PREVALENCE AND ASSOCIATED DETERMINANTS OF MALARIA INFECTION AMONG PREGNANT WOMEN IN MALARIA EPIDEMIC AREAS OF WESTERN HIGHLAND OF KENYA

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A Thesis Submitted to the School of Nursing and Midwifery in Partial Fulfilment of the Requirements for the Award of Degree of Master of Science in Advanced Nursing Practice (Community Health and Primary Care) of Masinde Muliro University of Science and Technology

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DECLARATION

This thesis is my original work prepared with no other than the indicated sources and support and has not been presented elsewhere for a degree or any other award.

Signature..... Date 11/5/2024

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance of Masinde Muliro University of Science and Technology a thesis entitled **"Prevalence and Associated Determinants of Malaria Infection Among pregnant women in Malaria Epidemic Areas of Western Highland of Kenya".**

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DEDICATION

I dedicate this study to my beloved parents Paul Clement Bally Amulavu and the late Mrs. Catherine Mwenesi for supporting me wholly to go to college and I am very grateful indeed.

God bless you all!

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ABSTRACT

Globally malaria in pregnancy continues to cause important public health concern for health care sector. Apparently, the disease remains to be a major determinant of maternal morbidity and mortality. In Kenya malaria infection in pregnancy is 18% while in Mt. Elgon Sub County malaria in pregnancy is unknown. It remains unclear which factors are associated with malaria in pregnancy in the highland epidemic prone areas in Western Kenya. Therefore, this study sought to determine prevalence and associated determinants of malaria infection among pregnant women in malaria epidemic areas of Western highland of Kenya specifically in Mt. Elgon Sub-County. Cross sectional analytical design was adopted and mixed methods used for data collection. For quantitative data collection, structured questionnaire was used to collect primary data from pregnant women who attended ANC in the selected health facilities. Qualitative approach adopted interview guides that targeted key informants in the health facilities. The information from the two methods were triangulated. Simple and systematic random sampling method was used to select health facility and participants. Laboratory tests were carried out by a qualified laboratory technologist using Rapid Diagnostic Test and microscopy for confirmation of *Plasmodium falciparum.* Response rate was 92.2%. The study results revealed that 16.2% of 389 respondents had malaria in pregnancy. Two thirds of women aged less than 25 years (67.3%, n=262) had positive malaria results compared to those aged $\geq$ 25 years (33.7%, n=137). The determinants of malaria in pregnancy with statistically significantly association were: place of residence (OR: 5.7; 95%CI: 2.6 – 12.4; $p < 0.0001$); those who tested positive in the last 2 years (OR: 1.7; 95%CI: 1.0 -2.9; $p=0.05$); preferred shape of ITN's (OR: 3.8; 95%CI: 1.5 – 9.7; $p = 0.008$); earth floor (OR: 1.8; 95%CI: 1.0 – 3.1; $p = 0.03$); mud wall (OR: 1.8; 95%CI: 1.0 – 3.1; $p = 0.03$); methods used to deliver health education (OR: 4.4; 95%CI: 1.6 -12.3; $p = 0.007$). Key informants blamed MiP on current policy that does not encourage the use of IPT in malaria prevention among pregnant women in the study area. In conclusion, age, place of residence, testing positive in the last 2 years, preferred shape of ITN, earth floor, mud wall and health education were identified as the most important determinants that were associated with MiP. Policy regarding non-use of IPT as a preventive measure could have contributed to reported malaria prevalence among such vulnerable group in the study area. The study recommends Bungoma County government to promote use of ITNs and preferable rectangular ITN's by ensuring they are translated to appropriate use, Educate and empower the residents on available income generating activities which could enable them to get funds for building improved housing which have floor made of cement while roof made of iron sheets. Thus play a major role in protection of pregnant women against malaria. The County Government through Department of Health should create awareness by use of print media to compliment the current malaria control measures. WHO and Kenyan Government should review IPTp-SP policy in the study area.

