

**FACTORS AFFECTING USE OF INSECTICIDE TREATED
NETS BY CHILDREN UNDER FIVE YEARS OF AGE IN
KENYA**

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**Research Project submitted to the school of Economics, University
of Nairobi, in partial fulfilment of the requirements for the Award
of the Degree of Master of Arts in Economics.**

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DECLARATION

This research project is my original work and has not been presented for the award of a degree in any other university.

Signature.....Date.....

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X50/73241/2012

The research project has been submitted with my approval as the university supervisor.

Signature.....Date.....

DR. URBANUS M. KIOKO

DEDICATION

This research project is dedicated to my wonderful daughter Natasha Mutheu and my loving husband Stanley Mutua for their love and support during my studies.

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ABSTRACT

Malaria is a major cause of morbidity and mortality worldwide and it mostly affects pregnant women and children under five years of age. It is among the leading cause of deaths in under fives with an approximate of 20 percent of all deaths in Kenya. The World Health Organization recommends the use of Long Lasting Insecticide Treated Nets (LLINs) and Insecticide Treated Nets (ITNs) for prevention of malaria infection. Although several studies have analysed the accessibility, availability, ownership and utilization of ITNs by children less than five years of age, few studies have examined the intra-household factors that influence utilization of ITNs by children less than five years of age. This study investigated the factors that influence use of ITNs and LLINs by under fives across the country using a binary logit approach. The regression results showed that age of household head, household size, gender of child and household head, presence of fever in a child 2 weeks prior to the survey treatment of net since acquisition significantly affected use of ITNs. The study concludes that these factors hinder use of ITNs by children under five years and therefore presence of an ITN in a household may not guarantee utilisation. The study recommends that efforts be made to increase awareness on the importance of ensuring children under five years sleep under an ITN if reduction in morbidity and mortality in this age group is to be reduced.

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ABBREVIATIONS

DOMC	Division of Malaria Control
EPR	Epidemic Preparedness and Response
IEA	Institute for Economic Affairs
IRS	Indoor Residual Spraying
ITNs	Insecticide Treated Nets
KNBS	Kenya National Bureau of Statistics
KPMR	Kenya Malaria Programme Performance Review
LLINs	Long-Lasting Insecticide Nets
MDG	Millennium Development Goal
MIP	Management of Malaria and Anemia in Pregnancy
NGOs	Non-Governmental Organizations
PSI	Population Service International
RBM	Roll Back Malaria
WHO	World Health Organization

CHAPTER ONE: INTRODUCTION

1.1 Background

Malaria is a major cause of morbidity and mortality worldwide and it mostly affects pregnant women and children less than five years of age. Sub-Saharan Africa is mostly affected with almost 86 percent of deaths occurring in children less than five years of age (WHO, 2013). Pregnant women and children are more vulnerable to malaria infection since it reduces a woman's immunity making them more prone to infection and this puts the life of unborn baby at risk (WHO, 2003). It's estimated that out of a population of 34 million Kenyans, 25 million are at risk of Malaria infection (IEA, 2011). In Kenya, malaria accounts for 30 percent of all hospital outpatient attendance, 15 percent of all admissions to health facilities and 3-5 percent of inpatient deaths (KMPR, 2009). The disease is the main cause of mortality of Under five children (approximately 20 percent) and it's ranked second after HIV/AIDs in the socioeconomic burden of diseases in Kenya (IEA, 2011). Its effects are far reaching as it also affects the economy as a whole. For instance, 170 million work days are lost each year due to the disease while 4-10 million school days are lost by children (Tilson, 2007). Its therefore not only considered as a health issue but also a socio-economic burden by the Kenyan government and therefore investment in its control should be a priority (Republic of Kenya, 2011).

1.2 Malaria prevalence in Kenya

According to the malaria indicator survey of 2010, malaria prevalence in children under-five years increased from 4 percent in 2007 to 8 percent in 2010 (Republic of Kenya, 2011).

Approximately 3 million children less than five years of age and 1 million pregnant women live in malaria prone areas (Tilson, 2007). Kenya has four malaria epidemiological zones and diversity in risk of infection is determined largely by altitude, rainfall patterns and temperature (DOMC, 2010). These zones include; i) Endemic zones, -these are areas of stable malaria around Lake Victoria in Kenya and in the coastal regions and the altitudes here range from 0 to 1300 meters. Rainfall, temperature and humidity are the key determinants of perennial malaria transmission.

Due to the stable climatic conditions, the life cycle of the malaria vector is short and survival rates are very high; ii) Seasonal transmission zones- this occurs in the arid and semi-arid areas of northern and south-eastern parts of the country. These areas experience short periods of high malaria transmission during rainfall seasons due to high temperatures and water pools created which provide breeding sites for malaria vectors; iii) Epidemic prone areas of western highlands of Kenya where malaria transmission is seasonal and varies from year to year. Temperatures of 18⁰ C during the long rains favors and sustains vector breeding and this increases the intensity of malaria transmission; iv) Low risk malaria areas-these are the central highlands of Kenya and Nairobi and the temperatures in these areas are too low to allow the malaria vector to survive.

According to Kenya Malaria programme Performance Review (2009), Kenya has witnessed a decline in malaria trends in areas where people use ITNs and other preventive measures. Population service international (PSI) reported that malaria admission in the Kenyan hospitals halved during 1999-2006 while mortality in children under-five years decreased by 36 percent in areas which use malaria control activities.

Globally, preventive measures have led to a decline in malaria infection by 17 percent during 2000 - 2010 while mortality rate decreased by 26 percent (WHO, 2013). There is therefore evidence that the use of preventive measures is effective in controlling malaria.

1.3 Overview of malaria control policies in Kenya

The Roll Back Malaria (RBM) initiative aims at achieving a world free from the burden of malaria. In April 2008 the United Nations secretary General proposed a vision of putting to end mortality due to malaria by ensuring universal coverage of malaria interventions by end of 2010. This was to be achieved by promoting the use of IRS and availing LLINs to all people at risk of malaria especially women and children in Africa (WHO, 2010). Effective malaria diagnosis and treatment was to be availed in all public health facilities too.

There are several approaches which have been put in place in order to help in malaria control and prevention as outlined in the Kenya malaria programme performance review of 2009. They include; case management which is aimed at formulating and implementing malaria treatment policy issues; management of malaria and anaemia in pregnancy (MIP) which is geared towards prevention and treatment measures for pregnant women; vector control which emphasizes on the use of ITNs and LLINs by communities at risk of infection and epidemic preparedness and response (EPR) which aims at improving the epidemic preparedness and response by establishing early warning systems and carrying out preventive measures in the IRS campaigns. In addition, the Millennium Development Goal, (MDG 6) aims at reversing the incidence of malaria and other major diseases by 2015. This would aid at achieving MDG4 which aims at reducing mortality rate among children under five by two-thirds by 2015 (WHO, 2010).

1.4 History of ITNs and LLINs

The World Health Organization (WHO) defines an ITN as a mosquito net that repels, disables and kills mosquitoes, which come into contact with insecticide on the netting material. An ITN can either be a conventionally treated net, which should be re-treated after three washes or at least once a year by use of pyrethroid insecticides or a long lasting insecticidal net, which can stay without retreatment for at least 20 washes or three years. Distribution of ITNs began in 2001 by Government of Kenya (GoK) through PSI as a social marketing strategy. In 2004, distribution was extended to health facilities where ITNs together with re-treatment kits were given to expectant mothers and children less than five years of age at a subsidized fee of 50 shillings.

