FACTORS INFLUENCING USE OF MALARIA CONTROL METHODS AMONG THE RESIDENTS OF NYANDO SUB-COUNTY, KISUMU COUNTY

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Factors Influencing Use of Malaria Control Methods among the Residents of Nyando Sub-County, Kisumu County

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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To my Loving father the late David Mbijiwe M'Ikiara Kimiri.

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ABBREVIATIONS AND ACRONYMS

Bs	Bacillus Sphaericus
Bti	Bacillus Thuringiensis Israelensis
CCMD	Citrus County Mosquito District
CHW	Community Health Workers
EM	Environmental Management
ERC	Ethics Review Commitee
DDT	Dichlorodiphenyltrichloroethane
DEET	N, N-Diethyl-Meta-Toluamide
DOMC	Division of Malaria Control
FGD	Focus Group Discussion
ITN	Insecticide Treated Net
IRS	Indoor Residual Spraying
KAP	Knowledge Attitudes and Practices
KEMRI	Kenya Medical Research Institute
KDHS	Kenya Demographic Health Survey
MC	Malaria Consortium
MOH	Ministry of Health
MS	Malaria Site
MWNV	Malaria West Nile Virus
NHLS	National Health Laboratory Services
P.I	Principal investigator
SAM	Scientists Against Malaria
SPSS	Statistical Package for the Social Sciences
SSC	Scientific Steering Committee
WHO	World Health Organization

SIMA System-wide Initiative on Malaria and Agriculture

DEFINITIONS OF OPERATIONAL TERMS

Environmental management: Any planned physical activities that through transformation of land, water and vegetation will result in the prevention, reduction or elimination of malaria.

Larviciding: The action or practice of treating with larvicides.

Larvicide: A chemical used for killing larvae.

Indoor residual spraying: Is the application of insecticide to the inside of dwellings, on walls and other surfaces that serve as a resting place for malaria-infected mosquitoes.

Prevalence: The proportion of a population with a disease or a particular condition at a specific point in time (point prevalence) or over a specified period of time (period prevalence).

Malaria: A life-threatening disease caused by parasites that are transmitted to people through the bites of infected female *Anopheles* mosquitoes.

ABSTRACT

Despite availability of effective malaria control methods, malaria still affects millions of people worldwide each year. The recent estimates show that about 24 million Kenyans are at risk of infection each year, with pregnant women and children below five years being the most affected. In order to develop strategies to promote/improve use of malaria control methods, it is necessary to determine factors that limit their use. The objective of the study was to determine factors influencing use of various malaria control methods among the residents of Nyando Sub-County, Kisumu County. The study was a cross-sectional one involving residents of Nyando. The study enrolled 402 study participants. A questionnaire was administered to consenting respondents to determine social demographic characteristics, knowledge, attitude and utilization of malaria control methods. Focus group discussion with some of the study participants was held. Quantitative data from the questionnaire was analyzed using SPSS while the qualitative data was analyzed using thematic analysis. The results showed that all the study participants were aware of Insecticide treated nets (ITNs) and owned and used them. Environmental management (EM) was known by 96.3% of the respondents and practiced by 95.5% of them. Larviciding was known by 22.9% of the respondents and had been practiced by 7.5% of them. Majority of the respondents perceived ITNs to be important in malaria control while larviciding was perceived to be not important in malaria control. Respondents who were married were more likely to use larvicides, mosquito repellents and window and door screens than those who were not married. Respondents with high level of education were more likely to use of larvicides, mosquito repellents and window and door screens than those with low level of education. Respondents with high monthly income were more likely to use mosquito repellents and window and door screens than those with low monthly income. Knowledge of all the malaria control methods was associated their use. Positive perceptions towards malaria control methods were associated with their utilization. Social economic factors such as the type of structure of the respondents' house was associated with use of larvicides, mosquito repellents and window and door screens while those who used water from boreholes were more likely to use larvicides and IRS than those who got theirs' from other sources. They should be educated on the other malaria control methods like larviciding, mosquito repellents, EM, IRS and window and door screens. They should be educated on the way they are used and their importance in malaria control. All the malaria control methods should be made available in Nyando for free or at a subsidized price.

CHAPTER ONE

INTRODUCTION

1.1: Background

Malaria remains one of the world's worst health problems, affecting individuals in 104 endemic countries where an estimated 207 million cases and an estimated 627,000 deaths were reported in 2012 (O'Brian *et al*., 2014). In sub-Saharan Africa, these deaths occur primarily among children under five years of age and pregnant women (Opiyo *et al.,* 2007). It is estimated that about 24 million Kenyans are at risk of infection each year, with pregnant women and children below five years of age being the most affected (KDHS, 2010). Approximately 70% of the country is at risk of malaria infection and the disease accounts for 30% of all outpatients' attendance and 19% of all admissions in the health facilities (Opiyo *et al.,* 2007).

Malaria is transmitted exclusively through the bites of *Anopheles* mosquitoes. The intensity of transmission depends on factors related to the parasite, the vector, the human host and the environment (NHLS, 2017). About 20 different *Anopheles* species are important around the world. All of the important vector species bite at night (SAM, 2017). They breed in shallow collections of freshwaters like puddles, rice fields and hoof prints. Transmission is more intense in places where the mosquito is relatively long-lived (so that the parasite has time to complete its development inside the mosquito) and where it prefers to bite humans rather than other animals. For example, the long lifespan and strong human-biting habit of the African vector species is the underlying reason why more than 90% of the world's malaria deaths are in Africa (WHO, 2017). Agricultural practices such as the use of irrigation during rice cultivation, the use of ponds for fish farming and the storage of water in tanks for livestock provide suitable breeding grounds for mosquito (Oladepo *et al.,* 2010).

Rice cultivation through irrigation has brought changes in the ecosystem which has affected the farmers' health in addition to creating habitats ideal for the breeding of vectors of diseases such as malaria and schistosomiasis. This is in addition to changing the epidemiological pattern of malaria from seasonal to perennial, consequently raising the disease incidence in communities with little prior exposure or immunity (Ng'ang'a *et al*.,2008). Malaria transmission in most agricultural ecosystems is complex and involves the interactions of the host-vector-parasite triad, environment and the socio-economic factors in the community (Ng'ang'a *et al*., 2008). Therefore, there is a need for developing a holistic malaria control intervention with adequate consideration of socio-economic factors which are equally important as biomedical, parasitological and entomological factors in determining infection and transmission of malaria in the community (Ng'ang'a *et al.,* 2008).

A new approach proposed by System-wide Initiative on Malaria and Agriculture (SIMA) in West and Central Africa, which involves investment in malaria focused agricultural research has been reported (Oladepo *et al.,* 2010).The initiative entails providing health education to farmers, with the aim of reducing malaria at its source, in many high-risk regions. The approach involves management of land, water and farming practices in ways that discourage mosquitoes from breeding and to reduce human-mosquito contact. This is based on the fact that malaria is a disease that can be controlled by good management of the environment where the vector breeds (Oladepo *et al.,* 2010).

Even though malaria can be a fatal disease, it is largely preventable and curable if it is promptly diagnosed and adequately treated. Concerning prevention, unfortunately there is no effective vaccine currently available for malaria (Thanabouasy *et al*., 2009). The most preventive measures according to World Health Organization are personal protection, malaria vector control and chemical control. The principle objective of vector control is reduction of malaria morbidity and mortality by reducing the level of transmission. As they are incapable of combating the vector (anopheles mosquito),

human beings are progressively suffering more from malaria, resulting in increased disease burden (Thanabouasy *et al*., 2009).

The scope of malaria control is changing worldwide with emphases placed on community and individual participation in malaria control and prevention measures rather than exclusive use of insecticides leading to the rapid rise of health education based on understanding knowledge, attitudes and practices (KAP) towards malaria control (Amusan *et al.,* 2017). Novel reports about knowledge, attitudes, and practices relating to malaria and its control are not lacking but these reports concluded that misconceptions on malaria transmission and risk factors still exist with negative impact on malaria control programmes (Amusan *et al.,* 2017).

Extensive public health promotional programs which focus on modern and established methods of malaria prevention and management are needed to achieve sustainable control of the disease. The importance of human behaviour in malaria transmission has not been extensively evaluated even though much is known about vector biology. Malaria control programmes must therefore consider the broad, complex and interrelated factors that influence human behavior (Amusan *et al.,* 2017). The importance of information on KAPs in designing and improving malaria control activities has been emphasised. Studies on KAP are also essential in establishing epidemiological and behavioural baselines useful to identify indicators for monitoring malaria control programmes (Amusan *et al.,* 2017).

Because malaria is associated with poverty (Forero *et al.,* 2014), most endemic countries or regions within a country usually correspond to those communities with the lowest socio-economic status (Forero *et al.,* 2014).These are frequently found in regions where malaria control is logistically and economically more challenging due to the limited capacity of local and national governments to invest in health and infrastructure. In these areas, community participation in malaria control and elimination activities is essential to achieve success and sustainability (Forero *et al.,* 2014). A community's commitment to participate in malaria prevention requires a minimal level of education in order to

develop an adequate understanding of transmission, and thereby contribute to adapting attitudes towards malaria control/elimination (Forero *et al.,* 2014).

Studies involving community knowledge, attitudes and practices have shown that factors, including education levels in some, are related to behaviour in malaria control. It is clear that a change in behaviour is an important component in malaria prevention and control, but the basis of the behaviour elucidated by determining the levels of malaria knowledge and the attitude and practices of the community is even more crucial (Shimaponda-Mataa *et al.,* 2017).

According to WHO Malaria Report, India has fourth highest number of malaria cases and deaths in the world (Gupta *et al.,* 2019). Malaria is highly endemic in Southern region of India, mostly in coastal area of Karnataka throughout the year (Gupta *et al.,* 2019). Mangalore, a city in southwest coastal region of Karnataka, considered to be one of the highly endemic places for malaria with 2.92 Annual Parasitic Index (Gupta *et al.,* 2019). Early case finding and treatment, vector control measures are some of the important strategies of Malaria control under National Vector Borne Disease Control Programme (NVBDCP) (Gupta *et al.,* 2019). But some of the beliefs, customs and practices of malaria, are often related to culture, which can influence the effectiveness of malaria control strategies (Gupta *et al.,* 2019).

Prevention of the disease through better knowledge and awareness is the appropriate way to keep the disease away and remain healthy. Studies pertaining to knowledge, attitude and practices showed that direct interaction with community plays an important role in circumventing malaria problem (Gupta *et al.,* 2019). Community beliefs, perception, and attitude towards malaria symptom identification, treatment, prevention and control can influence efforts to address malaria and are often overlooked in control efforts (Gupta *et al.,* 2019).

Experiences with malaria have shown that prevention is better and cheaper than cure; however, the practice of malaria preventive measures has been related to the knowledge and belief of people and have been found to be low and difficult to implement when malaria risk is perceived to be low **(**Erhun *et al.,* 2005). Malaria-related knowledge, attitudes and practices (MKAP) have been examined in many rural and partly urban multiethnic populations in Africa **(**Erhun *et al.,* 2005).Within Nigeria, surveys of residents of the Atlantic coast revealed a lack of knowledge and many misconceptions about the transmission and treatment of malaria, which could adversely affect malaria control measures and anti-malarial therapy **(**Erhun *et al.,* 2005).

Environmental factors and behavioral patterns of vectors and human populations combine to provide favorable conditions for malaria transmission (Habtai *et al.,* 2009). While much is known about vector biology and behavior and the malaria parasites, the importance of human behavior in malaria transmission has been largely overlooked. This failure to consider community attitudes and beliefs about malaria has contributed to the inability of programs to achieve sustainable control (Habtai *et al.,* 2009). Studies on knowledge, attitudes and practices (KAP) have demonstrated that direct interaction with community plays an important role in circumventing malaria spread (Habtai *et al.,* 2009). Knowledge, beliefs and practices of the population must be taken into account in the design of interventions against malaria transmission. Development of appropriate health education promotion message depends on analysis of knowledge, attitudes and behaviors of the affected community (Habtai *et al.,* 2009).

Despite the various initiatives developed over the years to address the public health challenges malaria pose, the problem still persists. This simply means that research should be directed towards personal-level characteristics of persons defined to be at high risk of malaria transmission. It is now well established that health behaviour has links to health outcomes and these links in turn are dependent on factors associated with cognitive processes of reasoning and health literacy, quality of healthcare services, available health-related information and decision-making process at the individual level

(Atulomah *et al.,* 2014). Understanding the various factors, especially, level of knowledge and attitudes associated with the practice of malaria prevention by pregnant mothers attending ante-natal care, consists an essential element in malaria control (Atulomah *et al.,* 2014).

Nyando Sub-County is one of the areas in Kenya with the highest prevalence of malaria along with others also found in the former Nyanza province. They are collectively referred to as the lake endemic zone with regards to malaria prevalence. According to the Kenya malaria indicator survey of 2010, the lake endemic zone has a prevalence of 38% while the rest of the country or zones have less than 5%. It is important to investigate what factors could be behind this high prevalence in Nyando Sub- County, and generally the lake endemic zone.

Studies have indicated that communities are not well aware of the multi-dimensional challenges of malaria. The knowledge of the community is far from perfect, and misconceptions are rampant. There have been a considerable number of reports about knowledge, attitude and practice relating to malaria and its control from different parts of Africa. These reports concluded that misconceptions concerning malaria still exist and that practices for the control of malaria have been unsatisfactory (Aderaw *et al*., 2013).

The 2010 Kenya Malaria Indicator Survey report indicated that about 71% of the rural community and 80.5% of the urban community have heard about malaria. This survey also reported that more than 90% of the respondents had heard about malaria. However, only 30.1% of the rural and 59.7% of urban community knew that mosquito bites can transmit malaria. This survey indicated that 39.1% of pregnant women, 49.5% of children had slept under ITNs on the night before the interview. Thus, understanding of the current knowledge level of the community, as well as their beliefs and practices with respect to the disease is required to obtain and maintain the community involvement in surveillance and control activities (Aderaw *et al*., 2013).

1.2: Statement of the problem

Malaria affects an estimated 207 million people worldwide with more than 90% of cases occurring in sub-Saharan Africa. In Kenya 24 million people are at the risk of the infection each year. It leads to loss of working/school hours, low birthweight and even death.

Nyando Sub-County is one of the areas in Kenya with the highest prevalence of malaria along with others also found in the former Nyanza province. They are collectively referred to as the lake endemic zone with regards to malaria prevalence. According to the Kenya malaria indicator survey of 2010, the lake endemic zone has a prevalence of 38% while the rest of the country or zones have less than 5%.

In Nyando there have been campaigns to sensitize people on malaria prevention especially with regards to use of ITNs. Insecticide treated nets are well known and are available in Nyando sub-county, but nets need to be complemented with other malaria control methods for malaria control programs to be effective. There is need to know if the other malaria control methods are known and are used in the area, and if they are not used what factors could be limiting their utilization.

Knowledge, attitudes and beliefs affect malaria control. Failure to consider community's knowledge, attitude, and practice about malaria is thought to contribute to the inability of programs to achieve sustainable control. People's native logic and rationality make sense within the realities and limitations of their local circumstances.

Correct use of malaria control methods such as ITNs, IRS, EM, mosquito repellents and larvicides singly or in integrated manner is key to the control and prevention of malaria. People who do not use the malaria control methods at all or those who do not use the malaria control in the right way are more likely to suffer from the disease.

Generally, research to document factors influencing use of malaria control methods in Nyando Sub-County is limited, and even more so, for the lake endemic region with

regards to malaria. This gap creates need for a study in malaria endemic regions to determine factors affecting utilization of malaria control methods. This study seeks to determine factors that influence use of malaria control methods in Nyando Sub-County which is a malaria endemic region in Kisumu County.

1.3: Justification of the study

Despite vigorous malaria campaigns in Nyando Sub-County, the prevalence of the disease is still high. There has been a reduction in number of cases of malaria in other parts of Kenya, with many areas having a prevalence of less than 5% but in Nyando Sub-County the prevalence of malaria is still very high and it's at 38%. Malaria control methods such as ITNs, IRS, window and door screens, EM, mosquito repellents and larviciding if regularly used and especially in combination can greatly reduce the spread of malaria.

Since a disparity exists between malaria control knowledge and utilization, indicating knowledge does not always lead to practice, it is therefore important to know the level of knowledge of malaria control methods, practice, perceptions towards malaria control methods and socio-economic factors influencing use of malaria control methods among the residents of Nyando Sub-County.

Understanding the challenges affecting use of malaria control methods would provide information to stakeholdes concerned with the prevention of malaria such as the ministry of health, non-governmental organizations and private entities.

Through identification of gaps in malaria control strategies stakeholders can plan, implement and focus action towards malaria prevention strategies and this can be important in reducing malaria in Nyando Sub-County. The study seeks to determine factors influencing use of malaria control methods among the residents of Nyando Sub-County, Kisumu County. Findings from this study will be communicated to public health officials in Nyando Sub-County to inform and strengthen malaria control activities and programs in the region.

1.4 Hypothesis

1.4.1 Null Hypothesis

Use of malaria control methods among the residents of Nyando Sub-county is not influenced by Knowledge of malaria control methods, attitudes towards malaria control methods, practices regarding malaria control, socioeconomic factors and other factors.

1.5 Research questions

1. What is the level of knowledge and practices regarding malaria control methods among the residents of Nyando Sub-County?

2. What are the attitudes towards malaria control methods among the residents of Nyando Sub-County?

3. What are the social economic factors influencing use of malaria control methods among the residents of Nyando Sub-County?

4. What is the level of utilization of malaria control methods among the residents of Nyando Sub-County?

1.6 Objectives

1.6.1 General objective

To determine factors influencing use of malaria control methods among the residents of Nyando Sub- County, Kisumu County.

1.6.2 Specific objectives

1. To determine the level of knowledge and practices regarding malaria control methods among the residents of Nyando Sub-County.

2. To determine attitudes towards malaria control methods among the residents of Nyando Sub-County.

3. To describe social economic factors influencing use of malaria control methods among the residents of Nyando Sub-County.

4. To establish the level of utilization of malaria control methods among the residents of NyandoSub-County.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Malaria is caused by plasmodium parasites that are spread through the bites of infected anopheles mosquito vectors. There are five different species of Plasmodium that cause malaria. They include Plasmodium falciparum, P vivax, P ovale, P malariae, and P knowlesi. Of the 5 parasite species that cause malaria in humans, plasmodium falcipuram is the deadliest (WHO, 2017). Transmission of malaria infection is caused by the bite from an infected female anopheles mosquito, which injects sporozoites into the blood stream of the human host. The patient experiences clinical symptoms which include headaches, pain in the joints, chills and fever, vomiting and mild diarrhoea. Treatment requires timely administration of an effective antimalarial drug regimen that clears the acute symptoms and prevents the reappearance of the parasites (Khambira, 2013).

In 2015, there were an estimated 212 million malaria cases globally and some 429,000 malaria deaths. Sub-saharan Africa continues to carry a disproportionately high share of the global malaria burden. In 2015, sub-saharan Africa was home to 90% of malaria cases and 92% of malaria deaths. Young children and pregnant women are particularly vulnerable to malaria (WHO, 2017). In Kenya, malaria remains a major cause of morbidity and mortality with more than 70 percent of the population at risk of the disease (KMIS, 2015).

The malaria burden in Kenya is not homogenous. The areas around Lake Victoria and on the coast present the highest risk, and children under age 5 and pregnant women are the most vulnerable to infection (KMIS, 2015). The lake endemic zone such as Nyando sub-county has the highest malaria prevalence at 27% compared to 8% in the coast endemic zone, 3% in the highland epidemic zone, and less than 1% in the semi-arid, seasonal and low risk areas (KMIS, 2015).

Although malaria is a serious disease it can be prevented, this is because of the fact that according to malaria indicator survey 2010 the prevalence of malaria in in the lake endemic zone was 38% but in the 2015 malaria indicator survey the prevalence of malaria had reduced to 27% and this is majorly due to use of malaria control methods.

2.2 The Life Cycle of the Malaria Parasite

Understanding the malaria lifecycle is useful for a full appreciation of the complexities of treatment, prevention and surveillance. For example, life cycle biology identifies several points where the malaria parasite can be damaged or destroyed. For example, Artemisinin drugs have the ability to target parasites in the erythrocytic stages which prevents the growth and spread of plasmodium (Etemesi, 2012).

The malaria parasite has a complex life cycle involving both asexual and sexual stages with obligatory phases in both humans and female Anopheles mosquito (Figure 2.2).

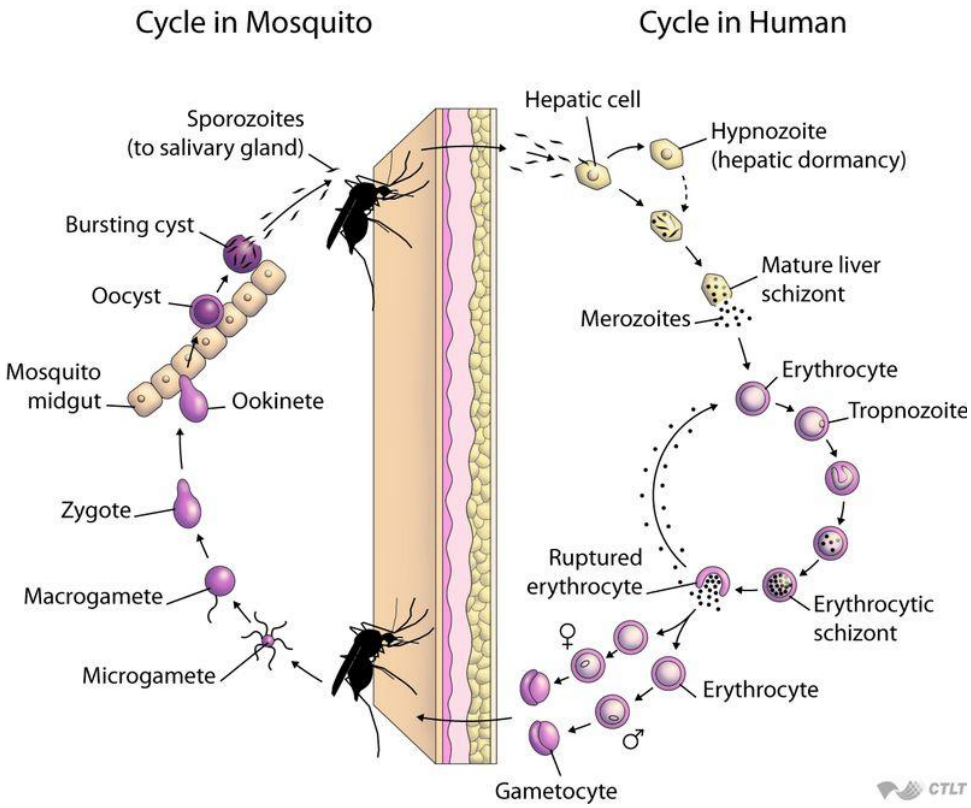

Figure 2.1 Life cycle of the malaria parasite [Source: http://ocw.jhsph.edu/].

Malaria infects both humans and mosquitoes spending its lifecycle partly in the mosquito and partly in the human host. The mosquito acts as the 'vector' to carry infection from one person to another (Etemesi, 2012).

Human stage: When a female Anopheles mosquito takes a blood meal on a human, it injects parasites from its salivary glands into the human blood stream. The parasites injected into the human are in their sporozoite form. Sporozoites then enter the liver cells and reproduce. These liver cells eventually rupture and release merozoites into the blood. The human blood stage is when these merozoites invade the red blood cells, reproduce and rupture red blood cells. This is often the stage when clinical features such as fever and chills begin. It is also the stage that is targeted by many antimalarial drugs. Some of the merozoites differentiate into becoming male or female gametocytes (Etemesi, 2012).

Mosquito stage: When a female anopheles mosquito bites an infected person, it takes up these gametocytes with the blood meal (mosquitoes can be infected only if they have a meal during the period that gametocytes circulate in the human's blood). The gametocytes, then, mature and become microgametes (male) and macrogametes (female) during a process known as gametogenesis. The time needed for the gametocytes to mature differs for each plasmodium species: 3- 4 days for *P. vivax* and *P. ovale*, 6- 8 days for *P. malariae* and 8- 10 days for *P. falciparum* (MWNV, 2017).

In the mosquito gut, the microgamete nucleus divides three times producing eight nuclei; each nucleus fertilizes a macrogamete forming a zygote. The zygote, after the fusion of nuclei and the fertilization, becomes the so- called ookinete. The ookinete, then, penetrates the midgut wall of the mosquito, where it encysts into a formation called oocyst. Inside the oocyst, the ookinete nucleus divides to produce thousands of sporozoites (Etemesi, 2012).

The oocyst ruptures and the sporozoites are released inside the mosquito cavity and find their way to its salivary glands but only few hundreds of sporozoites manage to enter.

Thus, when the above-mentioned infected mosquito takes a blood meal, it injects its infected saliva into the next victim marking the beginning of a new cycle (MWNV, 2017).

2.3 Commonly used malaria control methods

2.3.1 Insecticide Treated Nets

Bed nets provide personal protection to sleepers against night biting mosquitoes. If used by almost all members of a community, insecticidal nets kill large numbers of local malaria vectors, reducing the mean survival, sporozoite rate and population density of the vector population and hence substantially reducing its entomological inoculation rate (Maxwell *et al.,* 2006).

ITNs protect individuals either by diverting host-seeking vectors to search for a blood meal elsewhere or by killing those that attempt to feed on that person (Gerry and Thomas, 2007). This means that treated nets not only prevent malaria in a protected individual but can also reduce malaria risk in unprotected individuals by suppressing the density, survival, human blood indices and feeding frequency of vector populations (Gerry and Thomas, 2007). According to the World Health Organization, the use of insecticide-treated-nets (ITNs) is one of the most cost-effective interventions against malaria (Afolabi *et al.,* 2009). High levels of ITNs use have been shown to reduce malaria mortality by 17% in children of age 1 to 59 months old in African study settings (Afolabi *et al.,* 2009).

2.3.2: Indoor residual spraying

Indoor Residual Spraying (IRS) is the application of a long-lasting, residual insecticide to potential malaria vector resting surfaces such as internal walls, eaves, and ceilings of all houses or structures (including domestic animal shelters) where such malaria vectors might come into contact with the insecticide (WHO, 2015). IRS, carried out correctly, is a powerful intervention to rapidly reduce adult mosquito vector density and longevity and, therefore, reduce malaria transmission (WHO, 2015). The effectiveness of IRS as

malaria control intervention arises from the fact that many important malaria vectors are endophilic. That is, when searching for blood meals they enter human habitations or animal shelters where they rest on the walls, ceilings and other interior surfaces before and/or after feeding on the inhabitants.

When a vector comes into contact with a sprayed surface, it absorbs lethal doses of insecticide, thereby reducing its lifespan (WHO, 2015). This results in a progressive decline in vector density and longevity, especially among older female mosquitoes, reduces overall vectoral capacity, and contributes to a reduction in malaria transmission. IRS is most effective against indoor feeding (endophagic) and indoor resting (endophilic) vectors (WHO, 2015). One significant difference between the use of IRS and the use of treated mosquito nets is the point at which each intervention works to greatest effect. IRS may provide some small amount of individual house protection by repelling and reducing the number of vectors that come into a house. However, the greatest impact of an IRS intervention takes place after feeding when the anopheline mosquito is more likely to rest on a sprayed surface and pick up a lethal dose of insecticide, thus preventing it from going on to transmit the malaria parasite to others in the vicinity (WHO, 2015).

2.3.3 Use of mosquito repellents

A mosquito repellent is a substance applied to skin, clothing, or other surfaces which discourages insects and arthropods in general from landing or climbing on that surface (Patel *et al.,* 2012). There also exist mosquito repellent products that are based on sound production, particularly ultrasound (inaudibly high frequency sounds). Carbon dioxide, excretory products and lactic acid present in sweat in warm blooded animals act as an attractive substance for female mosquitoes (Craig F, 2001). Mosquitoes use chemical and heat receptors in their antennae to locate their prey. The repellents block the lactic acid receptors thus destroying upwind flight and as a result the mosquito loses its contact with the host (Patel *et al.,* 2012). Usually insect repellents work by masking human

scent, or by using a scent which insects naturally avoid. Synthetic repellants like DEET and permethrin are commonly used (Patel *et al.*, 2012).

2.3.4: Window and door screens

In the early twentieth century, improved housing and screening were regarded as priority methods of controlling malaria (Sheila *et al*., 2009). Screening houses using mosquito proofing materials significantly reduces indoor density of host seeking malaria vector and it provides equal protection for all occupants in the houses against bites of malaria vectors (Massebo *et al*, 2013). House screening has been associated with protection against malaria transmission, infection and morbidity (Kirby *et al.*, 2008). Furthermore, a pilot study conducted in The Gambia using experimental huts demonstrated that netting ceilings alone can reduce exposure to malaria vectors by 80%. In this situation, most mosquitoes entered the huts through the open eaves and were effectively trapped in the roof space (Kirby *et al.*, 2008).

2.3.5 Larviciding (killing of immature mosquitoes)

Larviciding is the regular application of chemical or biological agents to kill mosquito larvae in their aquatic habitats (WHO, 2012). Larviciding emphasizes targeting mosquitoes in their habitats where they reproduce. This gives the advantage of controlling the mosquitoes before they develop into biting adults (CCMD, 2007).There are different methods used in larviciding such as; Source reduction, gambusia (mosquito larvae eating fish), oils and films, methoprene which is an insect growth regulator, temephos which is an insecticide used to control mosquito larvae, and microbial larvicides such as Bti (Bacillus thuringiensis israelensis) and Bs (Bacillus sphaericus). Source reduction and oil and films are the methods that are commonly used for larval control (CCMD, 2007).

2.3.5.1 Source Reduction- This is the most efficient and ecologically safe approach at controlling mosquitoes (CCMD, 2007). Source Reduction is

removing breeding sites or making them inhospitable for mosquitoes (CCMD, 2007).

2.3.5.2 Oils and films - Oils and mono-molecular surface films are used to control pupae and late-fourth instar larvae. A small amount of this product will sheet across the surface of water and interfere with their ability to attach to the surface of the water to breathe (CCMD, 2007).

2.4 Factors influencing use of malaria control methods

2.4.1 Knowledge

To date, there is no vaccine or no safe, effective and affordable drug for mass chemoprophylaxis against malaria. Yet, the disease can effectively be prevented using the available preventive interventions (WHO, 2005). The recommended preventive interventions are use of insecticide treated mosquito nets (ITNs) and, indoor residual house spraying and other preventive interventions where appropriate and effective (Astatkie *et al.,* 2010). The term "*other preventive interventions*" in the preceding sentence is broad and embodies several possible interventions including environmental management. Thus, people's proper knowledge and practice of the available preventive methods is essential. Because practice is the application of knowledge, people should first have a good knowledge base of the available methods. Then, they will make use of the methods based on what they know (Astatkie *et al.,* 2010).

In a study carried out in Colombia on Knowledge, attitudes and practices of malaria, the two areas of Buenaventura and Tumaco had greater knowledge and better practices against malaria because of the permanent malaria education programmes in the areas (Forero *et al.,* 2014).

People's knowledge and perception of malaria influence both prevention and treatment-seeking behaviors. A study in Zimbabwe concluded that there is a significant

relationship between people's knowledge of the causes of malaria and their preventative measures taken against it, and that a household's level of understanding of the purpose of an insecticide spraying program is directly correlated with their compliance with having their house sprayed (Randell *et al.,* 2010).

