the bed net use for both sexes is the same.

4.4.2. Age of child

With the p-value of 0.000 as seen in Table 5 below, it implies that there is a strong statistically significant relationship between age of the child and the use of the bed net. However, when comparing different age categories with that of children aged less than one year (reference category), the table shows that at alpha 0.05, there is no statistical difference between a child who is one year and the one who is less than a year old. Furthermore, when comparing children who are 2 years to those who are less than a year, the table clearly shows that there is a significant statistical difference in use of bed net between these two categories. The statistics result shows that; a child at age two is 22% less likely to use the bed net that the child who is less than one-year-old. Also for a child who is 3-year-old, is approximately 28% less likely to sleep under the net than the child who is less than one-year-old. Lastly, the statistic in the table2 below shows that; a child who is 4-year-old is 38 percent less likely to sleep under the bed net in comparison to his/her counterpart who is less than a year old. Therefore, it may be ideal to conclude that; age of a child influence the use of bed net since the statistic shows that the use of net decrease with the age of a child. The older a child grows, the less likely the chance to sleep under the net.

4.4.3. Marital status of mothers

Overall, there is a strong statistically significant relationship between the marital status of the mother of children and the use of bed net indicated by a p-value of 0.000. Furthermore, when comparing the relationship of other women status (divorced, widowed, separated, etc.) to those married or live together with their partners, the table shows that children of mothers who are not

married or living together with their partners like husband and wife are almost 39% less likely to sleep under the bed net compared to their counterpart from mothers who are married/living together.

4.4.4. Mothers' highest education level

Education has been an important variable to evaluate socio-economic studies. Similarly, in this study, the result shows that overall there is a strong statistical significance between mother's education and the child use of the net. Children of women who have a primary level of education are almost 35% more likely to use bed net mosquito compared to children whose mothers have no level of education. So there is a statistically significant between these two categories as proven by a p value of =0.002. Moreover, children whose mothers have a secondary school level show even more protection than those of primary school and those of no education. Children of mothers who have a secondary school qualification are 70% more likely to sleep under the net than children whose mothers have no education (P=0.000). Additionally, children whose mothers have a higher than secondary school qualification have 209% more likely chance of sleeping under the net than those whose mothers have no level of education. With p-value of 0.000, there is a strong statistical significant difference between no educated mothers compared to a mother with a higher level of education.

4.4.5. Sex of household head

A child from a household headed by a female is 17% less likely to sleep under the bed net in comparison to the child from a household headed by a male (P= 0.002), the p-value confirms that there is a strong statistical relationship between sex of the household head and the use of bed net at 5% confidence interval.

4.4.6. Household wealth

Children from a middle class household are 31% more likely to use bed net compared to the children from the poor household. However surprisingly, children from the wealthier households are not significantly more likely to have slept under a bed net when compared to children from the

poor households. One would have expected children from the rich household would be more likely use more bed net in comparison to the children from a poor household.

4.4.7. Location (Urban and Rural)

There is no statistically significant relationship between the location of the household and the use of bed net in protection against malaria. This means that a child in the rural area and the child in the urban area both have an equal chance of sleeping or not sleeping under the bed net. One will be expected that urban area children would be more likely to be sleeping under the bed net than children in the rural area.

4.4.8. Province

There is a statistical significant between provinces when compared to the reference (reference) to determine bed net usage for children under five years. However, when comparing different provinces with Kinshasa as the reference province and the capital city of DRC, provinces such as Bas-Congo, Katanga, Maniema and Sud-Kivu; the use of bed nets was not statistically significantly different to the use in Kinshasa. However, in comparison to the reference province (Kinshasa), the other provinces are significantly more or less likely to sleep under the bed net. The province of Bandundu compares to Kinshasa; the statistics show that a child in Bandundu is almost 201% more likely to sleep under a bed net compare to the child in Kinshasa. Furthermore, in the province of Equateur, a child is almost 55% more likely to sleep under the net compares the counterpart from the capital city. Therefore, there is a statistical significance at alpha equal 0.05. A child who lives in Kasai-Occidental is approximately 44 percent less likely to sleep under the bed net compared to the child in Kinshasa. Furthermore, at alpha = 0.05, there is a statistical significant between a child who live in Nord-Kivu compared to the child in Kinshasa because a child in Nord-Kivu is approximately 52% less likely to sleep under the net than his/her counterpart from Kinshasa. Lastly, in the province Oriental, a child is almost 51% less likely to sleep under the bed net compared to the child in the capital city (Kinshasa).