However, this mode of distribution was not very successful as the ITNs re-treatment kit was not readily available. Also, most households were too poor to afford the subsidized ITNs. As funding increased, LLINs were given for free through mass distribution campaigns which targeted expectant mothers and children under-five living in epidemic prone areas. This enhanced ownership and accessibility which is a vital component in the use of ITNs/LLINs.

For instance, between 2001 and 2009, over 15 million ITNs and LLINs were distributed to expectant mothers and children under-five in Kenya. However, this figure could be slightly high as it has not accounted for the commercial sector which provides ITNs for people who are able to afford. The aim of the National Malaria Strategy is to ensure that 80 percent of people living in malaria risk areas use appropriate malaria prevention measures by 2013 through universal LLIN coverage (NMS, 2009-2017).

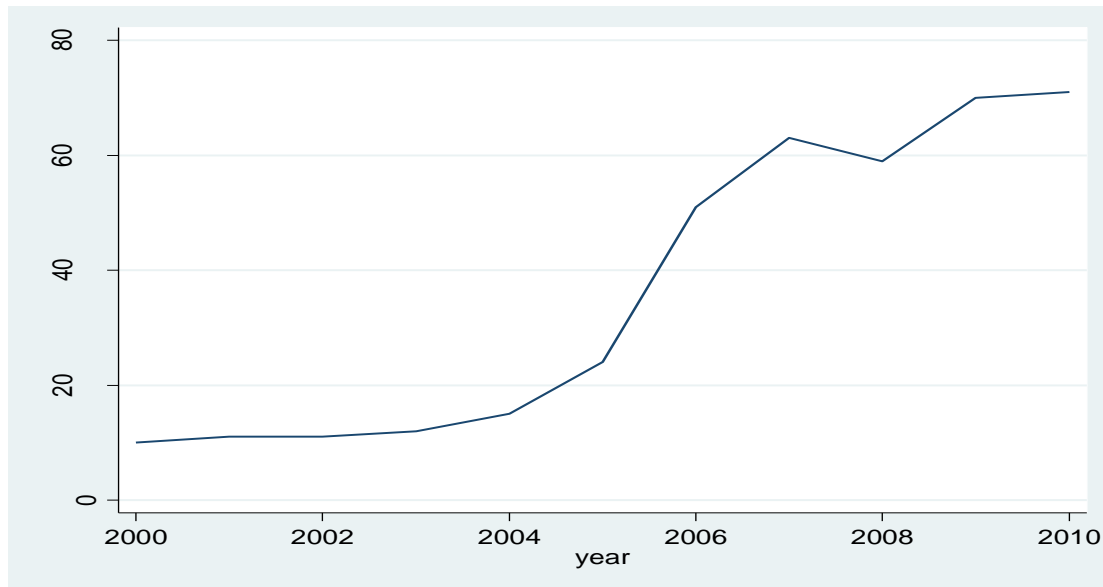
However, despite these concerted efforts, ITN coverage in malaria endemic countries has not yet reached the agreed targets and utilisation remains low (KMPR, 2009).

1.5 Ownership of ITNs in Kenya

Most international organizations and non-governmental organizations have had a lot of interest in distributing ITNs in malaria endemic countries in sub-Saharan Africa (WHO, 2003). Kenya has been a learning centre in the use of routine distribution system for the provision of ITNs (Republic of Kenya, 2011). This could be one of the reasons why ITN ownership has been constantly increasing in Kenya since 2000. Figure 1 shows the trend in ITN ownership in Kenya from 2000 to 2010. As it can be seen from the graph, ownership was low during the period 2000 to 2004, from which it started to increase gradually up to 2005.

From the year 2005, there was a rapid increase in ownership of ITNs with a gradual decrease in 2007 then another rapid increase to 2009. From 2009 to 2010, ownership seems more or less constant.

Figure 1: Ownership of ITNs in Kenyan households for the period 2000-2010



Source: World Health Organization, 2010

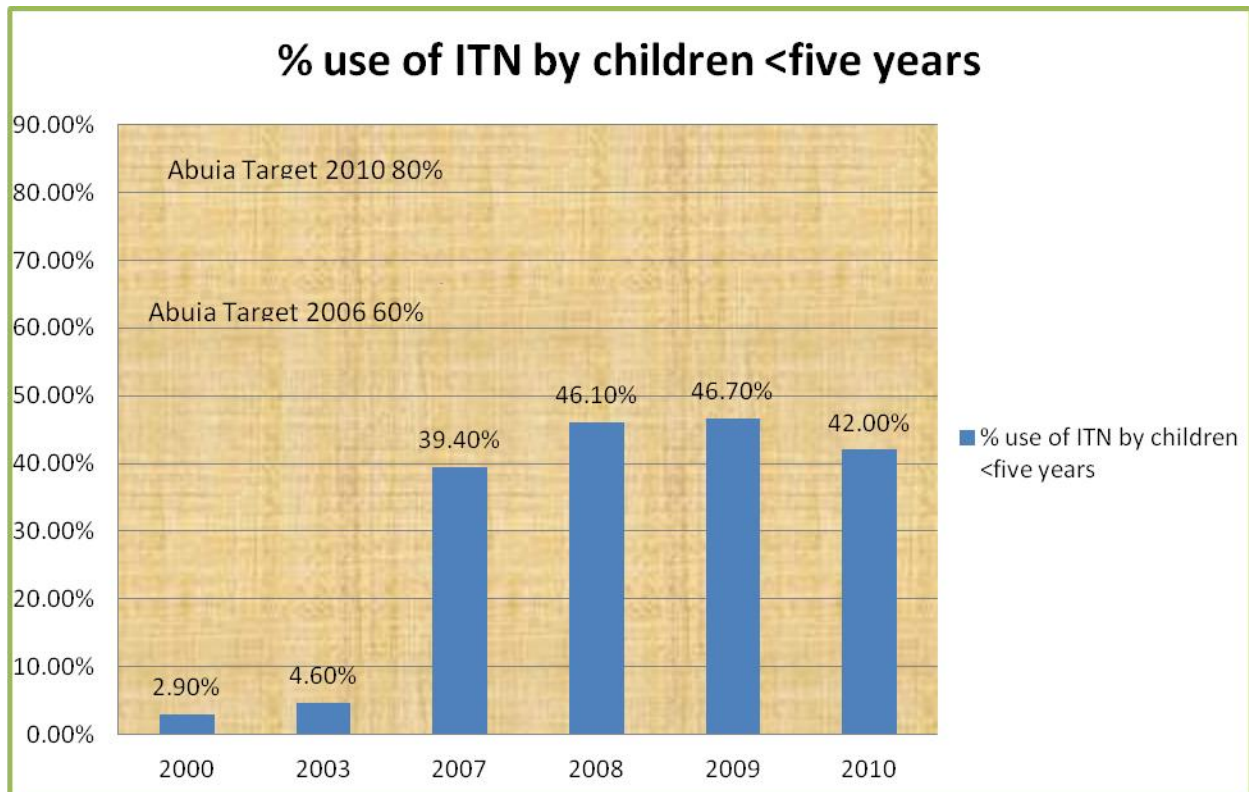
According to the population service international (PSI) which is one of the main distributors of ITNs for children less than five years of age and expectant mothers, once a child is given an ITN it's not replaced until the child gets to the age of five years (Tilson, 2007). Mutuku *et al.*, (2013) states that bed nets are optimally utilized when they are new and physically intact and withdrawal in use happens after 1.5 years of use. However, repeated campaigns are necessary in order to replace old, damaged and even expired nets for the ITNs to be effective (O'Meara *et al.*, 2011).

1.6 Use of ITNs by children less under five years of age in Kenya

According to the Kenya malaria indicator survey of 2010, only 42 percent of children less than five years of age sleep under ITNs. This falls below the Abuja target of 80 percent (see figure 2 below).

