Determinants Of Insecticide Treated Mosquito Nets Utilization Among Households Of Vihiga Sub-County

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ABSTRACT

Insecticide Treated Mosquito Net (ITN) use is one of the primary malaria intervention recommended by the Kenyan government of Kenya through the Ministry of Health. Although several studies have been done with regards to ITN utilization, no study had been done to investigate the household factors that affect the utilization of ITNs across all age groups. This study explored the household factors that affect net utilization in Vihiga Sub-County. It looked at various factors within the household that affected Insecticide Treated Net use i.e. the determinants of ITN use across all age groups in Vihiga Sub-County. The study used a binary logit method where Insecticide Treated Net (ITN) use was the dependent variable defined as total household members who slept under an ITN all nights throughout the year while the other variables were treated as either discrete dummy variables or continuous variables. Regression results showed that household size, knowledge of causes of malaria, perceived effectiveness of ITN and Knowledge of ITN as a malaria prevention strategy significantly affected ITN use. This was assessed through the p-values which were less than 1percent and z-scores which were more than 2. The study concludes that these factors hinder use of ITNs indicating that presence of an ITN in the house might not translate into use unless these factors are properly addressed. The key policy variable that government can work on is awareness creation due to the role of knowledge in the model. Hence the study recommends increased awareness creation through line ministries in order to achieve reduced morbidity and mortality across all age groups.

Key words: Insecticide treated mosquito nets, malaria

LIST OF ABBREVIATIONS

AIDS: Acquired Immune Deficiency Syndrome. CDC: Center for Disease Control. DHIS: District Health Information System. GOK: Government of Kenya. HIV: Human Immune Deficiency virus. ITN: Insecticide Treated Nets. KDHS: Kenya Demographic Health Survey. KMIS: Kenya Malaria Indicator Survey. KNBS: Kenya National Bureau of Statistics. MOH: Ministry of Health. NGO: Non Governmental Organization. PHO: Public Health Officer. UNICEF: United Nations International Children Empowerment Fund. WHO: World Health Organization.

1. INTRODUCTION

1.1 BACKGROUND TO THE STUDY

1.1.1 MALARIA BURDEN

Malaria has been documented as a leading cause of morbidity and mortality worldwide, affecting mostly the pregnant and young children, and more so in Tropical Africa where at least 90 percent of malaria deaths occur (UNICEF, 2004). According to World Health Organization, more than three quarters of global malaria deaths occur in under-five children living in malarias countries in Sub-Saharan Africa, where 25 percent of all childhood mortality below the age of five (about 800,000 young children is attributable to malaria) (WHO, 2003). In Kenya, malaria is the leading cause of morbidity and mortality, with close to 70 percent (24 million) of the population at risk of infection (MoH, 2010). It is responsible for one out of every four child deaths (World Bank 2013). In Vihiga County malaria accounted for 20, 221 and 39, 207 outpatient morbidity for children under five years and 5 years and above respectively in 2013 while in 2014 it accounted for 43, 151 under five and 116, 377 outpatient morbidity (KNBS 2014).

Malaria is known to affect all people regardless of age; however children under the age of five years and pregnant women living in malaria endemic regions are mostly affected. Malaria impacts heavily on the economic and social development of individuals and the society as a whole, children who are sick are not able to attend school affecting their performance, employees miss work thus affecting output, money that could have been used to other uses is used on treatment. The poor are also highly affected since they can neither afford a treated mosquito net, repellants nor access proper treatment whenever they fall sick (World Bank 2013)/(Tilson, 2007). Hence to the Kenyan government malaria is considered a health issue and at the same time a socio-economic problem and an important public health area of investment (GOK, 2011)

1.1.2 HISTORY OF INSECTICIDE TREATED NETS

Insecticide Treated mosquitoe nets (ITN) have been found widely to be one of the most cost effective malaria prevention tools. When used consistently and effectively they are highly effective in preventing transmission and reducing transmission of malaria by up to 90% (Gimning et al., 2003). This can also prevent up to 44% of under five mortality according to Lengeler et al., (2002). Research also shows that if more than 80 percent of households in an area sleep under an ITN, malaria transmission is reduced to a high extend and as a result acts

as a prevention strategy benefiting non-users, (CDC, 2008). Mutuku et al., (2011) suggests that ITNs significantly reduce vector densities. Prolonged use has been linked to the vector decline. The Kenya Malaria Programme Performance Review report of 2009 indicated the country's decline in malaria trends resulting from places where nets together with other preventive measures were being employed. Population Services – Kenya revealed that a reduction in malaria admission by half during the period 1999 -2006 and a decrease of 36% under five mortality in areas using malaria control activities. Despite there being evidence that Insecticide-treated bed nets (ITNs) when used effectively and consistently are known to be highly effective in reducing malaria morbidity and mortality, usage varies among households, (KDHS, 2009) indicating that a good proportion of the population do not use ITNs even when they are available.

There has been an increased international and national funding towards malaria prevention with more funding for treated mosquito nets. In Sub-Saharan Africa this has been made possible through funding from development partners such as the President Malaria initiative by the US government, the Global Fund, UNICEF among others. Kenya as a nation has been a beneficiary of these funding. Kenyans at risk of malaria have continued to acquire ITNs through routine distribution at health facilities targeting pregnant women and children less than five years, mass net distribution targeting the entire population and the routine distribution for people living with HIV/AIDS at the Comprehensive Care Clinics. The Kenya Demographic Health Survey of 2008-09 shows ITN ownership for households with at least one ITN to be at 56% while use is at 61%.