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LIST OF ABBREVIATIONS AND ACRONYMS

AL	**:**	Artemether Lumefantrine
ANC	**:**	Antenatal Clinic
ARCP	**:**	Artemisinin Resistance Containment Program
BCC	**:**	Behavioural Change Communication
CDC	**:**	Centre for Disease Control
FELTP	**:**	Field Epidemiology Lab and Training Program
IPTp	**:**	Intermittent Preventive Treatment Prophylaxis
ITN	**:**	Insecticide Treated Nets
KNBS	**:**	Kenya National Bureau Standard
LLIN	**:**	Long Lasting Insecticide Nets
MIP	**:**	Malaria in Pregnancy
MOH	**:**	Ministry of Health
NACOSTI	**:**	National Commission for Science Technology and Innovation
NMCP	**:**	National Malaria Control Program
PMI	**:**	President Malaria Initiative
RDT	**:**	Rapid Diagnostic Treatment
SP	**:**	Sulfadoxine Pyrimethamine
SPSS	**:**	Software Programme for Social Science
SSA	**:**	Sub Saharan Africa
U.S.A	**:**	United States of America
US	**:**	United State
USAID	**:**	United state Agency International and Development
WHO	**:**	World Health Organization

OPERATIONALIZATION OF TERMS

Associated determinants: These are elements that determine the nature of malaria infection in pregnant women. This study mainly focused on patient related determinants, environmental determinants and institutional related determinants in the area of study.

Highland epidemic areas: These are areas where malaria transmission rates is seasonal with many dynamics year to year. Malaria outbreaks occurs due to conducive conditions such areas include Mt. Elgon Sub-County where the study was conducted.

Intermittent preventive treatment prophylaxis (IPTp): It involves giving pregnant women three tablets of sulfadoxine pyrimethamine (SP) at sixteen weeks then four weeks apart interval during pregnancy.

Malaria prevalence: The number of pregnant women who test positive by use of rapid diagnostic test then confirmed by microscopy following malaria infection. For rapid diagnostic test a thin blood smear is taken while microscopy thick blood smear is used.

Placental malaria: Malaria that is harboured in the placenta for a woman with pregnancy. Once malaria parasite is taken up into the blood system, they are transported into the placenta where they hibernate causing adverse effects to the pregnant women and the growing un-born baby.

Severe anaemia: Complications following malaria parasite infection in pregnancy. The parasite destroys the red blood cells hence reducing haemoglobin levels below 5 mgs/dl.

CHAPTER ONE

INTRODUCTION

1.1 Overview

This part examined the following key areas: Background of the study, problem statement, justification, broad objective, specific objectives, hypothesis, research questions, limitations, conceptual framework and operationalization of definitions of the study.

1.2 Background of the study

Worldwide malaria is considered as an infection associated with poverty and is known to cause important centre of attraction as far as health sector is concern and to date remains a major determinant of maternal morbidity and mortality in the world (Moya, *et al.,* 2015; Ricci, 2016). However, efforts have been put in place under the influence of national political will and international agencies in reducing malaria prevalence in pregnancy by increasing the coverage of SP and insecticide-treated nets (ITN) (Salomoao, *et al.,* 2017).

In 2019, WHO reported over 11 million cases of malaria in pregnancy in Sub Saharan Africa with over 800,000 low birth weight (WHO, 2020). This infection has negatively influenced the wellbeing of the pregnant women and the growing foetus in the uterus. Failure to intervene in time can led to low birth weight, severe anaemia, pregnancy loss, intrauterine growth restriction, foetal hypotrophy, maternal hypoglycaemia, which substantiate the influence of malaria infection on the mother and the baby in relation to number of cases and death (Stephanie *et al.,* 2016).

In Nigeria, the prevalence of malaria in pregnancy in Sokoto is 52.2%. The malaria prevalence is much higher in second trimester with 62.2% as compared to first trimester 5.5% and third trimester 3.3%. The falciparum species is mostly

responsible for the transmission of malaria in pregnancy. (Idowu, *et al.,* 2017). Prevalence of malaria in northern Western Nigeria is 51%, in Calabar south Nigeria 70.1%, in Gombe state 92%, 57% in Abeokota and 67% in Enugu all in Nigeria (Franket, *et al.,* 2016; Yoriyo, *et al.,* 2014; Idowu, *et al.,* 2017).

In Ghana, malaria is the leading cause of hospital morbidity among pregnant women with 24.6%. Total number of bed days 20%, 29.4% of total mortality and total costs of patient user fees in the hospitals (Sicuri, *et al.,* 2018). However due to costs associated with malaria management, many women do not visit health facilities but prefer using herbal medicines in their home and this has really contributed to increased incidence of malaria cases (Sicuri, *et al.,* 2018).

In Zambia, malaria prevalence in local area among pregnant women is high. It's approximated that 4 million people are confirmed cases of malaria with 2389 deaths (WHO, 2015), Therefore malaria continues to be a disease of a great significance in Zambia in spite of current scaling up implementation and recorded decline in malaria challenges among pregnant women and children (Zambia MOH, 2016).