For households who own at least one ITN, only 71 percent of the children less than five years of age sleep under an ITN. This shows that around 30 percent of households own ITNs but do not use them. Again, use of ITNs by children in this age group decreases with age (KNBS, 2009)

Figure 2: Use of ITNs by children under five years in Kenya (%)



Source: World development indicators, Various issues; KMIS, various issues; KDHS (2008).

1.7 Problem statement

Insecticide treated nets and Long Lasting Insecticide Nets are highly effective in reducing malaria morbidity and mortality if properly used and maintained. Atieli *et al.*, (2011) notes that although ownership of nets in Kenya has achieved the RBM target of at least 60 percent, utilization has not reached the targeted level of 80 percent and the use of ITNs remains low compared to ownership. In the Kenyan highlands for instance, ownership is greater than 60 percent but utilization is at 53 percent (Atieli *et al.*, 2011). In Kenya, only 42 percent of children less than five years of age sleep under an ITN despite the Abuja target of 80 percent. Moreover, only 71 percent of children less than five years of age sleep under an ITN in households which own an ITN (Republic of Kenya, 2011).

In Kenya, there have been several programmes that have been put in place to enhance access of ITNs by households with the most pronounced one being the 2006 mass campaign. A number of studies have analysed the accessibility, availability, ownership and utilization of ITNs by children less than five years of age (see for instance Graves *et al.*, 2011, Oresanya *et al.*, 2008, Atieli *et al.*, 2011 and Garcia-Basteiro *et al.*, 2011). However, utilisation of ITNs in the country still remains low yet ownership has improved over the years. At this rate, it will not be possible for the country to achieve the national and international targets of ITN use unless the factors that hinder utilisation are identified and appropriate policy solutions found. This project endeavours to determine intra-household factors that may be contributing to low utilisation of ITNs by children under five years. To the best of my knowledge, there is no study that has addressed this issue in Kenya. The aim of this study was to bridge this knowledge gap.

1.8 Objectives of the study

The aim of this study was to determine the intra-household factors that affect the utilisation of ITNs by children less than five years of age in Kenya. The specific objectives were:

1. To establish the intra-household factors that affect the utilization of ITNs by children less than five years of age in Kenya
2. To examine how household's perceptions and attitude affect ITN use
3. To provide policy recommendations based on study findings.

1.9 Justification of the study

Kenya has made considerable effort in the procurement and distribution of ITNs for malaria control. The distribution of ITNs and LLINs has been strong and consistent but discrepancy still exists between ownership and use of mosquito nets. A lot of emphasis has been put on ownership but less attention has been given to the factors that affect the utilization of ITNs despite low utilisation. There has not been a study in Kenya looking at the factors that influence ITN utilisation. The information generated from this study will assist planners to explore ways of increasing utilisation of ITNs among children aged under 5 years.

Finally, this study has not been done elsewhere in Kenya and therefore its findings will contribute to existing literature by identifying factors affecting use of ITNs/LLINs by children under-five years of age.

1.10 Organization of the paper

Chapter two of this research project will be composed of literature review which will analyse and appreciate what other researchers have done in the same area. Chapter three presents the research methodology and specifically discusses the sources and nature of data, data collection methods, sample size and sampling technique, definition and measurement of variables, estimation methods, and the econometric model used in the analysis. Chapter four provides the results and discussion of the findings while Chapter five presents the conclusion and policy recommendations based on the study findings.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This section provides background understanding of the economic theories used in the analysis of individual choice patterns and research studies that have been carried out regarding insecticide treated nets. It mainly looks at ownership of ITNs in households, factors affecting use of ITNs and the effect of perceptions, attitude and retention of ITNs. The purpose of this literature is to identify gaps that need to be filled.

2.1 Theoretical Review

One of the theories used in economics to explain consumer behaviour is the theory of the consumer. This theory, which is based on a rational maximizing model, is a combination of positive and normative theories (Thaler, 1979). Normative theory argues on the basis of what ought to be done but the positive theory argue on basis of what is actually done. According tonormative theory, a consumer is assumed to choose a bundle of goods which they prefer from a given set of consumption bundles (Gravelle & Rees, 2004). Therefore, a consumer ranks the available consumption bundles in the order of preference and chooses the one which yields the highest level of utility. Thaler (1979) argues that consumers act in a manner that is inconsistent with economic theory in many occasions and in such situations economic theory end up making systematic errors in predicting consumer behavior due to exclusive reliance on the normative theory which describes how consumers ought to choose in many occasions.

Another theory applied by consumers in making decisions is the Expected Utility theory (EUT) (Starmer, 2000). This is the standard theory of individual choice in Economics. When faced with a number of different choices such as choosing whether to participate in a gamble or not, expected utility theory recommends that you calculate the expected utility of each choice and then choose the one with the highest expected utility. In the analysis of risky choices, choice should be made so as to maximize the expected utility (Edwards, 1954).

However, Kahneman and Tversky (1979) criticized the EUT by describing several classes of choice problems such as individuals' certainty or uncertainty of outcomes in which preferences violate the axioms of expected utility theory systematically. They concluded that though EUT is applied, it is not an adequate descriptive model of economic behavior. They proposed the prospect theory which differentiates two phases in the choice process which are the editing and evaluation phases. In the editing phase, a preliminary analysis of the offered prospects is done while in the evaluation phase, prospect of the highest value is chosen after evaluation.

Another theory used to explain consumer behaviour is the theory of individual decision making which describes two approaches used to model individual choice behavior. These are preference based approaches which assumes that a decision maker has a preference relation over a set of possible alternatives that satisfies certain rational axioms and choice based approach. The latter focuses on the behaviour of the decision maker and makes use of the weak axiom assumption of revealed preference which imposes an element of consistency on choice behavior.

The weak axiom assumption states that given a bundle of goods say a and b, and a consumer prefers a over b, then under no circumstance will a consumer prefer b to a if both bundles are available (Whinston & Green, 1995).

According to Green (2012), Random utility theory which is also used in the analysis of individual choice, basically involves modelling of discrete choice outcomes such as a choice among a set of alternatives or purchase decisions. This type of modelling relies on preferences of decision makers. The decision makers are faced with a situation or a set of alternatives and they reveal their preferences by the choice they make. Green further notes that models used to explain a binary dependent variable are typically motivated in two contexts. First, individual choice in two alternatives could be influenced by observable effects and unobservable aspects of the preferences of the individual. Second, the nature of data in other binary choice models dictates the special treatment of a binary dependent variable model.

If an individual faces a pair of choices and chooses one between the two that provides greater utility, then binary choice model is appropriate in modelling such a case. The binary choice outcome takes a value of 1 for success and 0 for failure. The dependent variable is an indicator of whether or not some outcome occurred rather than being a quantitative measure of some economic outcome. According to Green (2002), we model probabilities and by use of econometric tools make probabilistic statements about the occurrence of an event. This model is most appropriate for this study since it involves a binary choice outcome as opposed to the other consumer theories which assume continuity in the outcomes.

2.2 Empirical Review

Use of Insecticide treated nets is among malaria prevention measures used widely in many households. Therefore, ownership is one of the important factors influencing the use of ITNs (Hetzl *et al.*, 2012). Due to its central role in malaria prevention, ownership of ITNs has been increased in many African countries (Garcia-Basteiro *et al.*, 2011, Bennett *et al.*, 2012). For instance, ownership in Bioko Island in Equatorial Guinea was enhanced in 2007 where 110,000 LLINs were distributed to households.