In study carried out in Uganda on Knowledge and practices on malaria prevention in two rural communities in Wakiso District, it was established that knowledge on malaria prevention methods was low. However, participants were specifically highly aware of sleeping under mosquito nets to prevent malaria. High knowledge on mosquito nets was attributed to the Ministry of Health's extensive campaign on increasing awareness and use of ITNs in recent years, including free distribution to vulnerable groups of children and pregnant women. Besides mosquito nets, knowledge and practices on other malaria prevention methods was low in this study. Mosquito nets were well known and so they were used by many people but the other malaria control methods such repellants and window and door screens were not well known and were not used by many people (Musoke *et al.*, 2015).

In another study carried out in Kenya on determinants of utilization of malaria prevention strategies in Kilifi County, results showed that knowledge of malaria control was among the factors that were significantly associated with utilization of malaria preventive methods (Nthiga, 2018).

2.4.2 Attitudes

Attitude, a compound of affect, cognition and behaviour is an important component in malaria control although it has not been adequately considered in the design of interventions such as health education promotion messages, hindering sustainable control (Shimaponda-Mataa *et al.,* 2017).

In study carried out in LAO PDR, on assessment of knowledge, attitude and practices regarding malaria prevention towards population in Paksong district, Champansk

province results showed that peoples' attitude towards malaria control methods is associated with use of malaria control methods (Thanabousy *et al.,* 2009).

Also, in another study carried out in Ethiopia on knowledge, attitude and practice towards malaria and associated factors in areka town, results showed that one's attitude towards malaria was found to be significantly associated with practice on malaria. Those having positive attitude regarding susceptibility, seriousness and threat or consequences, treatment, prevention and control of malaria were about 5 times more likely to have good practice when compared to the one's having negative attitude. These findings could be considered as an interesting implication to the public health practice in the context that positive attitude is enhanced by knowledge, and in turn good practice is enhanced by positive attitude (Kebede *et al.,* 2017).

In a study carried out in Nigeria on malaria prevention: knowledge, attitude and practice, results showed that the factors influencing respondents' choice of malaria treatment and preventive methods were cost, religious beliefs, perceived safety, convenience and respondents' state of health (Erhun *et al.,* 2005).

Families are the primary context within which most health problems and illnesses occur and have a powerful influence on health. Most health belief and behavior are developed and maintained within the family. Community perceptions, beliefs, and attitudes about malaria causation, symptom identification, treatment of malaria, and prevention influence efforts to address malaria and are often overlooked in control efforts and it varies from community to community and among individual households (Singh *et al.,* 2014). Considering these issues can be an important step towards developing strategies aimed at controlling malaria. Understanding who already knows about malaria and malaria prevention, who has adopted malaria prevention and mosquito avoidance practices, and who is at risk of malaria infection is a necessary precursor to identifying and targeting vulnerable populations and ensuring successful implementation and sustainability of malaria control efforts (Singh *et al.,* 2014).

The failure to consider community's knowledge, attitude, and practice (KAP) about malaria has contributed to the inability of programs to achieve sustainable control. People's behavior may increase malaria risk, but to change such behavior is not easy. Indeed, there are many reasons why particular behaviors exist and they often are tied to considerable benefits in areas quite distinct from health. Thus, it is not usually the case that "these people don't know any better", but rather that their native logic and rationality make sense within the realities and limitations of their local circumstances (Singh *et al.,* 2014).

Studies have suggested that relevant preventive behaviour associated with other environmental measures are needed for effective malaria prevention and control effort. Any anti-malaria practices depend particularly on the preventive behaviour of the affected population. People's knowledge and perception of malaria influence both prevention and treatment seeking behaviours (Tamirat *et al.,* 2016).

In a study carried out in Kenya on determinants of utilization of malaria prevention strategies in Kilifi County, results showed that attitudes towards malaria control were among the factors that were significantly associated with utilization of malaria preventive methods (Nthiga, 2018).

2.4.3 Socio-economic

Socio-economic conditions of the community have direct bearing on the problem of malaria (Tyagi *et al.,* 2005). Ignorance and impoverished conditions of people contribute in creating source and spread of malaria and hinder disease control strategy (Tyagi *et al.,* 2005). Prevention of the disease through better knowledge and awareness is the appropriate way to keep disease away and remain healthy as illness confusion and health-seeking behaviour may enhance or interfere with the effectiveness of control measures. Studies pertaining to knowledge, attitude and practices (KAP) showed that direct interaction with community plays an important role in circumventing malaria problem (Tyagi *et al.,* 2005).

In a study carried out in India on Knowledge, awareness and practices towards malaria in communities of rural, semi-rural and bordering areas of east Delhi, results showed that there was high usage of commercially available mosquito repellents (mats and coils) by urban respondents and low usage by rural respondents due to the impact of socioeconomic conditions on the selection of protection means in communities (Tyagi *et al.,* 2005).

Because malaria is associated with poverty, most endemic countries or regions within a country usually correspond to those communities with the lowest socio-economic status (Forero *et al.,* 2014). These are frequently found in regions where malaria control is logistically and economically more challenging due to the limited capacity of local and national governments to invest in health and infrastructure. In these areas, community participation in malaria control and elimination activities is essential to achieve success and sustainability (Forero *et al.,* 2014). A community's commitment to participate in malaria prevention requires a minimal level of education in order to develop an adequate understanding of transmission, and thereby contribute to adapting attitudes towards malaria control/elimination (Forero *et al.,* 2014).

In a study carried out in LAO PDR, on assessment of knowledge, attitude and practices regarding malaria prevention towards population in Paksong district, Champansk province results showed that poor economic condition has a direct bearing on malaria prevention and control (Thanabousy *et al.,* 2009).

Education holds the key to a sustainable response to malaria prevention and the probability of dying from malaria is inversely related to income and education (Nthiga, 2018). Levels of education may affect malaria treatment seeking and prevention behaviors (Nthiga, 2018). In a study carried out in Tanzania on knowledge, attitudes, and practices about malaria and its control the findings of the study indicated that rural communities in northwestern Tanzania have high knowledge on malaria transmission, symptoms, and preventive measures. However, low education was detected as a major

drawback for effective control, and intervention measures and information campaigns should focus on this high-risk group (Mazigo *et al.,* 2010).

Research findings have shown that environmental, behavioral and socio-economic factors are associated with ability to avoid mosquitoes and prevention of malaria attack(Oyewole and Ibidapo, 2007).The wealthy and educated households often live in clean environment and are able to afford better mosquito-bite preventive measures, and good medical attention when afflicted with malaria(Oyewole and Ibidapo, 2007). While the major victims are usually the poor, less privileged and economic downtrodden people who often have no access to clean environment, and most of times have no means of acquiring better mosquito-bite preventive measures and no access to modern treatment (Oyewole and Ibidapo, 2007).

In a study carried out in Nigeria on malaria prevention: knowledge, attitude and practice the findings of the study showed that the factors influencing respondents' choice of malaria treatment and preventive methods were cost, religious beliefs, perceived safety, convenience and respondents' state of health (Erhun *et al.,* 2005).

Also, in another study carried out in Kenya on determinants of utilization of malaria prevention strategies in Kilifi County, findings of the study showed that social economic issues such as occupation were among the factors that were significantly associated with utilization of malaria preventive methods (Nthiga, 2018).

2.4.4 Practices regarding malaria control

The scope of malaria control is changing worldwide with emphases placed on community and individual participation in malaria control and prevention measures rather than exclusive use of insecticides leading to the rapid rise of health education based on understanding knowledge, attitudes and practices (KAP) towards malaria control (Amusan *et al.,* 2017). Novel reports about knowledge, attitudes, and practices relating to malaria and its control are not lacking but these reports concluded that

misconceptions on malaria transmission and risk factors still exist with negative impact on malaria control programmes (Amusan *et al.,* 2017).

There are best malaria control practices which are important in the control of malaria. They include: keeping window and doors closed between 5.00pm to 9.30pm and in the early morning since mosquitoes enters the house at this time for a blood meal, taking antimalarials before going to malaria endemic areas, going to the health centre when you think that you have malaria, ensuring that every person in the house sleeps under a mosquito net, checking every night if the nets have holes and repairing them, regularly using mosquito repellents, allowing houses to be sprayed with an IRS at least twice in a year, environmental management, wearing long sleeve clothes when going to the rice fields or at night since mosquitoes normally bite at night and they are many in the rice fields and retreating ITNs after washing them (Thanabouasy *et al*.,2009).

The success of malaria control programmes at present relies heavily on community perceptions and practices in the transmission, treatment and control of the disease (Deressa *et al.,* 2013). Incorrect beliefs or inappropriate behaviour can interfere with the effectiveness of a control measure, such as vector control or chemotherapy (Deressa *et al.,* 2013). These issues are particularly important in tropical areas where malaria control options are limited because of the parasite and vector resistance to antimalarial drugs and insecticides, respectively. In such cases, an understanding of the communities' beliefs and behaviour may be crucial to the success of specific control measures (Deressa *et al.,* 2013).

In a study carried out in Kenya on determinants of utilization of malaria prevention strategies in Kilifi County, the findings of the study showed that practices regarding malaria control were among the factors that were significantly associated with utilization of malaria preventive methods (Nthiga, 2018).

2.5 Level of utilization of malaria control methods

W.H.O. Ministerial Conference held in October, 1992 at Amsterdam evolved a Global Strategy for Malaria Control. The strategy broadly suggests de-emphasis on vector control and renewed emphasis on treatment. Early diagnosis and treatment; prevention of deaths; promotion of personal protection measures like use of ITMs; epidemic forecasting, early detection and control; monitoring, evaluation and operative research and integration of activity in Primary Health Centres are the salient aspects of this strategy (MS, 2002).

The control of malaria involves control of 3 living beings and their environment. Man, the host is a moving target and can take the disease with him to far and wide. Mosquitoes are moving, highly adaptable and have shown resistance to insecticides (MS, 2002). It is therefore important to target non-flying eggs and larvae. The parasite also is highly adaptable, hides in humans and mosquitoes and has also developed resistance to drugs. Therefore, for effective malaria control, target man first, control mosquitoes next and keep trying to tackle the parasite with development of effective drugs and vaccines (MS, 2002).

World Health Organization (WHO) currently advocates the use of Integrated Malaria Management (IMM) as the most effective tool to check the menace of malaria (Efunshile *et al.,* 2011). IMM consists of 3 tools: effective case management (ECM), integrated vector control (IVC), and personal protection (PP). These tools have to be applied simultaneously to be able to produce the desired impact (Efunshile *et al.,* 2011). ECM is the use of effective antimalarial drugs to remove parasites from infected human hosts thereby preventing transmission to mosquitoes (Efunshile *et al.,* 2011).

IVC is the use of adult mosquito killing measures, such as indoor insecticide sprays, and environmental management to remove the mosquito breeding sites, thus lowering the population densities of malaria vectors. Personal protection includes measures that prevent contact between man and mosquitoes, such as ITN, IRS, window, and door

screens. Although the use of ITN alone has been shown to reduce malaria morbidity and mortality, there is no doubt that better results will be achieved when combined with indoor insecticide spray (Efunshile *et al.,* 2011).

In study carried out in Haiti on Effectiveness of insecticide-treated bednets in malaria prevention in Haiti, findings showed that mass ITN campaigns did not reduce clinical malaria in Haiti and that alternative malaria control strategies should be prioritized (Steinhardt *et al.,* 2017).

In another study carried out in India on Attitudes, Knowledge, and Practices Regarding Malaria Prevention and Treatment among Pregnant Women in Eastern India results showed that most of the respondents reported using bed nets and mosquito coils for malaria control. A small proportion of them said that they cleaned their surroundings and other traditional methods like; rubbing mustard, neem or karanj oil or kerosene on one's body (Sabin *et al.,* 2010).

In another study carried out in Nigeria on Knowledge, Attitude and Practices on Malaria Among the Rural Communities in Aliero, most of the respondents reported that they used mosquito nets (treated and untreated) while only a few of them reported using the other malaria control methods like mosquito repellents, EM, indoor residual sprays and window and door screens (Singh *et al.,* 2014).

In a study carried out in Ethiopia on community knowledge, attitude and practice about malaria in a low endemic setting of shewa Rabit town most of the respondents used mosquitoe nets and Indoor residual spraying to prevent malaria (Abate *et al.,* 2013).

In another study carried out in Southern Sudan on the knowledge of and control practices for malaria in rural areas of mundri east county, findings showed that most of the respondents used mosquito nets for malaria control but other malaria preventive measures such as, spraying, repellents and use of coils were not commonly practiced due to unavailability in the market (Simon, 2011).

Also, in another study carried out in Baringo Kenya, the findings of the study showed that majority of community members had not used any mosquito repellents, or chemical sprays implying suboptimal utilization of complementary interventions for malaria prevention among the people in Baringo County. This could be attributed to over-reliance on mosquito nets and cultural transformation since those who used traditional mechanisms were considered retrogressive (Amadi *et al.,* 2018).

All these studies showed that there was over reliance on ITNs in malaria contol while the other malaria control was used to a small extent or not used at all.

In spite of the vigorous campaigns by the ministry of health and other stakeholders in the health sector on malaria control and prevention, the prevalence of malaria still remains high in Nyando Sub-County (Ochomo *et al*., 2014). The burden of malaria in Nyando Sub-County is attributed to large rice fields and heavy rains which provide a suitable breeding place for mosquitoes. Since the people of Nyando Sub-County have been informed of measures to control malaria, we expect the prevalence of malaria to have gone down. In a place like Swaziland where the prevalence of malaria was very high, it has been greatly reduced due to the effective use of malaria control methods (Khumbulani *et al.,* 2009).

Studies have shown that people with good knowledge and perceptions towards malaria control are less likely to suffer from the disease. In a study carried out in Swaziland on knowledge and perceptions of malaria control, most respondents were well aware of malaria control methods and they had good perceptions towards them. The study demonstrated why that country had a very low prevalence of malaria (Khumbulani *et al.*, 2009).

Socio-cultural practices and social structure/organization play a significant role in the treatment and prevention of malaria (Halima, 2003). This recognition has significantly pushed the malaria agenda forward in the last decade, albeit at a pace that is still not satisfactory. With the confirmation of the hypothesis that malaria is a disease of the

poor, it is important to understand the social, cultural and behavioral issues relating to treatment and prevention of malaria since approximately half the world's population lives in developing countries and lacks access to public health services (Halima, 2003). In a study carried out in north Nigeria on social cultural factors influencing control of malaria revealed that cultural beliefs and practices, poverty and high illiteracy levels of the people appear to have constituted a big barrier towards freely accepting the scientifically proven facts about effective malaria control (Jombo *et al.,* 2010).

Since pregnant women and children under the age of five are the most vulnerable to malaria, mothers' or caregivers' ability to recognize childhood malaria-related morbidity is crucial as about 80-90% of malaria cases are treated at home in Africa and several studies indicate that knowledge, attitudes and practices (KAP) of caregivers towards childhood malaria could influence response to signs of the disease (Yewhalaw *et al.,* 2010). Moreover, lack of knowledge and misconceptions of caregivers about the transmission and treatment of malaria may also affect malaria control interventions in general and jeopardize effective malaria treatment and home malaria management in particular (Yewhalaw *et al.,* 2010).

A case control study carried out in Ethiopia on caregivers' knowledge, perceptions and health-seeking behavior towards childhood malaria showed that mothers who were aware of signs, importance of antimalarials, usefulness of mosquito repellents and clearing of bushes, their children were less likely to suffer from malaria than those who didn't know the signs and usefulness of malaria prevention methods (Khumbulani *et al.,* 2009).

The prevalence of malaria could be high in Nyando Sub-County because of poor attitudes towards malaria control methods. In a study carried out in Ethiopia about the perception on malaria prevention, findings regarding preventive measures showed that most participants believed that malaria is preventable and mentioned spraying and the use of bed nets as key malaria preventive measures (Toé *et al.,* 2009).

Despite these positive responses a substantial number of them did not take any personal protective measures to guard against malaria infection (Toé *et al.,* 2009). These findings were similar to those of a study conducted in Rusinga Island, western Kenya on community factors relevant for participatory malaria control (Opiyo *et al.,* 2007). The researchers found that despite the fact that most of interviewees knew that bed nets protect from malaria only few people used them (Opiyo *et al.,* 2007). This study investigates factors influencing use of malaria control methods in Nyando Sub-County, Kisumu County.

2.6 Summary of literature review

The literature has indicated that a series of factors are associated with use of malaria control methods. However, each of the factors mentioned differ according to the sites, location, countries and population segments. Various methods have been employed by different countries to control malaria among their populations. Attitude and practices of various segments of the population have been found to influence use of malaria control to a great deal. Developing countries including Kenya, whose malaria burden is huge, have faced an uphill task in controlling malaria due to limited financial resources to mount effective campaigns on realistic malaria control methods.

2.7 Conceptual Framework

The schematic overleaf shows factors that were hypothesized to influence use of malaria control methods in Nyando Sub-County. These factors are categorized as demographic characteristics, knowledge of malaria control methods, attitudes towards malaria control methods and social economic status of the study population.

Demographic characteristics include gender, age, marital status, religion, level of education, income and occupation of the respondents.

Knowledge indicates what the respondent knows on causes of malaria, symptoms, preventive measures they can take and different control methods that they know.

Attitudes towards malaria control methods encompass aspects of safety, perceived effectiveness, and convenience of use and importance of these methods.

Social economic factors deal with such issues such as type of house structure and source of water.

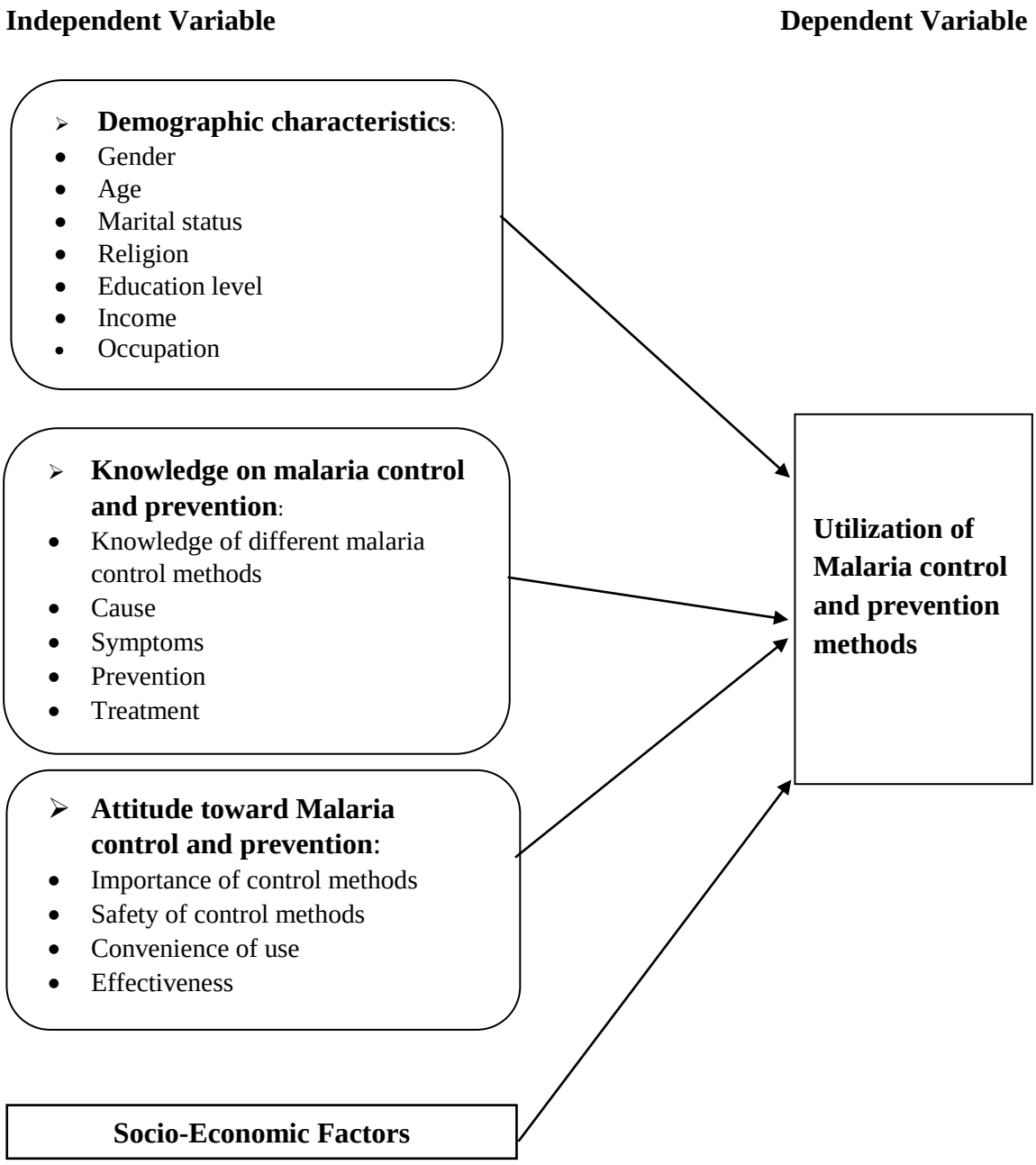

Figure 2.2: Conceptual Framework of Factors Associated with Use of Malaria Control Methods [Source: Adopted from Oso and Onen, 2009]

CHAPTER THREE

METHODOLOGY

3.1 Study site

The study was conducted in Nyando Sub-County; Kisumu County. The Sub-County is named after Nyando River. It comprises 5 wards namely East Kano, Awasi, Ahero, Kabonyo and Kobura. However, since all the wards had similar characteristics, 3 were selected to form the study area. These wards include East Kano, Awasi and Ahero. According to the 2009 national population census, Nyando Sub-County has a population of 141,037 persons and it covers approximately 431.2 square kilometers. Its estimated height above sea level is 1212 meters.

Awasi is the headquarters of Nyando sub- County and it is located in the border between Nyanza and Rift valley province. Ahero is located 20 kilometers east of Kisumu, Nyando River flows through central Ahero and helps irrigate its many rice fields. East Kano is located southeast of Kochogo and Kagimba and east of Bunde. The majority of people in the area are Luos and they practice fishing and farming in rice, sugarcane and vegetables. In addition, most of them especially women and youths belong to self-help groups where they support members in time of need. Nyando Sub-County is selected as the study area because it is one of the regions in the country with high prevalence of malaria resulting from favourable breeding places for mosquitoes in the flooded rice field plantations and the regular heavy rains that result in flooding in the area. The Sub-County is endemic for malaria and it has a prevalence of 27% which is more than the national prevalence for the disease. The most common vectors in the Sub-County are anopheles arabiensis and anopheles funestus. The vector control strategies put in place in the area are mainly use of ITNs and IRS.

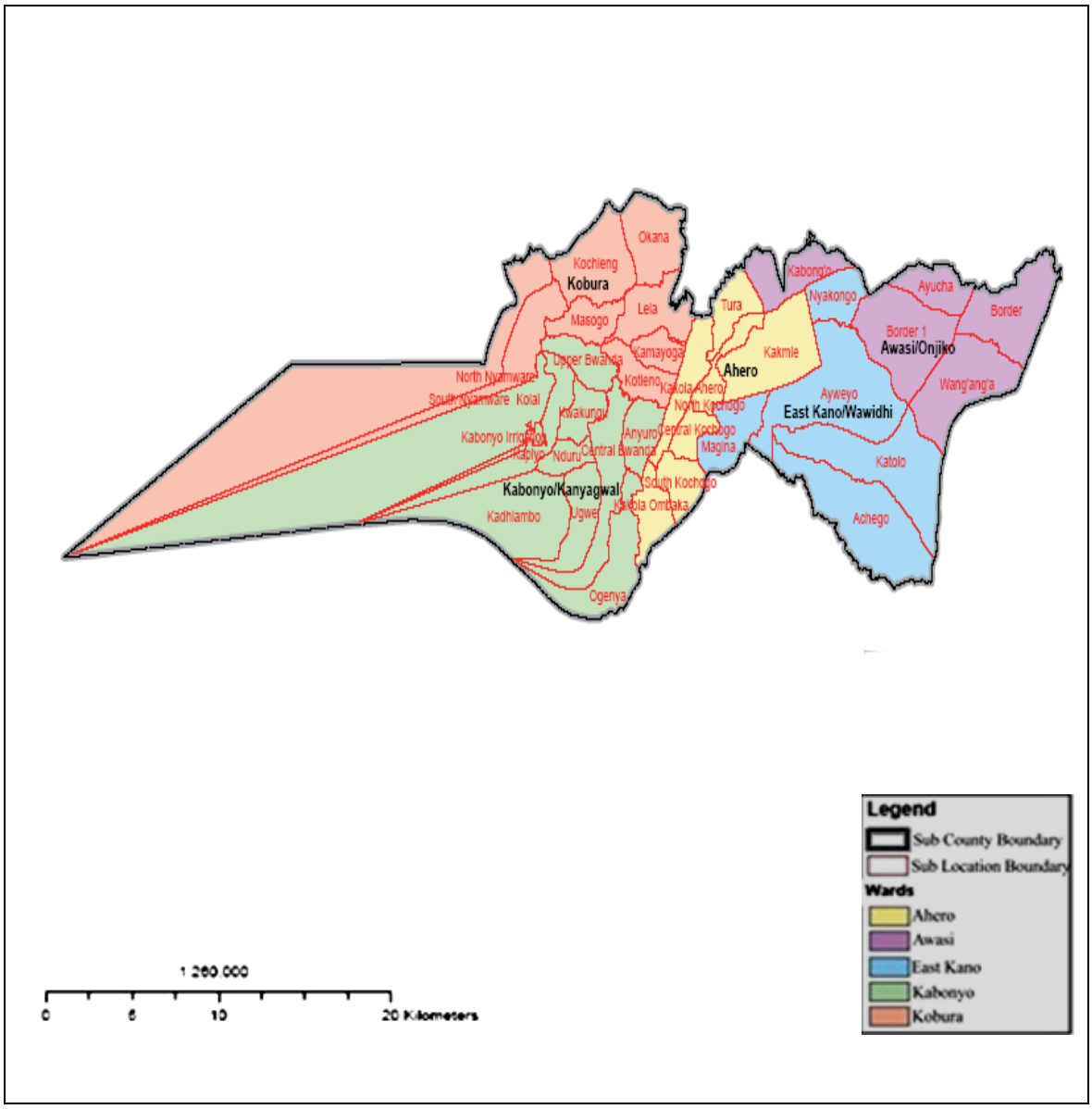

Figure 3.1 Map of Nyando Sub-county [Source: Constituency Development Fund Board Website].

3.2 Study design

The study was a cross-sectional study involving residents of Nyando Sub-County. It utilized both quantitative and qualitative methods in data collection.

- **Target population**
  - Household heads in Awasi, Ahero and East Kano wards in Nyando Sub County for six or more months.

- **Inclusion criteria**
  - Household heads who have been living in Awasi, Ahero and East Kano wards in Nyando Sub-County for the previous 6 months.
  - Consenting household heads.

- **Exclusion criteria**
  - Non-consenting household heads.
  - Household heads in Awasi, Ahero and East Kano wards in Nyando Sub-County who have been in the area for less than six months.

3.3 Sample size

For a descriptive study such as this one, the sample size calculation requires a known characteristic of the population like prevalence of the disease in question, the desired level of confidence should also be provided and a tolerance error margin or width of the confidence interval. The prevalence of malaria in Nyando-Sub County is 38% (at the time of data collection, July 2015) and so we use it to get our sample size.

The formula below by Cochran et al., (1963) was used to estimate the sample size.

$$n = \frac{z^2 pq}{e^2}$$

Where

p= prevalence of malaria in Nyando Sub-County is 38%

e= degree of precision for 95% confidence is 5%

z= level of confidence interval for 95%

q=1-p

Non-response = 0.9

$$n = \frac{(1.96)^2 \times 0.38 \times 0.62}{(0.05)^2}$$

=362

362 divided by non-response (0.9)

362/0.9=402

The sample size without factoring in non-response rate is 362. Therefore, the final sample size is 362 divided by 0.9 which gives us 402. The sample size is 402.This is the number of the household heads who were interviewed.

3.4 Sampling procedure

3.4.1 Quantitative data

Systematic sampling method was used to select the households. The sampling frame was obtained from the total number of households in all the 3 wards. In each ward the 1st household from the chief's office was selected to be the 1st household in the sample, after that every 5th household was included in the sample until the desired sample size was attained. The 3 wards were Ahero, Awasi and East Kano which were a sample representative of all the 5 wards in the Sub-County. The other two wards are Kobura and Kabonyo. The 3 wards were selected because all the 5 wards have similar characteristics and the results can be generalized to the whole Sub-County.

Since the sample size for the whole Sub-County is 402, this was divided by 3 which is the number of the wards that were sampled, so that all the wards were equally represented in the study. A community health worker and a research staff identified each household and introduced the researcher to the study participant. The research staff was a person who the principal investigator had already identified since he lives in Awasi and had conducted many surveys in the area. He was trained by the principal investigator before the study began. The community health worker was identified by the Sub-County public health officer. Consenting household heads provided the researcher with the information that was filled in the questionnaire.

3.4.2: Qualitative data

Participants for FGDs were selected using convenience sampling technique. The basis of convenience sampling is convenience since some people may be shy or may not have time to be interviewed. There were 2 FGDs per ward; one for males and another for females, which totaled up to 6 FGDs. There were different FGDs for each gender so that any gender sensitive issues could be captured. The FGDs were held in a central point agreeable to both the P.I and community health worker. The FGDs were used to bring out other factors not captured in the questionnaires that might influence in any way the use of malaria control methods.

3.5 Data collection

3.5.1 Data collection tools

Various methods were used to collect data:

- A questionnaire was administered to the household head. If the household head was a man and he was not present and it is a woman who was in the house, then she was interviewed by the researcher with the assistance of a trained research assistant. The main issues captured include, age, gender, marital status, religion, level of education, income, occupation, knowledge, attitudes, practice and utilization of malaria control methods (Appendix 1).
- Six Focus Group Discussions were conducted among 8 to 12 eligible participants by the researcher as the moderator and assisted by the research assistant who was taking notes and tape recording as back up. The FGDs were conducted to the saturation point (no new information was forthcoming). The FGDs were conducted for the different genders so that any gender sensitive issue could be discussed freely. The participants were chosen by convenience sampling because of reasons ranging from lack of time for the participants, shyness and inability of some participants to talk freely. A guide which captured issues such as perceptions towards malaria control methods, malaria control methods mostly

used in the community and any other factors that may influence use of malaria control methods in the community was used (Appendix 3).

3.6 Data management

All the questionnaires were checked for any errors and corrected (data cleaning) and then data was entered into SPSS dataset. All datasets including consent forms and other study materials were collected and stored at an office in Nyando Sub-district hospital courtesy of the medical superintendent. They were then saved into a computer protected by password. In addition, data was saved into flash disk strictly accessible to the principal investigator but was saved using identifiers only unique to the principle investigator.

3.7 Data analysis plan

The variables captured in the questionnaires were sex, level of education, marital status, age, income, malaria control practices, religion, awareness of malaria control methods, perceptions towards malaria control methods and social economic factors affecting use of malaria control. Statistical relationship was sought between the variables mentioned above which were independent variables and use of malaria control methods which was a dependent variable.

Quantitative data was entered into an SPSS dataset. These variables are categorical and for this reason they were analyzed using chi square in SPSS in order to get the association between the variables. The association was determined by looking at the level of significance at 0.05.

Qualitative data from FGDs was transcribed and translated to English (where applicable) and typed in Microsoft word and manually analyzed for content/context reading, evaluation, analysis and interpretation for development of themes and subthemes where applicable, results/findings were presented verbatim (thematic analysis).

3.8 Ethical considerations

The proposal to conduct this study was presented to the KEMRI scientific steering committee and scientific ethics review unit (SERU) for scientific and ethical approval respectively. Permission to carry out the study in the community was sought from the County director of health and the county administrator who facilitated in way of informing respective leaders at the Sub-County and village levels.