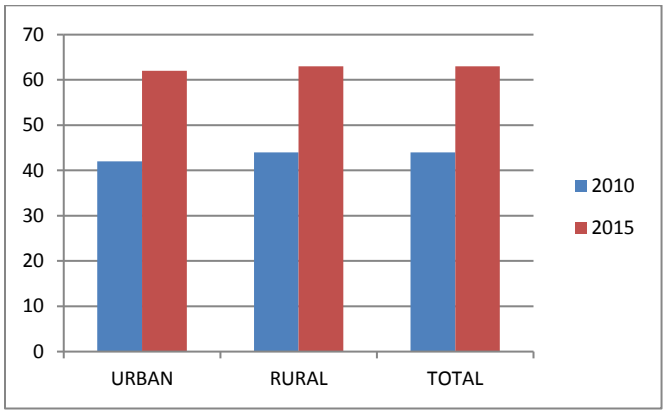
Although studies have shown a close relationship between ownership and use, there is still a wide gap between gap between coverage and use as evidenced by Eisele et al., (2009). Usage seems to be affected by various household factors such as decision making with regard to who should use an ITN and who actually uses it. Previous studies have reported factors such as ITNs knowledge, education level attained, caregivers occupation to be some of the factors affecting ownership and use in households (Wagbatsoma et al., 2010; Musa et al., 2009). A review of community acceptance of bed nets by Heggerhougen et al., (2003) revealed various factors that influence net use including cultural, behavioral and demographic factors, ethnicity, accessibility, gender relations and seasonality of malaria.

1.1.3 ITN OWNERSHIP AND USE IN KENYA

Kenya has been a beneficiary of international funding toward malaria prevention strategies. Through the Presidential Malaria Initiative Kenya has been able to conduct two mass ITN distributions targeting all malaria high risk regions. Through this initiative ITN ownership has been on the increase from 2010 when the first mass distribution was conducted. According to the Ministry of Health, Division of Malria control ITN are to be replaced after every 3 years through mass ITN distribution. This replacement is done as per the universal coverage requirement thus replacing both torn ITNs and those that have lost efficacy. However a study by Mutuku et al., (2013) revealed that use of ITNs by households is at its highest when ITNs are still new but as time goes by users tend to use the nets at decreased levels, either using them or never at all and thus by about

one and a half years many have stopped using the nets. This call for continued replacement as of old, torn or expired ones in order to enhance the effectiveness of the malaria control strategies as revealed by O'Meara et al., (2011). The figures below explain the increasing trend of ITN ownership from 2010 to 2015. According to Kenya Malaria Indicator Survey of 2015 ITN ownership of at least one ITN increased from 44% in 2010 to 63% in 2016 thus a 19% increase. Free distribution of ITNs to pregnant mothers and children under five years could also have contributed to the increase. The rural areas too have continued to experience increasing trends as compared to urban areas as shown in the figure below

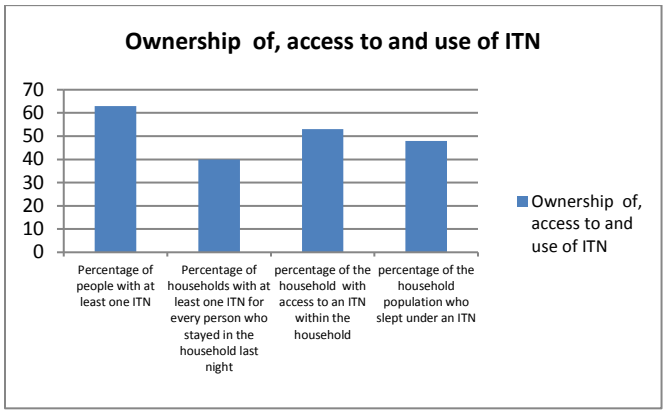
Figure 1: Trends in ITN ownership



Source: KMIS 2015

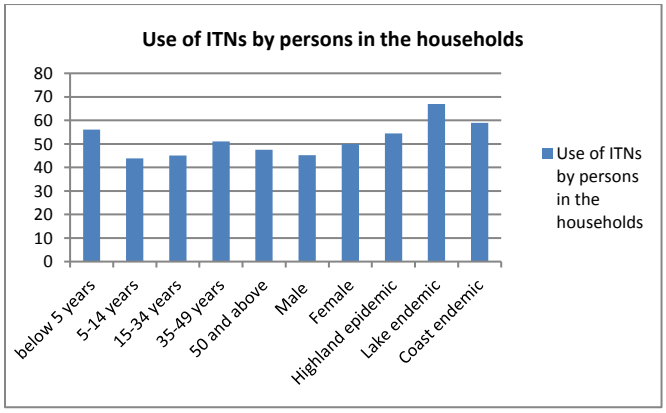
There has also been an increase in the level of ownership of ITNs between the malaria risk areas i.e. the highland epidemic, lake endemic and coast endemic. The results indicate that households in the lake endemic areas had the highest ownership of 87% as compared to coast endemic and highland epidemic which had 73%. Access to ITNs has continued to increase as household wealth increases with those at the lowest quintile being at 37% while those in the highest quintile having 63% access. Figure 2 below shows ownership of, access to and use of ITNs. Of the 63% of people with at least one household, 53% had access to an ITN within their households while 48% slept under an ITN. In addition as explained by figure 3 below children under 5 years had the highest use of ITN in the household where there was an ITN followed by those in the age bracket of 35-49, 50 and above with those with the lowest use being the 5-14 years. Females had a higher use at 49.9% as compared to males at 45.2%. Similarly the lake endemic had the highest use at 66.9 while the highlands had the lowest at 54.4%

Figure 2: Ownership of, access to and use of ITN



Source: KMIS 2015

Figure 3: Use of ITN by persons in the household



As seen from the above statistics there is still a discrepancy when it comes to ITN use both at malaria risk regions, area of residence, age of users and wealth quintiles. Therefore understanding the key determinants of ITN ownership and use across all age groups is essential to strengthen campaign strategies that will lead to increased ITN use resulting in the reduction in morbidity and mortality rates due to malaria. It was upon this background that this study explored the household factors that affect net utilization in Vihiga Sub-County.