Table 5: Table of unadjusted Odd Ratio for net use.

Variable	OR	95% CI	p-value
Sex of child			
Male	Ref.		
Female	1.01	0.93 – 1.11	0.728
Age of child			
0 (0 – 11 months)	Ref.		
1 (12 – 23 months)	0.99	0.87 – 1.13	0.929
2 (24 – 35 months)	0.78	0.70 – 0.87	0.000
3 (36 – 47 months)	0.72	0.64 – 0.81	0.000
4 (48 – 58 months)	0.62	0.55 – 0.703	0.000
Marital status			
Married / living together	Ref.		
Others	0.61	0.50 – 0.73	0.000
Mother education			
No education	Ref.		
Primary	1.35	1.12 – 1.62	0.002
Secondary	1.70	1.38 – 2.10	0.000
Higher	3.09	1.81 – 5.27	0.000
Sex of household head			
Male	Ref.		
Female	0.83	1.31 – 1.63	0.002

Household wealth			
Poor	Ref.		
Middle	1.31	1.09 – 1.58	0.004
Rich	1.20	0.97 – 1.48	0.099
Location (Urban / Rural)			
Urban	Ref.		
Rural	1.02	0.83 – 1.25	0.835
Province			
Kinshasa	Ref.		
Bandundu	3.07	2.08 – 4.54	0.000
Bas-Congo	1.75	1.00 – 3.06	0.051
Equateur	1.55	1.04 – 2.32	0.033
Kasai-Occidental	0.44	0.29 – 0.67	0.000
Kasai-Oriental	0.80	0.51 – 1.24	0.315
Katanga	1.29	0.88 – 1.89	0.191
Maniema	0.66	0.43 – 1.02	0.062
Nord-Kivu	0.52	0.28 – 0.96	0.037
Oriental	0.51	0.32 – 0.81	0.004
Sud-Kivu	1.15	0.68 – 1.95	0.590

4.5. The adjusted odd ratio for net use by children under 5 years.

The table 6 below shows or explains the odd ratio for the net use after adjusting for other variables that were significant in the univariate analysis. Those variables are as follows: age of the child, marital status of the mother, mother's education, the household wealth and province.

Age of child

When comparing different age categories with that of children aged less than one year (reference category), table 5 shows that; with p-value = 0.912, meaning that; there is no statistical difference between a child who is 1 year and the child who is less than one year in terms of bed net use. Furthermore, when comparing children who are 2 years old to those who are less than a year, the table clearly shows that there is a significant statistical difference in use of bed net between these two categories. The statistics result shows that a child at age 2 is approximately 23% less likely to use the bed net than the child who is less than one-year-old. Also for a child who is 3-year-old, is roughly 31% less likely to sleep under the net than the child who is less than one-year-old. Lastly, the statistic shows that; a child who is 4-year-old is approximately 42% less likely to sleep under the bed net in comparison to his/her counterpart who is less than a year old. Therefore, it may be ideal to conclude that age of a child influences the use of bed net since the statistic shows that the use of net decrease with the age of a child. The older a child grows, the less likely the chance to sleep under the net.

After controlling for other factors, children of one-year-old remains equal to those who are less than a year old. Therefore, there is no statistical difference between these age categories at alpha = 0.05. All other age categories remain strongly statistically significant with a p-value of 0.000 for all (two, three and four years) children. The decreasing relationship remains strong meaning that, the use of bed net to protect against malaria varies with age. The older a child became the less likely chance for him or her to sleep under the bed net in the DRC.