Furthermore, the high malaria prevalence in Zambia is due to human mobility. It is reported that there is importation of malaria from other countries and within Zambia across regions. More so, in Zambia, malaria prevalence in expectant women is associated with seasonal patterns of higher transmission recorded in the month of November and April. The peak incidence of this disease in Zambia it is in Northern, Luapula and Eastern provinces and the lowest is in Lusaka province (Zambia MOH 2016).

In Kenya, malaria prevalence in pregnancy is based on geographical two regions that is lowland areas (coastal and around Lake Victoria basin) and highland areas of Great Rift Valley. It is estimated that 16% of all outpatient consultations results from malaria. In addition, the state of malaria spread is largely associated with rainfall patterns, altitude and temperature. In Mt. Elgon Sub County, malaria prevalence rate is not clear in pregnant women (Wekesa, *et al.,* 2019). Observation made in Kenya is that plasmodium falciparum is rated highly as the most species which claims the lives of pregnant women by causing anaemia particularly in primigravidas women (Yatitch, *et al.,* 2015). Other associated negative outcomes are low birth weight, intrauterine growth restriction, pre-term labour and infant mortality (Bhattacharyya, 2015).

Furthermore, another study was conducted during rainy season, but malaria prevalence was centre of concern (Wekesa, *et al.,* 2019). However, this could be due to provision of ITNs as a policy by the Kenyan government. The survey noted that there was higher malaria prevalence rate of 66.1% in 2nd trimester as compared to other trimesters. This was due to delays of pregnant women to seek first ANC services in time but later go for ANC services in their 2nd trimester of pregnancy when diagnosis of the infection was carried out (Choonora, *et al.*, 2015).

1.3 Statement of the problem

Globally, malaria is among the top ten leading cause of death in low income and middle-income countries in pregnancy which accounted for 229 million cases and 409,000 death of malaria in pregnancy. This is regardless of World Health Organization (WHO) introducing cost effective malaria preventive strategies to curb the prevalence of malaria (Yaya, *et al.,* 2018).

Kenya as one of the middle-income countries in the world, nonetheless is not left out, progress towards improving malaria preventive services coverage in pregnancy remains a challenge with widespread regional and socio-economic differences in terms of accessibility and utilization of this highly cost-effective service (Atieli, *et al.*, 2015). Additionally, in Kenya malaria prevalence among pregnant women ranges between 9%-18% while in Mt. Elgon Sub County, which is categorised under highland epidemic prone malaria area, prevalence of malaria in pregnancy (MiP) is unknown (DHIS, 2018).

The impact of Plasmodium falciparum particularly in pregnancy is not clear although it is estimated that up to 200,000 infants die annually worldwide as a result of maternal malaria infection during pregnancy. Besides, previous studies have not identified predictors that are related with MiP in the highland epidemic prone areas in Western Kenya (Nthiga, 2018). Therefore, there is an urgent need to understand the prevalence and its determinants that predispose to malaria in pregnancy in the study area.

1.4 Justification of the Study

Globally malaria continues to ravage the lives of expectant women in malaria epidemic areas. Kenya as a third world country, malaria prevalence is high especially in malaria epidemic areas of western highlands in spite of government providing malaria preventive services hence need to conduct this study.

As regards Kenyan government, the study was very vital especially in the malaria epidemic areas of western highlands of Kenya particularly Mt. Elgon Sub County in providing information on the determinants of malaria prevalence since the government declared Western Highland area free from malaria and withdrew provision of IPTp-SP to expectant mothers in spite of there being cases of malaria in

pregnancy. It is anticipated that the study will be of great help to other academicians who could conduct a prospective study to determine cultural factors that may be associated with MiP. The findings from this study will provide useful information for designing strategies for effective malaria preventive measures in expectant mothers

The present study, therefore aimed to investigate the prevalence of malaria in pregnancy and its associated determinants in Mt. Elgon Sub County.

1.5 Broad Objective

To determine prevalence and associated determinants of malaria infection among pregnant women in malaria epidemic areas of western highland of Kenya.

1.6 Specific Objectives

1. To determine patient related determinants of malaria prevalence in pregnancy.
2. To assess environmental determinants of malaria prevalence in pregnancy.
3. To examine institutional related determinants of malaria prevalence in pregnancy.

1.7 Research Questions

1. What are the patient related determinants of malaria prevalence in pregnancy?
2. What are the environmental determinants of malaria prevalence in pregnancy?
3. What are the institutional related determinants of malaria prevalence in pregnancy?