2. METHODOLOGY

2.1 THEORETICAL MODEL

According to consumer choice theory, any potential user of a good or a service is said to be a risk-seeker, risk-neutral or risk-averse as stated by Varian, 1992. Assuming households targeted for this study are risk avoiders, they will be compelled to make a decision to use an insecticide treated mosquito net so that they are not infected by malaria or they have a reduced risk of being infected, they don't get the disease or die. For this kind of a

person there is an assumption that their behavior is as a result of rational decisions of the outcomes and opportunity cost of different decisions. Hence a household head is faced with a selection issue having to decide if to make use or otherwise of an insecticide treated net for his/her household members to prevent malaria infection. This, supported by the fact that some of the household members especially children are not in a position to decide on their own and would therefore rely on their parents or guardians to make or not to make this critical decision makes such a choice one sided though benefiting both parties involved.

The question at hand here is that the household head has to make a choice to take preventive measures to avert infection from the plasmodium parasite or to avoid it all together. The discrete choice theory in this case will mean that we work directly with the utility functions. The decision the household head takes is then taken as a function of the characteristics the household perceives in making the selection i.e. ITN use or non utilization of the same and the socio- economic attributes (Y_1).

This can be shown as $U_{ik} = U_{ik}(U_{ik}, Y_1)$…… (1)

Where;

U_{ik} is the utility that i^{th} household expects to derive from k^{th} option. The choices are presented in a way that when $k = 1$, it shows a household member uses an ITN and when $k = 0$, it shows a household member is not sleeping under an insecticide treated net. X_{ik} is a vector representing utilization or non utilization of the insecticide treated net variables such as sex of head of household, age, knowledge of malaria causes, number of household members while Y_1 is a vector of socio-economic attributes of the household head like the occupation of the household age, income level.

2.2 ECONOMIC MODEL

A binary response model will be used for this study because the dependent variable ITN utilization denoted as Y is binary and will therefore have only two possible outcomes (ITN Use and Non use) which can be denoted as 1 and 0.

The model will take the form;

$Pr(Y=1|X)=\Phi(X'\beta)$;

where Pr denotes probability that a household member uses ITN or does not use, X_1 is a vector of regressors which are assumed to influence the outcome Y and Φ is the Cumulative Distribution Function of the Standard Normal Distribution and β is a vector of parameter estimates

This implies thinking towards the probability of making a choice of 1 and in terms of probability it can be written as follows:

$Pr(Yi=1)=Pr(Yi^* \geq 0)=Pr(\beta Xi+\varepsilon i\geq 0)=Pr(\varepsilon i\geq -\beta Xi)$…….(i)

εi is a random variable which is assumed to be normal in probit models. Yi*is a latent/discrete variable ranging between 1 and 0. If Yi=1 we know Yi>0 and if Yi=0 we know Yi<0. Thus, the probit model by taking the probabilities into account can be written as:

$Pr(Yi=1)=Pr(\varepsilon i \geq -\beta Xi)= 1- \Phi(-\beta Xi)= \Phi(\beta Xi)$……..……(ii)

The last equal sign arises since standard normal distribution is symmetric about zero. In addition since Pr(Yi=0)=1-Pr (Yi=1) and this could also mean $Pr(Yi=0)= \Phi(-\beta Xi)$.

Thus, for probit model, p (Yi) is defined by noting that $Pr(Yi=1)= \Phi(\beta Xi)$ and $Pr(Yi=0)= \Phi(-\beta Xi)$

2.2.1 MODEL ESTIMATION

Based on this basic model, the following probit model is developed:

$Probability\ (IU) = \alpha + \beta_1 X_1 + \beta_2 Y_2 + \varepsilon$……..…… (iii)

ITN utilization (IU) is the dependent variable which is a dummy with a value of 1 for utilization and a value of 0 for non-utilization. X_1 is a vector for individual level characteristics or demographics; age, sex, education, economic status, occupation; Y_2 is a vector for variables that capture different factors affecting ITN utilization. The probit model will be used both to estimate the impact of the independent variables on ITN utilization by household members and to predict probabilities of change in ITN utilization under several simulated variable levels.

The probabilities that household members will use ITN or not will be calculated using $Pr(Yi=1)= \Phi(\beta Xi)$ and with many explanatory variables, $\Phi(\alpha+\beta X_1+ \beta X_2 +\ldots. \beta_k X_{k)}$ is the probability that household member with X_1, X_2…..X_k and in this study age, sex, education, economic status and occupation will be more likely to use ITN . X_1…..X_k are set to values of interest and then probabilities can be estimated

2.3 DATA SOURCE

The research design used was quantitative design by use of primary data collection. This was achieved through use of household questionnaires which were administered to household heads or whoever the household head appointed to respond

2.3.1 DATA COLLECTION TECHNIQUE

This was a cross-sectional study that involved both male and female as respondents. Quantitative methods were used thus generating quantitative data aimed at identifying determinants of ITN utilization.

2.3.2 THE TARGET POPULATION

The study was conducted in Vihiga Sub-County of Vihiga County. Vihiga County is located in western Kenya. It borders Kakamega County in the West, Kisumu County in the South, Nandi County in the East and Siaya County in the West. Vihiga Sub-county is the smallest Sub-county of the five sub-counties that make up Vihiga County. It hosts the county headquarters. It has an estimated total population of 91,616 according to 2009

population census (KNBS, 2009). Peasant farming is the main source of income and food with most people owning land less than an acre

2.4 SAMPLE SIZE

The study sample was determined by statistical calculation. It was based on Yamane's formula (Yamene, 1967)

$$n = \frac{N}{1 + Ne^2}$$

Where:

n is the size of the sample

N is the population

e is the errors at 5%

Therefore using this formula with a population of 91,616 (KNBS, 2009), the sample size was therefore calculated as shown below;

n=91616/1+(91616*0.05*0.05)=398.350 ~ 398

2.4.1 SAMPLING TECHNIQUE

The study used systematic random sampling which gives an equal chance of selecting the respondents in order to select the cases which are to be studied. It used a maximum of 398 cases and systematic sampling was used to identify the respondents (n=398).

2.4.2 PILOT OF RESEARCH INSTRUMENTS

A pilot of the household questionnaires was be conducted in Emuhaya Sub-County, Emabungo Ward to ascertain their suitability for the achievement of the study objectives. Emuhaya Sub-County is a county within Vihiga and also benefitted from the mass ITN distribution. It is also similar in many ways i.e. topography, climate, disease burden, poverty index to Vihiga Sub-County.