Marital status of mothers

When comparing the relationship of other women status (divorced, widowed, separated, etc.) to those married or living together with their partners, the table shows that children of mothers who

are not married or living together with their partners like husband and wife are almost 45% less likely to sleep in the bed net compared to their counterpart from mothers who are married/living together. This relationship is explained by the p-value = 0.000

Mothers' highest education level

In this study after adjusting for different other variables, the result shows that when comparing women at the different level of education, the statistic shows that children of women who have a primary level of education are almost 27% more likely to use bed net for mosquito compares to children whose mothers have no level of education. So there is a strong statistical significant between these two categories as proven by a p-value of 0.004. Moreover, children whose mothers have a secondary school level show even more protection than those of primary school and those of no education. Children of mothers who have a secondary school qualification are 48% more likely to sleep under the net than children whose mothers have no education ($p = 0.000$). Additionally, children whose mothers have a higher level of education beyond secondary school qualification have 233% more likely chance of sleeping under the net than those whose mothers have no level of education. With a p-value of 0.000, this shows a strong statistical significant difference between an illiterate educated mother and mother with a higher level of education.

The more educated you are, the better. Within categories, there is a slight change in the Odd values but not in their p values.

Sex of household head

Children from the female household head and children from the male household head have an almost equal likelihood of bed net use after adjusting the model for the other significant variables. The above statement is justified by the p-value of 0.692, which mean that there is no difference between children from a female household head in comparison to that of the male household head.

Household wealth

When comparing different classes and using poor household as a reference class, the middle class household is statistically significant and shows that children from a middle class household being

40% more likely to use bed net compares to the children from a poor household. Moreover, after adjusting other variables, at alpha 0.05 there is a significant statistical relationship between rich household and the use of bed net therefore, children from rich household are 30% more likely to use the bed net than their counterpart from poor households.

Location (Urban and Rural)

At alpha 0.05 and the overall p-value = 0.8351 as indicated in the table3 below, there is no statistically significant relationship between location and the use of bed net in protection against malaria. This means that a child in the rural area and the child in the urban area both have an equal chance of sleeping or not sleeping under the bed net. This is unexpected, as one will think that urban area children use more bed net than children in the rural area do.

Province

When comparing different provinces with Kinshasa the reference province and capital city of DRC as well as adjusting odd ratio with other variables, it is clear that at alpha equal 0.05 some provinces are statistically significant. Such as Kasai-Oriental, Maniema, Nord-Kivu, Oriental and Sud-Kivu meaning that for a child living in Kinshasa and the child living in these other provinces named above, on average have an equal chance of sleeping in the bed net. However, other provinces are statistically significant. The province of Bandundu remains significant compares to Kinshasa; the statistics show that a child in Bandundu is almost 315% more likely to sleep in bed net compare to the child in Kinshasa after adjusting for other significant independent variables. Furthermore, in the province of Equateur, a child is almost 121% more likely to sleep under the bed net compared the counterpart from the capital city. A child who lives in Kasai-Occidental is approximately 55% less likely to sleep under the bed net compared to the child in Kinshasa.

A child living in the province of Bas-Congo compares to the one living in Kinshasa is on average 131% more likely to sleep under the bed net. Also, the statistics show that there is a statistical significant at alpha = 0.05 meaning that a child living in Katanga is on average 62% more like to sleep under the bed net compares to a child in Kinshasa.

Table 6: The table showing the adjusted odd ratio.

Variable	OR	95% CI	p-value
Age of child			
0 (0 – 11 months)	Ref.		
1 (12 – 23 months)	1.01	0.88 – 1.15	0.912
2 (24 – 35 months)	0.77	0.69 – 0.86	0.000
3 (36 – 47 months)	0.69	0.61 – 0.78	0.000
4 (48 – 58 months)	0.58	0.51 – 0.65	0.000
Marital Status			
Married / living together	Ref.		
Others	0.55	0.44 – 0.69	0.000
Mother education			
No education	Ref.		
Primary	1.27	1.08 – 1.51	0.004
Secondary	1.48	1.20 – 1.82	0.000
Higher	3.33	1.94 – 5.70	0.00
Sex of household head			
Male	Ref.		
Female	0.97	0.83 – 1.13	0.692