However, a decline of 32 percent was reported in the year 2008/09 in household ownership of ITNs and this was attributed to increase in housing and population in the country. In Sierra Leone, over 3 million Long-lasting Insecticide treated nets (LLINs) were distributed to households in an effort to protect individuals from malaria infection. This distribution increased ownership from 37 percent to 87.6 percent (Bennett *et al.*, 2012).

One of the methods used to increase ownership in Kenya is the free distribution of ITNs/LLINs to expectant mothers and children under-five years of age through the ante-natal and post-natal clinics and mass campaigns (Republic of Kenya, 2011). Studies show that high coverage levels were achieved in Kenya after the mass distribution campaigns. In an effort to identify and address barriers to access and use of insecticide treated nets among the poorest populations in Kenya, (Chuma *et al.*, 2010) found that coverage among the under five at the national level was at 39.2. In some regions such as the highlands of western Kenya, ownership of ITNs was reported at 71 percent according to a study on insecticide treated net (ITN) ownership, usage and transmission in the highlands of western Kenya (Atieli *et al.*, 2011).

This is an epidemic prone area where the intensity of malaria transmission is high during the long rains. Malaria zones determine who is at high risk of malaria infection and priority is given to the high risk zones when it comes to distribution and this could be the reason ownership is high in these regions. According to Atieli *et al.*, (2011), socio-economic factors such as education level of household head were a significant determinant of ITN use. Other factors reported to be significant is presence of high numbers of nuisance mosquitoes and low indoor temperatures which were reported to increase use of ITNs. However, the National net ownership in Kenya has remained constant at about 48-50 percent since 2007 (Republic of Kenya, 2011).

In areas where ownership of ITNs has been enhanced, factors such as region of residence, knowledge on malaria transmission, presence of fever in a child two weeks prior to the survey, age, gender and occupational status of the household head and the household size were identified as significant determinants of use of ITNs (Afolabi *et al.*, 2008, Biadgilign *et al.*, 2012). Specifically, Biadgilign *et al.*, in a study on determinants of ownership and utilization of insecticide treated nets for malaria control in Eastern Ethiopia and by use of a logistic regression found a unit increase in the size of households increased the odds of ownership of a net more than twice. More importantly, the study showed that households which had at least one under-five child the odds of owning any net was about 60% higher than those with no under-five children. According to Garcia-Basteiro *et al.*, (2011), applied a logistic model to identify determinants of bed net use in children under five and household bed net ownership in Bioko Island, Equatorial Guinea and found that a child being sick 2 weeks prior to the survey and residing in an urban area had a strong positive association with use of ITNs while education level of household head was weakly associated with use of ITNs.

Bennett *et al.*, (2012) by use of logistic regression to assess household possession and use of insecticide treated mosquito nets in Sierra Leone 6 months after a national mass-distribution campaign found that those households' whose heads had malaria knowledge on transmission and had at least one ITN hanging were more likely to use ITN for malaria prevention.

However, despite the fact that ownership has been stable, available evidence shows that utilization of ITNs among children under five years of age has been low and the gap between ownership and utilization is large (see for instance Afolabi *et al.*, 2008, Oresanya *et al.*, 2008). According to Oresanya *et al.*, (2008), in the study on utilization of insecticide treated nets by under five children in Nigeria by use of logistic regression found that factors such as religion and presence of a health facility predicted use of ITNs by under fives. Specifically, having a health facility in the community where a child lived had a strong impact on the use of ITNs the night prior to the survey with odds three times higher than where the facilities were absent.

Again, the odds among Christian caregivers for under five to sleep under ITN was three times higher than for Muslim caregivers. It was also reported that for educated caregivers, a unit rise in wealth index increased the odds of utilization of ITNs by 43%.

In Ghana for instance, a study on mothers demand for preventive healthcare for children aged under-five years: a case of utilization of insecticide treated bed nets in Ghana by use of a logistic regression revealed that factors such as low-income among households, age of the child, area of residence, distance to the nearest health facility and distance to nearest food market predict mothers adoption and utilization of ITNs (Nketiah-Amponsah, 2010). It was found that the probability of a child to sleep under a net was inversely related with age.

Similar findings were reported by Kenya malaria indicator survey which showed that use of ITNs decreases as the age of child increases (Republic of Kenya, 2011). Although the Kenya malaria indicator survey highlights the fact that use of ITN is low at 42 percent by the under fives and use decreases as the age of child increases, it has not identified the intra-household factors that affect use of ITNS. Further, Nketiah-Amponsah showed a positive relationship between low income and use of ITNs.

This could be explained by the assumption that households in high income bracket are in a position to afford alternative malaria prevention methods or were living in areas where mosquitoes are not a nuisance.

On the contrary Oresanya, Hoshen and Sofala (2008) found a negative relationship between income and use of ITNs in Nigeria. The findings showed that children in the 2 upper quartiles were more likely to have slept under ITNs than the children in the 2 lower quartiles. These findings were supported by Astatkie and Feleke (2009) in a study on utilization of insecticide treated nets in Arbaminch Town and the malarious villages of Arbaminch Zuria District, southern Ethiopia found a negative relationship between use of ITNs and income in Ethiopia. According to Feleke and Astatkie (2009) factors such as sex, income of household head and presence of a radio in the household were predictors of utilization by any household member while education level of the household head and area of residence were predictors of utilization by high risk groups.

They noted that having a female household head, increase in income of household head and having a radio in the household decreased the odds of net utilization while increase in education and residing in rural area were found to increase the odds of utilization by high risk groups.

In Kenya, sleeping arrangement was found to be a significant predictor of use of ITNs (p-value 0.001) with those sleeping in beds having a higher probability of using nets than those not sleeping in a bed. The number of sleeping rooms was also found to be an important determinant of use of ITNs (Iwashita *et al.*, 2010).

Other key factors which explain the use of ITNs for malaria prevention relate to perceptions, attitude and retention level of ITNs. Documented evidence show that knowledge and misconception on causes and prevention of malaria, awareness on malaria prevention and the retention period of ITNs have a significant effect on use of ITNs (Arogundade *et al.*, 2011, Gobena, berhane, and worku ,2012). Arogundade *et al.*, while investigating the relationship between care-givers misconceptions and non-use of ITNs by under-five Nigerian children using a logistic regression model and Gobena *et al.*, in a study seeking to understand the cause of low long-lasting insecticide nets (LLINs) use among household members for protection against mosquito bite in kersa, Eastern Ethiopia reported a positive relationship between those with knowledge on causes of malaria and use of ITNs. In addition, use of ITNs was found to be low among people with little knowledge on malaria prevention methods.

Other studies such as by Mutuku *et al.*, (2013) while investigating the physical condition and maintenance of mosquito nets in Kwale county, coastal Kenya found that bed were optimally utilized when they are new and physically intact but their use decreases significantly after 1.5 years of use.

2.3 Synthesis of Literature

Studies have shown that ownership has been enhanced in many countries and despite it being high, utilisation still remains low. Evidence from the reviewed literature showed that utilization of ITNs is affected by a variety of factors including family size, number of sleeping rooms, age of the child, nature of the house, education level of the head residence, income and other social-economic factors. Most of the studies have analysed cross sectional data by use of logistic regression method.

The findings in these studies are not conclusive and there seems to be no consensus for some of the factors which affect use of ITNs. For instance, Garcia-Basteiro *et al.*, (2011) argues that use of ITNs in the rural areas is lower compared to urban areas in Equatorial Guinea while Bennet *et al.*, (2012) claims that use is high in the rural areas than urban areas in Sierra Leone.