Courtesy calls to the area chiefs, sub-chiefs and village elders were made with a view of informing them about the intended project for social mobilization and sensitization. The study participants were approached by the principal investigator together with the community health worker. The principal investigator then informed the area residents about what the study is all about and the benefits of participating in it; those who agreed to participate in the study were requested by the principal investigator to go through the informed consent or it was read to them for those who were not able to read.

They were also requested to sign the informed consent form. The risks involved in the study were wasted valuable time, but this was minimized by the principle investigator and research assistant having clarity in asking the questions and using the luo questionnaire for those people who had difficulties in understanding the English language. The benefits of participating in the study were that the information that the participants gave will help come up with remedial measures aimed at reducing the prevalence of malaria in Nyando Sub-County. Identity of participants and other records would remain confidential and would not appear when the study is presented or its results published. Also, no names were required from the study participants. Informed consent was sought from all individuals who participated in the study (appendix 5).

The data collected would be used only in this study and their information would be kept secretly. All data including tape recorded discussions were stored out of reach of unauthorized persons and would be used for research purposes only.

CHAPTER FOUR

RESULTS

4.1: Introduction

There were 402 study participants from the three wards of Nyando sub-county. The wards were Awasi, Ahero and East Kano. Source of data for this study was from questionnaire and focus group discussion.

4.1.1 Distribution of study participants by ward

A total of 402 study participants in 3 out of 5 wards in Nyando sub-county were enrolled in the study. One hundred and thirty-four study participants (which represented 33.3% (**Figure 4.1**) of the total number of study participants) were selected from Ahero, Awasi and East Kano wards.

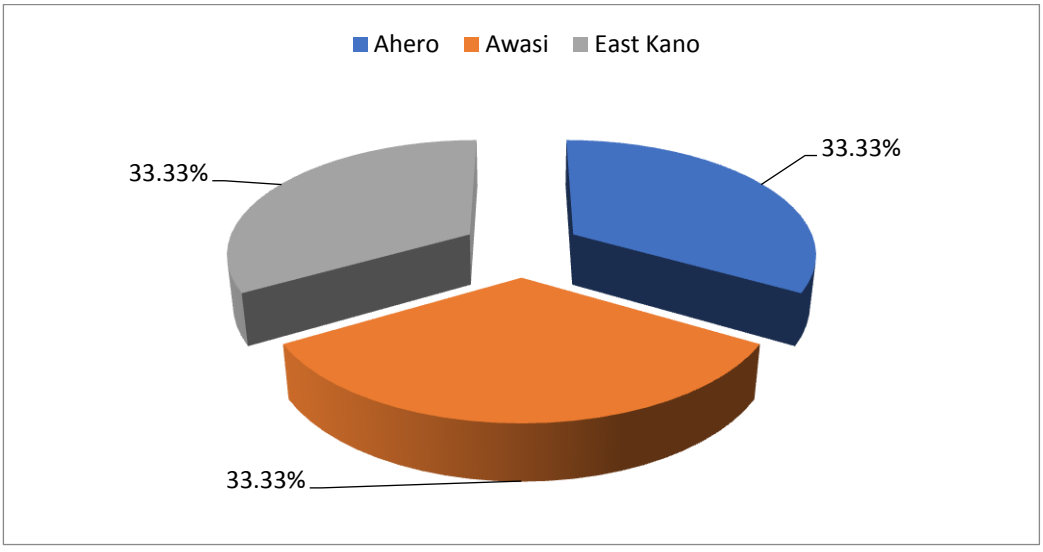

Figure 4.1: Distribution of study participants by wards of interest in Nyando sub-county

4.2a: Social Demographic Characteristics of the study population

As shown in (**Table 4.1a)**, 225 (56%) study participants were male and 177(44%) were female. Most of the respondents were aged between 26 to 33 years (25.6%), followed by those who were between 18 to 25 years old (15.4%). Those between 42 to 49 years were 13.4%, the ones between 34 to 41 years were 13.2%, 12.7% were over 65 years old and those between 50 to 57 years were 12.2%. A very small proportion, 7.5% were between 58 to 65 years. Three hundred and fifteen (78.4%) respondents were married, 6% were single while 15.7% were widowed. Three hundred and ninety-six (98.5%) respondents were Christians, 1% were Muslims and 0.5% were atheists. Two hundred and eighteen (54.2%) respondents had gone up to primary level of education; one hundred and ten (27.4%) had gone up to secondary level of education while fifty-three (13.2 %) respondents did not have any formal education. A small proportion, 5.2 % had reached college level of education.

Table 4.1a: Socio-demographic characteristics of the respondents

Variable	Category	Number	Percent (%)
Gender characteristics	Male	225	56
	Female	177	44
Age	18 – 25	62	15.4
	26 – 33	103	25.6
	34 – 41	53	13.2
	42 – 49	54	13.4
	50 – 57	49	12.2
	58 – 65	30	7.5
	65 and above	51	12.7
Marital status	Single	24	6
	Married	315	78.4
	Divorced	0	0
	Cohabiting	0	0
	Others	63	15.7
Religion	Christian	396	98.5
	Muslim	4	1
	Hindu	0	0
	Non – religious	2	0.5
Education level	No education	53	13.2
	Primary Education	218	54.2
	Secondary Education	110	27.4
	College education	21	5.2

4.2b: Social Demographic Characteristics of the study population

As shown in **(Table 4.1b)**, most of the respondents (35.8%) earned between Ksh. 500 to 4499, ninety-six (23.9%) of them had no income, 21.9% earned between ksh.4500 to 8499 while 10.7% earned between Ksh. 8500 to 12500, 2.7% earned between ksh.16, 500 to 20,499, 1.5% of the respondents earned between Ksh. 20500 to 24499 and a further 1.2% earned between Ksh. 12500 to 16499. Another proportion, 1.2% earned between Ksh. 28,500 to 32,499 and 0.5% earned between Ksh. 24,500 to 28,499 every month. Only 0.5% of the respondents earned Ksh. 32,500 and above. Businessmen/women formed 44.8%of the respondents while farmers were 40.3%. The other main occupation was salaried workers 7.7% while 7.2% were either students or not employed.

Table 4.1b: Socio-demographic characteristics of the respondents (ctd)

	No income	96	23.9
Monthly income	4500 – 8499	88	21.9
	8500 – 12499	43	10.7
	12500 – 16499	5	1.2
	16500 – 20499	11	2.7
	20500 – 24499	6	1.5
	24500 – 28499	2	0.5
	28500 – 32499	5	1.2
	32500 and above	2	0.5
Main occupation	Farming	162	40.3
	Business	180	44.8
	Salaried worker	31	7.7
	Others	29	7.2

4.3: Distance to the nearest health facility

As shown in **Figure 4.2** below, 74.4% of respondents resided between 1 to 5 kilometers from the nearest health facility, 18.9% less than a kilometer, while 6.2% and 0.5% were between 6 to 10 and 11 to 15 kilometers from the nearest health facility respectively.

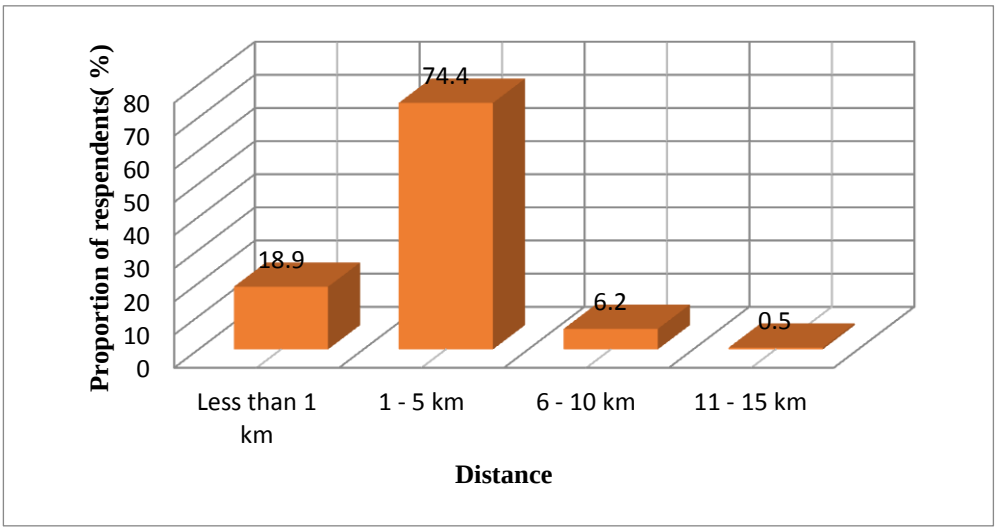

Figure 4.2 Distance to the nearest health facility

4.4: Mode of transport to health facility

Majority of the respondents accessed the health facility on foot 58.5% (**Figure 4.3)** followed by 29.9% who used motor cycles and bicycles. Forty six (11.4%) respondents used buses and matatus and only 0.2% used their own vehicle.

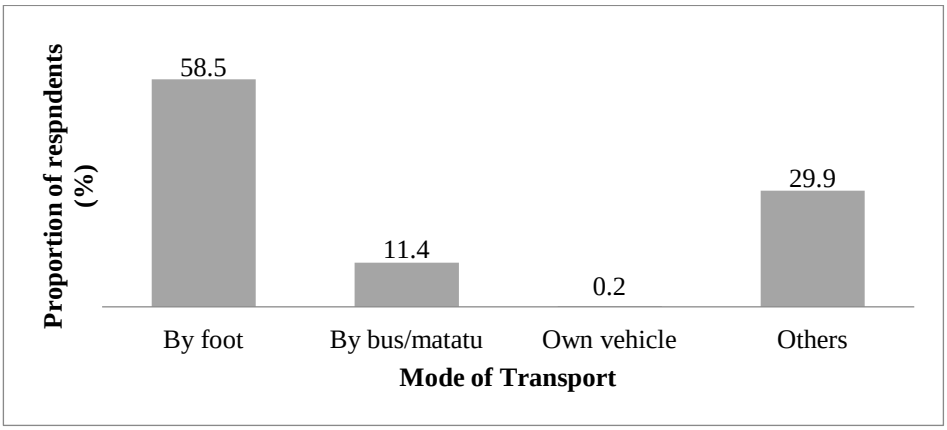

Figure 4.3 Mode of transport to health facility

4.5: Type of dwelling

A large proportion, 86.6% of the respondents lived in traditional mud houses (**Figure 4.4**), 8.5% lived in brick houses while 4% and 0.9% lived in stone and iron sheet houses respectively.

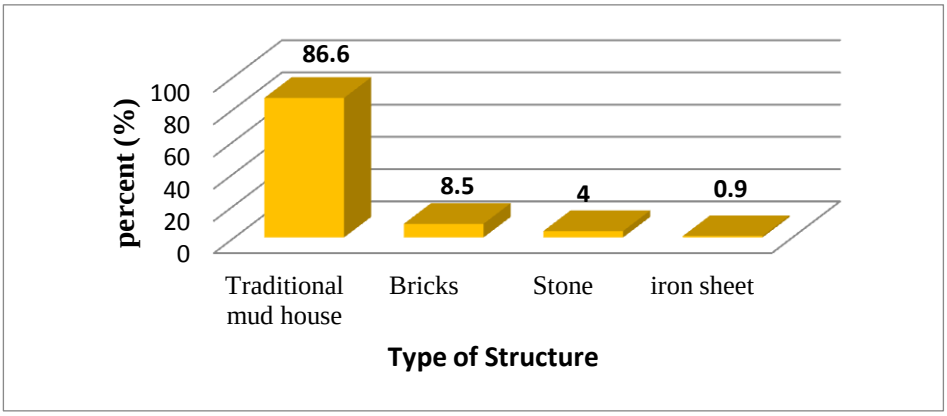

Figure 4.4: Type of dwelling

4.6: Source of water

As shown in **Figure 4.5**, a large proportion, 46.3% of the respondents got their water from shallow dams. Other sources of water were rivers/springs (20.1%), borehole (17.4%) and tap water (16.2%).

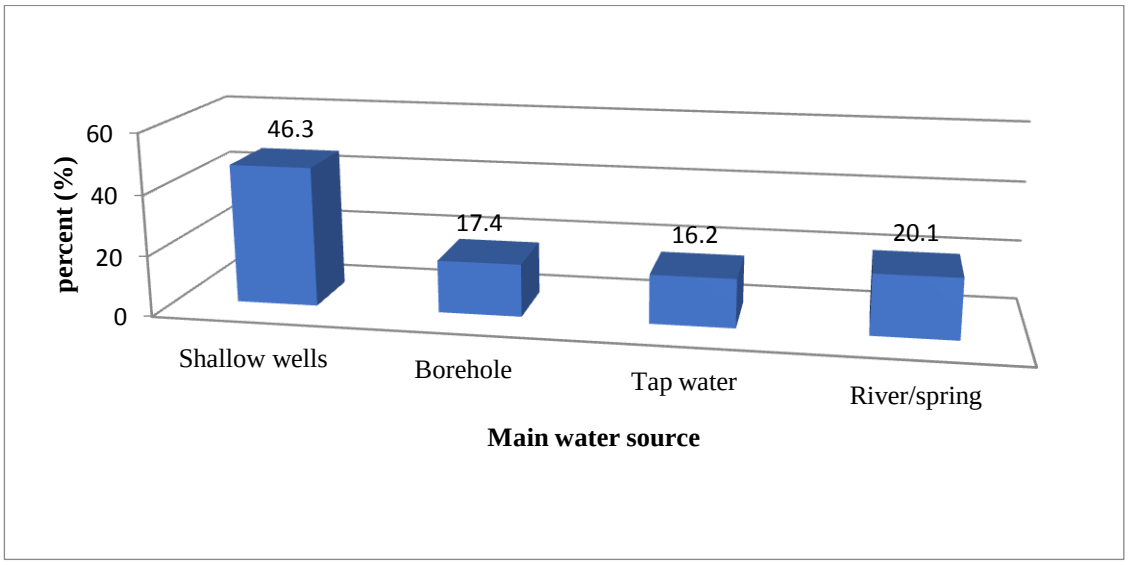

Figure 4.5: Respondent's main source of water

4.7 Knowledge on Malaria control and prevention

4.7.1 Respondents' knowledge on Malaria control and prevention

As shown in **Table 4.2**, 99% of the respondents said that malaria was a problem in their community. All of the respondents said that malaria can be prevented. When they were asked if they knew the drug that was being promoted by MOH, 83.1% of the respondents confirmed they knew it. However, when they were asked specifically about ACT, the proportion of those who knew it decreased to 80.8%.

Table 4.2: Knowledge on Malaria control and prevention

Variable	Yes	No
Malaria is a problem in this community	398 (99%)	4 (1.0%)
Malaria can be prevented	402 (100%)	0 (0%)
Knowledge of drug being promoted by MOH	334 (83.1%)	68 (16.9%)
Knowledge of ACT	325 (80.8%)	77 (19.2%)

4.7.2 Respondents' knowledge on Malaria and its control

As shown in **Table 4.3**, 97.8% of the respondents identified mosquitoes as the cause of malaria and 1.2% reported that it was either caused by cold or were not aware of what causes it. When asked about the symptoms of malaria, 57% of the respondents mentioned fever, 51% headache, 43% vomiting, 37.8% muscle/joint pain, 17.9% shivering and 9% of the respondents said diarrhea. Upon further interview on the malaria control methods that they knew, all the 402 respondents were aware of ITNs, EM was also well known because 96.3% of the respondents knew it and so was IRS which was known by 89.6% of the respondents. One hundred and ninety (47.3%) respondents knew mosquito repellents, 22.9% knew Larviciding, while a small proportion, 14.7% (59) respondents were the only ones who knew window and door screens as a malaria control method.

Table 4.3: Knowledge on Malaria and its control

Variable	Category	Frequency	Percent (%)
Knowledge on the cause of malaria	Food	1	0.2%
	Water	3	0.7%
	Mosquitoes	393	97.8%
	Dirt	0	0
	Friends	0	0
	Others	5	1.2%
Knowledge on the Symptoms of malaria	Fever	229	57%
	Headache	205	51%
	Muscle/joint pains	152	37.8%
	Vomiting	173	43%
	Diarrhea	36	9%
	Shivering	72	17.9%
Knowledge on the malaria prevetion methods	ITNs	402	100%
	Larviciding	92	22.9%
	EM	387	96.3%
	Mosquito repellents	190	47.3%
	IRS	360	89.6%
	Window and door screens	59	14.7%

4.7.3 Respondents' source of information for ACT

As shown in **Figure 4.6** below, 51% of the respondents said they had known about ACT from health workers, followed by media (27.4%), neighbours (1.7%) and others school and parents.

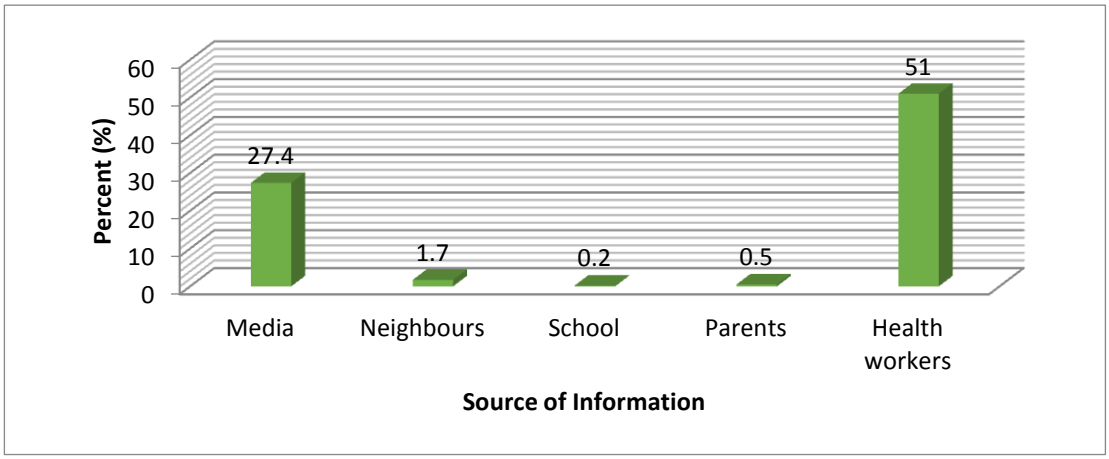

Figure 4.6: Source of information on Antimalarial Combination Therapy

4.7.4 Respondents' source of ACT

A large proportion, (62.4%) of the respondents said that their source of ACT drug was government clinics. Another proportion, 17.9% said it was pharmacies/clinics while others said shops and health workers as their source of ACT drug.

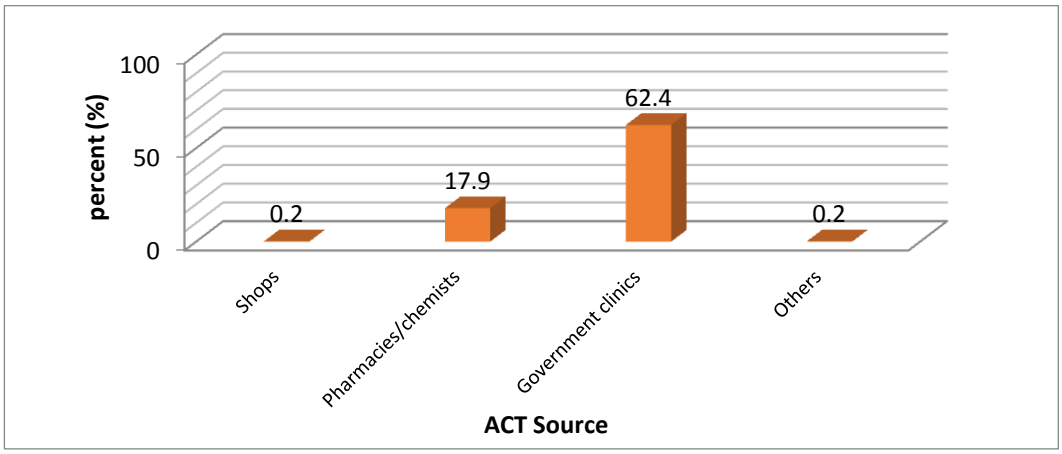

Figure 4.7: Source of Antimalarial Combination Therapy

4.7.5 Respondents' source of information for malaria control methods

Respondents' main source of information for ITNs was health workers (79.4%) (Figure 4.8), 12.4% of the respondents said that they had known ITNs through the media, 4% said it was school while others mentioned parents and neighbours.

Larviciding was not known well by the respondents; of those respondents who knew it 9.7% said they had known it through health workers, 6% said school, followed by media which was mentioned by 3.2% of the respondents while others mentioned parents and neighbours.

EM was well known by the respondents; 44.5% of the respondents said they had known it through health workers, followed closely by school (33.3%), parents (11.4%) while others mentioned media and neighbours.

When the respondents were asked about their source of information for mosquito repellents, 40.3% of the respondents reported health workers, 32.8% neighbours, 13.8% reported media, 9.0% said school and 4.2% said parents.

They were also asked about their source of information for IRS; a large proportion 40.3% of the respondents reported health workers, 4.5% media while others mentioned neighbours, school and parents.

They were further interviewed about their source of information for window and door screens, among the respondents who knew it, 40.3% said neighbours, 38.7% reported health worker, 9.7% school, 8.1% parents and 3.2% said they had known it through the media.

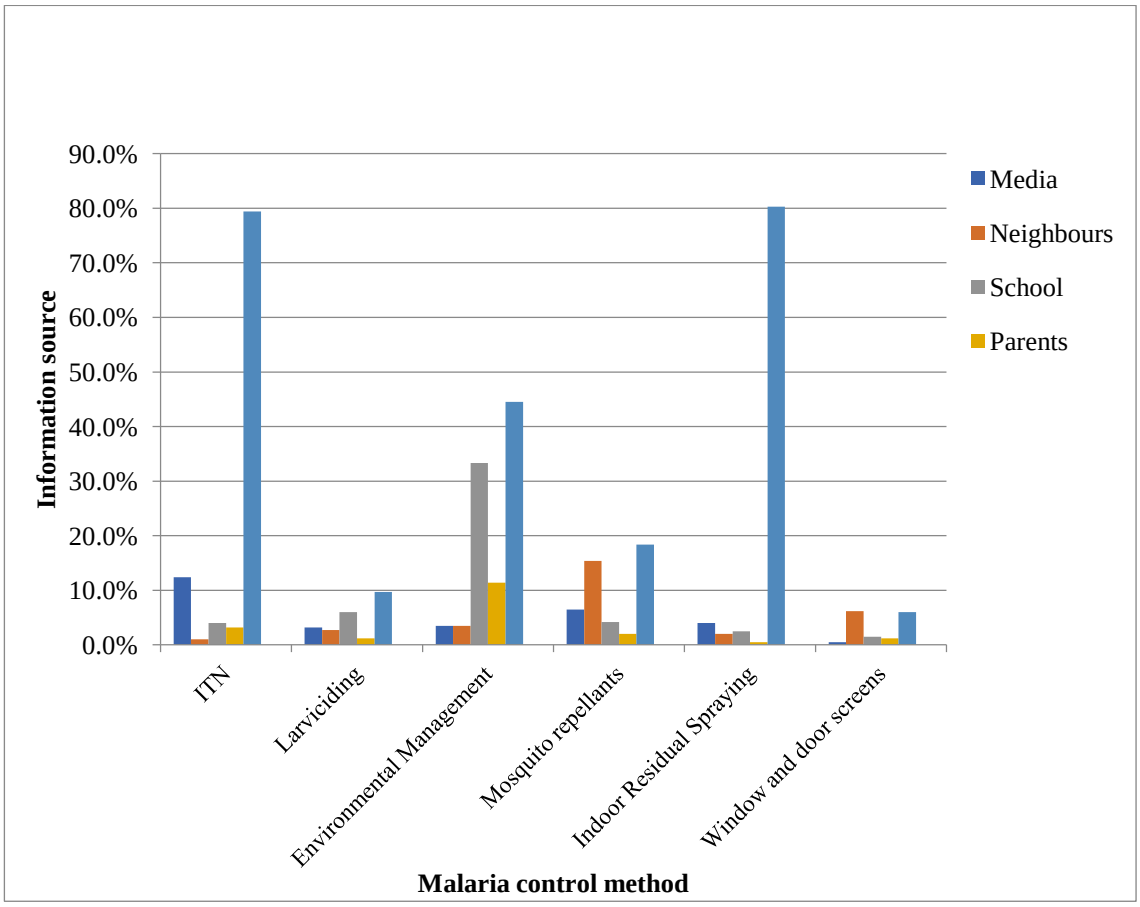

Figure 4.8: Source of information on Malaria control methods

4.8 Respondents' Attitudes towards malaria control methods

4.8.1 Respondents' perception on the importance of malaria control methods

As shown in **Table 4.4**, when the respondents were asked about their perception toward malaria control methods with regards to their importance in malaria control, 70.1% said ITNs are extremely important, 25.6% said they thought they were very important, 3.7% of the respondents said they are moderately important while only 0.5% of the respondents said that ITNs are not important. When they were asked about Larviciding, 46.3% of the respondents said it is moderately important, 28.1% said it was very

important, 17.7% said it was not important, while only 8% of the respondents reported that it was extremely important.

On the importance of window and door screens in malaria control, 59% of the respondents said it was moderately important, 18.7% said that window and door screens are not important in malaria control, 12.7% said it was very important and 9.7% of the respondents reported that it was extremely important. They were also asked about what they thought about mosquito repellents; 54.7% said they are very important, 27.1% said they are moderately important, 10.9% of the respondents said they are extremely important, and only 7.2% of the respondents said that mosquito repellents are not important in malaria control.

Another malaria control method whose importance respondents were asked about in malaria control is EM. Of all the 402 respondents, the majority 60.4% of the respondents said it was very important, 25.1% of the respondents said it was extremely important, 12.7% said it was moderately important and only 1.7% of the respondents said that EM was not important in malaria control. They were further queried on the importance of IRS in malaria control; 41% said it was very important, 31.3% said it was moderately important, 14.9% of the respondents said it was not important in malaria control while12.7% of the respondents said it was extremely important.

Table 4.4: Importance of malaria control methods

Importance of malaria control methods in malaria control		Frequency	Percent (%)
ITNs	Extremely Important	282	70.1
	Very Important	103	25.6
	Moderately Important	15	3.7
	Not Important	2	0.5
Larviciding	Extremely Important	32	8.0
	Very Important	113	28.1
	Moderately Important	186	46.3
	Not Important	71	17.7
Window and Door Screens	Extremely Important	39	9.7
	Very Important	51	12.7
	Moderately Important	237	59.0
	Not Important	75	18.7
Mosquito repellents	Extremely Important	44	10.9
	Very Important	220	54.7
	Moderately Important	109	27.1
	Not Important	29	7.2
Environmental Management	Extremely Important	101	25.1
	Very Important	243	60.4
	Moderately Important	51	12.7
	Not Important	7	1.7
Indoor Residual Spraying	Extremely Important	51	12.7
	Very Important	165	41.0
	Moderately Important	126	31.3
	Not Important	60	14.9

4.8.2 Respondents' perception on safety of use of malaria control methods

As shown in **Table 4.5**, when the respondents were asked about their opinion on the safety of use of the different malaria control methods, 59% of the respondents said that ITNs were extremely safe, 148 (36.8%) respondents said that they were very safe, 4.2% of the respondents said that they were a little safe while none of the respondents said that ITNs are not safe at all. When they were asked about the safety of larviciding; 61.4% said it was a little safe, 17.9% said it was very safe,10.9% of the respondents said that it was not safe at all while 9.7% of the respondents said that larviciding was extremely safe.

The respondents were also asked on their opinion on the safety of use of window and door screens; 45.8% reported that it was very safe, 42.5% said it was a little safe, 8.7% said it was extremely safe while 3% of them said it was not safe at all. Upon further interview, they were asked about their opinion on the safety of use of mosquito repellents; of all the 402 respondents, 46.8% said that it was very safe, 39.3% reported that it was a little safe, 11.2% said that it was extremely safe while a small proportion, 2.7% of the respondents said that it was not safe at all

The respondents were also asked their opinion on practicing EM; a large proportion, 58.5% of the respondents said that it was very safe, 33.3% said that it was extremely safe, 7.7% said that it was a little safe and only 0.5% of the respondents said that it was not safe. They were further asked to give their opinion on the safety of practicing IRS; of all the 402 respondents, 43.8% reported that it was very safe, 30.6% said it was a little safe, 13.2% of the respondents said that it was not safe at all while 12.4% of the respondents said that IRS was extremely safe.

Table 4.5: Safety of malaria control methods

Opinion on safety of use of malaria control methods		Frequency	Percent (%)
ITNs	A little safe	17	4.2
	Very safe	148	36.8
	Extremely safe	237	59.0
Larviciding	Not safe at all	44	10.9
	A little safe	247	61.4
	Very safe	72	17.9
	Extremely safe	39	9.7
Window and Door screens	Not safe at all	12	3.0
	A little safe	171	42.5
	Very safe	184	45.8
	Extremely safe	35	8.7
Mosquito repellent	Not safe at all	11	2.7
	A little safe	158	39.3
	Very safe	188	46.8
	Extremely safe	45	11.2
Environmental Management	Not safe at all	2	0.5
	A little safe	31	7.7
	Very safe	235	58.5
	Extremely safe	134	33.3
Indoor Residual Spraying	Not safe at all	53	13.2
	A little safe	123	30.6
	Very safe	176	43.8
	Extremely safe	50	12.4

4.8.3 Respondents' perception on convenience of use of malaria control methods

As shown in **Table 4.6**, the respondents were asked to what extent they felt it was convenient for them to use different malaria control methods. Of all the 402 respondents, a large proportion, 77.6% of the respondents said that using ITNs was convenient to a great extent,13.2% said it was convenient to a moderate extent, 8.7% said it was slightly convenient while only 0.5% of the respondents said it was not convenient at all to use ITNs. When asked about the convenience of practicing larviciding, a large proportion, 39.1% of the respondents said that it was convenient to a moderate extent, 36.6% said that it was convenient only slightly, 15.2% of them said that it was not at all convenient, while only a small proportion, 9.2% of the respondents said that it was convenient to a great extent.

The respondents were further interviewed on how convenient they felt it was for them to use window and door screens, a large proportion, 40.3% of the respondents said it was convenient to a moderate extent, 36.6% said it was convenient only slightly, 13.7% of them said it was not convenient at all while a small proportion, 9.5% of the respondents reported that it was convenient to a great extent. The respondents were also asked how they felt it was convenient for them to use mosquito repellents, a large proportion, 35.3% of the respondents said that it was convenient to a moderate extent, 29.6% said that it was convenient to a great extent, 25.2% said that it was convenient only slightly while 9.7% of the respondents said that it was not at all convenient to use mosquito repellents .

The respondents were further interviewed regarding the extent to which they felt it was convenient for them to practice EM; a large proportion, 63.7% of the respondents said that it was convenient for them to a great extent to practice EM, 30.8% of them said it was convenient to a moderate extent, 4.5% reported that it was only slightly convenient for them to practice it while only 1% of the respondents said that it was not convenient at all for them to practice it. The respondents were further interviewed on how

convenient they felt it was for them to practice IRS; a large proportion, 42.3% of the respondents said that it was only slightly convenient for them to practice it, 28.1% of them said that it was convenient for them to a great extent, 20.4% reported that they felt it was convenient for them only to a moderate extent, while 9.2% of the respondents said that it was not at all convenient for them.