Household wealth			
Poor	Ref.		
Middle	1.40	1.17 – 1.68	0.000
Rich	1.30	1.05 – 1.62	0.016
Province			
Kinshasa	Ref.		
Bandundu	4.15	2.73 – 6.31	0.000
Bas-Congo	2.31	1.30 – 4.13	0.005
Equateur	2.21	1.43 – 3.41	0.000
Kasai-Occidental	0.55	0.36 – 0.85	0.007
Kasai-Oriental	0.96	0.61 – 1.50	0.853
Katanga	1.62	1.08 – 2.42	0.019
Maniema	0.83	0.53 – 1.29	0.398
Nord-Kivu	0.68	0.37 – 1.25	0.210
Oriental	0.69	0.43 – 1.11	0.127
Sud-Kivu	1.48	0.87 – 2.51	0.149

4.6. Conclusion

This chapter detailed the research results by highlighting or clearing answers to the research questions through the analyses of the relationship between socio-demographic and socio-economic vis-à-vis the use of bed net to protect children against malaria. After adjusting odd ratio for net

use, there is a clear statistical relationship between most of the variables such as age of a child, marital status of the mother, mother's education and the household wealth. When compared to the capital Kinshasa (reference), the bed net usage in some provinces showed a significant difference, while others did not. The following part, chapter 5, will cover a summary of this work as well as highlight some recommendations for the future research.

CHAPTER 5: DISCUSSION OF RESULTS AND CONCLUSION

5.1. Introduction

This chapter will discuss the findings related to the determinants of bed net use for children under five in this study in light of the findings of other studies and the theoretical framework. The study found that age of the child, marital status of the mother, mother's education, the household wealth and province were significantly associated with bed net use. Gender of the child and of the household head was not significantly associated with bed net use.

5.2. Discussion of the results

Child characteristics

The gender of a child does not affect the utilization of bed net. These findings are closely related to the previous literature on bed net use in the DRC (Noor et al., 2009a). However, it may be different in other countries within the same region, depending on how much importance is given to the gender of the child. In a country such as Benin where gender inequalities are greater and there is a preference for male children, one could have expected that a male child would be more likely than a female child to be afforded the protective measure of sleeping under a bed net (Noor et al., 2009a).

With regard to the age category of the child, the research findings showed that there was no significant difference in the odds of bed net use among the youngest children of age 0 – 11 months and those between 12 – 23 months. This may be due to the fact that children in both these age categories are still very young and therefore, it is unlikely that they would be sleeping separately from their mothers/guardian as this practice is the norm in the DRC (Noor et al., 2009a). In addition, the fact that at this age category, the child may be the youngest in the household, therefore, there is no one else to take over his/her place under the net. However, as the child reaches the age of two years and older, there is a higher probability that another child may be born to that mother, therefore the previous child has to leave a space for the newborn child or the youngest (DRC DHS, 2013).

Thus, the results show that children aged from 24-35 months upward are significantly less likely to have slept under a bed net. A possible explanation is that households do not have enough bed nets for every under-five children (DRC Ministry of Health, 2014), and as the child grows older, he/she has to leave the bed and bed net to the younger one. Therefore, shortage of bed/bed net in some household due to poverty cause the older child to free the space for younger ones. Thus sleeping on the floor reduces the child chances of sleeping under the bed net. This finding corresponds with the research conducted by Oresanya, et al., (2008) where mass distribution of bed net gives advantages to children of younger ages to sleep under the bed net due to sharing bed with the parent as well as the bed net being used more by the younger children compared to the older ones (Oresanya et al. 2008).

Maternal characteristics

This section focuses more on the research question relating to the mothers' characteristics that are associated with the determinants that cause the use of bed net in protecting children under five years against malaria. Only 1% of mothers had attained education beyond secondary school and 19% of women had no form of education at all. Furthermore, in both the univariate and the multivariate analysis, the education of the mother is highly associated with the bed net use in the sense that the more a woman is educated, the higher the chances of covering a child under a bed net. These results imply that if all women can have a higher qualification and bed net availability, all under five children can be sleeping under the bed net. In addition, this result may imply that more children are victims of the societal living conditions and the environment. In this situation, children are victims of illiteracy of their parents and mostly mothers in this study. These educational inequalities are rooted in the past when more parents preferred sending their male children to attend to the missionary schools than their female children. Therefore, despite knowing the value of education for male, some society still do not allow the female to have equal access to it (Farzaneh et al. 2003).