All evidence from the literature indicate that significant effort has been made to enhance ownership in most Sub-Saharan African countries including Kenya, but utilisation of ITNs still remains below the national and regional targets compared to ownership. In view of this, it is imperative to examine factors which affect use of ITNs.

CHAPTER THREE: METHODOLOGY

3.1 Theoretical model

In the theory of consumer choice, a consumer can either be a risk-seeker, risk-neutral or risk-averse (Varian, 1992). On the assumption that individual households in Kenya are risk-averse, they would choose to use an ITN or LLIN to avoid or reduce the risk of malaria infection, development of clinical disease or even death. It's further assumed that the risk-averse behaviour emanates solely from the rational decisions of the likely outcomes and the opportunity costs of different decisions. Thus, the choice problem affecting the guardian is whether to use or not to use an ITN/LLIN for children less than five years of age for prevention of malaria. Further, given that children under-five years of age cannot make decisions on their own the Childs guardian is responsible for making decisions and the choice to take or not to take a precautionary measure is mutually exclusive.

The hypothesis is that the Childs' guardian is faced with the choice of whether to take a precautionary measure against malaria infection or not to take any precautionary measure. The discrete choice theory implies working directly with the utility functions. The choice decision of the guardian is taken to be a function of the attributes X_{ik} the household i perceives in the k^{th} ($k =$ use of ITN/LLIN, non-use of ITN/LLIN) choice; and households social-economic characteristics (Y_i). This hypothesis can be expressed as:

$$U_{ik} = U_{ik} (X_{ik}, Y_i) \dots \dots \dots (1)$$

Where;

U_{ik} is the utility that the i^{th} household expects to derive from the k^{th} option. The options are represented in a way that when $k=1$, it means a child under-five years sleeps under ITN/LLIN and when $k=0$ then it means a child does not sleep under an ITN/LLIN; X_{ik} is a vector of use or non-use of ITN attributes such as age and sex of guardian, knowledge on malaria treatment and intra-household factors such as family size and household characteristics while Y_1 is a vector of households socio-economic characteristics such as gender of household head.

3.2 Econometric model

This study employed the random utility model because of the nature of the outcomes which are discrete in nature. According to Kirigia *et al.*, (2005), the individual household's choice decision can be seen as a comparison of two rival utilities, U_{i1} and U_{i0} where U_{i1} and U_{i0} are defined as the indirect utilities, which the guardian of the i^{th} individual household associates with taking a precautionary measure and not taking any precautionary measure respectively. In a linear form, the utility functions take the following form:

$$U_{i0} = \beta_0 + X_{i0}\beta_0 + \gamma_0 w_0 + \varepsilon_0 \dots \dots \dots (2)$$

and

$$U_{i1} = \beta_1 + X_{i1}\beta_1 + \gamma_1 w_1 + \varepsilon_1 \dots \dots \dots (3)$$

Where the observable vector of characteristics of the guardian (like age, gender) is denoted by X , while w denotes features of the two choices that are choice specific and ε is the error term, which is specific to and known by the individual but not the observer.

The guardian will make a decision whether to use an ITN/LLIN based on the following options: One, the guardian will opt to use an ITN/LLIN for precautionary measure ($k=1$) if and only if it is perceived there is a net welfare improvement (i.e. opt for k^{th} option if $U_{i1} > U_{i0}$). Second, the guardian will choose the k^{th} option if the expected benefits are equal or greater than the options opportunity cost. Assuming that the motivation of the guardian is to maximize the welfare of his/her family, he/she will choose the decision with the highest expected benefit to the family. This can be expressed as:

$$p(k = 1) = p(z' \beta + \varepsilon > 0) \dots\dots\dots (4)$$

Where $z' \beta$ is a collection of all the observable elements of the difference in the two utility functions and ε is the difference between the two error terms. Using equation (4) above, the probability that a guardian in the i^{th} household opts for a precautionary measure against malaria infection can be estimated using the following logistic regression model:

$$p(k = 1) = \frac{e^{z' \beta}}{1 + e^{z' \beta}} \dots\dots\dots (5)$$

Such that and $p(k = 1)$ is the probability that a child sleeps under an ITN/LLIN and z is a linear combination of the explanatory variables.

Linearly, this can be expressed as shown below:

$$U = \beta_0 + \beta_1 \text{agehhhead} + \beta_2 \text{agesq} + \beta_3 \text{hhsiz} + \beta_4 \text{netrmratio} + \beta_5 \text{evertrted} + \beta_6 \text{malariazons} + \beta_7 \text{sex} + \beta_8 \text{advtrtmnt} + \beta_9 \text{no-boys} + \beta_{10} \text{fever2weeks} + \varepsilon_i \dots \dots \dots (6)$$

where;

β 's are the parameters to be estimated;

Age hhhead: the age of guardian who takes care of the child

Agesq: age of the guardian squared

Hhsiz: total number of persons in a household

Netrmratio: net room ratio

Ever trted: if the net was treated after it was acquired

Malaria zons: malaria zones

Sex: gender of household head

No-boys: gender of the child proxied by number of boys

Advc trtmnt: advice on treatment

Attd: attitude on malaria treatment

Fever 2wks: fever two weeks previous to the survey

U: Utilization of ITNs/LLINs

ε = is the error term.

In general equation (5) can be expressed as:

$$U = \alpha + \beta X_{ik} + E_{ik} \dots \dots \dots (7)$$

Where $U = 1$ if a child under-five years of age slept under ITN/LLIN, 0 otherwise.

3.3 Estimation Technique

The appropriate estimation technique for equation (7) is the maximum likelihood method because Ordinary Least Squares (OLS) estimates would be biased and inconsistent due to nature of the error term which is assumed to follow a logistic distribution. Furthermore, OLS does not restrict the outcomes between 0 and 1 which is the case for binary models. We assume the existence of a binary variable U_{ik} that takes the value of 1 if a child less than five years of age, i sleeps under a bed net (indexed as alternative $k = 1$) and 0 otherwise (indexed as alternative $k = 0$). This can be written as:

$$U_{ik} = 1 \text{ if } k = 1 \text{ (Child sleeps under a bed net)} \dots\dots\dots (8_a)$$

$$U_{ik} = 0 \text{ if } k = 0 \text{ (otherwise)} \dots\dots\dots (8_b)$$

Expressing the probability that a guardian i opts for alternative 1 as $P_{i1} = pr(U_{i1} = 1)$ and alternative 0 as $P_{i0} = 1 - pr(U_{i1} = 1)$, then the likelihood equation can be rewritten as:

$$l = \prod_{u=1} pr(U_{i1} = 1) \prod_{u=0} 1 - pr(U_{i1} = 1) \dots\dots\dots (9)$$

Assuming further that the sample consists of independent observations on n children less than five years of age, then the likelihood function is given by:

$$l(\beta) = \prod_{u=1}^n F(z' \beta) \prod_{u=0}^n [1 - F(z' \beta)] \dots\dots\dots (10)$$

Where \prod is the index for multiplication and indicates that the product is taken only over those cases where $u = 1$ and $u = 0$, respectively. By taking logs, we obtain the log likelihood equation as shown in equation (11):

$$\ln L(\beta) = \sum_{u=1}^n \ln F(z' \beta) + \sum_{u=0}^n \ln [1 - F(z' \beta)] \dots\dots\dots (11)$$

3.4 Data types and source

The study employed cross-sectional data from the Kenya malaria indicator survey (KMIS), a nationally representative household survey which was conducted between July-September 2010. The study which was carried out by the Division of Malaria Control (DOMC) and the Kenya National Bureau of Statistics (KNBS) in collaboration with other partners was aimed at determining the status of coverage of various key malaria intervention measures like use of bed nets and coverage among other things. The KMIS data provides information on household characteristics such as age, sex; characteristics of the household dwelling unit such as source of water and main cooking materials and information on use of ITNs. A sample of 7200 households was selected to be a representative of the entire household population in Kenya.