Table 4.6: Convenience of use of malaria control methods

Convenience of use of malaria control methods		Frequency	Percent (%)
ITN	Not at all	2	0.5
	Only slightly	35	8.7
	To a moderate extent	53	13.2
	To a great extent	312	77.6
Larviciding	Not at all	61	15.2
	Only slightly	147	36.6
	To a moderate extent	157	39.1
	To a great extent	37	9.2
Window and Door Screen	Not at all	55	13.7
	Only slightly	147	36.6
	To a moderate extent	162	40.3
	To a great extent	38	9.5
Mosquito repellent	Not at all	39	9.7
	Only slightly	102	25.4
	To a moderate extent	142	35.3
	To a great extent	119	29.6
Environmental Management	Not at all	4	1.0
	Only slightly	18	4.5
	To a moderate extent	124	30.8
	To a great extent	256	63.7
Indoor Residual Spraying	Not at all	37	9.2
	Only slightly	170	42.3
	To a moderate extent	82	20.4
	To a great extent	113	28.1

4.8.4 Respondents' perceived effectiveness of malaria control methods

Respondents were asked how effective they felt malaria control methods (**Table 4.7)** were in controlling malaria. When asked about ITN, A large proportion, 85.8% of the respondents said that ITNs are very good in controlling malaria, 11.2% said that it was good, 2.5% said that it is average while 0.2% of the respondents said that it very poor

and another 0.2% said that it was poor. The respondents were also asked about effectiveness of larviciding; a large proportion, 66.9% of the respondents said it was average, 13.2% said it was good, 12.9% said it was very good, 6% said it was poor and only 1% of the respondents said that it was very poor.

When they were asked to comment on the effectiveness of window and door screens, a large proportion, 70.6% of the respondents said it was average, 12.4% said it was very good, 11.7% said it was good, 4.7% said it was poor and 0.5% of them said it was very poor. The respondents were interviewed on their perceived effectiveness of mosquito repellents in malaria control; 37.8% of them said it was good, 30.6% said it was average, 29.1% said it was very good, 2.2% said it was poor and only 0.2% of the respondents said it was very poor.

On further interview they were asked what they thought about effectiveness of EM; a large proportion, 50.7% of the respondents reported that EM was very good in malaria control, 38.1% said it was good, 10.4% of the respondents said it was average, 0.5% said it was poor while 0.2% of the respondents said it was very poor. When the respondents were asked about effectiveness of IRS in malaria control; a large proportion, 35.8% of them said that it was very effective, 26.4% said it was good, 22.9% said it was average,10% of them said that it was poor while 5% of the respondents said that it was very poor.

Table 4.7: Perceived effectiveness of malaria control methods

Effectiveness of use of malaria control methods		Frequency	Percent (%)
ITN	Very poor	1	0.2
	Poor	1	0.2
	Average	10	2.5
	Good	45	11.2
	Very good	345	85.8
Larviciding	Very poor	4	1.0
	Poor	24	6.0
	Average	269	66.9
	Good	53	13.2
	Very good	52	12.9
Window and Door screens	Very poor	2	0.5
	Poor	19	4.7
	Average	284	70.6
	Good	47	11.7
	Very good	50	12.4
Mosquito repellents	Very poor	1	0.2
	Poor	9	2.2
	Average	123	30.6
	Good	152	37.8
	Very good	117	29.1
Environmental Management	Very poor	1	0.2
	Poor	2	0.5
	Average	42	10.4
	Good	153	38.1
	Very good	204	50.7
Indoor Residual Spraying	Very poor	20	5.0
	Poor	40	10.0
	Average	92	22.9
	Good	106	26.4
	Very good	144	35.8

4.9 The level of utilization of malaria control methods

4.9.1 Respondents' use of malaria control methods

As shown in **Table 4.8**, all the respondents used ITNs, 95.5% of them said they practiced EM, 62.4% said they had practiced IRS and mosquito repellents were only used by 18.7% of the respondents. Larviciding was only used by a small proportion,

7.5% of the respondents while window and door screens were used by only 3.5% of the respondents.

Table 4.8: Use of malaria control methods

Malaria control method	Use	
	Yes	**No**
ITN	402 (100%)	0
Larviciding	30 (7.5%)	372 (92.5%)
Window and door screens	14 (3.5%)	388 (96.5%)
Mosquito repellents	75 (18.7%)	327 (81.3%)
Environmental management	384 (95.5%)	18 (4.5%)
Indoor residual spraying	251 (62.4%)	151 (37.6%)

4.9.2 Respondents' reason for not using malaria control methods

As shown in **Table 4.9**, when the respondents were asked why they don't use malaria control methods; a large proportion, 72.1% of them reported they did not practice larviciding because they had never heard about it, 12.9% reported that it was not available, 4.5% of them said it is expensive and 1.7% said it was not comfortable to use. Another proportion, 0.5% of the respondents said that it could not control malaria, 0.5% said it was tedious to practice it while 0.2% of them said it could cause allergy.

When they were asked for the reason for not using window and door screens; 77.9% of the respondents said they had never heard about of it, 10% said it was not available, 8%

of them said it was expensive and 0.2% said it was not comfortable to use. Another 0.2% of the respondents said it could not control malaria, and a further 0.2% of them reported that it was tedious to practice it.

The respondents were also asked for the reason for not using mosquito repellents; a large proportion, 44.3% of them said they did not use mosquito repellents because they had never heard about them, 29.6% said they were not available, 5.5% said they were expensive, and 1.2% of the respondents said they were not comfortable to use. A small proportion, 0.7% of the respondents said they did not use mosquito repellents because they could cause an allergy while 0.5% said it was tedious to use it.

The respondents were further asked for the reason for not practicing EM; 1% said it could not control malaria and 0.5% of them said it was tedious to practice.

The respondents were also asked why they did not practice IRS; a large proportion, 26.4%, said it was not available, 6% of them said they were not aware of it and 3.5% of them said it was not comfortable to use. In addition, 0.7% of the respondents said it could not control malaria, 0.5% said it could cause an allergy while a further 0.5% of them said it was expensive.

Table 4.9: Reason for not using malaria control methods

Malaria control method	Reason for not using						
	Expensive	Not available	Not comfortable to use	Cannot control malaria	Allegy	Never heard it	Tedious
ITN	-	-	-	-	-	-	-
Larviciding	18 (4.5%)	52 (12.9%)	7 (1.7%)	2 (0.5%)	1 (0.2%)	290 (72.1%)	2 (0.5%)
Window and door screens	32 (8%)	40 (10%)	1 (0.2%)	1 (0.2%)	-	313 (77.9%)	1 (0.2%)
Mosquito repellents	22 (5.5%)	119 (29.6%)	5 (1.2%)	-	3 (0.7%)	178 (44.3%)	2 (0.5%)
Environmental management	-	-	-	4 (0.9%)	-	-	2 (0.5%)
Indoor residual spraying	2 (0.5%)	106 (26.4%)	14 (3.5%)	3 (0.7%)	2 (0.5%)	24 (6%)	-

4.9.3 Respondents' frequency of using malaria control methods

As shown in **Table 4.10**, the respondents were asked how frequently they used malaria control methods. When they were asked about their frequency of using ITNs, 99% of the respondents said they used it on a daily basis while 1% said they used it occasionally.

A large proportion, 95.5% of the respondents said they practiced EM occasionally and only 4.5% of them said they had never practiced it. On the frequency of practicing IRS, a large proportion, 79.9% of the respondents reported that their houses had been sprayed a few years back while 20.1% of them said they had never practiced it.

The respondents were also asked about their frequency of using mosquito repellents, a large proportion, 78.4% of them said they had never used it, 17.9% said they used it occasionally while only 3.7% of them said they used it on a daily basis.

When asked about larviciding; a large proportion, 92% of the respondents said they had never practiced it and only 8% of them said they used it occasionally. a large proportion, 96.5% of the respondents said that they had never used window and door screens while a small proportion, 3.5% of the respondents said they used window and door screens daily.

Table 4.10: Frequency of use of malaria control methods

Malaria control method	**Frequency of use**		
	Daily	**Occasionally**	**Never**
ITN	398 (99%)	4 (1%)	0
Larviciding	-	32 (8%)	370 (92%)
Window and door screens	14 (3.5%)	-	388 (96.5%)
Mosquito repellents	15 (3.7%)	72 (17.9%)	315 (78.4%)
Environmental management	-	384 (95.5%)	18 (4.5%)
Indoor residual spraying	-	321 (79.9%)	81 (20.1%)

4.10 Malaria control practices

4.10.1 Respondents' practices with regard to malaria control

The respondents were asked if they wore long-sleeved clothes at night **(Table 4.11)**, 45.8% of them said they always did, 38.1% said they did but only sometimes while 16.2% of the respondents said they never wore long-sleeved clothes at night. They were also asked if they visit health centers when they suspected that they had malaria, 88.8% of the respondents said they always visited the health centers when they thought they had malaria while 10.7% said they did but only sometimes.

Respondents were asked if everybody in their households slept under mosquito nets, 95.5% of the respondents reported that all the members of their household slept under mosquito nets, 2.2% said they did but sometimes while 2.2% of the respondents said all members of their house holds did not sleep under mosquito nets. They were also asked if they kept the windows of their houses closed between 5.00pm to 9.30pm and in the early morning, 71.9% of the respondents said they always closed the windows at that time, 17.2% said they closed the windows at that time but not always only sometimes while 10.9% of the respondents said they never close the windows at that time.

On further interview the respondents were asked if they checked whether their mosquito nets had holes, 72.9% of the respondents said they always did, 23.1% said they did but sometimes while 4% said that they never bothered to check. They were further asked if they immediately repaired their nets if they found they had holes, 50.2% of the respondents said they always did, 33.8% said they did but sometimes while 15.9% of the respondents said they never repaired the holes.

Table 4.11: Malaria control practices

Malaria control practices	Frequency of use		
	Always	**Sometimes**	**Never**
Wear long-sleeved clothes at night or when in the rice fields	184 (45.8%)	153 (38.1%)	65 (16.2%)
Visit health center when one suspects he/she has malaria	357 (88.8%)	43 (10.7%)	2 (0.5%)
All members of house sleep under ITN	384 (95.5%)	9 (2.2%)	9 (2.2%)
Keeping windows closed between 5.00pm to 9.30pm and in the early morning	289 (71.9%)	69 (17.2%)	44 (10.9%)
Check if mosquito net has holes	293 (72.9%)	93 (23.1%)	16 (4.0%)
Repair nets if there are holes	202 (50.2%)	136 (33.8%)	64 (15.9%)

4.10.2 Physical Condition, use and treatment of respondents' ITNs

As shown in **Table 4.12**, respondents were asked about the condition of their ITNs with regards to treatment, physical appearance and use, a large proportion, 99% of them reported that they used their nets on a daily basis,90.8% said their nets were treated while 29.1% of the respondents reported that their ITNs had holes.

They were also asked if they washed their ITNs regularly; 91.8% of them reported that they washed their nets regularly while 8.2% of the respondents said they did not wash them regularly.

The respondents were also asked if they re-treated their nets after washing them; 62.9% did not treat their nets after washing them, 28.6% of them said they treated their nets after washing them, while 8.5% of the respondents did not wash their nets at all.All the respondents used ITNs and 32.8% had their ITNs in good condition with regards to absence of holes, treated nets and re-treatment after washing.

Table 4.12: Condition of insecticide treated mosquito nets

Condition of ITN	Yes	No	Not applicable
It has holes	117 (29.1%)	285 (70.9%)	-
Not treated	37 (9.2%)	365 (90.8%)	-
Don't use everyday	4(1%)	398 (99%)	-
Wash it regularly	369 (91.8%)	33 (8.2%)	-
Treated after cleaning	115 (28.6%)	253 (62.9%)	34 (8.5%)
I don't use it at all	-	402 (100%)	-
Good condition	132 (32.8%)	270 (67.2%)	-

4.10.3 Indoor residual spraying and Environmental management

Only 3% of the respondents reported that their houses had been sprayed in the previous 12 months (**Table 4.13).** They were asked the number of times their houses were sprayed in the previous 12 months, 2% of them said it was done once and 1% said it was done two times.

When they were asked who sprayed their houses, they said it was done by government/program worker.

Three hundred and eighty-four (95.5%) respondents said they practiced Environmental Management.

Table 4.13: Indoor residual spraying in previous 12 months and practicing of Environmental Management

Variable	Category	Frequency		Percent (%)
Indoor residual spraying	Has anyone sprayed inside the walls of your house in last 12 months	yes	12	3
		No	390	97
	House sprayed in the last 12 months		12	3
Number of times house sprayed in last 12 months	Once	8		2
	Two times	4		1
	More than two times	0		0
	Not sprayed at all	390		97
Who sprayed the house	Government worker/program	12		3
	Private company	0		0
	House hold member	0		0
	Other	0		0
EM	Clear bushes/drain stagnant water	384		95.5

4.10.4 Mosquito repellents

The respondents were asked how frequently they used mosquito repellents, 78.4% of them said they had never used them, 17.9% said they used them occasionally while only 3.7% of the respondents reported that they used them on a daily basis **(Table 4.14)**.

Table 4.14: Frequency with which respondents applied mosquito repellents

Frequency of applying mosquito repellents		
Daily	Occasionally	Never
15 (3.7%)	72 (17.9%)	315 (78.4%)

4.10.5 Window and door screens

As shown in **Table 4.15** below, the respondents were asked about the condition of their window and door screens, a large proportion, 96.5% of them said they never used window and door screens, 2.7% of them said their window and door screens were in good condition, 0.5% of them reported that their window and door screens had holes while said 0.2% said theirs were not treated.

Table 4.15: Condition of window and door screens

Window and door screen condition			
Has holes	Not treated	Others (Good condition)	Not used at all
2 (0.5%)	1 (0.2%)	11 (2.7%)	388 (96.5%)

4.10.6 Environmental Management

Respondents were asked if they practice EM; it was established, as indicated in **Table 4.16** that 95.5% of the respondents practiced it.

Table 4.16: Use of Environmental Management

		Frequency	Percent (%)
Do you drain excess water/ clear unwanted vegetation in you farm or home	**Yes**	384	95.5
	No	18	4.5
	Total	**402**	**100**

4.11 Social-economic practices

4.11.1 Respondents' practices with regard to malaria control

Respondents were asked if they lived in traditional houses, 87% of the respondents lived in traditional houses while 13% lived in other kind of houses.

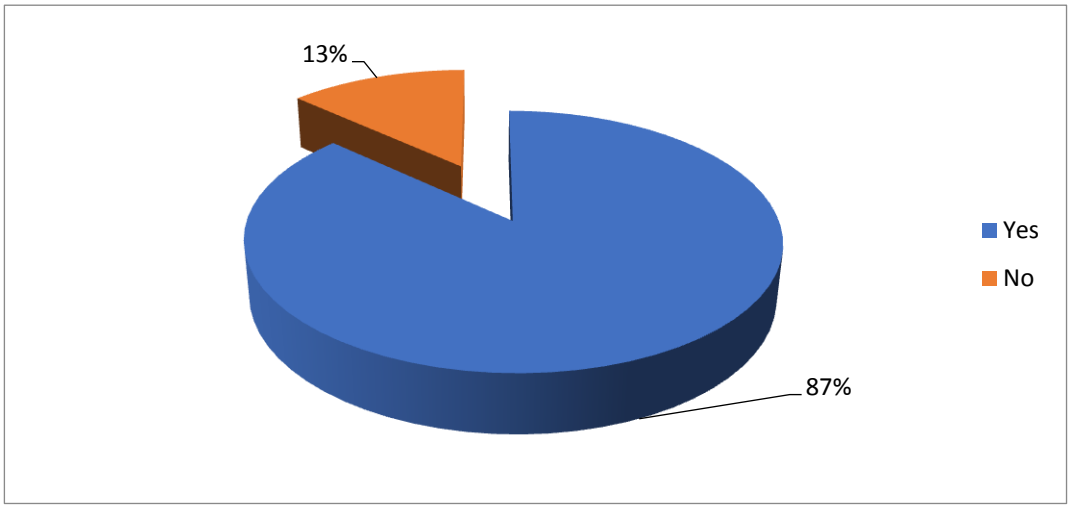

Figure 4.9: Proportion of respondents living in traditional houses

4.11.2 Respondents' source of water

Respondents were asked if they got their water from shallow dams, 46% of them got their water from shallow dams while the rest got theirs' from other sources.

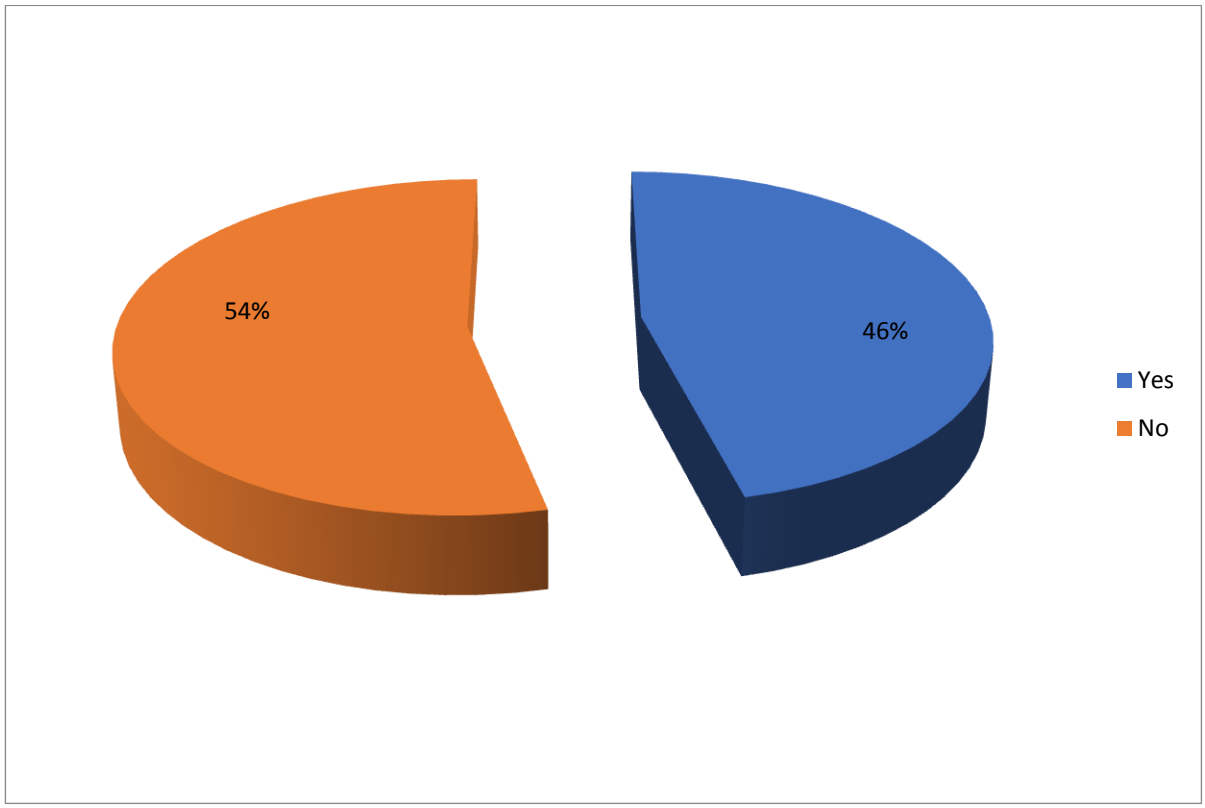

Figure 4.10: Respondents fetching water from shallow dams

4.12 Social-demographic characteristics and their influence on the knowledge of malaria control methods.

4.12.1 Association between respondents' gender and knowledge of malaria control methods

As shown in **Table 4.17**, gender was significantly associated with knowledge of larviciding (P=0.006), knowledge of mosquito repellents (P=0.006) and knowledge of window and door screens (P=0.011) but there was no association between gender and knowledge of EM (P=0.204) and knowledge of IRS (P=0.871). Male respondents were more likely to know about larviciding, mosquito repellents and window and door screens than females but the gender of the respondents did not affect their knowledge of EM and IRS.

Table 4.17: Association between respondents' gender and knowledge of malaria control methods

Knowledge of malaria control method	Gender		P –Value
	Male	Female	
Larviciding			
Yes	63 (28%)	29 (16%)	0.006
No	162 (72%)	148 (84%)	
Environmental management			
Yes	219 (97%)	168 (95%)	0.204
No	6 (3%)	9 (5%)	
Mosquito repellents			
Yes	120 (53%)	70 (40%)	0.006
No	105 (47%)	107 (60%)	
Indoor residual spraying			
Yes	201 (89%)	159 (90%)	0.871
No	24 (11%)	18 (10%)	
Window and door screens			
Yes	42 (19%)	17 (10%)	0.011
No	183 (81%)	160 (90%)	

4.12.2 Association between respondents' age and knowledge of malaria control methods

As shown in **Table 4.18**, age was significantly associated with knowledge of mosquito repellents (P<0.001) and IRS (P=0.004) but there was no association between age and knowledge of larviciding (p=0.197), EM (P=0.152) and window and door screens

(P=0.713). Older respondents were likely to be more knowledgeable on mosquito repellents and IRS than those who were younger. But the age of the respondents did affect their knowledge of larvicides, EM and window and door screens.

Table 4.18: Association between respondents' age and knowledge of malaria control methods

Knowledge of malaria control method	Age of respondents							P- value
	18-25	26-33	34-41	42-49	50-57	58-65	65 and above	
Larviciding								
Yes	20	27	13	12	6	6	8	0.197
No	42	76	40	42	43	24	43	
EM								
Yes	57	98	51	54	49	30	48	0.152
No	5	5	2	-	-	-	3	
Mosquito repellents								
Yes	21	56	33	33	26	11	10	<0.001
No	41	47	20	21	23	19	41	
IRS								
Yes	48	91	50	46	46	29	50	0.004
No	14	12	3	8	3	1	1	
Screening								
Yes	11	14	10	10	5	4	5	0.713
No	51	89	43	44	44	26	46	

4.12.3 Association between respondents' marital status and knowledge of malaria control methods

As shown in **Table 4.19**, marital status of the respondents was significantly associated with knowledge of larviciding (P<0.001), knowledge of mosquito repellents (P<0.001), knowledge of IRS (P=0.005) and knowledge of window and door screens (P=0.001) but

it was not associated with knowledge of EM (P=0.195). Married respondents were more likely to have knowledge on larviciding, mosquito repellents and window and door screens than those who were not married. But the marital status of the respondents did not affect their knowledge of EM.

Table 4.19: Association between respondents' marital status and knowledge of malaria control methods

Knowledge of malaria control method	Marital status			P –Value
	Single	Married	Divorced/Widowed	
Larviciding				
Yes	10 (42%)	81 (26%)	1 (2%)	<0.001
No	14 (58%)	234 (74%)	62 (98%)	
EM				
Yes	24 (100%)	301 (96%)	62 (98%)	
No	-	14 (4%)	1 (2%)	0.195
Mosquito repellents				
Yes	14 (58%)	166 (53%)	10 (16%)	<0.001
No	10 (42%)	149 (47%)	53 (84%)	
IRS				
Yes	23 (96%)	274 (87%)	63 (100%)	0.005
No	1 (4%)	41 (13%)	-	
Screening				
Yes	6 (25%)	53 (17%)	-	0.001
No	18 (75%)	262 (83%)	63 (63%)	

4.12.4 Association between respondents' religion and knowledge of malaria control methods

As shown in **Table 4.20**, religion of the respondents was only significantly associated with knowledge of IRS (P=0.001) but there was no association between religion and knowledge of larviciding (P=0.094), knowledge of EM (P=0.994), knowledge of

mosquito repellents (P=0.689) and knowledge of window and door screens (P=0.08). Respondents who were Christians were more likely to know IRS than those who were not Christians. But the respondents' religion did not influence their knowledge of larvicides, EM, mosquito repellents and window and door screens.

Table 4.20: Association between respondents' religion and knowledge of malaria control methods

Knowledge of malaria control method	Religion				P – Value
	Christian	Muslim	Hindu	Non-religious	
Larviciding					
Yes	90 (23%)	-	-	2	0.094
No	306 (77%)	4 (100%)	-	-	
EM					
Yes	381 (96%)	4 (100%)	-	2 (100%)	0.994
No	15 (4%)	-	-	-	
Mosquito repellents	186 (47%)	2 (50%)	-	2 (100%)	0.689
Yes	210 (53%)	2 (50%)	-	-	
No					
Indoor residual spraying	356 (90%)	-	-	2 (100%)	0.001
Yes	40 (10%)	4 (100%)	-	-	
No					
Window and door screens	57 (14%)	2 (50%)	-	1 (50%)	0.080
Yes	339 (86%)	2 (50%)	-	1 (50%)	
No					

4.12.5 Association between the education level of the respondents and knowledge of malaria control methods

The level of education **(Table 4.21)** was significantly associated with knowledge of larviciding (P<0.001), knowledge of mosquito repellents (P <0.001) knowledge of IRS (P=0.008) and knowledge of window and door screens (P <0.001), however there was

no association between the level of education and knowledge of EM (P=0.197). Respondents who more educated were more likely to know about larviciding, mosquito repellents and window and door screens than those who were less educated. But knowledge of EM was not affected by the respondents' level of education.

Table 4.21: Association between the education level of the respondents and knowledge of malaria control methods

Knowledge of malaria control method	Education level				P –Value
	No Education	Primary Education	Secondary Education	College Education	
Larviciding					
Yes	5 (9%)	31 (14%)	43 (39%)	13 (62%)	<0.001
No	48 (91%)	187 (86%)	67 (61%)	8 (38%)	
EM					
Yes	50 (94%)	206 (94%)	110 (100%)	21 (100%)	
No	3 (6%)	12 (6%)	-	-	0.197
Mosquito repellents	8 (15%)	80 (37%)	83 (75%)	19 (90%)	<0.001
Yes	45 (85%)	138 (63%)	27 (25%)	2 (10%)	
No					
IRS					
Yes	52 (98%)	183 (84%)	104 (95%)	21 (100%)	0.008
No	1 (2%)	35 (16%)	6 (5%)	-	
Screening					
Yes	5 (9%)	20 (9%)	26 (24%)	8 (38%)	<0.001
No	48 (91%)	198 (91%)	84 (76%)	13 (62%)	

4.12.6 Association between the monthly income of the respondents and knowledge of malaria control methods

As shown in **Table 4.22**, the monthly income of the respondents was significantly associated with knowledge of larviciding (P=0.003), mosquito repellents (P<0.001) and window and door screens (P<0.001). But there was no association between monthly

income of the respondents and knowledge of EM (P=0.981) and IRS (P=0.967). Respondents who had high monthly income were more likely to know about larviciding, mosquito repellents and window and door screens than those with low monthly income. But the respondents' monthly income did affect their knowledge of EM and IRS.

Table 4,22: Association between the monthly income of the respondents and knowledge of malaria control

Knowledge of malaria control method	Monthly income of the respondents										P-value
	No income	500-4499	4500 - 8499	8500 - 12499	12500-16499	16500-20499	20500-24499	24500-28499	28500-32499	32500 and over	
Larviciding											
Yes	11	36	18	13	1	5	3	1	4	-	0.003
No	85	108	70	30	4	6	3	1	1	2	
EM											
Yes	91	138	86	41	5	11	6	2	5	2	0.981
No	5	6	2	2	-	-	-	-	-	-	
Mosquito repellent											
Yes	28	74	41	23	2	8	5	2	5	2	<0.001
No	68	70	47	20	3	3	1	-	-	-	
IRS											
Yes	85	127	80	40	4	10	5	2	5	2	0.967
No	11	17	8	3	1	1	1	-	-	-	
Screening											
Yes	5	16	19	8	1	2	1	1	4	2	<0.001
No	91	128	69	35	4	9	5	1	1	-	

4.12.7 Association between the occupation of the respondents and knowledge of malaria control methods

As shown in **Table 4.23**, the main occupation of the respondents was significantly associated with knowledge of larviciding (P<0.001), knowledge of mosquito repellents

(P=0.006), knowledge of IRS (P<0.001) and knowledge of window and door screens (P<0.001), but there was no association between the main occupation and knowledge of EM (P=0.177). Respondents who were employed were more likely to know about larviciding, mosquito repellents and IRS than those who were not employed. But knowledge of EM was not affected by the respondents' occupation.

Table 4.23: Association between the occupation of the respondents and knowledge of malaria control methods

Knowledge of malaria control method	**Main occupation**				**P –Value**
	Farming	Business	Salaried worker	Not employed	
Larviciding					
Yes	26 (16%)	38 (21%)	16 (52%)	12 (41%)	<0.001
No	136 (84%)	142 (79%)	15 (49%)	17 (59%)	
EM					
Yes	157 (97%)	173 (96%)	31 (100%)	26 (90%)	0.177
No	5 (3%)	7 (4%)	-	3 (10%)	
Mosquito repellents					
Yes	69 (43%)	81 (45%)	23 (74%)	17 (59%)	0.006
No	93 (57%)	99 (55%)	8 (26%)	12 (41%)	
IRS					
Yes	156 (93%)	155 (86%)	28 (90%)	21 (72%)	<0.001
No	6 (4%)	25 (14%)	3 (10%)	8 (28%)	
Screening					
Yes	17 (11%)	23 (13%)	14 (45%)	5 (17%)	<0.001
No	145 (89%)	157 (87%)	17 (55%)	24 (83%)	

4.12.8 Association between gender of the respondents and use of malaria control methods

As shown in **Table 4.24** below, there was no association between gender and use of larviciding (P=0.22), EM (P=0.314), mosquito repellents (P=0.436), IRS (P=0.119), and window and door screens (P=0.236). Being male or female did affect the use of of larviciding, EM, mosquito repellents, IRS and window and door screens.

Table 4.24: Association between gender of the respondents and use of malaria control methods

Use of malaria control method	Gender		P –Value
	Male	Female	
Larviciding			
Yes	20 (9%)	10 (6%)	0.22
No	205 (91%)	167 (94%)	
Environmental management	217 (96%)	167 (94%)	0.314
Yes	8 (4%)	10 (6%)	
No			
Mosquito repellents			
Yes	45 (20%)	30 (17%)	0.436
No	180 (80%)	147 (83%)	
Indoor residual spraying			
Yes	148 (66%)	103 (58%)	0.119
No	77 (34%)	74 (42%)	
Window and door screens			
Yes	10 (4%)	4 (2%)	0.236
No	215 (96%)	173 (98%)	

4.12.9 Association between the age of the respondents and use of malaria control methods

As shown in **Table 4.25** below, the age of the respondents was not significantly associated with use of larviciding (P=0.310), EM (P=0.236), mosquito repellents (P=0.588), IRS (P=0.535) and window and door screens (P=0.544). Use of larviciding, EM, mosquito repellents, IRS and window and door screens was not affected by the age of the respondents.

Table 4.25: Association between the age of respondents and use of malaria control methods

Use of malaria control method	Age of respondents							P-value
	18-25	26-33	34-41	42-49	50-57	58-65	65 and above	
Larviciding								
Yes	6 (10%)	6 (6%)	3 (6%)	5 (9%)	1 (2%)	5 (17%)	4 (8%)	0.310
No	56 (90%)	97 (94%)	50 (94%)	49 (91%)	48 (98%)	25 (83%)	47 (92%)	
EM								
Yes	56 (90%)	98 (95%)	51 (96%)	52 (96%)	49 (100%)	30 (100%)	48 (94%)	0.236
No	6 (10%)	5 (5%)	2 (4%)	2 (4%)	-	-	3 (6%)	
Repellents								
Yes	9 (15%)	23 (22%)	11 (21%)	13 (24%)	8 (16%)	5 (17%)	6 (12%)	0.588
No	53 (85%)	80 (78%)	42 (79%)	41 (76%)	41 (84%)	25 (83%)	45(88%)	
IRS								
Yes	35 (56%)	60 (58%)	36 (68%)	37 (69%)	31 (63%)	22 (73%)	30 (59%)	0.535
No	27 (44%)	43 (42%)	17 (32%)	17 (31%)	18 (37%)	8 (27%)	21 (41%)	
Screening								
Yes	3 (5%)	4 (4%)	1 (2%)	4 (7%)	1 (2%)	-	1 (2%)	0.544
No	59 (95%)	99 (96%)	52 (98%)	50 (93%)	48 (98%)	30 (100%)	50 (98%)	

4.12.10 Association between marital status of the respondents and use of malaria control methods

As shown in **Table 4.26**, there was an association between the marital status of the respondents and use of larviciding (P=0.049), mosquito repellents (P<0.001) and

window and door screens (P=0.001) since all of them had a P-value of less than 0.05 and therefore they were statistically significant.