1.8 Limitations of the Study

It was anticipated that the study was subjected to some study design limitations as data was collected at a single point in time though was minimised through triangulation of data sources (Karoki, *et al.,* 2016). Self-reports from respondents on factors contributing to malaria in pregnancy could have drawn biased results. However, by testing of blood drawn from the respondents and validation using microscopy helped in confirming true cases of MiP (Wekesa, *et al.,* 2019).

Additionally, there could have been variations in data collected from secondary sources due to biased reporting from facilities. For example, the documentation in the MOH 405 registers may not have been fully complete because missing data (Karoki, *et al.,* 2016). However, the researcher heavily relied on laboratory test results as a confirmation of MiP rather than reported recorded data in Mt. Elgon Sub-County. Finally, even though collection of data was after the rainy season when malaria cases are expected to be high, the interest on the researcher was not on trends but prevalence and factors contributing to MiP.

1.9 Conceptual Framework

Figure 1.1 is a conceptual framework which tries to depict the anticipated association between independent and dependent factors using the three arrows that points on the three variables. Patient related determinants which were examined in terms of age, parity, education, employment, place of residents, ownership and Nets use were expected to determine malaria prevalence in pregnancy. Furthermore, Environmental determinants were explained in terms of the type of housing conditions, environment around the house and the type of cooking fuel. They were considered to determine significantly malaria prevalence in pregnancy. More also the study was expected to examine institutional related determinants in terms of methods used to deliver health

education and policy on SP use as determinants of malaria prevalence in pregnancy. This conceptual framework was adopted from a survey carried out by Wekesa, *et al.*, (2019).