After merging individual characteristics with household characteristics, the data, was imported to STATA from SPSS. The data was then cleaned and the variables of interest were generated from the cleaned data. The definition, measurement and a priori expected impact of the independent variables on the dependent variable are summarised in Table 3.1.

3.5 Definition of variables and the expected A priori signs

This sub-section provides definition of variables used in estimating the equation. The independent variable is Utilization of ITNs. This variable is derived from the question on whether anyone slept under a net the night prior to the survey. It is a dummy variable taking the value of 1 if a child slept under ITN/LLIN the night prior to the survey, 0 otherwise.

3.5.1 Explanatory variables

Household size

The household size is measured as the total number of family members. The family size is hypothesised to have a positive effect on the use of ITNs because the ITNs are given to children and expectant mothers. In a family, there is high probability of having more than one child, but the number of beds and nets are likely to be fewer (Iwashita et al., 2010).

Age of the guardian

This is the age of the child's mother or the guardian measured in terms of the number of years. The effect of age and its square is uncertain prior to the survey. However, age squared which measures the experience of the guardian with respective preventive measures against malaria, meaning that the older the guardian the higher the probability of using ITNs. This is hypothesised to have a positive effect on utilisation of ITNs.

Net room ratio

The Malaria Indicator Survey data contains information on the number of rooms in a household. It is hypothesised that the more rooms available in a household, the higher the utilisation of

ITNs. The net room ratio is calculated as the number of nets divided by the number of sleeping rooms in a household.

Gender

Based on previous studies, the effect of gender on use of INTs is positive. This is a dummy variable taking the value of 1 for female headed households or guardian and 0 otherwise.

Malaria zones

Although few studies have examined the effect of malaria zones on the use of ITNs in under-five children, we hypothesise a positive relationship between malaria endemic zones and use of nets. In Kenya malaria prevalence zones classified as highland epidemic zones (=1), lake endemic zones (=2), moderate malaria zones (=3), seasonal malaria zones (4) and the low risk malaria zones (=5 and is the reference zone). It is hypothesized that areas with high malaria prevalence are more likely to use ITNs and therefore important to assess the effect of these malaria zones on utilization.

Advice on treatment of malaria

This is a dummy variable taking the value of 1 if household ever sought advice on malaria treatment and 0 otherwise. We hypothesise a positive association between net use and those who sought advice on the treatment of nets. Available literature shows that high awareness on the benefits of attitude/perception on the use of ITNs affects their utilisation.

Fever two weeks

Households inflicted by malaria or fever during the last two weeks prior to the survey, an indicator of malaria presence are likely to use a net compared to those households who did not experience fever over the same period. This is a dummy which takes a value of 1 if a child in a household experienced fever two weeks prior to the survey and 0 otherwise.

Sex of child

The sex of the child is proxied by the number of boys. The sex of the child could not be used because there were different children in a household. It's not certain whether gender of the child will have a positive or negative effect on use of ITNs.

Ever treated a net

The malaria indicator survey contains information on treatment/retreatment of the nets since buying. Treatment of nets is an indicator of the importance of that the guardian places in the prevention of malaria. We hypothesise a positive relationship between treatment of net and utilisation. This is a dummy variable taking the value of 1 if the guardian ever treated the ITNs/LLINs since acquisition and 0 otherwise.

Table 3.1: Definition of variables used in the estimation and their expected apriori signs

Variable	Definition of variable	Measure	Expected sign
Age of hhhead	Age of the household head or guardian	Number of years	Uncertain
Agesq	Experience in malaria prevention	Number of years squared	Positive
hhsz	average number of household members	average number of people in a household	positive
Net room ratio	Number of sleeping rooms divided by the number of bednets	Ratio of rooms to bednets in a house	Uncertain
Sex	Gender of household head	Dummy variable taking the value of 1 if household head is female, 0 otherwise.	Positive
malaria zones	These are malaria zones showing the prevalence of malaria	A dummy variable taking the value of 1=highland epidemic prone zone, lake endemic zones (=2), moderate malaria zones (=3), seasonal malaria (=4) and low risk malaria zone (=5)	positive
Advice-treatment	Households who sought advice on treatment of nets	Dummy variable taking the value of 1 if guardian sought advice on malaria treatment, 0 otherwise	Positive
Fever	Number of households reporting a child having contracted fever two weeks prior to the survey	A dummy variable taking the value of 1 if a child experienced malaria 2 weeks prior to the survey and 0 otherwise	Positive
No_boys	This is a proxy for sex of the child	Number of boys in a household	Uncertain
Ever treated	Households who reported having treated their nets since acquisition	dummy variable taking the value of 1 if the guardian never treated the nets after acquisition, 0 otherwise	Positive

CHAPTER FOUR: ECONOMETRIC RESULTS

4.0 Introduction

This chapter reports estimation results based on logistic regression method. First, i discuss the specification test by use of likelihood ratio test. Second, i present the descriptive statistics of the variables used in the logistic regression model, the odds ratios results and finally the marginal effects results.

4.1 Specification test

Likelihood ratio test was used to find out if the model was correctly specified. The binary logit estimation resulted in a maximized log likelihood of -996.11055. The test of joint significance of the effect of predators has a statistically significant chi-square statistic of 459.61(given by the probability of 0.000). A significant log-likelihood chi-square statistic implies that the model with coefficients from the predictors is a better improvement of the model with the intercept only. It means that the intra-household factors such as size of the household and socio-economic characteristics such as gender and age of household head are jointly important determinants in use of ITNs. A pseudo R2 of 34.09 was reported.

4.2 Descriptive Statistics

After data cleaning, the final sample size was 2182 children under the age of five years. Tables 4.1a and 4.1b show the descriptive statistics of the variables used in the estimation. Regarding the usage of ITNs, approximately 48 percent of the children slept under an ITN the night prior to

the survey. This is comparable to the national reported statistics which have remained relatively constant since 2007 ranging from 39.4 percent to 48.42 percent.

This could be attributed to the fact that net ownership has remained relatively constant within the same time period ranging between 48-50 percent (Republic of Kenya, 2011). This figure is relatively low compared to the 80 percent Abuja target of 2010. The mean age of the household head was 45 years with a maximum and minimum age of 96 and 12 years respectively while the average total number of people living in a household varied from one to 28 people, with a mean value of 4.44 ± 2.59 per household. The net room ratio per household was 0.56 ± 0.61 rooms, with a maximum of 4 nets and minimum of 0 nets.

Table 4.1a.Descriptive Statistics (continuous variables)

Variable	observations	mean	std dev	min	max
age of hhhead	3687	45.33	16.39	12	96
agesq	3687	2323.09	1662.12	144	9216
net-room-ratio	3672	.5524	.6143	0	4
No-boys	3687	.8207	1.2878	0	10
hh-size	3687	4.4437	2.5923	1	28

Source: Own computation (with STATA)

Table 4.1b presents a summary of descriptive characteristics of discrete variables. Only 11 percent of households treated their nets since acquisition while over 88 percent who owned a net indicated that they never treated the net since acquisition. The majority (62.7%) of the households had a female as its household head. Only 7% of the respondents in the sample had sought advice on malaria treatment while about 13% , of the households had experienced fever two weeks prior to the survey.

In the sample size, 26.4 percent of the respondents lived in malaria low risk zones, 18.7 percent in malaria moderate zones, 9.57 percent in malaria high risk zones, 20.3 percent in malaria lake zones and 24.95 percent in malaria seasonal zones.