The findings of this study correspond to other studies conducted by Pettifor et al., (2008) and Gobena et al., (2014) by showing the greatest importance of mothers' education in protecting children under five years and all household in general. This is because of sufficient knowledge and exposure they may have acquired during the years of schooling (Pettifor et al., 2008). Those

women without or with little formal education should be educated about the benefits of covering the child with a bed net and get proper instructions and education on the use of bed nets as well as other health-related protection.

Continuing with the mother or care givers characteristics associated with the use of bed net, with the principal focus on the marital status of the mother, the study after considering married and living together in one category, found that children who live with both parents are more likely to sleep under the bed net than other children. This is not contrary to what one could have expected because of the shared responsibilities of child bearing by both parents. Other studies within Sub-Saharan Africa have found similar results like was reported by a by Mugisha et al, (2003) in Uganda, showing a 4 times likelihood of a child sleeping in under the net if the mother is married than otherwise and supported by the finding of Kimbi et al., (2014) in Cameroon.

Household characteristics

In this section, the research is trying to determine the household characteristics that are associated with the use of bed net in protecting children under the age of five. Therefore, the relevant question of the study has been designed to find out if children residing in households located in urban areas are more likely to sleep under the bed net than those in rural areas. This study found that there was no significant difference in bed net use among children in the rural and those in the urban areas.

This finding may be due to the high mass distribution of bed net that was launched years before data collection with the effort of the government of DRC, together with its partners and other NGOs such as UNICEF, PMI which are helping fighting the pandemic of malaria as well as advocating child protection against malaria in the country. Despite the infrastructure difficulties, such roads to the rural areas etc. donors working through NGOs have tried their best to reach as many rural households as possible (Stanton et al. 2013).

Furthermore, despite the expectation that bed net use in urban areas should be more than that in rural areas, DRC being a very poor country where the cost of medication and other costs of health treatment related depend mostly on individual funding (Kalisya et al., 2015), the fortunate rural households who have obtained bed nets may have interest in using them and understand that

“prevention is better than cure”. Therefore, some of rural households’ preference may be to cover children under the bed net than exposing them to mosquito bite or waiting until children are infected with malaria.

Also, linking this finding to financial means, poor households who are more concentrated in rural areas may not have enough funds to provide for primary household need such as food, clothing and others. Getting money to pay for treatment of sick children is more difficult (DRC DHS, 2013). Hence, the use of cost-effective preventive strategies is emphasized. This finding is more surprising since most of the literature in the previous part indicate the opposite. However, the study by Adeyeri in 2011 shows a factor of 1.61 increase in favor of rural areas household using bed net compares to urban households. According to the research, this may be partly due to better health care and public health center facilities in urban areas, therefore these may decrease the use of nets or even the ownership in urban areas (Adeyeri, 2011).

According to Marivoet et al., (2011), based on the asset-based approach and analysis of the DHS conducted in 2004-5 in the DRC poverty is less structured in an urban area than rural areas in DRC in the sense that households from the urban area have in possession more important assets and facilities. Thus, this gives the urban population advantages in terms of leading a stable life and less vulnerability to shocks such as malaria and other related burden when compared to rural areas population. This is shown to be more of the case in the capital city of Kinshasa than other provinces search as Bandundu, Maniema, Oriental and Equateur.

The country has 11 provinces but different provinces are statistically significant while others are not. This may be because the country is too huge with a very large population but less funding to cover all the country in one round of distribution of net. Therefore, some provinces may have received the net in different time compared to others. For example, although an increase in bed net has been recorded, 42 health zones have not received financial support in terms of the national plan to fight malaria, 5 in Kinshasa, 11 in Bas-Congo, 2 in Bandundu, 3 in Kasai Oriental, 2 in Kasai Occidental, 10 in North Kivu et 19 health Zones in Katanga. Adding to these, 84 zones are not fully covered in terms of fighting the pandemic (DRC Ministry of Health, 2014). Thus, the use of bed net may not be evenly distributed countrywide.