But there was no association between the marital status of the respondents and use of indoor residual sprays (P=0.113) and EM (P=0.11) since both of them had a P-value of more than 0.05 and therefore they were not statistically significant. Respondents who were married were more likely to use larvicides, mosquito repellents and window and door screens than those who were not married. But the marital status of the respondents did not affect the use of IRS and EM.

Table 4.26: Association between marital status of the respondents and use of malaria control methods

Use of malaria control methods	Marital status			P –Value
	Single	Married	Divorced/ Widowed	
Larviciding				
Yes	2 (8%)	28 (9%)	-	0.049
No	22 (92%)	287 (91%)	63 (100%)	
Environmental management	24 (100%)	298 (95%)	62 (98%)	0.11
Yes	-	17 (5%)	1 (2%)	
No				
Mosquito repellents				
Yes	5 (21%)	69 (22%)	1 (2%)	<0.001
No	19 (79%)	246 (78%)	62 (98%)	
Indoor residual spraying				
Yes	15 (62%)	204 (65%)	32 (51%)	0.113
No	9 (38%)	111 (35%)	31 (49%)	
Window and door screens	4 (17%)	10 (3%)	-	0.001
Yes	20 (83%)	305 (97%)	63 (100%)	
No				

4.12.11 Association between religion of the respondents and use of malaria control methods

As shown in **Table 4.27** below, there was an association between the religion of the respondents and use of window and door screens (P=0.004) because the P-value was less than 0.05 and was therefore stastically significant but there was no association between the religion of the respondents and use of larviciding (P=0.921), EM (P=0.269), mosquito repellents (P=0.456) and indoor residual spraying (P=0.198) since they all had P-values of more than 0.05 and therefore they were not statistically significant. Respondents who were Christians were more likely to use window and door screens than respondents who were not Christians. But the religion of the respondents to did not affect the use larvicides, mosquito repellents and IRS.

Table 4.27: Association between religion of the respondents and use of malaria control methods

Use of malaria control method	Religion				P –Value
	Christian	Muslim	Hindu	Non-religious	
Larviciding					
Yes	30 (8%)	-	-	-	0.921
No	366 (92%)	4 (100%)	-	2 (100%)	
Environmental management	379 (96%)	4 (100%)	-	1 (50%)	0.269
Yes	17 (4%)	-	-	1 (50%)	
No					
Mosquito repellents					
Yes	75 (19%)	-	-	-	0.456
No	321 (81%)	4 (100%)	-	2 (100%)	
Indoor residual spraying					
Yes	248 (63%)	-	-	2 (100%)	0.198
No	148 (37%)	4 (100%)	-	-	
Window and door screens					
Yes	13 (3%)	-	-	1 (50%)	0.004
No	383 (97%)	4 (100%)	-	1 (50%)	

4.12.12 Association between the education level of the respondents and use of malaria control methods

As shown in **Table 4.28**, there was a significant association between the level of education and use of larvicides (P=0.022), window and door screens (P=0.016) and mosquito repellents (P<0.001) since they all had P-values of less than 0.05 and so they are statistically significant. On the other hand, there was no association between the level of education and indoor residual spraying (P=0.352) and practicing environmental management (P=0.155) because they both had P-values of more than 0.05 and so they are stastically not significant. Respondents who were highly educated were more likely to use larvicides, window and door screens and mosquito repellents than those who were not highly educated. The level of education did not affect the use of EM and IRS.

Table 4.28: Association between the education level of the respondents and use of malaria control methods

Use of malaria control method	Education level				P – Value
	No Education	Primary Education	Secondary Education	College Education	
Larviciding					
Yes	3 (6%)	10 (5%)	(12%)	4 (19%)	0.022
No	50 (94%)	208 (95%)	97 (88%)	17 (81%)	
EM					
Yes	51 (96%)	205 (94%)	107	21 (100%)	0.155
No	2 (4%)	13 (6%)	(97%)	-	
			3 (3%)		
Mosquito repellents					
Yes	2 (4%)	24 (11%)	38 (33%)	11 (52%)	<0.001
No	51 (96%)	194 (89%)	72 (67%)	10 (48%)	
IRS					
Yes	31 (59%)	133 (61%)	76 (69%)	11 (52%)	0.352
No	22 (41%)	85 (39%)	34 (31%)	10 (48%)	
Screening					
Yes	1 (2%)	4 (2%)	6 (5%)	3 (14%)	0.016
No	52 (98%)	214 (98%)	104	18 (86%)	
			(95%)		

4.12.13 Association between the monthly income of the respondents and use of malaria control methods

As shown in **Table 4.29**, the monthly income of the respondents was significantly associated with use of mosquito repellents (P=0.017) and window and door screens (P<0.001). But there was no significant relationship between monthly income and use of EM (P=0.982), larviciding (P=0.146) and IRS (P=0.141). Respondents with high monthly income were more likely to use mosquito repellents and window and door screens than those with low monthly incomes. But the use of IRS and EM was not affected by the monthly income of the respondents.

Table 4.29: Association between the monthly income of the respondents and use of malaria control methods

Use of malaria control method	Monthly income of the respondents										P-value
	No income	500-4499	4500 - 8499	8500 - 12499	12500-16499	16500-20499	20500-24499	24500-28499	28500-32499	32500 and over	
Larviciding											
Yes	3	13	5	5	-	2	2	-	-	-	0.146
No	93	131	83	38	5	9	4	2	5	2	
EM											
Yes	90	137	85	41	5	11	6	2	5	2	0.982
No	6	7	3	2	-	-	-	-	-	-	
Mosquito repellent	10	32	15	5	2	5	3	1	1	1	0.017
Yes	86	112	73	38	3	6	3	1	4	1	
No											
IRS											
Yes	51	98	50	29	2	9	5	2	3	2	0.141
No	45	46	38	14	3	2	1	-	2	-	
Screening											
Yes	-	5	2	1	-	2	-	1	3	-	<0.001
No	96	139	86	42	5	9	6	1	2	2	

4.12.14 Association between the main occupation of the respondents and use of malaria control methods

As shown in **Table 4.30**, there was a significant association between the main occupation of the respondents and use of window and door screens (P<0.001), mosquito repellents (P=0.031) and indoor residual spraying (P=0.001) since they all had P-values of less than 0.05 and so they are stastically significant.

Table 4.30: Association between the main occupation of the respondents and use of malaria control methods

Use of malaria control method	Main occupation				P –Value
	Farming	Business	Salaried worker	Not employed	
Larviciding					
Yes	9 (6%)	13 (7%)	4 (13%)	4 (14%)	0.275
No	153 (94%)	167 (93%)	27 (87%)	25 (86%)	
EM					
Yes	157 (97%)	172 (96%)	30 (97%)	25 (86%)	0.186
No	5 (3%)	8 (4%)	1 (3%)	4 (14%)	
Repellents					
Yes	23 (14%)	33 (18%)	10 (32%)	9 (31%)	0.031
No	139 (86%)	147 (82%)	21 (68%)	20 (69%)	
IRS					
Yes	117 (72%)	102 (57%)	21 (68%)	11 (38%)	0.001
No	45 (28%)	78 (43%)	10 (32%)	18 (62%)	
Screening					
Yes	3 (2%)	4 (2%)	7 (23%)	-	<0.001
No	159 (98%)	176 (98%)	24 (77%)	29 (100%)	

On the other hand, there was no association between the main occupation of the respondents and use of larvicides (P=0.275) and practicing environmental management (P=0.186) because they both had P-values of more than 0.05 and so they are statistically

not significant. Respondents who were employed were more likely to use window and door screens, mosquito repellents and IRS than those who were not employed while the respondents' occupation did not affect the use of larvicides and EM.

4.12.15 Association between the respondents' knowledge of malaria control methods and their utilization

There was significant association between knowledge of all the malaria control methods as shown in Table **4.31** and their use because they all had P-values of <0.001, which is less than 0.05 and so they were all statistically significant. Respondents who knew the malaria control methods were more likely to use them than those who did not know them.

Table 4.31: Association between the respondents' knowledge of malaria control methods and their utilization

Knowledge of malaria control methods		Utilization		P-value
		Yes	No	
Larviciding	Yes	30(33%)	62(67%)	<0.001
	No	-	310(100%)	
Environmental management	Yes	383(99%)	4(1%)	<0.001
	No	1(7%)	14(93%)	
Mosquito repellent	Yes	75(39%)	115(61%)	<0.001
	No	-	212(100%)	
IRS	Yes	251(70%)	109(30%)	<0.001
	No	-	42(100%)	
window and door screens	Yes	14(24%)	45(76%)	<0.001
	No	-	343(100%)	

4.12.16 Association between social-economic issues and the respondents' knowledge of larviciding

As shown in **Table 4.32**, the type of structure of the respondents' houses was significantly associated with knowledge of larviciding; this is because it had a P-value of <0.001 which was less than 0.05 and therefore it was statistically significant. Also, the source of water for the respondents had a significant relationship with knowledge of

larviciding (P<0.001), this is because it had a P-value of less than 0.05 and it was therefore statistically significant. Respondents who lived in houses made of iron sheet and stone were more likely to have knowledge of larviciding than the others. Also, those who got their water from boreholes were more likely have knowledge of larviciding than those who got their water from other sources.

Table 4.32: Association between social-economic issues and the respondents' knowledge of larviciding

Social-economic issues		**Knowledge of Larviciding**		**p-value**
		Yes	**No**	
Type of structure of the house	Mud	73(21%)	276(79%)	<0.001
	Bricks	7(21%)	27(79%)	
	Stone	10(63%)	6(37%)	
	iron sheet	2(67%)	1(33%)	
What is your main source of water?	Shallow wells	50(27%)	136(73%)	<0.001
	Borehole	23(33%)	47(67%)	
	Tap water	4(6%)	61(94%)	
	River/spring	15(19%)	66(81%)	

4.12.17 Association between social-economic issues and the respondents' knowledge of EM

As shown in **Table 4.33**, the respondents' type of structure of their houses and their source of water had no relationship with their knowledge of EM because their P- values were 0.079 and 0.343 respectively which were all greater than 0.05 and, therefore, were not statistically significant. Knowledge of EM was not influenced by the type of structure or source of water for the respondents.

Table 4.33: Association between social-economic issues and the respondents' knowledge of EM

Social-economic issues		**Knowledge of Environmental management**		**p-value**
		Yes	**No**	
Type of structure of the house	Mud	335 (96%)	14 (4%)	0.079
	Bricks	34 (100%)	-	
	Stone	16 (100%)	-	
	iron sheet	2 (67%)	1 (33%)	
What is your main source of water?	Shallow wells	177 (95%)	9 (5%)	0.343
	Borehole	69 (99%)	1 (1%)	
	Tap water	64 (98%)	1 (2%)	
	River/spring	77 (95%)	4 (5%)	

4.12.18 Association between social-economic issues and the respondents' knowledge of mosquito repellents

As shown in **Table 4.34**, the type of structure of the respondents' houses was significantly associated with knowledge of mosquito repellents; this is because it had a P-value of 0.014 which was less than 0.05 and therefore it was statistically significant. On the other hand, the source of water for the respondents did not have a significant

relationship with knowledge of mosquito repellents (P=0.097), this is because it had a P-value of more than 0.05 and it was therefore not stastically significant. Respondents who lived in houses made of stone were more likely to have knowledge on mosquito repellents than those who lived in houses made of other materials. The respondents' source of water did not influence in any way their knowledge of mosquito repellents.

Table 4.34: Association between social-economic issues and the respondents' knowledge of mosquito repellents

Social-economic issues		**Knowledge of mosquito repellents**		**p-value**
		Yes	**No**	
Type of structure of the house	Mud	155 (44%)	194 (56%)	0.014
	Bricks	22 (65%)	12 (35%)	
	Stone	12 (75%)	4 (25%)	
	iron sheet	1 (33%)	2 (67%)	
What is your main source of water?	Shallow wells	96 (52%)	90 (48%)	0.097
	Borehole	32 (46%)	38 (54%)	
	Tap water	22 (34%)	43 (66%)	
	River/spring	40 (49%)	41 (51%)	

4.12.19 Association between social-economic issues and the respondents' knowledge of IRS

The respondents' type of structure of their houses **(Table 4.35)** and their source of water had no significant relationship with their knowledge of IRS, this is because their P-values were 0.124 and 0.06 respectively, which were all more than 0.05 and, therefore, were not statistically significant. Knowledge of IRS was not affected by the type of structure or respondents' source of water.

Table 4.35: Association between social-economic issues and the respondents' knowledge of IRS

Social-economic issues		Knowledge of IRS		p-value
		Yes	No	
Type of structure of the house	Mud	310 (89%)	39 (11%)	0.124
	Bricks	32 (94%)	2 (6%)	
	Stone	16 (100%)	-	
	iron sheet	2 (67%)	1 (33%)	
What is your main source of water?	Shallow wells	170 (91%)	16 (9%)	0.06
	Borehole	66 (94%)	4 (6%)	
	Tap water	58 (89%)	7 (11%)	
	River/spring	66(81%)	15(19%)	

4.12.20 Association between social-economic issues and the respondents' knowledge of window and door screens

As shown in **Table 4.36**, the type of structure of the respondents' houses was significantly associated with knowledge of window and door screens; this is because it had a P-value of 0.033 which was less than 0.05 and therefore it was statistically significant. Respondents' source of water had a significant relationship with their knowledge of window and door screens (P=0.005), this is because it had a P- value of less than 0.05 and therefore it was statistically significant. Respondents who lived in houses made of stone were more likely to have knowledge on window and door screens than those who lived in houses made of other materials. Also, respondents who got their water from boreholes were likely to have knowledge on window and door screens than those who got their water from other sources.

Table 4.36: Association between social-economic issues and the respondents' knowledge of window and door screens

Social-economic issues		knowledge of window and door screens		p-value
		Yes	No	
Type of structure of the house	Mud	45 (13%)	304 (87%)	0.033
	Bricks	8 (24%)	26 (76%)	
	Stone	6 (38%)	10 (62%)	
	iron sheet	-	3 (100%)	
What is your main source of water?	Shallow wells	34 (18%)	152 (82%)	0.005
	Borehole	15 (21%)	55 (79%)	
	Tap water	5 (8%)	60 (92%)	
	River/spring	5 (6%)	76 (94%)	

4.12.21 Association between social-economic issues and larviciding

As shown in **Table 4.37**, the type of structure of the respondents' houses was significantly associated with use of larvicides; this is because it had a P-value of 0.042 which was less than 0.05 and therefore it was statistically significant. Respondents' source of water had a significant relationship with the use of larvicides (P=0.002), this is because it had a P- value of less than 0.05 and therefore it was statistically significant.

Respondents who lived in houses made of iron sheet and stone were more likely to use larviciding than the others. Also, those who got their water from boreholes were more likely use larviciding than those who got their water from other sources.

Table 4.37: Association between social-economic issues and larviciding

Social-economic issues		Larviciding		P-value
		Yes	No	
Type of structure of the house	Mud	21(6%)	328(94%)	0.042
	Bricks	4(12%)	30(88%)	
	Stone	4(25%)	12(75%)	
	iron sheet	1(33%)	2(67%)	
What is your main source of water?	Shallow wells	16(9%)	170(91%)	0.002
	Borehole	10(14%)	60(86%)	
	Tap water	-	65(100%)	
	River/spring	4(5%)	77(95%)	

4.12.22 Association between social-economic issues and the respondents' use of window and door screens

The type of structure of the respondents' houses **(Table 4.38)** had a significant relationship with the use of window and door screens; this is because it had a P-value of <0.001 which was less than 0.05 and therefore it was statistically significant. Respondents' source of water had no significant relationship with the use of window and door screens (P=0.536), this is because it had a P- value of more than 0.05 and therefore it was not statistically significant.

Respondents who lived in houses made of stone were more likely use window and door screens than those who lived in houses made of other materials. On the other hand, the respondents' source of water did not influence their use window and door screens.

Table 4.38: Association between social-economic issues and the respondents' use of window and door screens

Social-economic issues		Use window and door screens		P-value
		Yes	No	
Type of structure of the house	Mud	7(2%)	342(98%)	<0.001
	Bricks	4(12%)	30(88%)	
	Stone	3(19%)	13(81%)	
	iron sheet	-	3(100%)	
What is your main source of water?	Shallow wells	9(5%)	177(95%)	0.536
	Borehole	2(3%)	68(97%)	
	Tap water	1(2%)	64(98%)	
	River/spring	2(2%)	79(98%)	

4.12.23 Association between social-economic issues and the respondents' use of mosquito repellents

As shown in **Table 4.39**, the type of structure of the respondents' houses had a significant relationship with the use of mosquito repellents; this is because it had a P-value of 0.006 which was less than 0.05 and therefore it was statistically significant. Respondents' source of water had no significant relationship with the use of mosquito repellents (P=0.303), this is because it had a P-value of more than 0.05 and therefore it was not statistically significant.

Respondents who lived in houses made of stone were more likely to use mosquito repellents than those who lived in houses made of other materials. The respondents' source of water did not influence in any way their use of mosquito repellents.

Table 4.39: Association between social-economic issues and the respondents' use of mosquito repellents

Social-economic issues		Use mosquito repellents		P-value
		Yes	No	
Type of structure of the house	Mud	58(17%)	291(83%)	0.006
	Bricks	7(21%)	27(79%)	
	Stone	9(56%)	7(44%)	
	iron sheet	1(33%)	2(67%)	
What is your main source of water?	Shallow wells	32(17%)	154(83%)	0.303
	Borehole	12(17%)	58(83%)	
	Tap water	10(15%)	55(85%)	
	River/spring	21(26%)	60(74%)	

4.12.24 Association between social-economic issues and the respondents' practice of EM

There was no significant relationship between the type of structure of the respondents' houses and environmental management **(Table 4.40)**; this is because it had a P-value of 0.063 which was more than 0.05 and therefore it was not statistically significant. Respondents' source of water had no significant relationship with practicing environmental management (P=0.378), this is because it had a P- value of more than 0.05 and therefore it was not statistically significant. EM practice was not influenced by the type of structure or source of water of the respondents.

Table 4.40: Association between social-economic issues and the respondents' practice of EM

Social-economic issues		EM		P-value
		Yes	No	
Type of structure of the house	Mud	332(95%)	17(5%)	0.063
	Bricks	34(100%)	-	
	Stone	16(100%)	-	
	iron sheet	2(67%)	1(33%)	
What is your main source of water?	Shallow wells	175(94%)	11(6%)	0.378
	Borehole	68(97%)	2(3%)	
	Tap water	64(98%)	1(2%)	
	River/spring	77(95%)	4(5%)	

4.12.25 Association between social-economic issues and the respondents' practice of IRS

As shown in **Table 4.41**, there was no significant relationship between the type of structure of the respondents' houses and indoor residual spraying; this is because it had a P-value of 0.402 which was more than 0.05 and therefore it was not statistically significant. There was a significant relationship between respondents' source of water and indoor residual spraying (P<0.001), this is because it had a P- value of less than 0.05 and therefore it was stastically significant. Indoor residual spraying was not affected by the respondents' type of structure. But those who got their water from boreholes were more likely to practice indoor residual spraying than the respondents who got their water from other sources.

Table 4.41: Association between social economic issues and the respondents' practice of IRS

Social-economic issues		Do you use IRS		P-value
		Yes	No	
Type of structure of the house	Mud	216(62%)	133(38%)	0.402
	Bricks	20(59%)	14(41%)	
	Stone	13(81%)	3(19%)	
	iron sheet	2(67%)	1(33%)	
What is your main source of water?	Shallow wells	85(46%)	101(54%)	<0.001
	Borehole	53(76%)	17(24%)	
	Tap water	51(78%)	14(22%)	
	River/spring	62(76%)	19(24%)	

4.12.26 Association between perceived importance of malaria control methods and their knowledge

As shown in **Table 4.42**, there was a statistically significant relationship between perceived importance of all the malaria control methods in the table and knowledge of all the malaria control in the table, because all had a P-value of <0.001 except for IRS which had a P-value of 0.002 but was also statistically significant. Respondents who knew the malaria control methods were more likely to perceive them to be important in malaria control than those who did not know them.

Table 4.42: Association between perceived importance of malaria control methods and their knowledge

Perceived importance of larviciding	**Knowledge of larviciding**		**P-value**
	Yes	No	
Extremely important	26(81%)	6(19%)	<0.001
Very important	42(37%)	71(63%)	
Moderately important	22(12%)	164(88%)	
Not important	2(3%)	69(97%)	
Perceived importance of EM	Knowledge of EM		P-value
	Yes	No	
Extremely important	100(99%)	1(1%)	<0.001
Very important	243(100%)	-	
Moderately important	41(80%)	10(20%)	
not important	3(43%)	4(57%)	
Perceived importance of mosquito repellents	Knowledge of mosquito repellents		P-value
	Yes	No	
Extremely important	38(86%)	6(14%)	<0.001
Very important	113(51%)	107(49%)	
Moderately important	35(32%)	74(68%)	
Not important	4(14%)	24(86%)	
Perceived importance of IRS	Knowledge of IRS		P-value
	Yes	No	
Extremely important	49(96%)	2(4%)	0.002
Very important	155(94%)	10(6%)	
Moderately important	102(81%)	24(19%)	
Not important	54(90%)	6(10%)	
Perceived importance of window and door screens	Knowledge of window and door screens		P-value
	Yes	No	
Extremely important	19(49%)	20(51%)	<0.001
Very important	22(43%)	29(57%)	
Moderately important	17(7%)	220(93%)	
Not important	1(1%)	74(99%)	

4.12.27a Association between perceived effectiveness of malaria control methods and their knowledge

As shown in **Table 4.43a**, there was a statistically significant relationship between knowledge of all the malaria control methods and perceived effectiveness of all the malaria control methods in the table below, because all of them had a P-value of <0.001 which was stastically significant. Respondents who knew the malaria control methods

were more likely to perceive them to be effective in malaria control than those who did not know the malaria control methods.

Table 4.43a: Association between perceived effectiveness of malaria control methods and their knowledge

Perceived effectiveness of larviciding	**Knowledge of larviciding**		**P-value**
	Yes	**No**	
Very poor	-	4(100%)	<0.001
Poor	3(12%)	21(88%)	
Average	16(6%)	253(94%)	
Good	33(62%)	20(38%)	
Very good	40(77%)	12(23%)	
Perceived effectiveness of EM	**Knowledge of EM**		**P-value**
	Yes	**No**	
Very poor	-	1(100%)	<0.001
Poor	2(100%)	-	
Average	29(69%)	13(31%)	
Good	152(99%)	1(1%)	
Very good	204(100%)	-	
Perceived effectiveness of mosquito repellents	**Knowledge of mosquito repellents**		**P-value**
	Yes	**No**	
Very poor	-	1(100%)	<0.001
Poor	2(22%)	7(78%)	
Average	31(25%)	92(75%)	
Good	78(51%)	74(49%)	
Very good	79(68%)	38(32%)	

4.12.27b Association between perceived effectiveness of malaria control methods and their knowledge

As shown in **Table 4.43b**, there was a statistically significant relationship between knowledge of the malaria control methods in the table below and perceived effectiveness of all the malaria control methods in the table below, because all of them had a P-value of <0.001 which was stastically significant. Respondents who knew the malaria control methods were more likely to perceive them to be effective in malaria control than those who did not know them.

Table 4.43b: Association between perceived effectiveness of malaria control methods and their knowledge

Perceived effectiveness of IRS	Knowledge of IRS		P-Value
	Yes	No	
Very poor	18(90%)	2(10%)	<0.001
Poor	39(98%)	1(2%)	
Average	67(73%)	25(27%)	
Good	97(92%)	9(8%)	
Very good	139(96%)	5(4%)	
Perceived effectiveness of window and door screens	**Knowledge of window and door screens**		**P-Value**
	Yes	**No**	
Very poor	-	2(100%)	<0.001
Poor	-	19(100%)	
Average	13(5%)	271(95%)	
Good	16(34%)	31(66%)	
Very good	30(60%)	20(40%)	

4.12.28a Association between perceived importance of malaria control methods and their utilization

As shown in **Table 4.44a**, there was a statistically significant relationship between use of all the malaria control methods and perceived importance of all the malaria control methods in controlling malaria in the table below, this is because all of them had a P-value of <0.001 which is less than 0.05 and therefore they are all stastically significant. Respondents who perceived the malaria control methods to be important were more likely to use them than those who did not perceive them to be important in malaria control.

Table 4.44a: Association between perceived importance of malaria control methods and their utilization

Perceived importance of larviciding	**Practice Larviciding**		**P-value**
	Yes	**No**	
Extremely important	9(28%)	23(72%)	<0.001
Very important	19(17%)	94(83%)	
Moderately important	2(1%)	184(99%)	
Not important	-	71(100%)	
Perceived importance of EM	**Practice EM**		**P-value**
	Yes	**No**	
Extremely important	99(98%)	2(2%)	<0.001
Very important	242(99%)	1(1%)	
Moderately important	40(78%)	11(22%)	
Not important	3(43%)	4(57%)	

4.12.28b Association between perceived importance of malaria control methods and their utilization

As shown in **Table 4.44b**, there was a statistically significant relationship between use of all the malaria control methods and perceived importance of all the malaria control methods in controlling malaria in the table below, because all of them had a P-value of less than 0.05 and were all stastically significant. Respondents who perceived the malaria control methods to be important were more likely to use them than those who did not perceive them to be important in malaria control.

Table 4.44b: Association between perceived importance of malaria control methods and their utilization

Perceived importance of mosquito repellents	**Use of mosquito repellents**		**P-value**
	Yes	No	
Extremely important	17(39%)	27(61%)	0.001
Very important	44(20%)	176(80%)	
Moderately important	12(11%)	97(89%)	
Not important	2(7%)	27(93%)	
Perceived importance of IRS	Practice IRS		P-value
	Yes	No	
Extremely important	40(78%)	11(22%)	0.025
Very important	99(60%)	66(40%)	
Moderately important	71(56%)	55(44%)	
Not important	41(68%)	19(32%)	
Perceived importance of window and door screens	Use of window and door screens		P-value
	Yes	No	
Extremely important	7(18%)	32(82%)	<0.001
Very important	5(10%)	46(90%)	
Moderately important	2(1%)	235(99%)	
Not important	-	75(100%)	

4.12.29a Association between practices related to use of malaria control methods and their utilization

As shown in **Table 4.45a**, practices relating to use of mosquito repellents had a significant relationship with its utilization. This because it had a p-value of 0.001 which was statistically significant. Practices relating to use of window and door screens had a significant relationship with its utilization because it had a p-value of <0.001 which was statistically significant. Practices relating to use of indoor residual spraying had a significant relationship with its utilization because it had a P-value of 0.02 which was

statistically significant. Respondents who had good practices with regards to use of mosquito repellents, window and door screens and indoor residual spraying were more likely to use them than those who did not have good practices with regards to their use.

Table 4.45a: Association between practices related to use of malaria control methods and their utilization

Practices related to use of malaria control methods	**Use of malaria control methods**		**P-value**
Mosquito repellents – frequency of application	Use of mosquito repellents		
	Yes	No	
Daily	15 (100%)	-	0.001
Occasionally	57 (84%)	11 (16%)	
I do not apply at all	3 (1%)	316 (99%)	
Window and door screens condition	Use window and door screens		
	Yes	No	
They have holes	2 (100%)	-	<0.001
Not treated	1 (100%)	-	
In good condition	11 (100%)	-	
I do not use at all	-	388 (100%)	
IRS	Practice IRS		
Number of times house sprayed in last 12 months	Yes	No	
Once	8 (100%)	-	0.02
Two times	3 (75%)	1 (25%)	
More than two times	-	1 (100%)	
Not sprayed at all	240 (62%)	149 (38%)	

4.12.29b Association between practices related to use of malaria control methods and their utilization

As shown in **Table 4.45b**, Larviciding and EM related practices had a significant relationship with their utilization because they both had P-values of <0.001 which was statistically significant. Practices relating to use of indoor residual spraying had a significant relationship with its utilization because it had a P-value of 0.036 which was statistically significant.

Respondents who had good practices with regards to use of EM and larviciding were more likely to use them than those who did not have good practices with regards to their use.

Table 4.45b: Association between practices related to use of malaria control methods and their utilization

Practices related to use of malaria control methods		**Use of malaria control methods**		**P-Value**
Larviciding – frequency of larviciding		**Practice Larviciding**		
		Yes	**No**	
Daily		-	-	<0.001
Occasionally		30	2	
Never		-	370	
EM		**EM**		
Drain stagnant water/Clear unwanted vegetation		**Yes**	**No**	
	Yes	375 (99%)	1 (1%)	<0.001
	No	9 (35%)	17 (65%)	
IRS		**IRS**		
House sprayed in last 12 months		**Yes**	**No**	
	Yes	11 (92%)	1 (8%)	<0.001
	No	240 (62%)	150 (38%)	

4.12.30a Association between respondents' knowledge of malaria control methods and practices related to their use

As shown in **Table 4.46a**, practices related to use of mosquito repellents had a significant relationship with its knowledge because it had a P-value of <0.001 which was statistically significant. Practices relating to use of window and door screens had a significant relationship with its knowledge because it had a P-value of <0.001 which was

statistically significant. Practices relating to use of indoor residual sprays had no significant relationship with its knowledge because it had a P-value of 0.581 which was not statistically insignificant.

Respondents who knew mosquito repellents and window and door screens were more likely to have good practices with regards to their use than those who did not know them, while practices regarding indoor residual spraying were not affected by respondents' knowledge of IRS.

Table 4.46a: Association between respondents' knowledge of malaria control methods and practices related to their use

Practices related to use of malaria control methods	Knowledge of malaria control methods		P-value
Mosquito repellents	**Mosquito repellents**		
frequency of application	**Yes**	**No**	
Daily	15 (100%)	-	<0.001
Occasionally	68 (100%)	-	
I do not apply at all	107 (34%)	212 (66%)	
Window and door screens condition	**Window and door screens**		
	Yes	**No**	
They have holes	2 (100%)	-	<0.001
Not treated	1 (100%)	-	
In good condition	11 (100%)	-	
I do not use at all	45 (12%)	343 (88%)	
IRS	**IRS**		
Number of times house sprayed in last 12 months	**Yes**	**No**	
Once	8 (100%)	-	0.581
Two times	3 (75%)	1 (25%)	
More than two times	1 (100%)	-	
Not sprayed at all	348 (89%)	41 (11%)	

4.12.30b Association between respondents' knowledge of malaria control methods and practices related to their use

As shown in **Table 4.46b**, practices regarding larviciding had a significant association with its knowledge. This is because it had a P-value of <0.001 which is statistically significant. Practices regarding EM had a significant relationship with its knowledge. This is because it had a P-value of <0.001 which was statistically significant. Practices

relating to use of indoor residual sprays had no significant relationship with its knowledge because it had a P-value of 0.808 which was statistically insignificant.

Respondents who knew EM and larviciding were more likely to have good practices with regards to their use than those who did not know them. While practices regarding indoor residual spraying were not affected by respondent's knowledge of IRS.