2.5 ETHICAL CONSIDERATIONS AND PROCEDURE

The researcher got an introductory letter from Nairobi University. The letter was presented to the County Director of Health Services and the Sub-County MOH, Vihiga Sub-County and the Ward Public Health Officers (PHOs).

With the assistance of Ward PHOs, appointments were made with the selected respondents. The interviews were conducted in homes of respondents. The interviews lasted 35 to 40 minutes. The researcher explained to the respondents the study, informed them of their rights, assured them of the confidentiality of their responses and sought their consent before embarking on interviewing them.

3. DATA ANALYSIS, RESULTS AND DISCUSSION

This chapter presents both descriptive and logistic results as per the study model.

3.1 DESCRIPTIVE STATISTICS OF ALL VARIABLES

Demographic characteristics

The findings are from 398 targeted respondents. Table 4.1 presents the demographic characteristics. Out of the 398, more than third (144) were within the age range of 20-30 and those over sixty years of age were the least 16 (3.8%). The median age was 35 (31-40) years.

Table 3.1: Demographic Characteristics of the respondents

Variable	Category	No.	%
Age in completed years	<20	36	8.6
	20 – 30	136	32.2
	31 – 40	108	25.7
	41 - 50	62	14.7
	51 – 60	47	11.2
	>60	32	7.6
	Median 35 (31 - 40)		
Gender	Male	130	30.9
	Female	291	69.1
Education level	None	63	15
	Primary	161	38.2
	Secondary	129	30.6
	College	68	16.2
Marital status	Single	60	14.3
	Married	286	67.9
	Widowed	67	15.9
	Divorced/separated	8	11.9
Occupation	Farmer	168	39.9
	Salaried	81	19.2
	None	76	18.1
	Business/self employed	96	22.8
Type of job	Skilled	97	23
	Semi-skilled	152	37.1
	None	172	40.9
Literacy level	Read	43	10.2
	Read and write	327	77.7
	Neither	51	12.1
No. of people in the HH	<3	183	43.5
	3 – 5	100	23.8
	>5	138	32.8
House structure	Grass/Semi-permanent	300	71.2
	Permanent	121	28.8

With regard to gender, majority of the respondents were female 244 (58.0%). The vast majority were married 286 (67.9%), the remaining accounted for widowed 67 (15.9%), single 60 (14.3%), separated 8 (1.9%). Three to five was the median household membership, while 23.8% and 32.8% had less than two and over six household members. Primary education was the common education level 199 (47.3%), followed by secondary 180 (42.8%). Few had tertiary education 23 (5.5%) and no formal education 19 (4.5%) respectively. The

average number of beds in HH was two but 70 (16.6%) did not own a bed while 75 (17.8%) had more than four beds.

Pattern of ITN utilization

Table 4.2 shows the results on pattern of ITN utilization. Only 286 (67.9%) of the study participants owned ITN. Against this, 79 (27.6%), owned one net. 87 (30.4%) two nets, 59 (20.6%) three and 61 (21.3%) owned four or more. Utilization of ITN throughout the seasons was 190 (66. 4%). Not everyone slept under a net in many household. At least in 147 (51.4%) household, everyone slept under at a net but in 56 (19.6%), in 52 (18.2%), and in 31 (10.8%) households three to five, six and less than three people do not everyone sleep under a net. Similarly, the pattern of sleeping a under a net is not uniform across the board. Whereas it is recommended that people sleep under a net throughout the night, only 191 (66.8%) do so, while 60 (21.1%) sleep under a net some parts of the night and 35 (12.2%) sleep in most parts of the night. Tucking process 13.3%, chemical 31.9%, perception that nets are for children 20.7%, mosquitoes bites everywhere 13.3% and that malaria spread despite people sleeping a under a net (1.5%) were reason behinds people not sleeping under a net regularly. The mother decides who sleeps under a net in 234 (55.6%) cases while the father decides in 39 (13.6%). Both parents make decision in 12 (4.5%). The main reason for lack of nets was affordability 75 (55.6%) and absences during the day of distribution 55 (40.7%). Five (3.7%) were unaware of ITNs. A vast majority had hanged the nets 274 (95.8%).

Table 3.2: Pattern of ITN utilization

Variable	Frequency	%
Ownership of ITNs		
Yes	286	67.9
No	135	32.1
Utilization of ITN all seasons		
Yes	190	66.4
No	96	33.6
No. of ITns in the household		
None	79	27.6
Two	87	30.4
Three	59	20.6
Four and above	61	21.3
Hanging of ITNs		
Yes	274	65.1
No	12	34.9
No. of people who sleep under an ITN		
<3	31	10.8
3	56	19.6
>3	52	18.2
Everyone	147	51.4
Who decides on who sleeps under an ITN		
Father	39	13.6
Mother	234	81.8
Both parents	13	4.5
Frequency of HH members sleeping under an ITN		
Always	191	66.8
Occasionally	95	32.2

Pattern of sleeping under an ITN		
All night round	191	66.8
Throughout the night during mosquito season	54	18.9
Most parts of the night	31	10.8
Some parts of the night	10	3.5

3.2 DESCRIPTIVE STATISTICS OF MODEL VARIABLES

Table 3.3: Discrete Household's Demographic, Environmental and Socio-economic Variables