Table 4.1b.Descriptive Statistics (Discrete Variables)

Variable	Freq	Percent
Treatment of ITNs		
Never-treated net	1943	88.52
Ever-treated net	252	11.48
Fever 2 weeks		
Presence of fever 2 weeks	252	12.58
No fever 2 weeks	1973	87.42
Advice on malaria treatment		
Sought advice	158	7.00
Never sought advice	2099	93.00
Sex of hhhead		
Male	1377	37.35
Female	2310	62.65
Malaria Zones		
malaria lake	749	20.33
malaria high	353	9.57
malaria moderate	690	18.71
malaria seasonal	920	24.95
malaria low risk	975	26.44
Utilization		
Slept under ITN/LLIN	1057	48.42
Not slept under ITN/LLIN	1126	51.58

Source: Own computation (With STATA)

4.3 Logistic Regression Results

The results obtained from running equation 7 using the binary logit model are shown in table 4.2.

The coefficients explain the changes in the probabilities of the outcome as a result of a unit change in the explanatory variables. Utilization is used as the outcome category in this equation.

Six variables were found to be statistically significant in this output: age of household head,

presence of fever two weeks prior to the survey, household size, sex of household , gender of the child and if the net was ever treated since acquisition.

Presence of fever in a child two weeks prior to the survey increases the log of the probability of using an ITN by 2.05 compared to those who never experienced fever two weeks prior to the survey. Presence of fever two weeks prior to the survey is statistically significant at 0.05 level. This means that in households where a child had experienced fever before, the guardians in these households were 2.05 times more likely to make sure their children slept under an ITN as compared to those children who never experienced any fever episode before.

The age of the household head decreases the log of the probability of using an ITN by 0.14. This means that having very old guardians was 0.14 times less likely to ensure that children slept under an ITN as compared to younger guardians. On the other hand, age squared increases the log of the probability of using an ITN by 0.0007. This means that for the guardians who have used nets before, they are 0.0007 times more likely to make sure their children sleep under an ITN as compared to those who have never used ITNs before. Both age of household head and age squared are statistically significant at 0.05 level.

Household size increases the log of the probability of using an ITN by 0.31 and it statistically significant at 0.05 level. The average number of members in a household in our sample is four. This means that households with four or less members are 0.31 times more likely to ensure that children under five years of age sleep under an ITN as compared to those household with more than four members. Also, the gender of the household head increases the log of the probability of using an ITN by 0.23 and is statistically significant at 0.05 level. This means that households

headed by female heads are 0.23 times more likely to have children sleep under ITN as compared to those households headed by males.

Being a boy increased the log of probability of using an ITN by 0.59 and is statistically significant at 0.05 level. This means that a boy child was 0.59 times more likely to use ITNs as compared to a girl child. If the household ever treated the ITNs since acquisition had a negative effect on use of ITNs and this decreased the log of probability of using an ITN by 0.51 and is statistically significant at 0.05 level. This means that household which reported to have treated their nets since acquisition were 0.51 times less likely to use ITNs.

Table 4.2: Logit results

Variable	coefficient	z-statistic	p-value
agesq	.000701	2.58	.010
fever 2weeks	2.051047	4.85	.000
advice-treatment	-.0620564	-.11	.914
malaria low risk	-.3254693	-1.51	.130
malaria seasonal	-.1623216	-.78	.437
malaria moderate	-.0407963	-.19	.851
malaria lake	-.180759	-.89	.371
hhsz	.3108217	8.6	.000
age of hhhead	-.1425883	-5.69	.000
sex	.2342167	1.95	.051
No-boys	.5948445	9.38	.000
Net-room-ratio	.0850111	.78	.436
Ever-treated net	-.5118032	-2.92	.003
cons	1.96074	2.95	.003
<i>no of obs=2182</i> <i>wald chi2(15)=459.61</i> <i>prob>chi2=0.0000</i> <i>pseudo R2=.3409</i> <i>log pseudolikelihood= -996.11055</i> <i>iteration=4</i>			

Source: Own Computation (with STATA)

4.4 Odds Ratio Results

The odds ratio is the ratio between the probability of using an ITN and the probability of not using an ITN. Odds ratios are obtained by taking the exponents of the coefficients shown in table 4.2. Its multiplicative effect implies that positive effects are greater than 1 and negative effects are between 0 and 1. Like the binary logit model results, six variables are statistically significant. A child having experienced fever two weeks prior to the survey increases the ratio of probability of using an ITN by 7.78 times as compared to those who never experienced fever. This implies that a child having experienced fever increases the probability of the guardian to ensure that children sleep under an ITN because they understand the dangers of malaria infection which could be the cost of treatment or even death.

The analysis further showed that it was 1.36 times more likely for a child under-5 years to sleep under an ITN in families with an average of four members in a household compared with households with more than four household members. Sex of the household head increases the ratio of probability of using an ITN by 1.26 times implying that families whose household head was female were 1.26 times more likely to put a child under an ITN while sleeping than families whose household head was a male.

On the other hand, age of household head lowers the ratio of the probability of using an ITN by 0.87 times. This implies that as the household head gets more aged, the probability of them using an ITN for malaria prevention reduces. On the other hand, age squared increases the ratio of the probability of using an ITN by 1.00 times.

Since age squared is used as a proxy for experience, then these findings shows that as the house hold head gets more experience on the use of ITNs, then use in the households' increases.

Low treatment of ITNS since acquisition decreases the ratio of the probability of using an ITN by 0.60 times implying that treatment of ITN influences their use negatively. This could be attributed to the fact that WHO is advocating for the use of LLINs which do not require retreatment and therefore most household could be using them. Finally, having a boy child increases the ratio of probability of using an ITN by 1.81 times. This implies that a boy child influences the use of ITNs in a household positively.

Table 4.3: Odds ratio results

Variable	odds ratio	z-statistic	p-value
agesq	1.000701	2.58	.010
fever 2 weeks	7.77604	4.85	.000
advice treatment	.9398299	-0.11	.914
malaria low risk	.7221883	-1.51	.130
malaria seasonal	.8501678	-0.78	.437
malaria moderate	.9600247	-0.19	.851
malaria lake	.8277237	-0.89	.371
hhsz	1.364546	8.6	.000
age hhhead	.867111	-5.69	.000
sex	1.263918	1.95	.051
no-boys	1.812749	9.38	.000
net room ratio	1.088729	0.78	.436
ever treated net	.5994137	-2.92	.003
constant	7.104585	2.95	.003
<i>obs=2182</i> <i>iteration=4</i> <i>wald chi2(15)=459.61</i> <i>prob>chi2=0.0000</i> <i>pseudo R2=.3409</i> <i>log pseudolikelihood= -996.11055</i>			

Source: Own Computation (With STATA)

4.5 Marginal Effects Results

Table 4.4 provides the marginal effects of a change in the probability of an outcome as a result of change in the explanatory variable. For continuous variables, change is calculated from the mean while the discrete variables are treated as dummy variables. From the results, a child having experienced fever 2 weeks prior the survey increases the probability of using ITNs by 42.77 percent. Few members in a household too increase the probability of using an ITN by 7.75 percent in a household. Having a female as household head increases the probability of using ITNs by 5.82 percent.

A boy child increases the probability of using ITNs by 14.82 percent. However, having never treated an ITN since acquisition decreases use by 12.43 percent. Similarly, household led by aged guardians have a lower probability of using ITNs by 3.55 percent. However, experience which measures importance of use of ITNs for malaria prevention proxied by age squared increases use by 0.17 percent.