Table 4.46b: Association between respondents' knowledge of malaria control methods and practices related to their use

Practices related to use of malaria control methods		**Knowledge of malaria control methods**		**P-Value**
Larviciding – frequency of larviciding		**Practice Larviciding**		
		Yes	**No**	
Daily		-	-	<0.001
Occasionally		31	1	
Never		61	309	
EM		**EM**		
Drain stagnant water/Clear unwanted vegetation		**Yes**	**No**	
	Yes	375 (99%)	1 (1%)	<0.001
	No	12 (46%)	14 (54%)	
IRS		**IRS**		
House sprayed in last 12 months		**Yes**	**No**	
	Yes	11 (92%)	1 (8%)	0.808
	No	349 (89%)	41 (11%)	

4.12.31a: SUMMARY OF QUALITATIVE FINDINGS (FOCUS GROUP DISCUSSION)

Table 4.47a: Summary of qualitative findings (FGD)

	THEMES	SUB-THEMES	MAIN RESPONSES
1.	**MALARIA**	Cause of malaria and transmission	*"Malaria is caused and transmitted by mosquitoes."*
		How malaria can be prevented	*"Sleeping under insecticide treated mosquito net and clearing bushes around the compound."*
		Malaria control methods that can be used to control malaria	*"We use ITNs because they are easy to get since the government provides them for free."* *"We practice environmental management because it is cheap to practice since we do it ourselves."*
		Reason for not using other malaria control methods	*"We don't use Mosquito repellents because it's not available in this area."* *"We don't use larviciding because we use that water for domestic purposes."* *"We don't use window and door screens because we have never heard about it."*
	Factors that prevent people of this area from using all or some of the malaria control methods	Cost Availability Knowledge	*"There are people in this area who have never heard about mosquito repellents, larviciding and window and door screens."* *"It's expensive to use larvicides, mosquito repellents and window and door screens."* *"Mosquito repellents, larvicides and window and door screens are not available in this area."*
2.	**PERCEPTION** Perceptions of people of this area towards malaria control methods	ITNs Effectiveness Reliability	*"ITNs are very effective in controlling malaria."* *"We rely on it very much in controlling malaria."*
		Larviciding Effectiveness Reliability	*"It's very bad because we use that water for domestic purposes."* *"It's bad we cannot rely on it completely."*
		Environmental management Effectiveness Reliability	*"It's moderately effective in controlling malaria."* *"People practice it but we cannot rely on it very much."*

4.12.31b SUMMARY OF QUALITATIVE FINDINGS (FOCUS GROUP DISCUSSION)

Table 4.47b: Summary of qualitative findings (FGD)

	THEME	SUB-THEME	MAIN RESPONSES
1.	**UTILIZATION OF MALARIA CONTROL METHOD**	Malaria control method that people would be interested in using	*"ITNs, mosquito repellents and environmental management. This is because ITNs and EM are easy to practice, easily available and are not expensive. Mosquito repellents can protect us when we are out of our houses."*
		Malaria control method that people may have a problem using	*"Larviciding may contaminate the water that we use for domestic purposes."* *"IRS is not effective; it also causes allergy and brings bedbugs."* *"Screening is expensive, not easily available and cannot be effective because of the way we construct our traditional houses."*
		Malaria control method mostly used by the residents of this area	*"ITNs and clearing bushes because they are easy to practice, not expensive and ITNs are easily available."*
2.	**SOCIO-ECONOMIC FACTORS INFLUENCING USE O F MALARIA CONTROL METHODS**		*"The hospital is quite some distance and so we have to use buses or motor cycles and even sometimes walk for a long distance to get the drugs."* *"According to the way our traditional houses are constructed leaving a space below the roof we cannot practice screening."* *"In this area we use stagnant water for our livestock and use at home, so we cannot drain it or use any type of larvicide."*

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1. Socio-demographic characteristics of the respondents

There were more male than female study participants. This can be attributed to the fact that the study was targeting household heads and also only one-third of households in Kenya are headed by women (KDHS, 2014). Most of the respondents fell between the age of 26 and 33 years. Majority of the respondents were married and were Christians. Majority of Kenyans are Christians and are married (KDHS, 2014).

Most of the respondents had reached primary school level. This is consistent with Kenya demographic survey 2014 where most of the Kenyans had had reached primary level of education (KDHS, 2014).

Majority of the respondents earned a monthly income of between KES 500 and 4499; almost half of them were businessmen/women. Most of the respondents lived between 1 to 5 kilometers from the nearest health facility. Most of them accessed the health facility on foot, while a large proportion lived in traditional mud houses. Majority of them got their water from shallow dams (surface rain water).

5.1.2 Knowledge of malaria and its control

The aim of the study was to determine factors influencing use of malaria control methods among the residents of Nyando sub-county. The results show that almost all the people of Nyando sub-county acknowledged that malaria was a problem in their community. They said that they knew what causes it and that it could be prevented; this information was also provided for in the focus group discussion.

Majority of the respondents knew that mosquitoes cause malaria. This was higher than findings of a study carried out in Ethiopia (Abatel *et al*., 2013) where the cause of

malaria was mentioned as mosquitoes by 85.2% of the respondents and 20% of them mentioned chewing maize stalk, hunger, lack of personal hygiene and exposure to cold weather. This difference can be attributed to the considerable proportion of respondents in Ethiopia who had misconception about the cause and transmission of malaria.

However, when it came to mentioning the symptoms of malaria only fever and headache were mentioned by more than half of the respondents, while the other symptoms were only known by a small proportion of the population eg diarrhea. These findings were lower than those of a study carried out in LAO PDR where fever and headache was mentioned by 94.8% and 88.5% of the respondents respectively (Thanabousy *et al*., 2009). This difference may be attributed to lack of proper education on malaria symptoms by community health workers in Nyando.

A large proportion of the respondents knew that ACT was the drug that was being promoted by MOH to cure malaria and only a very small proportion were not aware of it and mentioned other drugs like chloroquine and fansidar. These findings were lower than those for a study carried out in Tanzania where 94.8% of the respondents had knowledge of ACT (Mazigo *et al*., 2010). The difference in level of knowledge of ACT may be as a result of lack of proper education on malaria and its control by community health workers since they are ones who are charged with the responsibility of educating members of the community on health issues. Knowledge of ACT from the study was also corroborated by results from FGDs, which showed that most of participants were aware of ACT and only a small number mentioned other drugs like fansidar and chloroquine.

All the respondents were aware of ITNs and owned and used them at home. Knowledge of EM was good and so was its use. Knowledge of IRS was also good and it had been practiced by more than half of the respondents although the spraying had been done more than 3 years before the study was conducted, making it ineffective. These results were higher than findings of a study carried out in Ethiopia where knowledge of ITNs was 93.7% and its use was 86.6%, knowledge of EM was 84.2% and its use was 71.2%

and knowledge of IRS was 78.9% and its use was 59.5% (Abatel *et al*., 2013). The difference in the level of knowledge and use of ITNs, EM and IRS between the two studies could be attributed to the fact the people of Nyando got their ITNs free of charge, IRS had been practiced a few years back and so most of the people remembered it while EM was practiced by even those people who did not know it was a malaria control method.

Knowledge of mosquito repellents was fair and its use was poor. These results were similar to findings of a study carried out in Nigeria where 37.8% of the respondents knew mosquito repellents and 17.5% used them (Singh *et al*., 2014).

The other malaria control methods were poorly known and used because only a small proportion of the respondents knew larviciding and used it, this was lower than the findings of a study carried out in Salvador where 88.2% of the respondents were aware of larviciding and 39.1% of the respondents practiced it (Mejía *et al*., 2016). The difference in the findings of the two studies could be attributed to fact that larviciding was not being promoted as a malaria control method in the same way as others were being promoted in Nyando.

Only a small proportion of the respondents were aware of window and door screens and used them. These findings were consistent with those of a study carried out in Iran where 14.5% of respondents were aware of window and door screens but differed in their use, since 14.7% of the respondents used it (Soleimani-Ahmadi *et al*., 2014). The low level of knowledge and use of window and door screens could be attributed to the fact that window and door screens were not being promoted as a malaria control method in Nyando. The FGD results showed that the high level of knowledge of ITNs and EM was as a result of wide media coverage and emphasis of their use by health workers. IRS on the other hand was well known but this was because of the fact that sometime back their houses were sprayed and so most them still remembered it. The other malaria control methods were poorly known because the respondents had never heard of them from any quarter.

Knowledge of malaria control methods can be improved by increased information coverage by media and health workers since they were mentioned by most respondents as their source of information for all the malaria control methods.

5.1.3 Attitudes towards malaria control methods

Majority of the respondents were of the opinion that ITNs were extremely important as means of malaria control; this was similar to findings of Kenya malaria indicator survey 2010 where 75% of the respondents noted that ITNs are safe and important in malaria control (KMIS, 2010). EM was mentioned to be very important by more than half of the respondents in malaria control. This was lower than findings of a study carried out in Tanzania where 73% of the respondents felt that EM was important in reducing malaria (Randell *et al*., 2010). This difference could be due to the fact that although majority of the respondents said they knew EM as a malaria control method, their perception towards it was not good since only half of the respondents said that it was very effective in malaria control.

Larviciding was perceived as not being as important by almost half of the respondents in malaria control, this was different from findings of a study carried out in Tanzania where 73% of the respondents said that they trusted larviciding in malaria control (Mboera *et al.,* 2014). This difference could be attributed to poor perceptions of the Nyando residents towards larviciding since most of the respondents said that it could contaminate the water that they use for domestic purpose.

Window and door screens were perceived as not being as important by more than half of the respondents in malaria control. These findings were similar to results of a study carried out in Iran where inspite of 98% of the respondents knowing about malaria prevention, only 14.5% of the respondents mentioned window and door screens as a preventive measure against malaria (Soleimani-Ahmadi *et al.*, 2014).

From the FGD larviciding was not preferred because the respondents felt that it could contaminate the water that they use for domestic purposes. As concerns window and

door screens, respondents felt that it could not be effective because their houses are built in such a way that there is a space that is left between the roof and wall for ventilation purpose that could let mosquitoes get into their houses. They also felt that it could be expensive to install the screens, and that they are also not available in Nyando.

Further, a significant proportion of respondents said that mosquito repellents were very important in malaria control. However, others were of the opinion that it is not an important malaria control method while the rest of them felt that it was not as important in malaria control. These findings were lower than those of a study carried out in Ghana where majority (81.8%) of the respondents said that mosquito repellents were important in reducing mosquito bites and malaria (Dadzie *et al*., 2013).

The inconsistency in the findings could be attributed to mixed perceptions of the people of Nyando towards mosquito repellents; this is because although more than half of the respondents felt that it was effective in malaria control the rest had a different opinion on its perceived effectiveness in malaria control. From the FGDs participants felt that it could be effective but the only problem is that it was not available.

For IRS slightly more than half of the respondents felt that it was important in malaria control. These results were lower than findings of a study carried out in Iran where 96.2% of the respondents indicated that IRS was important in malaria prevention (Hanafi-Bojd *et al.,* 2011). This difference in the results can be attributed to poor perceptions towards IRS by the people of Nyando since almost half of the respondents reported that it was not safe and convenient to practice.

From the FGDs, when the respondents were asked about their perceptions towards IRS, some said that it was effective only for a short period; others said that it requires technical expertise to practice, while others said it caused emergence of bedbugs and fleas. Further to this, there were some who felt that spraying their houses would interfere with their privacy.

The respondents' perception of malaria control methods was assessed in terms of safety of use with majority of the respondents feeling that ITNs were safe to use; this was higher than findings of the Kenya malaria indicator survey 2010 where 75% of the respondents said that ITNs are safe and important to use in malaria control (KMIS,2010). This difference can be attributed to good perceptions by the Nyando residents towards ITNs since a large proportion of respondents said it was convenient to use, important in malaria control, and perceived it to be effective in malaria prevention. EM was reported by respondents to be safe; this was similar to results of a study carried out in Uganda where the respondents said EM was a safe malaria control method after ITNs (Mutero *et al*., 2012).

Almost equivalent proportions of respondents felt that window and door screens are safe or unsafe to use. These findings were different from results of a study carried out in Gambia where majority of the respondents said that window and door screens is a safe malaria control method (Kirby *et al*., 2009). The inconsistency in the findings of the two studies could be attributed to poor knowledge of window and door screens by the people of Nyando since it was known by a small proportion of the respondents, so most of the respondents were not in a position to comment on its safety.

Mosquito repellents had equivalent proportions of respondents who said it was safe or unsafe. This was consistent with findings of a study carried out in Cambodia where equivalent proportion of respondents perceived mosquito repellents to be safe or unsafe (Gryseels *et al*., 2015). IRS had equivalent proportion of respondents who said it was safe or unsafe to use as a malaria control method. These findings were similar to those of a study carried in Rwanda where some respondents said that IRS was good in malaria control, while a similar proportion said that it would activate fleas, mites and bedbugs (Ingabire *et al.*, 2015).

Conversely, majority of the respondents were of the opinion that larviciding was unsafe to use in malaria control. These findings were also inconsistent with those of a study carried out in Tanzania where 73.4% of the respondents said that larviciding was a safe method in malaria control (Mboera *et al*., 2014). This difference could have been due to

good perceptions towards larviciding in Tanzania since most of respondents were receptive to it and were ready to practice it unlike in Nyando where majority of the residents rejected it in totality. These results were corroborated with results from FGDs where majority of the respondents said larviciding was not safe in malaria control because it could contaminate the water that they use for domestic purposes.

Perception of the respondents towards the various malaria control methods was looked at in terms of their convenience of use. A large proportion of the respondents opined that ITNs were convenient to use. This was different from findings of a study carried out in Msambweni where 79.2% of the respondents reported that ITNs are very expensive and that was the reason they did not use them (Khambira, 2013). This difference could be attributed to the fact that ITNs were distributed to the people of Nyando free of charge while their counterparts in Msambweni had to buy them.

A small proportion of the respondents felt that mosquito repellents are convenient to use in malaria control. This was much lower than findings of a study carried out in Tibet where 87.7% of the respondents said that mosquito repellents are a convenient way to control malaria (Liu *et al*., 2014). This difference could have been due to poor knowledge of mosquito repellents by the people of Nyando because slightly less than half of the respondents had knowledge of mosquito repellents. Other reasons that came out in FGDs were respondents indicating they did not use mosquito repellents because they were not available in Nyando, and some of them felt they are expensive.

More than half of respondents said that EM was convenient to use. This was different from findings of a study carried out in Mwea where 56.3% of the respondents said that they do not practice EM because of lack of time (Ng'ang'a *et al*., 2008). This difference can be attributed to poor perceptions towards EM by the people of Mwea since EM related practices require time to practice and therefore, they may have considered EM to be tedious and time consuming.

With regards to IRS, a small proportion of the respondents felt that IRS was convenient to use. This was lower than findings of a study carried out in Ethiopia where 59.5% of the respondents said they used IRS in malaria control because they get their houses sprayed during IRS mass campaigns (Abatel *et al*., 2013). This difference could be attributed to the fact that unlike Ethiopia where IRS is carried out frequently, the people of Nyando reported that it was carried out three years prior to the data collection time and also they had other reasons like that it had a strong repugnant smell, caused allergies, and that they would not allow strangers to enter their bedrooms because of cultural norms and insecurity. From the FGDs, reasons for using ITNs and EM were easy availability, ease of practice, and not being expensive. Repellents on the other hand would protect them when they were outdoors.

A large proportion of the respondents said that window and door screens are not convenient to use. This was similar to the findings of a study carried out in Tanzania where 75.5% of the respondents said they did not use window and door screens because they are expensive (Ogomar *et al*., 2009). These findings were also corroborated by FGDs where majority of the respondents felt that window and door screens are expensive, not easily available in Nyando, and also from the fact that from the way their houses are built they felt it would not work for them.

In the case of larviciding a large proportion of the respondents felt that it was not convenient to use as a malaria control method, which was consistent with findings of a study carried out in Uganda where majority of the respondents, felt that larviciding could contaminate water sources (Mutero *et al*., 2012). These findings were also corroborated by results from FGDs where respondents said that larviciding was expensive, not available, required technical expertise to practice and could contaminate the water that they use for domestic purpose.

Perception was then looked at in terms of effectiveness of malaria control methods. Majority of the respondents felt that ITNs were effective in malaria control, which was similar to findings of a study carried out in Ethiopia where 93.7% of the respondents

said that ITNs are effective in malaria control (Abatel *et al*., 2013). A large proportion of the respondents said that EM was effective in malaria control, which was consistent with findings of a study carried out in Ethiopia where 84.2% of the respondents said that EM was effective in malaria control.

IRS on the other hand was mentioned to be effective by more than half of the respondents. This was lower than findings of a study carried out in Ethiopia where 78.9% of the respondents said that it was effective in malaria control. This difference could have been due to poor perceptions by the people of Nyando towards IRS since almost half of the respondents said it was not important and convenient to use in malaria control. Also, from the FGDs respondents said it was effective only for a short period and it caused emergence of bedbugs, required technical expertise to practice and interfered with peoples' privacy.

However, for larviciding, more than half of the respondents said it was effective in malaria control. This was lower than findings of a study carried out in Tanzania where 73.4% of the respondents said larviciding was effective in malaria control (Mboera *et al*., 2014). This difference could have been due to poor perceptions of the respondents towards larviciding since most of the respondents said that it was not important in malaria control, not convenient to use in malaria control, and also that it was not a safe malaria control method.

A large proportion of respondents said that mosquito repellents are effective in malaria control. This was lower than findings of a study carried out in Ghana where majority (81.8%) of the respondents said that mosquito repellents were effective in reducing mosquito bites and malaria (Dadzie *et al*., 2013). This difference could be attributed to poor knowledge of mosquito repellents by the residents of Nyando since slightly less than half of the respondents knew it, so they were not likely to know how effective it is in malaria control.

Only a small proportion of the respondents felt that window and door screens were effective when used in malaria control. This was higher than the findings of a study carried out in Tanzania where 4.9% of the respondents said they used window and door screens to prevent them from contracting malaria (Ogomar *et al*., 2009).

This difference could have been brought about by poor knowledge and perceptions towards window and door screens in malaria control by the respondents in the study carried out in Tanzania. This is because in spite of the fact that it was widely practiced in Tanzania, most of the respondents cited other reasons for its installation such as it being fashionable, keeping the house cool, and preventing entry of dust.

5.1.4 Practices related to malaria control

Slightly less than half of the respondents wore long-sleeved clothes at night or when going to the rice fields, followed closely by those who wore them sometimes. This was higher than the findings of a study carried out in LAO PDR where only 25.2% of the respondents wore long-sleeved clothes at night (Thanabousy *et al*., 2009). This difference could be attributed to people of Nyando having better knowledge on malaria control than the people of LAO. Although the results are better than those for LAO it is not good enough since mosquitoes bite at night and those people who don't wear long-sleeved clothes are more likely to be bitten by mosquitoes (Thanabousy *et al*., 2009).

EM related practices such clearing bushes and draining stagnant water was good because almost all the respondents practiced it, this was higher than findings of a study carried out in Tanzania where EM was practiced by 63% of the respondents (Randell *et al*., 2010).This difference can be attributed to the good attitudes towards EM by the people of Nyando since a large proportion of the respondents said it is important in malaria control.

A large proportion of respondents, said that they always visited the health center when they suspected they had malaria. This was higher than findings of a study carried out in LAO PDR, where only 58.1% of the respondents reported that they visited the hospital

when they thought they had malaria (Thanabousy *et al*., 2009).This difference could also be due to better attitudes and better knowledge on malaria control practices by the Nyando residents compared to their counterparts in LAO.

Other malaria control practices like all the members of the household sleeping under ITNs was good because almost all the respondents said they always slept under ITNs. This was higher than the findings of a study carried out in Ethiopia where 73.3% of the respondents said they used ITNs (Teklemariam *et al*., 2015).

Results of the studies could have differed because of good attitudes towards towards ITNs by the Nyando residents since almost all the respondents said it was important in malaria control. Majority of the respondents said they always closed their windows in the evening and early morning. This was higher than findings of a study carried out in Ethiopia where 40.8% of the respondents always closed their windows (Abatel *et al*., 2013). This difference could also be attributed to better knowledge and attitude towards malaria control by the Nyando residents than their Ethiopian counterparts. Since evenings and early mornings is the time that mosquitoes enter the house; then those people who don't close their windows during that time are more likely to have mosquitoes enter their houses and eventually cause malaria (Thanabousy *et al*., 2009).

A large proportion of the respondents always checked whether their nets had holes, but the rest of the respondents checked only sometimes (or did not check at all) putting them at risk of contracting malaria since nets with holes are not effective in malaria control.

Half of the respondents said that they always repaired their nets if they found any holes, while the rest repaired their nets sometimes or never repaired their nets at all. These findings were higher than those of a study carried out in LAO PDR since in that study only 28.4% of the respondents reported checking if their nets had holes and only 29.4% of the respondents always repaired their nets if they had holes (Thanabousy *et al*., 2009). This difference could also be attributed to better knowledge and attitudes towards malaria control by the Nyando residents than their LAO PDR counterparts.

A small proportion of the respondents had nets which were in good condition. This was higher than findings of a study carried out in Kwale where 30.7% of the respondents had nets which were in good condition (Khambira, 2013). A small proportion of the respondents' nets had holes. This was lower than findings of a study carried out in Kwale where 78% of the respondents' nets had holes (Khambira, 2013).

ITNs should not have holes because a single small hole is enough to render the net useless (Willy, 2005). A very small proportion of the respondents used untreated nets, and this was lower than findings of a study that was carried out in Kwale where 14.7% of the respondents used untreated nets (Khambira, 2013). Nets should be treated because the insecticide used repels mosquitoes; nets that are not treated are not useful (Willy, 2005).

More than half of respondents washed their nets regularly and did not re-treat them.This can be attributed to lack of K-OTab in Nyando, which is used to treat nets.These results were lower than findings of a study carried out in Kwale where 67% of the respondents washed their nets regularly and did not retreat them (Khambira, 2013).ITNs should be regularly re-treated because they lose efficacy after three washes (Willy, 2005).

The difference in the results of the two studies can be attributed to good perceptions of the Nyando residents towards ITNs since almost all the respondents said they are important in malaria control and also all the respondents owned ITNs. Untreated nets are not effective in malaria control because when a person who is covered by the net comes into contact with the nets, he/she can be bitten by the mosquito because there is nothing that can prevent the mosquito from resting on the net, while nets with holes cannot be effective until all the holes are fully repaired. Washing nets regularly reduces the amount of the insecticide and so it must be re-treated to make it effective (Willy, 2005).

A Large proportion of the respondents' houses had not been sprayed in the previous 12 months. Other malaria control methods like use of ITNs was the malaria control method that was largely practiced in Nyando since the policymakers seemed to be more

interested in its use and not the other malaria control methods. The findings of this study with regards to use of IRS was very low compared to findings of a study carried out in Ethiopia where 70.4% of the respondents reported that their houses had been sprayed in the previous 12 months (Abatel *et al*, 2013).

This difference can be attributed to the fact that there are regular mass spraying campaigns in Ethiopia unlike in Nyando where houses had been sprayed more than two years back when the study was being carried out. This cannot be effective in malaria control since houses are supposed to be sprayed after 3 to 4 months (Wanjala *et al*., 2015).

Practices in relation to mosquito repellents were poor because few respondents applied repellents on a daily basis, a small proportion applied repellents occasionally while a majority did not use repellents at all; these was lower than the findings of a study carried out in LAO PDR where 35.1% of the respondents used it daily, 36.2% occasionally and only 28.7% never used it (Thanabousy *et al*.,, 2009). This difference could be due to unavailability of mosquito repellents in Nyando sub-county which was mentioned by majority of the participants in FGDs

With regards to window and door screens, a very small proportion of the respondents used them. These results were lower than those of a study carried out in Tibet where 49.3% of the respondents used window and door screens and 41.9% used mosquito repellents (Liu *et al*., 2014). This inconsistency in the results can be attributed to lack of knowledge and unavailability of window and door screens by Nyando residents since it was known by a small proportion of the respondents. These findings were also corroborated by FGD results where majority of the participants said they were not aware of window and door screens, and in addition they said it was not available in Nyando.

5.1.5 Social-demographic characteristics and their influence on knowledge of malaria control methods

Gender was significantly associated with knowledge of larviciding, mosquito repellents and window and door screens. These findings were similar to those of a study carried out in Ghana that showed gender had a significant relationship with knowledge of malaria control (Opare *et al*., 2014). Majority of the respondents who had knowledge of larviciding and mosquito repellents were male. This shows that males were more likely to know about larviciding and mosquito repellents than females. But the knowledge of the other malaria control methods was not associated with the gender of the respondents.

Marital status was significantly associated with knowledge of larviciding, mosquito repellents, IRS and window and door screens. These findings were consistent with those of a study carried out in LAO, PDR where the marital status of the respondents was significantly associated with knowledge of malaria prevention (Thanabousy *et al*., 2009).

Majority of the respondents with adequate knowledge of larviciding, mosquito repellents and IRS were married. Married respondents were more knowledgeable on the malaria control methods mentioned above than respondents who were single, divorced or widowed.

Religion was significantly associated with knowledge of IRS. Majority of the respondents with knowledge of IRS were Christians. This could be an indication that although most of the respondents said their source of information for IRS was health workers, others could have heard about it in the church.

Education level was significantly associated with knowledge of larviciding, mosquito repellents, IRS and window and door screens. These findings were consistent with those of a study carried out in LAO, PDR where the level of education was significantly associated with knowledge of malaria prevention (Thanabousy *et al*., 2009). Most of the

respondents who had knowledge of the four malaria control methods mentioned above had completed college education.

This shows that most of the respondents who had knowledge of the four malaria control methods had reached secondary level of education and above which shows that respondents who were highly educated were the ones who were more likely to know the malaria control methods mentioned above. This shows that the source of information for the malaria control methods mentioned above was school since they were known by people who were highly educated.

The monthly income of the respondents was significantly associated with knowledge of larviciding, mosquito repellents and window and door screens. These findings were consistent with those of a study carried out in LAO, PDR where the occupation and monthly income of the respondents was significantly associated with knowledge of malaria prevention (Thanabousy *et al*., 2009). This may be as a result larviciding, mosquito repellents and window and door screens being known by people who were more educated and this were professionals who also had higher salaries. Also, these respondents could have known these malaria control methods from their places of work.

5.1.6 Social-demographic characteristics and their influence on use of malaria control methods

Gender of the respondents did not have a significant relationship with use of malaria control methods. These findings were similar to results of a study carried out in Uganda where gender was found not to have a significant relationship with use of malaria control methods (Mwanje, 2013).

Age of the respondents did not have a significant relationship with use of malaria control methods. These findings were inconsistent with those of a study carried out in Ghana that showed age was associated with use of malaria control methods (Dako-Gyeke *et al*., 2015). This could have been as a result of the respondents having almost similar

demographic characteristics and so use of malaria control methods was determined by other factors and not the age of the respondents.

Marital status was significantly associated with use of larvicides, mosquito repellents and window and door screens. Majority of the respondents who used larvicides, mosquito repellents and window and door screens were married. Married respondents were also more knowledge on the malaria control methods mentioned above than respondents who were single, divorced or widowed. This high level of knowledge of the malaria control methods mentioned above among married respondents could have translated to them using the larvicides, mosquito repellents and window and door screens than respondents who were single, divorced or widowed

Religion was significantly associated with use of window and door screens. These findings were inconsistent with those of a study carried out in Ghana that showed religion was not associated with use of malaria control methods (Dako-Gyeke *et al*., 2015).

Majority of the respondents who used window and door screens were Christians. This could be an indication that although most of the respondents said their source of information for window and door screens was health workers, others could have heard about it in the church and that is why they used it.

The level of education was significantly associated with use of larvicides, mosquito repellents and window and doors screens. These findings were similar to those of a study carried out in Ghana where the level of education of the respondents had a significant relationship with use of malaria prevention methods (Dako-Gyeke *et al*., 2015).

Most of the respondents who used the three malaria control methods mentioned above had reached secondary school level and above. They were also more knowledgeable on the malaria control methods mentioned above and were more likely to use them since they knew them and also knew their benefits.

Monthly income of the respondents was significantly associated with use of mosquito repellents and window and door screens. These findings were similar to those of a study carried out in Ghana where the income of the respondents had a significant relationship with use of malaria prevention methods (Dako-Gyeke *et al*., 2015). Since mosquito repellents and window and door screens are not provided free of charge in Nyando Sub-County like ITNs, people with higher income are ones who were more likely to use them.

The main occupation of the respondents was associated with use of mosquito repellents, IRS and window and door screens. These findings were consistent with those of a study carried out in LAO, PDR where the occupation of the respondents was significantly associated with malaria prevention (Thanabousy *et al*., 2009). The three malaria control methods mentioned above were used by people who were more educated since they were mostly known by highly educated people and more so they are expensive and are not provided for free.

5.1.7 Knowledge of malaria control methods and its influence on use of malaria control methods

Knowledge of larviciding, EM, mosquito repellents, IRS, and window and door screens was significantly associated with their utilization. Most respondents who had knowledge of the malaria control methods were more likely to use them. This could have been due to the knowledge of the benefits of the malaria control methods among those respondents who were aware of them. Those who were not aware of the malaria control methods were not likely to use them since they did not know them and for that reason, they were not likely to use them. It is very hard for someone to use something that he/she does not know or understand.

5.1.8 Social-Economic issues and their influence on knowledge of malaria control methods

Type of structure of the respondents' houses was significantly associated with knowledge of larviciding, mosquito repellents and window and door screens. Respondents who lived in houses made of stone and bricks were more knowledgeable on the different malaria control methods than the other respondents. This is because those respondents had more income than those living in traditional mud houses. They were also more educated than the other groups and that could have been the reason why they had more knowledge on the different malaria control methods than the others.

Source of water for the respondents was significantly associated with knowledge of larviciding and window and door screens. This could be due to the fact that those respondents who used water from boreholes could be more educated than those who used water from shallow wells. Shallow well water is surface rain water than collects after it rains.

People who are more educated may not use that kind of water because they understand the risk that is associated with it. Knowledge of larviciding and window and door screens was high among respondents who had reached secondary school level and above. This could be the reason why respondents who used borehole water were more knowledgeable on use of larvicides and window and door screens than the others.

5.1.9 Social-Economic issues and their influence on use of malaria control methods

Type of structure of the respondents' houses was significantly associated with use of larviciding, mosquito repellents and window and door screens. These findings were similar to those of a study carried out in Ghana where the type of housing of the respondents had a significant relationship with use of malaria prevention methods (Dako-Gyeke *et al*., 2015).

Most of the respondents who used larviciding, mosquito repellents and window and door screens lived in houses built of stones. These respondents were well to do members of

the society and were also more educated. Larviciding, mosquito repellents and window and door screens were mainly known by those respondents who had reached secondary school level and above.

Mosquito repellents and window and door screens were not provided in Nyando free of charge. So those people who more likely to use them were those who could afford them while larviciding could only be practiced by those people who were more educated. This could be the reason why respondents living in houses made of stone that were wealthy and educated members of the society used larviciding, mosquito repellents and window and door screens.

Source of water for the respondents was significantly associated with use larviciding and IRS. Majority of the respondents who used larvicides and IRS were those using water from boreholes. This could be due to the fact that those respondents who used boreholes could be more educated than those who used water from shallow wells. People who are more educated may not use that kind of water because they understand the risks that are associated with its use.

Knowledge of larviciding was high among respondents who had reached secondary school level and above. This could be the reason why people who used borehole water were more knowledgeable on use of larvicides and that could be the reason they were using it. Knowledge of IRS was not affected by the level of education of the respondents because even those who were not well educated remembered it since it was carried out in Nyando sometime back before the time the study was being conducted.

What could have affected use of IRS are the perceptions associated with its use like emergence of bedbugs which was high among the respondents who were not well educated. Therefore, the respondents who were more educated were more likely to use it because they had good perceptions associated with its use and did not believe in witchcraft issues which affected its use.