Variable	Percentages	Mean	Std. Deviation	Min	Max
consistency in using ITNs (n=421) all year round =1 otherwise =0	45.37 54.63	.4536817	.4984423	0	1
gender of individual (n=421) Male =1 Female =0	43.46 56.54	.4346793	.5104939	0	1
marital Status (n=421) Married =1 Not married =0	67.93 32.07	.6793349	.4672875	0	1
literacy (n=421) literate =1 illiterate =0	90.74 9.26	.9073634	.2902674	0	1
Feeling on usage of ITNS (n=421) effective ineffective	66.98 33.02	.6698337	.4708323	0	1
Malaria education Yes no	86.46 13.54	.8646081	.3425488	0	1
ITNS knowledge(n=421) Yes no	62.71 37.29	.6270784	.4841569	0	1
Knowledge on protection Yes no	68.65 31.35	.6864608	.4644834	0	1
job type (n=421) skilled =1 unskilled =0	7.60 92.40	.0760095	.2653286	0	1
sleeping arrangement (n=421) Children sleeping alone =0 Children accompanied =1	6.89 93.11	.9311164	.2535574	0	1
house structure (n=421) Semi – permanent =0 Permanent =1	83.37 16.63	.1662708	.3727665	0	1
number of rooms (n=421)		3.672209	.6186869	1	4
household size (n=421)		2.090261	.7473287	1	3
number of ITNS in household (n=421)		2.667832	1.055386	1	4
number of beds (n=421)		2.836105	1.376409	1	5
Age (n=421)		43.37767	16.35258	18	90

From the descriptive statistics, 45.37 percent of the total households use ITNs all year round with 54.63 percent who did not use the nets all year round. On the household demographic, 43.46 percent are male headed with 56.54 percent being female headed. Turning to marital status, the results depict that 67.93 percent are married with 32.07 percent being either single, divorce or not married at all. 90.74 percent of all the households are literate in that they know how to read and write with only 9.26 percent being illiterate. On the education level of the household head, 95.40 percent of household head have education level that is beyond primary school.

Minimal of 7.670 percent of household head are involved in skilled jobs with a majority of 92.40 percent being in either semi-skilled or unskilled jobs. Our results also reveal that 83.37 percent of household live in semi-permanent houses with only a few of 16.63 percent having permanent houses. On the sleeping arrangement, 6.89 percent of the total household are likely to have the children under five years sleeping alone, with 93.11 percent of total households having children either sleeping together with an adult of children sleeping together in the event that the visitor comes and has to sleep in the household.

3.3 ECONOMETRIC ANALYSIS

This section presents the findings of the econometric analysis. To achieve the main objective of the study, logit model was employed in analysis determinants of insecticide treated mosquito nets utilization among households of Vihiga sub-county. To correct for heteroskedasticity, robust standard errors were used for regression.

3.3.1 RESULTS AND FINDINGS OF THE STUDY

The dependent variable in this study was the utilization ITNS within the households in Vihiga. This was measured by consistency in the utilization of ITNs in the households with the sleeping under the ITN all year round being the ideal scenario. Therefore sleeping under the ITN all year round was denoted by 1 and 0 otherwise.

Table 3.4: Logit model estimates

	Coef	Std. Err.	z	P>|z|	[95% Conf. Interval]
male	-0.1973	0.2160	-0.910	0.361	-.6206761 .2261551
lnage	-0.3222	0.2753	-1.170	0.242	-.8617343 .2173694
married	0.3257	0.2401	1.360	0.075	-.1448373 .7962148
permanent	-0.0322	0.3028	-0.110	0.950	-.6257645 .5613837
sleeping arrangements	-0.1520	0.4094	-0.370	0.711	-.9544529 .650543
skilled	0.2968	0.4326	0.690	0.493	-.5510305 1.144596
literacy	-0.2296	0.3704	-0.620	0.535	-.9555678 .4962959
lnroom	0.8666*	0.5248	1.650	0.099	-.1619882 1.895282
malaria education	0.4758	0.3309	1.440	0.150	-.1727591 1.124417
lnbed number	-0.1398	0.1967	-0.710	0.477	-.5252872 .245699
ITNS knowledge	0.7590***	0.2232	3.400	0.001	.3215542 1.196496
knowledge on protection	0.1325*	0.0781	1.700	0.090	-.0205968 .2855601
household size	-0.5500***	0.2533	-2.170	0.030	-.046546 -.0534443
effective	0.5421***	0.2217	2.440	0.014	.01529 .9766089
constant	-0.1732	1.41772	-0.12	0.903	-2.951933 2.605444

Number of obs = 421

LR chi2(13) = 32.46

Prob > chi2 = 0.0021

Log likelihood = -273.77598

Pseudo R^2 = 0.0560

This Table presents regression with robust standard errors results. Estimations were performed using fixed effects estimation. T-Statistics are in parentheses and significance at the 10%, 5%, and 1% level is denoted by *, ** and *** respectively.

Analysis was done using the logit model. The key variables under consideration in the model were: the gender of the individual, the individual's age, the size of the household, marital status, literacy within the household, , the type of the job for the house head, type of the house structure the household lives in, number of rooms, knowledge on the usage on ITNs within the household, sleeping arrangement in the event that the visitor sleeps in the household, feeling on the usage of ITNs in preventing malaria, education on malaria and knowledge on the protection against malaria.

Prior to running the logit model, benchmark dummies were generated for the binary variables. For gender variable, female was used as the benchmark dummy, not married was used as the benchmark dummy for marital status. On the type of the job, semi – skilled was the benchmark dummy while permanent house structure was applied as the benchmark dummy for the house type the household lives in. not knowing how to read and write was used as the benchmark dummy for literacy level variable. Regarding sleeping arrangement in event that the visitor sleeps in the household, a child sleeping alone was applied as the benchmark dummy. Regarding the knowledge on ITNs, lack of knowledge was the benchmark dummy with lack of knowledge on malaria being used as the benchmark dummy for knowledge on malaria variable. Regarding the knowledge on protection, lack of knowledge on the protection was used as the benchmark dummy.

From the results as presented in table 4.5 we find that:

Having knowledge of ITN increased the log probability of ITN use by 0.7590 and is statistically significant at 0.05 level. This means that household that had knowledge of ITN were 0.76 times more likely to use ITNs as compared to households with no knowledge. This means that this households mostly probably knew what ITNs are used for and were willing to use them for malaria prevention.