Table 4.4: Marginal effects

Variable	Marginal effects	z-statistic	p-value
agesq	.0001747	2.57	.010
fever 2 weeks	.4276773	7.44	.000
advice treatment	-.015437	-.11	.914
malaria low	-.0802583	-1.54	.124
malaria seasonal	-.0403205	-.78	.435
malaria moderate	-.0101598	-.19	.851
malaria lake	-.0469285	-.90	.368
hhszise	.0774607	8.58	.000
age hhhead	-.0355348	-5.66	.000
sex	.0581879	1.96	.050
No-boys	.1482427	9.29	.000
net room ratio	.0211858	.78	.436
ever treated net	-.1243071	-3.04	.002
<i>obs=2182</i> <i>iteration=4</i> <i>wald chi2(15)=459.61</i> <i>prob>chi2 =0.0000</i> <i>pseudo R2=.3409</i> <i>log likelihood= -996.11055</i>			

Source: Own Computation (with STATA)

4.6 Discussion of the results

The findings from this study showed that only 48 percent of children included in this study slept under an ITN. This shows a noticeable change compared to a rate of 39.4 percent reported in the Kenya malaria indicator survey in 2007. However, this level of utilisation is still not acceptable as it falls below the 80 percent target of (2010) for under-5 children, set by the African head of states in Abuja. Moreover 14 years after the RBM target declaration in Abuja, Kenya like many African countries has not yet met the target. In the sample, there were 51.58% children who reported not having slept under an ITN two weeks prior to the survey.

Given that some households in the sample did not own an ITN, and the average number of ITNs in a household was 0.55, then it is imperative for the government to ensure that more nets (and sustainable supply channels) are available at least as urgently as the creation of awareness of the benefits of using ITNs. Awareness creation without extra campaign supply could help to increase ITN usage in areas with complementary sources of ITNs.

From the results, children who were reported to have had fever two weeks prior to the survey were more likely to sleep under ITNs. There was a positive association between a child having experienced fever and the use of ITNs and this was significant at ($p=0.000$). In previous studies, similar findings were reported by Oresanya, Hoshen and Sofala (2008) and Garcia-Basteiro et al., (2011) who showed that previous episodes of fever in a child was a significant determinant of use of ITNs by children under five years. An increased awareness of risk brought about by being sick may translate into better compliance with malaria protection. This could be explained by the consequences which come along with not using an ITN which could include hospitalization cost or even death in case of malaria infection. It is therefore important to address the misconception that children should use nets once they have been sick through information, education and communication (IEC) messages.

Households with female heads were more likely to use ITNs with an odds ratio of 1.26 and this was significant at ($p=0.051$). This implies that female house heads were more likely to put an under-5 child under an ITN during sleep than were male household heads.

One of the explanations for this is that women and mothers are better in carrying out domestic chores including health-related activities; particularly child related ones such as use of ITN and administration of medicines as compared to males. It is therefore not surprising that the probability of an under-5 child to sleep under a bed net in households where a woman is the head is higher than those with males headed households. Similar findings were reported by Graves *et al.*, (2011) and Bennette *et al.*, (2012) who reported female led households were more likely to use ITNs.

Number of members of a household is found to have a significant and positive effect on the use of ITNs ($p=0.000$). This survey finds that an average of four members or less in a household influences use of ITNs positively. Similarly, Biadgilign, Reda and Kedir (2012) found that household with four members or less were more likely to use ITNS. This could be attributed to the availability of ITNs since it is easier for few members of a household to share the ITNs as compared to when household members are many with few ITNs.

Age of household head was found to be statistically significant though it had a negative effect on use of ITNs. On the other hand, Age squared which is used as a proxy for experience affects use of ITNs positively and is statistically significant at ($p= 0.01$). This implies that age squared is an important determinant in the usage of bed net by an under-5 child. Older household heads seem to use ITNs more than younger household heads.

This could be associated with more exposure to awareness, education during ANC visits, and perhaps exposure to media, internet and frequent use of health facilities by the more experienced mothers which is likely to increase the probability of being informed about the ITN program of receiving ITNs, and the importance of using ITNs for prevention of malaria in under five children over that in younger people. Failure to treat ITNs affects use of ITNs negatively significant at ($p=0.02$).

This study found that having sought advice on malaria treatment did not have any significant effect on use of ITNs. However, previous studies such as Graves *et al.*, (2011) and Garcia-Basteiro *et al.*, (2011) found that having knowledge on malaria transmission had a significant effect on use of ITNs. Malaria zones and wealth too didn't have significant effect on use of ITNs.

CHAPTER FIVE: CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Conclusions

This chapter presents conclusions and policy implications based on the findings. The use of ITNs has been found to be effective in preventing malaria infection. However, in Kenya and other Sub-Saharan African countries, use of ITNs by children under five years of age had not achieved the Abuja target of 80 percent by 2010. One of the objectives of this study is to identify the intra-household factors that affect use of ITNs among under fives. This study therefore concludes that there are intra-household and socio-economic factors that affect utilization of ITNs within households with children under five years of age. These factors include: gender of household head, presence of fever in a child two weeks prior to the survey, household size gender of child, age of household head and if ITN was ever treated after acquisition. These factors therefore hinder proper coverage of all household members and therefore presence of an ITN in a household may not guarantee utilisation. Other factors not identified in this analysis may certainly also have contributed to non-usage, at least indirectly. For instance, some households reported as not owning an ITN may have received an ITN but for some reason disposed it off. Therefore, efforts to increase ITN use should be based on detailed evidence on particular area/zone why people don't use ITNs.

5.2 Suggested policy implications

Based on this study, household size is found to significantly affect use of ITNs with households with fewer members being more likely to sleep under an ITN. This could be attributed to inadequate ITNs to cover all household members in case of large houses since the ITNs may not be enough. Since this study points out that expectant mothers and children under five years of age were the beneficiaries of the free distribution of ITNs, plans should be made to increase the number of free ITNs distributed to households. Such a strategy can eliminate the possibility of the adults using ITNs made for the young children who may not have the first priority for using the nets due to scarcity of ITNs in the household.

The study further found that presence of fever in a child two weeks prior to the survey had a positive impact on use of ITNs. This finding suggests the need for education as a means of achieving increased and appropriate ITN utilization so as to avoid the misconception that children use ITNs once they have been sick. Increased awareness of the risk brought by one being sick result to better compliance with malaria prevention.

The other key finding of this study which needs to be addressed is the effect of gender of both the household head and child on use of ITNs and the age of household head. Since female heads tend to use ITNs more for malaria prevention and the results reveal that being a boy child increases the chances of sleeping under an ITN, it is important to highlight the importance of using ITNs for all children without discrimination by sex and all guardians and household heads, male and female, young and old should be enlightened on the benefits of using an ITN.

While recognizing that the Division of Malaria control (DOMC) cannot embark on adult education of the vast majority in the slums and rural communities where most people are either illiterate or semi-literate, it could liaise with some ministries such as the ministry of communication, education and women development in developing and disseminating information on ITN use and benefits in the language that audience best understand.

5.3 Suggestions for further research

One of the major limitations of this study is the use of quantitative data solely obtained from the Kenya malaria indicator survey of 2010. As revealed in the literature review, use of ITNs in households is influenced by many factors many of which are not captured in the data set. Determining the extent of retention of ITNs, who is most likely to sleep under an ITN, perceptions and attitude on use of ITNs, sleeping arrangements in the households are believed to play an important role but obtaining such information requires a lot of qualitative interviews with household heads. As a result, the study failed to provide rich information as far as the factors affecting use of ITNs by underfives is concerned. It is suggested that further studies should be conducted using primary data so as to capture as many variables of interest as possible that are likely to influence use of ITNs.

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