Income is an important variable to evaluate the health status of a child in the developing countries because of its high influence on the survival of a child. As for the DRC, this is not an exception. In fact, as one of the poorest nations on the planet, household wealth may be a critical determinant of child protection and survival. A variety of goods, services and assets at the household level operate on child health and mortality through the proximate determinants. These may include housing and preventive care among others, which may include the purchase of necessary materials like insecticides and secure the means to pay for certain preventive services as well as child care, antenatal care and immunization (Mosley and Chen, 1984).

This research found out that even when adjusting for other variables, greater household wealth variable was associated with bed net use, with children from the middle class household most likely to sleep under a bed net. Thus, household wealth is a critical component of the socio-economic factors. However, one has to remember here that NGOs and other donors found the majority of the nets distributed in the country. The different private organization, NGOs and other donors support DRC DHS 2013 reveal that the government of the Congo spends only 4% of the annual budget in the fight against malaria (DRC DHS, 2013) and the rest. Therefore, answering the question on household wealth and its effect on the use of bed nets, it is evident that wealth affects the use of bed net by under five children. Moreover, without NGOs support this gap could even be huge because of a large number of poor who may not be able to afford to purchase bed net on their own.

5.3. Theoretical Framework

This framework aimed to study child survival determinants in developing countries by including the socioeconomic determinants influencing such survival. The framework posits that socioeconomic factors operate through proximal determinants to affect child mortality specifically in developing countries. Therefore, the correlation, in this case, has been between mortality and socioeconomic characteristics. In most cases, income and maternal education are the two most commonly correlated with the child mortality in the developing country populations.

The variable mothers' education in the study results agrees with many studies including the theoretical framework too. The importance of educating women in Congo appear to have great

importance since it affects most determinants related to child survival. According to the DRC DHS 2013-2014, on average a woman gives birth to 6.6 children in her entire life. However, this number varies according to different factors such as location with a big number in a rural area (7.3 children) versus 5.4 children in the urban area. The number of children per woman also varies significantly according to provinces with a minimum of 4.2 children in the city of Kinshasa the capital to a maximum of 8.2 Children in the Kasai Occidental. This reflects the discrepancy in education but also wealth inequality as well as the lack of employment (DRC DHS, 2013). The implication of this statistics shows the hardship of child survival which due to poverty and even death of one or both parents due to malaria. These factors influence child survival considering poverty and scarcity of means of protecting children against malaria and other related diseases.

5.4. Study limitations

Some limitations have been noticed as this research progress, the major one is the quantitative data collected by the DRC Demographic and Health Survey 2013-2014. Despite quality data collected, many other factors may influence the bed net use for the survival of children under five and those factors were not covered in this research. For instance, questions on the attitude and perception on the use of bed nets, sleeping arrangements in the household are some of the factors that may play a huge role in understanding bed net usage but the data set did not cover them. As a result, despite answering well on the research questions, the research failed to provide all information on the bed net use for children survival in the DRC.

5.5. Recommendations

The high rate of mortality among children under the age of five due to malaria despite the disease being well known as both curable and preventable still remains a concern. As shown previously, the use of bed net is of great importance in child survival from malaria in developing countries. Thus for improvement in an under five children wellbeing and survival from malaria, this study suggests some recommendations which focus mainly on the government of the DRC, secondly, NGOs and other donors, thirdly, mothers, household heads and care takers. Lastly to the community as a whole.

5.5.1. Government

Due to different structure, geographical and political situation of the DRC, study at the provincial level will be recommended than generalizing the result in the country that has been politically and economical unstable for many decades and the situation is worse in different provinces than it is in others (PMI, 2015). This will allow comparison between different communities in provinces and hence will provide a clear picture of intra-household dynamics that affect utilization of bed net within household with children under five years.

Public health efforts in addressing this risk group provincially should be strengthened to avoiding any decline in bed net usage or coverage among children. The emphasis has been to reinforce the use of bed net for young children and for pregnant adult women when the number of bed nets in the household is limited (Kilian et al. 2016). Although this may challenge previous norms, it is essential to give privilege to the most vulnerable groups.