Household size decreased the log probability of ITN use by 0.5500 and is statistically significant at 0.05 level. This means that household with more members was 0.55 times less likely to use ITNs as compared to households with more members. This can be because a household with less members is able to afford additional ITNs as compared with a household with more members bearing in mind that most of the household were farmers and thus of low income

Perception of an ITN as an effective way of malaria prevention by the household increased the log probability of ITN use by 0.5424 and is statistically significant at 0.05 level. This means that household that perceived that ITNs were effective were 0.54 times more likely to use ITNs as compared to those who perceived them as less effective. Perception of effectiveness will compel one to use an ITN all night throughout the years

A household which is headed by a male decreased the log probability of using an ITN by 0.1973 and is statistically insignificant at 0.05 level. This means that a male headed household is 0.1973 times less likely to use an ITN as compared to a female headed household

The age of the household head decreased the log probability of using an ITN by 0.3222 and is statistically insignificant at 0.05 level. This means that having an old household is 0.32 times less likely to have its members use an ITN as compared to a household head who is younger.

Being married increased the log probability of ITN use by 0.3257 and is statistically insignificant at 0.05 level. This means that a household of married couples is 0.33 times more likely to use an ITN than a house where the household is single. This can as a result of collective responsibility between couples

Living in a permanent house decreased the log probability of ITN use by 0.0322 and is statistically insignificant at 0.05 level. This means that living in a permanent house is 0.03 times less likely to result in ITN use than living in a semi-permanent house. People living in permanent house are considered to be of high economic status and are therefore able to afford other malaria prevention strategies like use of repellants, screening and thus may tend to use other strategies other than ITN

Sleeping arrangements seems to decrease the log probability of ITN use by 0.1520 and is statistically insignificant at 0.05 level. This means that having a sleeping arrangement where a child is displaced when a visitor spends a night in the household is 0.15 times less likely to interfere with ITN use. This may mean that where children are relocated to a different sleeping area to create space for a visitor the child moves with her/his ITN to the new location.

Where a household has a skilled job the log probability of using an ITN is increased by 0.2968 and is statistically insignificant at 0.05 level. This means that household heads who have skilled jobs are 0.3 times more likely to have their household use an ITN than household heads who have unskilled jobs. This may means that the skilled household heads are able to afford ITNs and therefore in addition to the campaign ITNs targeting two people for one ITN, they can buy more to fill the gap

In a household whose head was able to read and write the log probability of ITN use was decreased by 0.2296 and is statistically insignificant at 0.05 level. This means that a household whose head knows how to read and write is less likely to use ITN all year round compared to a household whose head is illiterate by 0.23 times.

Number of rooms increased the log probability of ITN use by 0.8666 and is insignificantly at 0.05 level. This means that households with more rooms are more likely to use ITN by 0.87 times than where household have less rooms. A house with less rooms may not be able to accommodate ITN hanging for all its occupants thus forcing others to sleep without an ITN even when they are available.

Having had education on malaria increased the log probability of ITN use by 0.4758 and is statistically insignificant at 0.05 level. This means that household that had received education on malaria were 0.48 times likely to use ITNs as compared to households that had received no education on malaria. The household that had been educated on malaria most likely had been enlightened on the causes and the prevention using ITN thus adopted ITN use as a prevention strategy.

Number of beds decreased the log probability of ITN use by 0.1398 and is statistically insignificant at 0.05 level. This means that households with more bed are less likely to use ITN by 0.14 times that those with less beds. This can be attributed to the reasoning that more beds will mean more ITNs and this might not be possible considering that most of the respondents were farmers and of two beds per household

Table 3.5: Marginal effects of Logit model

	dy/dx	Std. Err.	z	P>|z|	[95% Conf. Interval]
male	-0.0487	0.0531	-0.920	0.360	-.15278 .055448
lnage	-0.0797	0.0681	-1.170	0.242	-.213139 .053776
married	0.0798	0.0581	1.370	0.170	-.034105 .193763
permanent	-0.0080	0.0747	-0.110	0.915	-.154403 .138499
sleeping arrangement	-0.0378	0.1022	-0.370	0.712	-.238032 .162474
skilled	0.0739	0.1079	0.690	0.493	-.137578 .28545
literacy	-0.0572	0.0925	-0.620	0.537	-.238422 .124103
lnroom	0.2143	0.1297	1.650	0.098	-.039891 .468567
malaria education	0.1143	0.0762	1.500	0.134	-.035066 .263573
lnbednumber	-0.0346	0.0486	-0.710	0.477	-.129909 .06076
ITNS knowledge	0.1834	0.0519	3.530	0.000	.081612 .285153
knowlegde on Protection	0.0328	0.0193	1.700	0.090	-.005096 .070626
household size	-0.1360	0.0627	-2.170	0.030	-.258858 -.0131
effective	0.1343	0.05453	2.46	0.014	-.241127 -.027376

From the marginal effects table above (4.6) we get the marginal effects of change in the probability of an outcome as a result of change in the explanatory variable.

The results indicate that a male household head decreases the probability of using an ITN by 4.87%. The household head being old decreases the probability of using an ITN by 7.97% while being married increases the probability of using an ITN by 7.98%.

Having a sleeping arrangement where children are displaced from their sleeping area when a visitor spends a night decreases the probability of using an ITN by 3.78%. Residing in a permanent house decreases the probability of using an ITN by 0.08% while having a head of the household who has a skilled type of employment increases the probability of using an ITN by 0.74%. At the same time having a household head who knows how to read and write decreases the probability of using an ITN by 0.57%.

A household living in a house with many rooms increases the probability of ITN use by 21.4%. While at the same time having a household with many beds decreases the probability of using an ITN by 0.34%. Having a

household that had received malaria education increases the probability of using an ITN by 11.43%. Similarly having a household that has knowledge concerning insecticide treated nets increases the probability of using an insecticide treated net by 18.34%. In a household where the head has knowledge of how to protect its members from malaria using ITN the probability of using ITN increases by 3,28%. Finally a household head who perceives the effectiveness of ITN as a malaria prevention tool increases the probability of using an insecticide treated net by 13.43%

From the results above we conclude that the significant variables in determining the usage of ITNs among the households of Vihiga Sub-County are knowledge of ITNs, knowledge on protection against malaria transmission by using ITN, the household size and the feeling of the household with regard to effectiveness of ITNs in preventing malaria transmission.