5.1.10 Influence of respondents' perceptions towards malaria control methods on their knowledge of the malaria control methods

Respondents' perceptions towards larviciding, mosquito repellents, EM, IRS and window and door screens were significantly associated with their knowledge of the malaria control methods. Malaria control methods that were well known to the respondents were perceived to be effective in malaria control.

Respondents' perceived importance of larviciding, EM, mosquito repellents, IRS and window and door screens was significantly associated with their knowledge. Malaria control methods that were well known to the respondents were perceived to be important in malaria control. Majority of the respondents perceived EM and ITNs to be very important in malaria control because almost all the respondents knew them.

Majority of the respondents perceived mosquito repellents to be important in malaria control although it was an average number of respondents who knew it as malaria control method. This could be due to the reasons given in the FGDs that it was expensive and not available in Nyando. A very small proportion of respondents knew larviciding which was similar to the small proportion of respondents who perceived it to be important in malaria control. For window and door screens a very small proportion of respondents knew it while an average number of respondents said it was good in malaria control. This could be due to the reasons given in FGDs that it was expensive and not available in Nyando.

Respondents 'perceived effectiveness of larviciding, EM, mosquito repellents, IRS and window and door screens was significantly associated with their knowledge of the malaria control methods .These findings were consistent with those of a study carried out in Ghana that showed local perception and health-seeking behaviour are critical to the success and sustainability of malaria management and control (Laar *et al*., 2013).

Malaria control methods that were well known to the respondents were perceived to be effective in malaria control. Majority of the respondents perceived EM and ITNs to be

very effective in malaria control because almost all the respondents knew them. Majority of the respondents perceived mosquito repellents to effective in malaria control although an average number of respondents knew it as a malaria control method. This could be due to the reasons given in the FGDs that it was expensive and not available in Nyando.

A very small proportion of respondents knew larviciding which was similar to the the small proportion of respondents who perceived it to be effective in malaria control. For window and door screens a very small proportion of respondents knew it while a large proportion of respondents said it was effective in malaria control. This could be due to the reasons given in FGDs that it was expensive and not available in Nyando.

5.1.11 Influence of respondents' perceptions towards malaria control methods on their utilization

Respondents' perceived importance of larviciding, EM, mosquito repellents, IRS and window and door screens was statistically associated with their utilization. These findings were consistent with those of a study carried out in Ghana that showed local perception and health-seeking behaviour are critical to the success and sustainability of malaria management and control (Laar *et al*., 2013).

Malaria control methods that were perceived to be important in malaria control were used by the respondents. Majority of the respondents perceived EM and ITNs to be very important in malaria control and so was their level of utilization; all the respondents used ITNs while EM was used by almost all the respondents. Majority of the respondents perceived mosquito repellents to important in malaria control although a small proportion of respondents used it as a malaria control method. This could be due to the reasons given in the FGDs that it was expensive, not available in Nyando and it was not known by all the respondents.

A very small proportion of respondents perceived larviciding to be important in malaria control. Similarly, a small proportion of respondents used it. This may be attributed to

reasons for not using it that came out in the FGDs; not known, it could contaminate the water that they use for domestic purposes and it is expensive.

For window and door screens a small proportion of respondents perceived it to be important in malaria control while a very small proportion of the respondents used it in malaria control. This could be due to the reasons given in FGDs that it was not known by many respondents, it is expensive and not available in Nyando.

5.1.12 Influence of malaria control practices on respondents' utilization of malaria control methods

Malaria control practices such as frequency of larviciding, draining excess water/clearing bushes, frequency of using mosquito repellents, frequency of IRS application and checking the condition of window and door screens were significantly associated with use of malaria control methods. Respondents who had good practices with regards to use of malaria control methods had a high level of utilization of the malaria control methods.

5.2 Conclusion and recommendations

5.2.1 Socio-demographic characteristics of the respondents

Most of the respondents were between 26 and 33 years. There were more male respondents than females. Majority of them were married and were Christians. Most of them had reached primary school level.

Majority of the respondents earned between KES 500 and 4499, and most of them were businessmen/women. A large proportion of them lived between 1 to 5 kilometers from the nearest health facility and it was accessed mainly on foot. A large proportion of the respondents lived in traditional mud houses and most fetched their water from shallow dams (surface rain water).

5.2.2 Knowledge of malaria and its control

Majority of the respondents knew that mosquitoes cause malaria while the symptoms that were known by many respondents were fever and headache. Malaria control methods that were known by most of the respondents were ITNs, EM and IRS.

ACT anti-malarial drug was known by a large proportion of the respondents.

5.2.3 Perceptions towards malaria control methods

Majority of the respondents said ITNs, EM, and mosquito repellents were very important, very safe and very convenient to use in malaria control.

ITNs, EM and mosquito repellents were also perceived to be effective in malaria control by most of the respondents.

5.2.4 Use of malaria control methods

ITNs and EM were the malaria control methods practiced by majority the respondents.

5.2.5 Malaria control practices

Malaria control practices such wearing long-sleeved clothes at night, visiting health center when one suspects he/she has malaria, sleeping under ITNs, keeping windows closed in the evenings and early morning, repairing nets if they have holes were well observed by the residents of Nyando sub-county. The only challenge was indoor residual spraying which is supposed to be done by the government and it had not been done for quite some time.

5.2.6 Association between socio-demographic characteristics, knowledge, perceptions, practices, socio-economic issues and use of malaria control methods

Social demographic characteristics of the respondents influenced use of different malaria control methods. Gender of the respondents was associated with knowledge of larviciding, mosquito repellents and window and door screens while their marital status

was associated with use of larvicides, mosquito repellents and window and door screens. Age was significantly associated with knowledge of mosquito repellents and IRS

Religion of the respondents was only associated with use of window and door screens while the level of education of the respondents was associated with use of larvicides, mosquito repellents and window and door screens.

The monthly income of the respondents was associated with use of mosquito repellents and window and door screens.

Knowledge of larvicides, EM, mosquito repellents, window and door screens and IRS was associated with their utilization.

Perceptions towards larvicides, EM, mosquito repellents, window and door screens and IRS was associated with their utilization.

Social economic factors such as type of structure of the respondents' houses was associated with use of larvicides, mosquito repellents and window and door screens. The respondents' main source of water was associated with use of larvicides and IRS.

Malaria control practices such as frequency of larviciding, draining excess water/clearing bushes, frequency of using repellents, frequency of IRS and checking the condition of window and door screens was associated with use of all the malaria control methods.

5.3 Recommendations of the study

The people of Nyando should be educated on the other malaria control methods like larviciding, mosquito repellents, EM, IRS, window and door screens, and not only ITNs. They should be educated on the way they are used; their importance in malaria control, and also where they can be sourced. This is because integrated malaria management has been shown to be key in malaria control.

Since CHWs are known to greatly increase access to health services especially among rural and hard-to-reach communities. As people involved in health service delivery, they can be utilized to carry out health promotion on malaria control methods such larviciding, mosquito repellents, EM, IRS and window and door screens in Nyando sub-county.

The government and policy makers should make water available by sinking more boreholes or providing piped water in Nyando sub-county so as to discourage people from using surface rain water which is a favorable breeding ground for malaria causing mosquitoes, and can also cause other water borne diseases like cholera, dysentery and typhoid.

People living in mud houses should be encouraged to screen their houses since the space that is left for ventilation in their houses also allows mosquitoes to get in and cause malaria.

All the malaria control methods should be made available in Nyando for free or subsidized price to allow people to use them.

EM related practices such as clearing bushes and draining stagnant water should be upscaled because of the poor drainage in Nyando which results in a lot of stagnant water in the area. There is also a lot of unwanted vegetation in the area that provides favorable breeding place for malaria causing mosquitoes.

Policy makers should also practice larviciding in areas where draining of stagnant water is not possible.

Indoor residual spraying should be practiced every 3 to 4 months in Nyando sub-county so that it can be effective in malaria control.

5.3.1 Recommendation for further research

There is need to have more studies on integrated malaria management (IMM) in Nyando so as to identify effective ways of reducing malaria in the area.

There is need to have more studies on indoor residual spraying in Nyando since many respondents had concerns about its safety and effectiveness in malaria control.

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APPENDICES

Appendix I: Questionnaire (English Version)

SECTION A: Personal information

1. Ward_____

2. Gender

1. Male 2.Female

3. Age in year's/ Date of birth _____

1. 18 – 25 2. 26 – 33 3. 34 – 41 4. 42 – 49

5. 50 – 57 6. 58 – 65 7. 65 and above

4. Marital status

1. Single 2.Married 3.Divorced 4. Cohabiting 5. Others (specify)_____

5. Religion

1. Christians 2.Muslim 3. Hindu 4. Non - religious _____

6. Eduation level

1. No education 2. Primary education 3. Secondary education 4. College education

7. What is your approximate monthly income (KES)?

1. 500 - 4499 2. 4500 - 8499 3. 8500 - 12499

4. 12500 - 16499 5. 16500 - 20499 6. 20500 - 24499

7. 24500 – 28499 8. 28500 – 32499 9. 32500 and above

8. What is your main occupation? (Multiple answers are possible)

1. Farming 2. Business 3. Salaried worker 4. Others (please specify)_____

9. What is the distance from your place of residence to the nearest public health facility?

1. Less than 1 km 2.1 – 5 km 3.6 – 10 km 4. 11 – 15 km

10. What is the mode of transport to the health facility?

1. By foot 2. By bus/matatu 3. Own vehicle 4. Others (specify)_____

11. Type of structure of the house

1. Traditional mud house 2.Bricks 3. Timber 4.stone 5.Iron sheet

12. What is your main source of water?

1. Shallow wells/dams 2. Borehole 3. Tap water 4. River/spring

13. Do you live in a traditional mud house?

1. Yes 2. No

14. Do you get your water from shallow wells/dams?

1. Yes 2. No

SECTION B: Knowledge on malaria control and prevention.

15.Is malaria a problem in this community?

1. Yes 2. No

16. What causes malaria?

1. Dirt 2. Food 3. Water 4. Mosquitoes 5. Friends

6. Others (specify).....

17.How would you know someone has malaria? (Multiple answers are possible)

1.Fever 2. Headaches 3. Muscle/joint pains 4. Vomiting 5. Diarrhoea 6. Shivering

18.Can malaria be prevented?

1. Yes 2. No

19. Do you know of any drug being promoted by the ministry of Health for the prevention of malaria?

1. Yes 2. No

If yes, give the name of the drug _____

20. Have you seen or heard information relating to "ACT" or "AL"?

1. Yes 2. No

If no skip to question 23.

21. If yes, what was the source of information?

1. Media 2. Neighbours 3. School 4. Parents 5. Healthworkers

6. Others (specify)_____

22. In your commuity where can one get "ACT' or "AL"?

1. Shops 2. Pharmacies/Chemists 3. Government Clinics 4. Other Clinics

5. Others (specify) _____

23. How can malaria be prevented?

1. Use of ITNs 2. Larviciding (killing of immature mosquitoes) 3. EM (Clearing bushes and draining stagnant water) 4. Use of mosquito repellants 5. Use of IRS 6. Use of window and door screens

Respondents only to answer the malaria control methods they have said they know in Q23

24. What was your source of information on malaria control methods listed below?

i). Use of ITNs

1. Media 2. Neighbours 3. School 4. Parents 5. Healthworkers

6. Others (please specify) _____

ii). Larviciding (killing of immature mosquitoes)

1. Media 2. Neighbours 3. School 4. Parents 5. Healthworkers

6. Others (please specify) _____

iii). Clearing bushes and draining stagnant water

1. Media 2. Neighbours 3. School 4. Parents 5. Healthworkers

6. Others (please specify) _____

iv). Use of mosquito repellants

1. Media 2. Neighbours 3. School 4. Parents 5. Healthworkers

6. Others (please specify) _____

v). Use of IRS

1. Media 2. Neighbours 3. School 4. Parents 5. Healthworkers

6. Others (please specify) _____

vi). Use of window and door screens

1. Media 2. Neighbours 3. School 4. Parents 5. Healthworkers

6. Others (please specify) _____

SECTION C: Attitude on malaria control and prevention.

25. How important do you think the following malaria control methods are in controlling malaria?

i. ITNs

1. Extemely important 2. Very important 3. Moderately important

4. Not important

ii. Larviciding (killing of immature mosquitoes)

1. Extemely important 2. Very important 3. Moderately important

4. Not important

iii. Window and door screens

1. Extemely important 2.Very important 3. Moderately important

4. Not important

iv. Mosquito repellants

1. Extemely important 2.Very important 3. Moderately important

4. Not important

v. Environmental management

1. Extemely important 2.Very important 3. Moderately important

4. Not important

vi. IRS

1. Extemely important 2.Very important 3. Moderately important

4. Not important

26. What is your opinion on use of the following malaria control methods with regards to safety of use?

i. ITNs

1. Not safe at all 2. A little safe 3. Very safe 4. Extremely safe

ii. Larviciding (killing of immature mosquitoes)

1. Not safe at all 2. A little safe 3. Very safe 4. Extremely safe

iii. Window and door screens

1. Not safe at all 2. A little safe 3. Very safe 4. Extremely safe

iv. Mosquito repellants

1. Not safe at all 2. A little safe 3. Very safe 4. Extremely safe

v. Environmental management

1. Not safe at all 2. A little safe 3. Very safe 4. Extremely safe

vi. IRS

1. Not safe at all 2. A little safe 3. Very safe 4. Extremely safe

27. To what extent do you feel it is convenient for you to use the following malaria control methods?

i. ITNs

1. Not at all 2. Only slightly 3. To a moderate extent 4. To a great extent

ii. Larviciding (killing of immature mosquitoes)

1. Not at all 2. Only slightly 3. To a moderate extent 4. To a great extent

iii. Window and door screens

1. Not at all 2. Only slightly 3. To a moderate extent 4. To a great extent

iv. Mosquito repellants

1. Not at all 2. Only slightly 3. To a moderate extent 4. To a great extent

v. Environmental management

1. Not at all 2. Only slightly 3. To a moderate extent 4. To a great extent

vi. IRS

1. Not at all 2. Only slightly 3. To a moderate extent 4. To a great extent

28. How effective do you feel the following malaria control methods are in controlling and preventing malaria?

i. ITNs

1. Very poor 2.Poor 3. Average 4. Good 5. Very Good

ii. Larviciding (killing of immature mosquitoes)

1. Very poor 2.Poor 3. Average 4. Good 5. Very Good

iii. Window and door screens

1. Very poor 2.Poor 3. Average 4. Good 5. Very Good

iv. Mosquito repellants

1. Very poor 2.Poor 3. Average 4. Good 5. Very Good

v. Environmental management

1. Very poor 2.Poor 3. Average 4. Good 5. Very Good

vi. IRS

1. Very poor 2.Poor 3. Average 4. Good 5. Very Good

SECTION D: Utilization of malaria control and prevention methods

29. Which of the following malaria control methods do you use?

i. ITNs

1. Yes 2. No

ii. Larviciding (killing of immature mosquitoes)

1. Yes 2. No

iii. Window and door screens

1. Yes 2. No

iv. Mosquito repellants

1. Yes 2. No

v. Environmental management

1. Yes 2. No

vi. IRS

1. Yes 2. No

30. If no, what are the reasons?

i. ITNs

1. Expensive 2. Not available 3. Not comfortable to use 4. Cannot control malaria

5. Allegy 6. Never heard of this method 7. Tidious

ii. Larviciding (killing of immature mosquitoes)

1. Expensive 2. Not available 3. Not comfortable to use 4. Cannot control malaria

5. Allegy 6. Never heard of this method 7. Tidious

iii. Window and door screens

1. Expensive 2. Not available 3. Not comfortable to use 4. Cannot control malaria

5. Allegy 6. Never heard of this method 7. Tidious

vi. Mosquito repellants

1. Expensive 2. Not available 3. Not comfortable to use 4. Cannot control malaria

5. Allegy 6. Never heard of this method 7. Tidious

v. Environmental management

1. Expensive 2. Not available 3. Not comfortable to use 4. Cannot control malaria

5. Allegy 6. Never heard of this method 7. Tidious

vi. IRS

1. Expensive 2. Not available 3. Not comfortable to use 4. Cannot control malaria

5. Allegy 6. Never heard of this method 7. Tidious

31. How often do you use the following malaria control methods?

i. ITNs

1. Daily 2. Occassionally 3. Never

ii. Larviciding (killing of immature mosquitoes)

1. Daily 2. Occassionally 3. Never

iii. Window and door screens

1. Daily 2. Occassionally 3. Never

vi. Mosquito repellants

1. Daily 2. Occassionally 3. Never

v. EM

1. Daily 2. Occassionally 3. Never

vi. IRS

1. Daily 2. Occassionally 3. Never

SECTION E: Malaria control practices

32. Do you wear long-sleeves clothes at night or when going to the rice fields?

1. Always 2. Sometimes 3. Never

33. Do you go to the health centre when you think you have malaria?

1. Always 2. Sometimes 3. Never

34. Do all the people in your household sleep under mosquito net?

1. Always 2. Sometimes 3. Never

35. Do you keep the windows of your house closed between 5.00pm to 9.30pm and in the early morning?

1. Always 2. Sometimes 3. Never

36. Do you check if your mosquito net has holes?

1. Always 2. Sometimes 3. Never

37. Do you immediately repair the mosquito net when you find that it has holes?

1. Always 2. Sometimes 3. Never

38. What is the condition and how do you use your Insecticide Treated Nets?

1. It has holes 2. It is not treated 3. I don't use it everyday 4. I wash it regularly 5. I don't use it at all

39. At any time in the past 12 months, has anyone come into your dwelling to spray the inside walls against mosquito to control malaria?

1. Yes 2. No

40. How many times was your house sprayed with an IRS in the last 12 months?

1. Once 2. Two times 3. More than two times 4. It was not sprayed at all

41. Who sprayed the house?

1. Government worker/program 2. Private company 3. Household member

4. Others (Please specify)_____

42. How many times do you apply mosquito repellant?

1. Daily 2. Occassionally 3. I don't apply at all

4. Other (Please specify)_____

43. What would you say about the condition and how you use window and door screens

1. They have holes 2. Not treated 3. I don't use it at all

4. in good condition 5. Other (Please specify)_____

44. Do you drain excess water/ clear unwanted vegetation in your farm or home?

1. Yes 2. No

Appendix II: Questionnaire (Dholuo Version)

SECTION A: Weche jachiwore owuon

1. wod_____

2. Chwech

1. Chwech madichwo 2.Chwech mamiyo

3. Hiki/chieng' nyuol_____

1. 18 – 25 2. 26 – 33 3. 34 – 41 4. 42 – 49

5. 50 – 57 6. 58 – 65 7. 65 na gu kalo

4.Chal mar keny

1.Mingli 2. Osekenda/asekendo 3. Osekenda/asekendo to ne wawere

4.Wadak mak mana ni pok wakendore e yor chik 5. Mamoko **(**Ler) _____

5.Geno kata Kit lemo

1.Jakristo 2. Muislam 3. Jahindu 4. Mamoko (Ler) _____

6. Okang' mar somo

1. Ok asomo 2. Achopo e primari 3. Achopo e sekondari
4. Achopo e mbalariany

7. Yutomari edwe rom nade?

1. 500 - 4499 2. 4500 - 8499 3. 8500 - 12499

4. 12500 - 16499 5. 16500 - 20499 6. 20500 - 24499

7. 24500 – 28499 8. 28500 – 32499 9. 32500 na gu kalo

8. En tich mane migeno makelo ni yuto?(Dwoko mopogore opogore nyalore)

1. Pur 2. Ohala 3. Tij andika 4. Mamoko (tem lero) _____

9. Kowuok kama idakie nyaka kar thieth mar sirkal machiegni kodi dibed ma bor marom nade**?**

1. Tin ma 1 km 2.1 – 5 km 3.6 – 10 km 4. 11 – 15 km

10. En yoo mane ma itiyogo eyor wuoth mondo mi ichop kar thieth?

1. Awuotho gi tienda 2. Aidho bas/matatu 3. Mtoka mara 4. Mamoko(Ler)_____

11. Chal mar gik moger go odi.

1. Od Loo/chuodho kod lum 2.Briks/matafari 3. Yien/bao 4.Kidi 5.Mabati

12. Pii ma itiyo go igilo kanye?

1. Yawo ma thany thany/ma ok tut 2. Kisima/Pii ma okuny matut 3.Pii fereji 4.Aora/pii ma mol

13. Bee idak e od loo/chuodho?

1. Eee 2. Ooyo

14. Bee iyudo pii ka owuok yawo ma thany thany

1. Eee 2.Ooyo

SECTION B: Ngeyoni ewi thiro kod geng'o maleria.

15. Bende tuo mar maleria en chandruok e gweng'u ka?

1. Eee 2. Ooyo

16.En ang'o makelo maleria?

1. Chilo 2. Chiemo 3. Pii 4. Suna 5. Osiepe 6. Mamoko (Ler).....

17.Inyalo ng'eyo nadi ni ng'ato nigi malaria**?** (Duoko moloyo achiel nyalore)

1. Del maoore 2. Wich bar 3. Delmaremo/fuoni maremo 4. Ng'ok 5. Diep 6. Tetni

7. Mamoko(Ler).....

18. Bende maleria inyalo geng'**?**

1. Eee 2. Ooyo

19. En yath mane manyien mar maleria ma ilando gi migawo mar sirkal mar thieth **?**

1. Eee 2. Ooyo

Ka eee mana_____

20. Bende iseneno kata winjo wach modok kor ACT kata AL?

1. Eee 2. Ooyo

Ka ooyo to kal penjo mar 23

21. Ka ee, ne iyudo wachni kanye?

1. Kuom yore mag lendo 2. Joma odak machiegi kodwa 3. Sikul 4. Jonyuol

5. Jorit ngima 6. Mamoko (ler)_____

22. Egweng'u, ere kama ng'ato nyalo yudo "ACT" kata "AL"?

1. Dukni 2. Od yath/duka yath 3. Klinik mag sirkal 4. Klinik mamoko

5. Mamoko(Ler) _____

23. Ere kaka maleria inyalo geng'?

1.Tiyo gi nede mothiedhi 2. Nego kute mag suna 3. Beto kuonde ma oyugno kendo goyo ohula ne pii mochung' 4. Tiyo gi modhi mariembo suna 5. Goyo yath manego suna ei udi

6. Tiyo gi dirisa kod dhot manigi sing'enge matindo

Joduok penjo duoko mana penjo mar yore thiro maleria ma giwacho ni ging'eyo e penjo mar 23

24. Ne iyudo koa kanye weche mag yore thiro malaria e list ma pinyni?

i. Tiyo gi nede mothiedhi

1. Kuom yore lendo 2. Joma odak machiegni kodwa 3. Skul 4. Jonyuol 5. Jorit ngima

6. Mamoko(tem lero)_____

ii. Nego kute mag suna

1. Kuom yore lendo 2. Joma odak machiegni kodwa 3. Skul 4. Jonyuol 5. Jorit ngima

6. Mamoko(tem lero)_____

iii. Beto kuonde ma oyugno kendo goyo ohula ne pii mochung'

1. Kuom yore lendo 2. Joma odak machiegni kodwa 3. Skul 4. Jonyuol 5. Jorit ngima

6. Mamoko(tem lero)_____

iv. Tiyo gi modhi mariembo suna

1. Kuom yore lendo 2. Joma odak machiegni kodwa 3. Skul 4. Jonyuol 5. Jorit ngima

6. Mamoko(tem lero)_____

v. Goyo yath manego suna ei udi

1. Kuom yore lendo 2. Joma odak machiegni kodwa 3. Skul 4. Jonyuol 5. Jorit ngima

6. Mamoko(tem lero)_____

vi. Tiyo gi dirisa kod dhot manigi sing'enge matindo

1. Kuom yore lendo 2. Joma odak machiegni kodwa 3. Skul 4. Jonyuol

5. Jorit ngima6. Mamoko(tem lero)_____

SECTION C: Paro mari kuom thiro kod geng'o maleria

25. En okang' mane ma iparoni yore mag thiro malaria thiro malaria?

i). Nede moth

ii). Nego kute mag suna

iii).Dirisa kod dhoot manigi Sing'enge matindo Modhi mariembo suna

iv). Rito aluora

v).Goyo yedhe manage suna ei udi

26. Iparo nade kuom yoregi ma itiyogo ethiro malaria kaluwore gi ber kuom tiyo kodgi?

i). Nede mothiedhi

1. Tiyo kodgi kelo hinyruok 2. Hinyruok gi tin 3. Onge hinyruok

4. Onge hinyruok kata matin

ii). Nego kute mag suna

1. Tiyo kodgi kelo hinyruok 2. Hinyruok gi tin 3. Onge hinyruok

4. Onge hinyruok kata matin

iii). Dirisa kod dhoot manigi Sing'enge matindo

1. Tiyo kodgi kelo hinyruok 2. Hinyruok gi tin 3. Onge hinyruok

4. Onge hinyruok kata matin

iv). Modhi mariembo suna

1. Tiyo kodgi kelo hinyruok 2. Hinyruok gi tin 3. Onge hinyruok
4. Onge hinyruok kata matin

v). Rito aluora

1. Tiyo kodgi kelo hinyruok 2. Hinyruok gi tin 3. Onge hinyruok
4. Onge hinyruok kata matin

vi. Goyo yedhe manego suna ei udi

1. Tiyo kodgi kelo hinyruok 2. Hinyruok gi tin 3. Onge hinyruok
4. Onge hinyruok kata matin

27. Tiyo gi yore mag thiro maleria yotni marom nadi?

i. Nede mothiedhi

1.Ok yot 2. Yot matin 3. Yot ma ediere 4. Okang' ma malo

ii. Nego kute mag suna

1.Ok yot 2. Yot matin 3. Yot ma ediere 4. Okang' ma malo

iii. Dirisa kod dhoot manigi sing'enge matindo

1.Ok yot 2. Yot matin 3. Yot ma ediere 4. Okang' ma malo

iv. Modhi mariembo suna

1.Ok yot 2. Yot matin 3. Yot ma ediere 4. Okang' ma malo

v.Rito aluora

1.Ok yot 2. Yot matin 3. Yot ma ediere 4. Okang' ma malo

vi. Goyo yedhe manego suna ei udi

1. Ok yot 2. Yot matin 3. Yot ma ediere 4. Okang' ma malo

28. En ranginy mane ma iparo ni yore gi mag thiro maleria, thiro kendo geng'o malaria?

i. Nede mothiedhi

1. Rach ahinya 2.Rach 3. Man ediere 4. Maber 5. Maber ahinya

ii. Nego kute mag suna

1. Rach ahinya 2.Rach 3. Man ediere 4. Maber 5. Maber ahinya

iii.Dirisa kod dhoot manigi sing'enge matindo Modhi mariembo suna

1. Rach ahinya 2.Rach 3. Man ediere 4. Maber 5. Maber ahinya

iv. Rito aluora

1. Rach ahinya 2.Rach 3. Man ediere 4. Maber 5. Maber ahinya

v. Goyo yedhe manego suna ei udi

1. Rach ahinya 2.Rach 3. Man ediere 4. Maber 5. Maber ahinya

SECTION D: Tiyo eyo makare gi yore mag thiro kod geng'o maleria

29. Gin yore mage kuom yore ma ithiro godo maleria ma itiyogo?

i. Nede mothiedhi

1. Eee 2. Ooyo

ii. Nego kute mag suna

1. Eee 2. Ooyo

iii. Dirisa kod dhot manigi sing'enge matindo

1. Eee 2. Ooyo

iv. Modhi mariembo suna

1. Eee 2. Ooyo

v. Rito aluora

1. Eee 2. Ooyo

vi. Goyo yedhe manegosuna ei udi

1. Eee 2. Ooyo

30. Ka ooyo gin ang'o momiyo?

i. Nede mothiedhi

1. Nengo/bechgi tek 2. Ok gi yudre 3. Tiyo kodgi ok yot 4. Ok onyal thiro maleria 5. Ok gi winjre gi ngimana 6. Pok awinjo yorni 7. Tije tek

ii. Nego kute mag suna

1. Nengo/bechgi tek 2. Ok gi yudre 3. Tiyo kodgi ok yot 4. Ok onyal thiro maleria 5. Ok gi winjre gi ngimana 6. Pok awinjo yorni 7. Tije tek

iii. Dirisa kod dhot manigi sing'enge matindo

1. Nengo/bechgi tek 2. Ok gi yudre 3. Tiyo kodgi ok yot 4. Ok onyal thiro maleria 5. Ok gi winjre gi ngimana 6. Pok awinjo yorni 7. Tije tek

iv. Modhi mariembo suna

1. Nengo/bechgi tek 2. Ok gi yudre 3. Tiyo kodgi ok yot 4. Ok onyal thiro maleria 5. Ok gi winjre gi ngimana 6. Pok awinjo yorni 7. Tije tek

v. Rito aluora

1. Nengo/bechgi tek 2. Ok gi yudre 3. Tiyo kodgi ok yot 4. Ok onyal thiro maleria 5. Ok gi winjre gi ngimana 6. Pok awinjo yorni 7. Tije tek

vi. Goyo yedhe manego suna ei udi

1. Nengo/bechgi tek 2. Ok gi yudre 3. Tiyo kodgi ok yot 4. Ok onyal thiro maleria 5. Ok gi winjre gi ngimana 6. Pok awinjo yorni 7. Tije tek

31. Ithoro tiyo gi yoregi mag thiro maleria marom nade?

i. Nede mothiedhi

1.Pile 2. Ka dichiel 3. Pok atiyo kode

ii. Nego kute mag suna

1.Pile 2. Ka dichiel 3. Pok atiyo kode

iii. Dirisa kod dhoot mani gi sing'enge matindo

1.Pile 2. Ka dichiel 3. Pok atiyo kode

iv. Modhi mareimbo suna

1.Pile 2. Ka dichiel 3. Pok atiyo kode

v. Rito aluora

1.Pile 2. Ka dichiel 3. Pok atiyo kode

vi. Goyo yedhe manego suna ei udi

1.Pile 2. Ka dichiel 3. Pok atiyo kode

SECTION E: **Yore ma ithoro tigodo kuom thiro maleria**

32. Bende iruako lewni mabede gi boyo gotieno kata ka idhi kuma opidhie mchele?

1. Seche tee 2. Seche moko 3. Pok arwako

33. Bende idhi kar thieth ka iparo ni in gi malaria?

1. Seche tee 2. Seche moko 3. Pok arwako

34. Bende joodi duto nindo ebwo net mar suna?

1. Nindo seche tee 2. Nindo seche moko 3. Pok gi ninde

35. Bende iloro ga dirisemag odi ekind saa apar gachiel godhiambo nyaka saa adek gi nus gotieno, kod gokinyi mangich?

1. Aloro Seche tee 2. Aloro Seche moko 3. Pok aloro

36. Bende irango ka nedi mar suna nigi buche

1. Arango Seche tee 2. Arango Seche moko 3. Pok arango

37. Bende ikongo nedi mar suna mapiyo kifwenyo ni en gi buche)

1.Akonge Seche tee 2. Akonge Seche moko 3. Pok akonge

38. Ang'oma inyalo wacho kaluwore gi chal kod kaka itiyo gi net mothiedhi gi yadh suna?

1.En gi buche 2. Ok othiedhe 3. Ok ati kode pile pile 4. Athoro luoke

5. Ok ati kode kata matin

39. Saa asaya edweche 12 mokalo, bende ng'ato osebiro kuma idakie mondo ogoye odi gi iye ne suna mondo ogeng' malaria?

1. Eee 2. Ooyo

40. Nyadidi mane odi ogoye gi yath mar suna ma iruwo kuom dweche 12 mokalo?

1.Dichiel 2.Diriyo 3. Moloyo diriyo 4. Ne ok nogoye kata matin)

41. Ng'a mane ogoyo yathe odi?

1. Jatich sirkal/chenro mar sirkal 2.Kambi mar ji ajiya 3.Achiel kuom joot

4.(Mamoko) (Tem lero)_____

42. Nyadidi ma iwire moo mariembo suna?

1.Pile 2.Diriyo odiechieng' 3. Ok awir kata matin

4.Mamoko (Tem lero) _____

43. Inyalo wacho ang'o kaluwore gi chal kod kaka itiyo gi dirisa kod dhoot sing'enge man gi buche matindo mageng'o suna?

1. Gin gi buche 2. Ok othiethgi 3. Ok ati kode kata matin

4. Mamoko (Tem lero)_____

44. Bende igoyo ohula ne pii mogudore mangeny kata beto oboke/alode ma ok idwa e puothi kata dalani?

1.Eee 2. Ooyo

Appendix III: Focus Group Discussion Guide (English Version)

Introduction

Hallo, my name is Kenneth Koome a student at Jomo Kenyatta University of Agriculture and Technology/ ITROMID doing Master of Science in Public Health. I am doing a study on factors influencing use of malaria control methods among the residents of Nyando Sub-County. I am going to ask you a few questions about malaria control so as to collect information on your knowledge on malaria control methods and your opinion on factors that could be affecting the use of these malaria control methods. Please answer the questions freely and honestly as you can remember. There are no wrong answers and feel free to interject. Your information which will be tape recorded will be kept private and confidential and this form will not have your name anywhere. If you have any questions or do not understand what I am asking you at any time feel free to ask for clarification. Please remember that you do not have to answer any question that you do not want to answer and you may discontinue the discussion at any time. Do you have any questions before we begin?