In addition, DRC government might avoid relaying on NGOs and donors' help to protect children against malaria. Proper budgeting and planning on how to fight malaria on their own may allow the country to achieve the RBM goal. This may prevent alarming death rates due to malaria if donors run short of funds.

Continuous training of nurses and health care providers will assist in protecting more vulnerable people in going in communities to share information and distribute free bed nets to community members especially household with less than five years' children. This strategy will be beneficial mostly to the rural areas where women are more likely to have home deliveries and have less chances of attending antenatal care.

5.5.2 NGOs and other Donors

As main funders and advocacies of the fight against malaria, NGOs and other partners may be interested to undergo a qualitative research for in-depth knowledge in understanding other factors that determine the use of bed net for children under five. This information may be gathered through primary data collected to capture as many variables as possible from the household heads.

5.5.3 Mother, household heads and care takers

On the positive side, it has been seen that mothers or caretakers have understood that both male and female children need to be protected against malaria. However, the use of such net needs to be increased and most importantly to be consistent. The emphasis here is on the proper and day-to-day use of bed net to maximize the protection of children.

5.5.4 Community

A massive education of the community to eliminate the backward perceptions and attitudes against bed nets use is necessary. However, such strategy should recognize that changing behavior and perception is a gradual process. The community approaches that associate social monitoring to target such process of behavioral change have shown to be more successful in implanting change (Atkinson et al. 2010). Instead of individual campaigns, interventions that involve small communities helping each other in encouraging change might be of greater benefit.

Educational messages must be culturally sensitive and capitalize on the positive beliefs and behaviors that already exist in local communities can play a critical role in the adoption of preventive behaviors and improve rates of child survival.

5.6. Conclusion

Bed nets are the best and more cost-effective malaria control tool to be developed and as such, they have been an important component of global and national malaria control policy since the mid-1990s. This study uses secondary data from the Demographic and Health Survey 2013-2014 in DRC. Concerning the objectives of the study, the quantitative methodology was used to provide answers to the research questions in line with the socioeconomic determinants influencing child survival from malaria by means of using protection mainly bed net. The study population is children from the age 1 – 4 years. The nature of the argument is that of knowing child characteristics, mother characteristics as well as household characteristics associated with a child sleeping under the bed net.

With the results obtained from this study it can be concluded that socioeconomic and sociodemographic factors are highly associated with child protection against malaria and therefore, they affect child survival in the country. The research shows a greater importance of mother's education on child survival, higher level of education to higher level increases the mothers' awareness to the need to adopt protective measures against malaria. Furthermore, this is important because if many Congolese women can be educated to the higher standard, not only will children survive but also the community as a whole will benefit. Once Dr. James Kwegyir-Aggre said; "*If you educate a man, you educate an individual, but if you educate a woman, you educate a family (nation)*" (Suen, 2013).

Household wealth as one of the common socioeconomic factor for child survival in developing countries plays an important role in the DRC situation as well. However, the financial aspect may need more qualitative research for the in-depth understanding relationship between the wealthy and poor class category and their use of bed nets. So that, a thorough understanding and clarity can be made in terms of bed net usage, replacement and retreatment of the net with insecticide when due because most of the bed net are financed by NGOs and the country only budget 4% in the fight against malaria.

Marital status of the mother proved to be of great influence on a child survival in the case of DRC. A child who live with both parents no matter parent are married or just staying together as partners. A huge difference between the two categories of married/stay together and none married mothers who live with their children only but not fathers is recorded.

Talking about the age of a child, the youngest child is more privileged; this privilege may be viewed as just an advantage because of the age meaning that; very young children benefit sleeping in the net because of sharing a bed with parents.

Despite differences in gender, education status, regional location, wealth and other variables, overall the use of bed net is still very low for children under five in DRC. This low rate may explain the high mortality rate due to malaria in the country in general and more among those under 5 years in particular. With an average of 58% of a child sleeping under the bed net, reaching NMCP

of above 80% is a myth for the DRC government. Thus, it is clear that DRC is still very far from achieving the NMCP as well as the RBM targets and eradicating the burden of malaria.

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