3.4 DISCUSSION OF THE FINDINGS

This study sought to investigate the determinants of utilization ITNS within the households in Vihiga.

The government of Kenya has made a conceited effort to ensure that all malaria at risk populations have access to an ITN. This has been made possible through the free distribution of ITNs to children less than five years, pregnant women, the people living with HIV/AIDS and to the entire population risk which significantly reduced the inequalities in the ownership and subsequent utilization across all age groups and social status. This is as shown by the malaria Indicator survey of 2015.

This study found out 67.9% of the population under study owned an ITN while 62.71% reported to be using sleeping under an ITN. This is above the KMIS survey of 2015 that reported ownership at 53% and utilization at 48%. This significantly relates with data from household surveys and national malaria programmes that have indicated an increasing proportion of the population sleeping under an ITN in Sub-Saharan Africa from less than 2% in 2000 to an estimated 55% in 2015, however this still falls short of the universal coverage (WHO 2015)

From the results we find that a household which is headed by a male is more likely to use ITN all year round compared to a household that is female headed by 0.028 units. This has some contradictions with Opiyo et al., 2007 findings that revealed that households headed by women were likely to purchase preventive measure for malaria

Looking at the individual age, Age was not statistically significant to utilization of ITN ($\chi 2=0.923$; df=5; p=0.975) however young respondents less than 20 years were more utilizers than the rest. This can be due to the routine distribution of ITNs to under fives and pregnant mothers at ANC clinics increasing use among this age group. It could also be attribute to collaboration between the Ministry of Health and the Ministry of Education to have all pupils/students in boarding schools sleep under an ITN, a virtue that could be carried

home. The results posit that as one age up he or she is less likely to use ITN all year round. As such the usage of ITNs is likely to be higher among the young that among the old by 0.0005 units. This is in harmony with Auta et al. (2012) who found out that the age among other household demographics such as locality and wealth status of the family are significant in determining ITN utilization. According to Graves et al., (2011) on factors associated with mosquito net use by individuals in households owning nets in Ethiopia, it was revealed that factors such as age in the bracket of twenty five to forty nine at an odds ratio of 1.5; CI 95% or 50 years and above at odds ratio 1.3; 95% increased net usage when compared to children below five years. This was among other factors such as sex and in this case female, children above five years, pregnancy and higher number of portable ITNs within the household together with elevated net volume which increased net usage. Ages five to twenty 25 in comparison with under fives, higher number of nets one year and above and higher household size were factors associated with low net usage There is also some similarity with findings from a study by Ngwibwere et al, 2016 that pregnant women and children under five years and the sick are given priority to sleep under an ITN as compared to the rest of the population. In contrast Mwamba Sichande, 2010 found age of the household head to be an important factor of ITN utilization whereby more individuals from households where the head was below 45 years slept under an ITN than those from households where the head was above 45 years

Turning to marital status a household head who is married person is less likely to use ITN compared to unmarried by 0.0134 units. This can perhaps be as a result of one having to seek consent from the spouse who might not be willing to use an ITN as a malaria prevention strategy basically due to ignorance of its importance or misconceptions. However Onoriode et al., (2015) while studying determinants of insecticide treated nets among pregnant women in Nigeria found marital status as a non significant factor to ITN use

The type of house one lives in may significantly contribute to use of ITN. According to this study households living in permanent houses were less likely to use ITN all year round compared to their counterparts who live in semi - permanent houses by -0.0080units. this findings concurs with findings of a study by Adeyeri Oluwakeni, (2011) on determinants of Insecticide Treated Nets who found out that the type of house one lives in significantly affected ITN use where most of the respondents (63.9%) in his study living in semi-permanent houses stated that they were not hanging nets simply because the houses they lived in were too small to accommodate net hanging.

On literacy, a household whose head knows how to read and write is more likely to use ITN all year round compared to a household whose head is illiterate by 0.0484 units. Etieli et al., (2011) found similar results where households where at least a member had primary or secondary education compared to households with no education had a higher significant percentage of ITN ownership and usage. this was because households where a member had primary or secondary education had knowledge about malaria. Regarding knowledge on cause

of malaria, a household head that has knowledge on the cause of malaria is more likely by 0.0328 units to use ITN. This agrees with Etieli et al., (2011) who showed that education level and knowledge about malaria transmission were some of the significant reasons affecting ITN ownership and usage. Similarly Baume et al., (2009) found out that knowledge about malaria influenced ITN utilization. This also agree with Arogundande et al., (2011) who on studying the relationship of caretakers misconceptions and non utilization of ITNs in children below five years in Nigeria and Gobena et al., (2012) who on looking at the cause of low ITNs use among household occupants against bites by mosquitoes in Eastern Ethiopia respectively, they found that there was a significant relation to knowing what causes malaria and utilization of ITN. It also showed low uptake of ITN by people who had an insignificant knowledge on preventive strategies for malaria

Focusing on perception about ITN effectiveness in malaria control, a person who perceived an ITN to be effective was more likely to use an ITN by 0.1343 units. This significantly influenced the use of ITN. This can be as a result of the trust and confidence one has in use of ITNs and having had an opportunity to experience an improved quality of life as a result of malaria infections averted due to use of an ITN. This agrees with a study by Nuwaha et al., (2002) whose study found out ITNs effectively prevented bites from mosquitoes thus malaria infection. Likewise a study by Winch et al., (1997) concluded that ITNs are effective in malaria control although local perceptions, acceptance and use of ITNs together with other preventive strategies were invaluable in malaria control programmes. This also to some extend agrees with a study carried out in Western Kenya by Allaii et al., (2003) to assess community reactions before the introduction of permethrin-treated bed nets which found out that even though malaria was considered as an important disease among the study population, they believed ITNs were only partially beneficial and this was because of their perception on multiple causes of malaria