1) What is malaria? *Probe on the cause of malaria, how it is transmitted, people who are more vulnerable to the disease and severity of malaria in your community,*

2) How can malaria be prevented? *Probe for use of ITNs, larviciding, environmental management, indoor residual spraying, window and door screens, mosquito repellents and antimalarials.*

3) Which malaria control methods can be used for malaria control? *Probe on why they use the methods that they mention, why they don't use the other malaria control methods and frequency of use.*

4) What factors prevents people of Ahero, Awasi and East kano from using all or some of the malaria control methods? *Probe for cost, availability, cultural factors, knowledge and technical expertise in using the malaria control methods. Probe for any other reasons and not necessarily the factors mentioned above.*

5) What are perceptions of the people of this area towards the malaria control methods listed below? *Probe for effectiveness and reliability; ITNs, larviciding, environmental management, indoor residual spraying, screening, mosquito repellents and use of antimalarials.*

6) How are the malaria control methods mentioned above used? *Check whether they know how to use them correctly.*

7) Would people in this area be interested in using the malaria control methods mentioned in question 5? Why would they be interested in using the malaria control methods that you have mentioned? What is the reason for not being interested in using the other malaria control methods?

8) In this community, which malaria control method(s) is mostly used by the residents of this area? What is the reason for using or not using them, are there any people in this community who have any problem with any or some of the malaria control methods? If yes what is the reason(s) behind it?

9) What can be done to make the people of this area use all the malaria control methods mentioned in question 5?

10) What can be done to reduce the burden of malaria in this community?

THANK YOU VERY MUCH FOR YOUR COOPERATION

Appendix IV: Focus Group Discussion Guide (Dholuo Version). Oboke mar tayo twak mar grup

Amosou! Nyinga en Kenneth Koome, japuonjre e mbalariany mar Jomo Kenyatta University of Agriculture and Technology/ITROMID. Atimo digri mar masters e yore mag ngima oganda.Atimo nonro ewii gik manyalo miyo tii kata kik tii gi yore mag thiro maleria e kind jodak ma Nyando Sub-kaunti.

Adhi penjou penjo matin ewii thiro maleria mondo mi ayud weche matut ewii weche ma ung'eyo kuom yore mag thiro maleria kod paro ma un gokuom gik manyalo miyo ok tii gi yore mag thiro malaria gi. Akwayou ni u bed thuolo e dwoko penjogi adiera ma ung'eyo.Onge duoko marach, kendo un thuolo mondo mi upenj penjo ka twak dhi mbele. Weche ma ubiro chiwo ibiro maki gi ramak mar dwol kendo ibiro kan gi kama kende kendo maling'ling', kendo oboke ni ok bi tudi gi nyinge u eyo moro amora.Ka in gi penjo kata ok iwinj tiend penjo ma apenjo in thuolo mondo ikwa mondo aler nigo. Un thuolo mar weyo ma ok udwoko penjo moro amora ma ok un go thuolo, kendo un thuolo mar weyo bedo e nonro e saa asaya.

Kapok wachako, inyalo bedo gi penjo moro amora?

1) Ang'o ma ungeyo kendo uparo ewi malaria? *Nyis gi gilerni matut ewi gigo makelo maleria, kaka igamo maleria, jogo ma ohinyo gamo maleria ahinya to kod okang' ma maleria nitiere e gweng'u.*
2) Ere kaka maleria inyalo geng' kendo thiro? *Nyisgi gilerni matut ewi tiyo gi nede mothiedhi, nego kute manyuolo suna, rito aluora, goo yath manego suna ei udi, tiyo gi dirise gi dhoudi sing'enge man gi buche matindo tindo mageng'o suna, yedhe mariembo suna to kod yedhe mathiedho maleria.*
3) Gin yore mage mag thiro maleria ma inyalo tiyogo ethiro maleria? *Nyisgi gilerni matut e wi gima omiyo gitiyo gi yore ma giwachogo, gima omiyo ok gi tii gi yore ma moko mag thiro malaria; kendo kaka gi thoro tiyo kodgi.*

4) Gin ang'o gini ma sindo joma odak e gweng' ka tiyo gi yore tee kata tiyo gi moko kuom yore mag thiro maleria? *Nyisgi gilerni matut ewi nengo, yudruokgi, kido kod timbe mag joma odak egweng'no, ng'eyo mar gi kod tiegruok e yore mag tiyo gi yore mag thiro maleria. Penj e wi yore mamoko ma opogore gi yore ma owachi e penjo motelo.*

5) Jogweng'ni wacho ang'o ewi yore gi mag thiro maleria?*Non kaka yore go tiyo gi yot mantie e yudo gi.*

Tiyo gi nede mothiedhi, nego kute manyuolo suna, rito aluora, kwoyo yath manego suna ei udi, tiyo gi dirise gi dhoudi sing'enge man gi buche matindo tindo mageng'o suna, yedhe mariembo suna to kod yedhe mathiedho maleria.

6) Ere kaka yore mag thiro maleria ma owach malo kae itiyogo? *Non ka be gi ng'eyo tiyo kodgi eyo makare.*

7) Be jogweng'ni nyalo dwaro tiyo gi yore mag thiro maleria ma owachi e penjo namba 5?*Ang'o ma omiyo gi nyalo dwaro tiyo gi yore mag thiro maleria ma iwacho go? En ang'o momiyo ok gi nyal dwaro mondo gi tii gi yore mamoko mag thiro maleria?*

8) Ei gweng' ka, gin yore mage mag thiro maleria ma ithoro tii go gi jodak ma ka?*En ang'o momiyo gi tiyo kodgi kata ok gi tii kodgi, bende nitiere jomoko e gweng' ka man gi chandruok gi yoo moro amora mar thiro maleria kata kuom yore moko mag thiro maleria? Ka ee, en ang'o ma omiyo?*

9) Ang'o ma inyalo tim mondo omi jogweng'ka oti gi yore tee mag thiro maleria ma owachi e penjo man malo enamba 5?

10) Ang'o ma inyalo tim mondo odwok chien ting' mar tuo mar malaria e gweng' ka?

EROKAMANO MADUONG' KUOM MIYA THUOLO MARI

Appendix V: Informed Consent (English Version)

Title of the study: Factors influencing use of malaria control methods among the residents of Nyando Sub-County.

Introduction

This is a study on factors influencing use of malaria control methods among the residents of Nyando Sub-County, Kisumu County. The study is being done by a student of Jomo Kenyatta University of Agriculture and Technology (JKUAT)/ Kenya Medical Research Institute (KEMRI). Correct use of malaria control methods singly or in integrated manner is key to the control and prevention of malaria. People who do not use malaria control methods or those who do not use the control methods in the right way are more likely to suffer from the disease. The purpose of this consent form is to give you (the participant) information that might help you decide whether to participate in the study or not.

The research will take about one month. You are allowed to ask questions related to the study and implications on your part.

Purpose of study

The aim of the study is to understand factors influencing use of malaria control methods in Nyando Sub-County. Your contribution will enable us to know whether this malaria control methods are being used, if they are being used correctly and how they are perceived by the people in Nyando Sub-County.

Procedures to be followed

The researcher, research assistant and a community health worker will go to the selected household in each location. As a community member you will be asked to give information about your age, knowledge, use, practices and perceptions towards the various methods for malaria control. All the information you give will be written down and kept confidential. This process will run for about forty minutes.

Risks

Valuable time will be spent while participating in the study. You will not be expected to give your names to the person collecting data from you. For the study participants who will participate in quantitative research there will be no compensation but this will be provided for in the FGD in form of travel reimbursement and refreshments during the discussion.

Benefits

There will be no direct benefit to you at the moment. However, by taking part in the study, you will provide important information that will inform policy makers why the prevalence of malaria is still high in Nyando Sub-County and come up with ways of controlling the disease.

Assurance of confidentiality

Everything you tell the interviewer will be kept private. Your name will not be on any questionnaire document as you will not be required to give your name. You will be given a unique number instead. Only those people involved in the study will be allowed to handle the information you give us.

Storage of data

The data will be stored in secure cabinets and computer password/s will only be accessible to the investigators. The data will be stored for a period of five years after completion of the study before it is destroyed.

Right to refuse or withdraw

Participation in the study is voluntary. You can refuse to answer any question/s and stop the interview anytime you feel like doing so. You may change your mind later and stop

participating even if you agreed earlier. You do not have to answer any question or take part in the study if you don't wish to do so.

I acknowledge that this consent form has been fully explained to me in a language that I understand and had the opportunity to ask questions which have been answered to my satisfaction. I agree voluntarily to participate in this study and understand that I have the right to withdraw at any time without penalty.

Participant's name_____

Participant's signature or thumb
print_____Date:_____

Name of the witness:_____Date:_____

Signature of the witness:_____ Date: _____

Investigator's signature: _____ Date: _____

Contact: In case of any queries or concerns, please feel free to contact The secretary, KEMRI/National Ethical Review Committee, P.O Box 58840 – 0020,Nairobi; Telephone 020 – 2722541; Email seru@kemri.com or Mr. Kenneth Koome Mbijiwe, Telephone 0722 272150.

Appendix VI: Informed Consent (Dholuo Version).Oboke Mar Yie Donjo Enonro

Thoro mar nonro: Gik manyalo miyo tii gi yore mathiro malaria kuom jodak ma Nyando Sub County.

Weche motelo

Nonro ni en kuom gik manyalo miyo tii kata ok tii gi yore mathiro malaria kuom jodak ma Nyando Sub County ei Kisumu kaunti. Nonro ni itimo gi japuonjre moa Mbalariany mar Jomo Kenyatta Agriculture and technology kod migawo mar timo nonro mar Kemri. Yoo makare mar tiyo gi yore thiro maleria achiel kata mopogre opogore en gima duong' malich e wach mar thiro kendo geng'o maleria. Jogo ma nyalo yudo tuo mar malaria ahinya gin ji ma ok tii gi yore mag thiro malaria kata ma tiyo go to mak mana ni ok gi tii godo e yo ma kare.Wach maduong' ei oboke ni en ni mondo in kaka jaduok penjo omiyi thuolo mar ng'eyo matut wach mantie ka mondo in iwuon ine ka inyalo duoko penjogi kata ka ok iyie kod duoko penjogi**.**

Nonro ni biro kawo thuolo maromo dwe achiel.Oyieni mondo ipenj penjo moro a mora modok kor ka nonro ni kata ka oluwore gi yore miparo ni onyalo muli godo e yo moro a mora.

Gima duong' momiyo itimo nonroni:

Nonro ni itimo mondo okel winjo matut kuom gigo mamiyo ji tiyo kata ok ti gi yore mithiro godo tuo mar malaria ei Nyando distrikt kae. Gigo ma wabiro yudo kowuok kuomi e nonroni biro konyowa ng'eyo ka bende ji tiyo gi yore mag thiro malaria, ka bende itiyo kodgi e yo makare to kod kaka ji okawogi ei Nyando distrikt.

Okan'g ma ibiro luu e nonroni**.**

Jatim nonro maduong', jotich mabiro konyo jatim nonro maduong' kod jodong gwen'g biro dhi e ute ma oyier e lokeson ka lokeson. Kaka jagwen'g , ibiro kwayi mondo ichiw weche modok korka hiki, okang' mar sombi, yore tiyogo, kaka itimoga kod kaka ineno

yore mopogore opogore mag thiro maleria.Weche duto ma ichiwo ibiro ndik piny kendo wechegi ibiro ketgi maling'ling. Ma biro timore kuom thuolo mar dakika 40.

Hinyruok

Nonro ni ok bi keloni hinyruok moro a mora kendo kata nyingi ok bi dwar mondo i chiw ne ja nonro ma biro penji penjo.

Ber

Onge ber ma achiel ka achiel ne in (ma ibiro yudo e nonro ni). To kata kamano, bedo ni e nonro ni biro chiwo weche mabiro konyo jogo maloso chike e medo ng'eyo gima miyo ji pod yudo tuo mar malaria e rang'iny ma malo ei Nyando district kendo fwenyo yore manyalo thiro tuoni

Mijing'o kuom maling'ling' mar weche michiwo.

Weche ma imiyowa ibiro kan maling'ling' e okang' machik dwaro.Nyingi ok bi bedo e andikewa moro amora nikech ok bi dwari mondo ichiw nyingi. Wabiro miyi namba ma mari ma ibiro tiyogo.Mana jotij nonroni ema oyienegi kawo weche ma imiyowa.

Keno mar weche ma imiyowa

Weche ma imiyowa ibiro kan e sanduku ma olor kod computa manigi ralor mare kendo wechegi inyalo nee mana gi jochung' ne nonro. Bang' ka nonro ni oserumo, wechegi ibiro kan kuom higni abich bang'e to eka ikethogi.

Ratiro mar dagi kata wuok enonro

Chiwruokni enonroni en kuom yieroni.Inyalo dagi mar duoko penjo moro amora kata chungo nonro saa asaya ma iparo mar timo kamano.Inyalo kata loko pachi bang'e kendo chungo chiwruokni kata obedo ni ne iseyie motelo.Ok ochuno ni nyaka iduok penjo moro amora kata bedo achiel kuom jok ma ochiwore enonro ka ok berni timo kamano.

Oselerna tie oboke mar nonroni gi dhok mawinjo kendo abedo gi thuolo mar penjo penjo kendo ayudo duoko kaka adwaro .Ayie chiwora eherona mondo adonj enonroni kendo an gi ratiro mar wuok saa asaya maonge kum.

Nying jachiwre _____

Sei mar jachiwre/Ranyisi mar lwedo mathuon_____ Tarik: _____

Nying janeno: _____Tarik:_____

Sei mar janeno:_____Tarik: _____

Sei mar jatim nonro: _____Tarik: _____

Yor tudruok: Ka in gi penjo kata weche machandi, bed thuolo mondo itudori gi jagoro mar KEMRI kata komiti ma ochung'ne ratiro mar jochiwre e sanduk barua **58840 – 0020**,Nairobi; Simo **020 – 2722541,**Email seru@kemri.com**,** kata Mr. Kenneth Koome Mbijiwe, simb ong'we yamo **0722 272150**.

Appendix VII: Focus Group Discussion Informed Consent (English Version)

Title of the study: Factors influencing use of malaria control methods among the residents of Nyando Sub-County.

Introduction

You are being invited to participate in this study on factors influencing use of malaria control methods among the residents of Nyando Sub-County, Kisumu County. The study is being carried out by a student of Jomo Kenyatta University of Agriculture and Technology (JKUAT)/ Kenya Medical Research Institute (KEMRI). Correct use of malaria control methods singly or in integrated manner is key to the control and prevention of malaria. People who do not use malaria control methods or those who do not use the control methods in the right way are more likely to suffer from the disease. The purpose of this consent form is to give you (the participant) information that might help you decide whether to participate in the study or not.

The focus group discussion will take about one and a half hour.

Purpose of study

The aim of the study is to understand factors influencing use of malaria control methods in Nyando Sub-County. Your contribution will enable us to know whether these malaria control methods are being used, if they are being used correctly and how they are perceived by the people in Nyando Sub-County.

Procedures to be followed

There will be a moderator and a person who will be recording the discussion. We will seek your consent to record the discussion. The principal investigator will act as the moderator and the research assistant will record the discussion. As members of this community you will be asked to give information on you knowledge on malaria control

methods and your opinion on factors that could be affecting the use of this malaria control methods. The discussion will be tape recorded and latter transcribed.

Risks

There are no anticipated risks in participating in this study. However your valuable time will be spent while participating in the study.

Compensation

There will be travel reimbursement and in addition snacks and sodas will be provided during the discussion.

Benefits

There will be no direct benefit to you at the moment. However, by taking part in the study, you will provide important information that will inform policy makers why the prevalence of malaria is still high in Nyando Sub-County and come up with ways of controlling the disease.

Assurance of confidentiality

If you choose to participate, you will not be asked your name at the focus group discussion. If by any chance, you or someone you know addresses you by your name in the session, the transcriber will be instructed to delete all names from the transcription. Also all members of the FGD will be asked to sign a confidentiality form showing that they will not divulge any information that was provided by any member of the FGD.

Storage of data

The recorded tapes will be stored in lockable cabinets before and after being transcribed, these cabinets will be accessible only by the researcher.

Right to refuse or withdraw

Participation in the study is voluntary. You can refuse to answer any question/s and stop the interview anytime you feel like doing so. You may change your mind later and stop participating even if you agreed earlier. You do not have to answer any question or take part in the study if you don't wish to do so.

I acknowledge that this consent form has been fully explained to me in a language that I understand and had the opportunity to ask questions which have been answered to my satisfaction. I agree voluntarily to participate in this study and understand that I have the right to withdraw at anytime without penalty.

Participant's name_____

Participant's signature or thumb print_____ Date:_____

Name of the witness:_____Date:_____

Signature of the witness:_____ Date: _____

Investigator's signature: _____ Date: _____

Contact: Incase of any queries or concerns, please feel free to contact The secretary, KEMRI/National Ethical Review Committee, P.O Box 58840 – 0020,Nairobi; Telephone 020 – 2722541; Email seru@kemri.comor Mr. Kenneth Koome Mbijiwe, Telephone 0722 272150.

Appendix VIII: Focus Group Discussion Informed Consent (Dholuo Version). Oboke Mar Chiwo Yie Mar Donjo E Twak Ma Kanyakl (Mar Dholuo)

Thoro mar nonro: Gik manyalo miyo tii kata kik tii gi yore mathiro maleria kuom jodak ma Nyando Sub-Kaunti

Weche motelo

Igweli mondo mi ibedi e nonro e wi gik manyalo miyo tii kata kik tii gi yore mathiro maleria kuom jodak ma Nyando sab-kaunti ei Kisumu kaunti. Nonro ni itimo gi japuonjre moa Mbalariany mar Jomo Kenyatta Agriculture and Technology (JKUAT) kod migawo mar timo nonro mar thieth (KEMRI). Yoo makare mar tiyo gi yore thiro maleria kar kende, kata kanyakla gi yoremoko mopogore opogore, en gima duong' moloyo e wach mar thiro kod geng'o maleria. Jogo ma ok tii gi yore mag thiro maleria kata ma ok tii kodgi e yo ma kare ema hinyo yudo tuo mar maleria ahinya.Wach maduong' ei oboke ni en ni mondo in kaka jaduok penjo, omiyi thuolo mar ng'eyo matut weche mantie mondo omi iyier ka inyalo donjo e nonro kata ka ok inyal donjo**.**

Bedo etwak mar kanyakla biro kawo madirom saa achiel gi nus

Gima omiyo itimo nonroni

Nonro ni itimo mondo okel winjo matut kuom gigo mamiyo itiyo kata ok tii giyore mathiro maleria kuom jodak ma Nyando Sub-Kaunti.Weche ma ichiwo biro konyowa ng'eyo ka yore mag thiro maleria gi itiyogo, ka bende itiyo kodgi e yo makare; kendo gi paro ma jodak ma Nyando Sub-Kaunti ni godo kuom yore gi.

Chenroma ibiro luwo

Twak biro bedo gi jataa twak kod ng'at ma biro mako weche ma itwakie gi ramak mar dwol. Jatend nonro maduong biro bedo kaka jataa twak kendo jakony mare e nonro biro mako weche mag twak gi ramaki mar dwol. Kaka jodak ma gweng'ni, ibiro kwau mondo uchiw weche ma ung'eyo ewi yore mag thiro malaria kaachiel gi chiwo pachwu

kuom **g**ik manyalo miyo tii kata kik tii gi yore mag thiro maleria. Twag ni ibiro maki gi ramak dwol(tape) bang'e to ibiro lok weche mowachi e yo andike.

Hinyruok

Onge hinyruok ma nyalo wuok kuom bedo e nonro ni. Kata kamano, thuolo mari makende ibiro kawo mondo omi ibed e nonro ni.

Duoko erokamano kuom kinde ma ikawo

Ibiro dwokni ting' ma ikawo e yor wuoth kendo ibiro chiw soda kod gigo ma imadhe go seche ma ji twak.

Ber

Onge ber ma achiel ka achiel ne in,to kata kamano, bedo ni e nonro ni biro chiwo weche mabiro konyo jogo maloso chike e medo ng'eyo gima miyo ji pod yudo tuo mar maleria e rang'iny ma malo ei Nyando Sub-Kaunnti kendo fwenyo yore manyalo thiro tuoni.

Mijing'o kuom maling'ling' mar weche michiwo

Ka iyie donjo e nonro to ok bi kwayi mondo iful nyingi seche ma ji lalore e twak. Ka opoore ni in kata ng'at machielo ma ong'eyi olwongo nyingi e chuny twak, to jalo ma biro loko weche twak ma omaki e yo andike biro ng'ado oko nyinge tee. Jok ma biro bedo e twak ibiro kwayo mondo gi ket sei e oboke mar rito maling'ling', ma biro nyiso ni ok gi bi golo oko weche mane owachi gi ng'at ang'ata e seche mag twak.

Kano weche ma imiyowa

Weche ma omakisaa twak ibiro kan e sanduku ma olor manigi ralor mare kapodi kendo bang'e ka osendikgi.Wechegi inyalo nee mana gi jotim nonro.

Ratiro mar tamruok kata weyo nonro

Chiwruokni enonroni en kuom yieroni.Inyalo tamori duoko penjo moro amora kata chungo nonro saa asaya ma iyiero timo kamano.Inyalo kata loko pachi bang'e kendo chungo chiwruokni kata obedo ni ne iseyie motelo.Ok ochuno ni nyaka iduok penjo moro amora kata bedo achiel kuom jok ma ochiwore enonro ka ok idwar timo kamano.

Ayie ni oselerna nonroni matut gi dhok mawinjo kendo asebedo gi thuolo mar penjo penjo, kendo ayudo duoko kaka adwaro.Ayie chiwora eherona mondo adonj enonroni kendo an thuolo mar wuok e saa asaya maonge kum ne an.

Nying jachiwre _____

Sei mar jachiwre kata Ranyisi mar lwedo mathuon_____ Tarik: _____

Nying janeno: _____Tarik:_____

Sei mar janeno:_____Tarik: _____

Sei mar jatim nonro: _____Tarik: _____

Yor tudruok: Ka in gi penjo kata weche machandi, bed thuolo mondo itudri gi jagoro mar KEMRI kata riwruok ma ochung'ne ratiro mar jochiwre e sanduk barua **58840 – 00200**,Nairobi; Simo **020 – 2722541;** Email seru@kemri.com kata Mr. Kenneth Koome Mbijiwe, simb ong'we yamo **0722 272150**.

Appendix IX: Focus Group Discussion Confidentiality Form

RE: CONFIDENTIALITY OF FOCUS GROUP DISCUSSION

Your identity will be known to other focus group participants and the researchers cannot guarantee that others in these groups will respect the confidentiality of the group. We will ask you to sign below to indicate that you will keep all comments made during the focus group discussion confidential and not discuss what happened during the focus group discussion outside the meeting.

- I have reviewed the information in this letter and have had any questions about the study answered to my satisfaction.
- I am agreeing to have the focus group discussion tape recorded.
- I agree to maintain confidentiality of information shared in this focus group discussion.
- I have received a copy of this information letter.
- I agree to participate in the research study.

Participant's name_____

Participant's signature or thumb print_____Date:_____

Name of the witness:_____Date:_____

Signature of the witness:_____ Date: _____

Investigator's signature: _____ Date: _____

Appendix X: Focus Group Discussion Confidentiality Form

(Dholuo Version)
RE: RITO MALING'LING' SECHE MA ITIMO TWAK KANYAKLA

Ibiro ng'eyi gi jo weteni ma in go e twak kendo jatim nonro onge kaka nyalo geng'o mondo joma un go e twak orit malingling mar kanyakla.Wabiro kwayo mondo iket sei ni piny ka mondo onyisi ni ibiro rito weche duto ma owachi e kinde ma watwak kanyakla eyo maling'ling' kendo ok ibi wuoyo ewi weche ma otwagie e oko mopogore gi twak mar kanyakla

- Ase ng'iyo matut weche mantie ei oboke ni kendo penjo moro amora ewi nonro ni ose duoki kaka adwaro.
- Ayie mondo twak ma wadhi bedo go kanyakla omaki gi ramak duol.
- Ayie mondo arit maling'ling' mag weche ma owachi e twak mar kanyakla
- Ase yudo oboke machal kama ma oting'o wechegi
- Ayie mondo adonj e nonro ni

Nying jachiwre _____

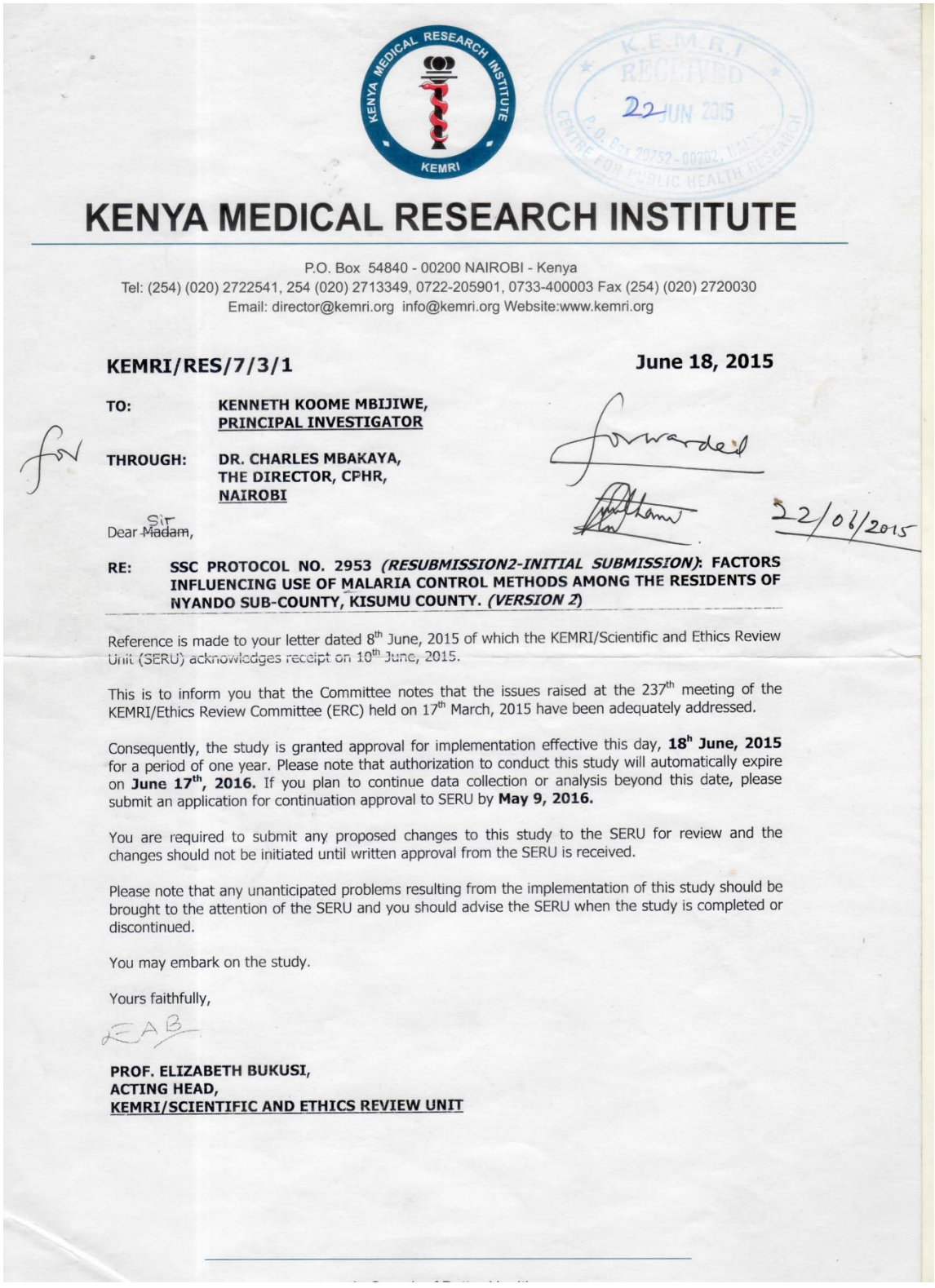
Sei mar jachiwre kata Ranyisi mar lwedo mathuon_____ Tarik: _____

Nying janeno: _____Tarik:_____

Sei mar janeno:_____Tarik: _____

Sei mar jatim nonro: _____Tarik: _____

Appendix XI: KEMRI/ SERU Approval



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Email: director@kemri.org info@kemri.org Website:www.kemri.org

KEMRI/RES/7/3/1 **June 18, 2015**

TO: **KENNETH KOOME MBIJIWE,**
PRINCIPAL INVESTIGATOR

THROUGH: **DR. CHARLES MBAKAYA,**
THE DIRECTOR, CPHR,
NAIROBI

Dear ~~Madam~~ Sir,

RE: **SSC PROTOCOL NO. 2953 *(RESUBMISSION2-INITIAL SUBMISSION)*: FACTORS INFLUENCING USE OF MALARIA CONTROL METHODS AMONG THE RESIDENTS OF NYANDO SUB-COUNTY, KISUMU COUNTY. *(VERSION 2)***

Reference is made to your letter dated 8th June, 2015 of which the KEMRI/Scientific and Ethics Review Unit (SERU) acknowledges receipt on 10th June, 2015.

This is to inform you that the Committee notes that the issues raised at the 237th meeting of the KEMRI/Ethics Review Committee (ERC) held on 17th March, 2015 have been adequately addressed.

Consequently, the study is granted approval for implementation effective this day, **18h June, 2015** for a period of one year. Please note that authorization to conduct this study will automatically expire on **June 17th, 2016.** If you plan to continue data collection or analysis beyond this date, please submit an application for continuation approval to SERU by **May 9, 2016.**

You are required to submit any proposed changes to this study to the SERU for review and the changes should not be initiated until written approval from the SERU is received.

Please note that any unanticipated problems resulting from the implementation of this study should be brought to the attention of the SERU and you should advise the SERU when the study is completed or discontinued.

You may embark on the study.

Yours faithfully,

PROF. ELIZABETH BUKUSI,
ACTING HEAD,
KEMRI/SCIENTIFIC AND ETHICS REVIEW UNIT