Looking at the type of the job, we find that a household whose head is in a skilled job is more likely to use ITN all year round compared to a household whose head is in semi – skilled and unskilled job. This could be perhaps be explained for the fact that those involved in skilled jobs are better off in terms of income and therefore are more likely to afford buying ITNS for their household compared to those in the semi – skilled and unskilled jobs. This contradicts a study Garcia- Basteiro et al., (2011) which showed that in households where heads occupation was farming and wives engaged as housewives the likelihood of using ITN was lower than of traders. The farmer's possibility of owning an ITN was five times higher than for traders. This was attributed to the fact that the low income people are likely to take preventive measures against diseases so as to be able to save for other basic needs

Number of household members was significantly associated with ITN utilization, whereby a household with fewer members was more likely to use an ITN by 0.1360 units. This can be as a result of sharing the available ITNs. This agrees with Biadgili, Reda and Kedir (2012) who indicated that households with four or less

members were likely to use ITNS since it's easier to share ITNS when household members are few than when they many. The study revealed that households with a family size of four and below had a higher probability of using an ITN as compared to those above four while a family size of less than three was less likely to have owned an ITN

Upon the visitor visiting and spending a night in the household, a sleeping arrangement where children are accompanied by an adults are more likely to use ITN as compared to a sleeping arrangement where children sleep alone by 0.0255 units. The findings are consistent with the findings by Mugisha and Arinaitwe, (2003) who assert that sleeping arrangement becomes an important factor in determining ITN utilisation where preference to use the available ITN is to a particular individual within the household and therefore a person who shares the bed with that individual is also likely to use an ITN. As a result children who shared the bed with their parents benefited as compared to those who did not. This has implications on ITN utilization since it is not ethically acceptable for people of certain ages or sex (unless married) to share a bed. Sleeping on the floor was also found to be a barrier to ITN utilisation as it was difficult to hang the nets as found out by Baume et al, (2009). A study done by Lwashita et al., (2010) in Kenya noted that sleeping arrangement was an important determinant of ITN utilization whereby those sleeping in beds had a higher probability of sleeping under a net than those sleeping on the floor or other places. The same study also noted that the number of sleeping rooms in the house was also a predictor of importance.

Regarding the number of rooms and the number of ITNs in the household, we find that households with more rooms and INTs are more likely to use ITN by 0.0508 and 0.0160 units respectively. The finding is in agreement with Larson et al, (2012), ITN availability is also an important factor in determining usage since no one can use an ITN if it does not exist in the first place. This can be as result of the number of ITNs at their disposal whereby the universal coverage of ITNs targets two people one ITN yet this people may be of different ages and sex thus not able to share the ITN and therefore where there is less ITNs priority are given to children under five years and pregnant women and the household heads are encouraged to purchase more at subsidized prices for the rest of the household. Although various factors affect ITN accessibility such as distance to the health centers. The inequity created as a result of socio-economic status has been bridged by distribution of free ITNs especially to vulnerable groups. This has resulted in more increase in ITN ownership in rural areas than urban areas (MoH, 2010) but this might not translate into a similar trend when it comes to utilization. This was also reported by (Hazel et al, 2012). Further, Biadgilign et al., (2012) found out that a household with at least a child under the age of five years had a 60% chance ITN ownership than a house with none. Garcia- Basteiro et al., (2011) showed that a child being sick prior to the survey contributed significantly to net ownership, this study also found education level of the head of the household as a weak associate of ITN use.

4. SUMMARY OF FINDINGS, CONCLUSION AND POLICY RECOMMENDATIONS

This chapter presents the summary of the findings, conclusions and recommendation as per the findings of this study which sought to identify the determinants of ITN use across all age groups. Effective use of ITNs has been shown as one of the most cost-effective tool of malaria control strategies; however various studies including demographic health surveys have indicated underutilization. According to this study 67.9% of the population under study owned an ITN while 62.71% reported to be using sleeping under an ITN. This is above the KMIS survey of 2015 that reported ownership at 53% and utilization at 48%. This significantly relates with data from household surveys and national malaria programmes that have indicated an increasing proportion of the population sleeping under an ITN in Sub-Saharan Africa from less than 2% in 2000 to an estimated 55% in 2015, however this still falls short of the universal coverage (WHO 2015)

This study found out that there are both individual and socio-economic characteristic affecting ITN utilization. The factors are: household size, knowledge of ITN as a malaria prevention tool and perception households have concerning effectiveness of ITN for malaria prevention. These factors are likely to hinder utilization of ITN despite their being available in the household.

Whereas there was high awareness on ITN as a malaria prevention strategy translating into positive perception that insecticide treated nets are effective in malaria control and thus usage of 62.71% almost close the national achievement of 63% (KNBS, 2015), there are other factors mentioned by respondents which can hinder utilization like ITNs being put to alternative use like fencing of kitchen garden and poultry sheds though they stated that this happens once the ITNs are torn, some people might be misled into tearing new ITNs and using them for that same purpose.

It is therefore necessary in any effort undertaken by the government to increase ITN coverage and use to take into consideration these household factors to ensure that these efforts yield maximum results as concerning actual use of ITN.

4.1 POLICY RECOMMENDATIONS

Whereas this study found out that household size, individual knowledge of ITN as a malaria prevention strategy and perception of effectiveness of ITN significantly affected ITN use there is need to embark on malaria health education targeting the entire community inclusive of the school going children. This can be done in liason with line ministries of education, gender, youth and social services and communication and the information disseminated in an easy to understand language and manner.

4.2 FURTHER RESEARCH

A key limitation to this study was use of quantitative data solely obtained from household questionnaires. As shown in the literature review, there are a number of factors affecting ITN use which this particular tool could not capture since they required a lot of qualitative data. These include factors around knowledge, attitude and

perception of ITN use. As a result the study did not capture rich information as per factors affecting ITN use across the entire household. It is therefore suggested that future research be conducted using both quantitative and qualitative data in order to capture key variables that might generate rich information as concerns such a study.

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