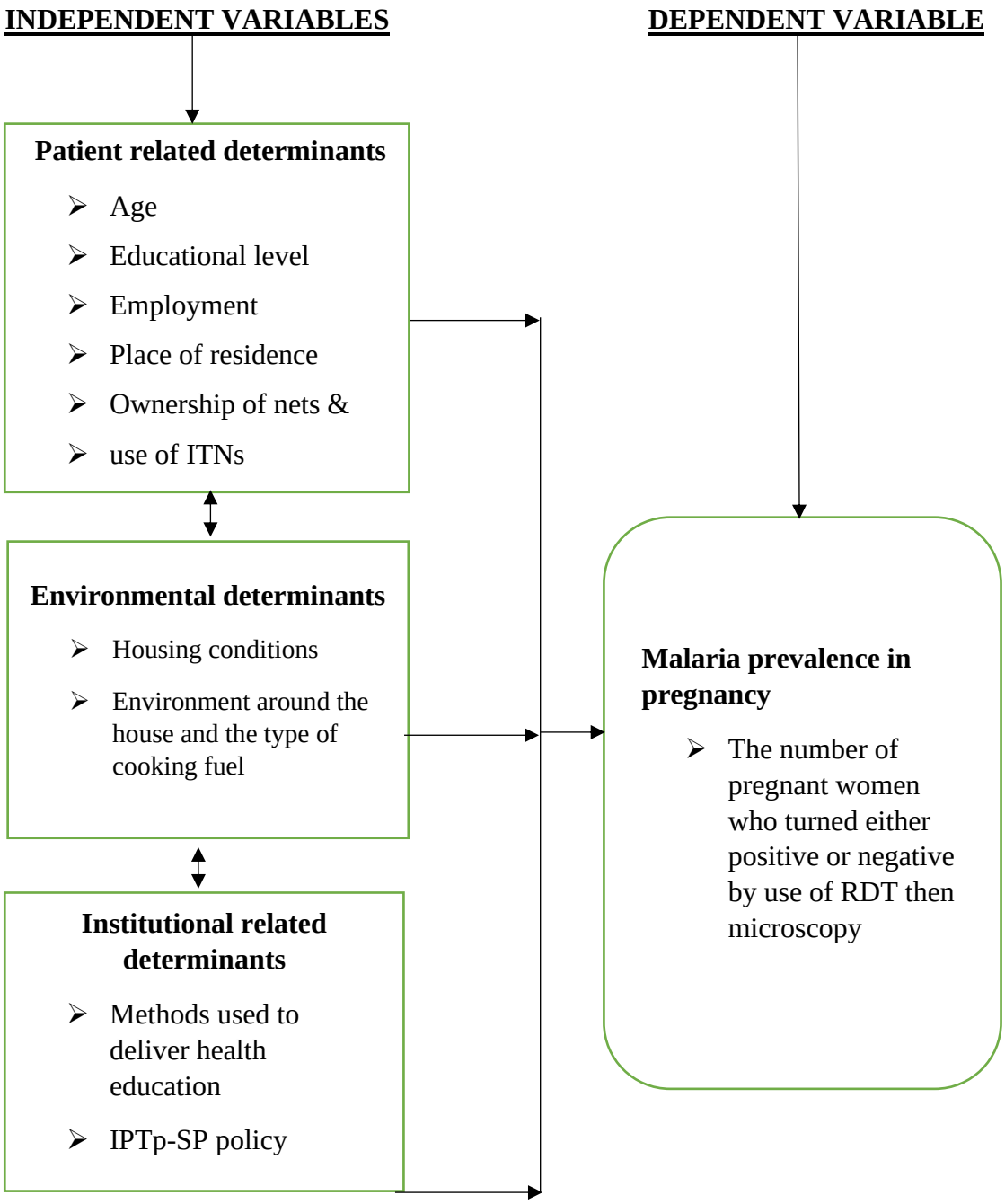

Figure 1.1 Conceptual framework

Author: Adopted from Wekesa, *et al.*, (2019)

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This section addressed prevalence, causes, transmission, presentation, diagnosis, management and prevention of malaria in pregnancy. Furthermore, the study also focused on patient related determinants, environmental determinants and institutional related determinants as determinants of malaria prevalence in pregnancy. Finally, the study also looked at summary of literature review and gaps identified in the literature reviewed.

2.2.1 Prevalence of malaria in pregnancy

Malaria is an infection that is caused by female anopheles' mosquito with the common species being Plasmodium Falciparum. Worldwide current report indicates that there is an upsurge of two hundred and nineteen million infections of malaria in 2017 as compared to two hundred and seventeen million infections of malaria in 2016 with 435 000 death in 2017 (Walker, *et al.*, 2014). In 2019, WHO reported over 11 million cases of malaria in pregnancy in Sub Saharan Africa with over 800,000 low birth weight (WHO, 2020).

In Uganda epidemic highland areas: The epidemiological malaria varies widely, low prevalence in highlands though with intense outbreaks There is unstable to stable dense agricultural areas recorded highest in malaria transmission intensities in the world (Adoke, *et al.,* 2012); Malaria causes death among pregnant women, it accounts for estimated 30%-50% of OPD cases, 35% inpatients cases, 9%-14% hospital mortality. This observation is made in Southern west areas in 15 districts, Eastern highlands of Uganda, in the surrounding of Ruwenzori Mountain (Adoke, *et al.,* 2012).

Malawi epidemic highland areas: Study carried out in Malawi shows that malaria transmission is based on three zones; lakeshore, lowland and highland respectively. Notably 20% of expectant women suffer from malaria yearly in Malawi. Malaria spread keeps on varying according daily weather as from (December-April) when there is collection of stagnant water terraces providing sites for malaria parasites (Dzinjalamala, 2018).

Kenya epidemic highland areas: Study conducted by Larson, *et al.,* (2016); (KDHS, 2018) demonstrated that in Kenya, prevalence of malaria in epidemic areas of western highlands of Kenya is 5%-20%. Furthermore, malaria prevalence varies according to two rainy seasons- long rains that occurs in March-May and short rains from October to December. More also in Kenya, 70% it's people is vulnerable of malaria hence highland epidemics area has been singled out to pin point the varied risks.

The prevalence of malaria in these areas is seasonal and varies year to year. It is approximated that 20% of Kenyan population stays in these areas, Mt. Elgon sub-county being included as the area for this study (Wekesa *et al.,* 2019). More so some two sub counties in Baringo have been categorised as epidemic highland areas. The malaria prevalence in this region oscillates between 5-20% (Imbahale, *et al.,* 2015). Jekins studies in Lake Victoria Nyanza regions demonstrate that prevalence of *Plasmodium falciparum* malaria in pregnancy stands at 28% (Atieli, *et al.,* 2015). Nonetheless regardless of Kenyan government adopting WHO preventive measures, the pathology is still up in western highland of Kenya. In Bungoma County as compared to other studies carried out in Africa, malaria prevalence rate in pregnant women is 32% than 11.6% in Ethiopia, 16.5% in Ghana. This is due to variability in climatic and geo-ecological weather that determines plasmodium species in varied

survey areas (Gatechelo, *et al.,* 2015). Moreover, due to different population characteristics and demographic changes in the study area this could significantly influence malaria prevalence (Wekesa, *et al.,* 2019).

2.2.2 Causes of malaria in pregnancy

Female anopheles' mosquitoes are the major causes of malaria amongst pregnant with prevalence of 50.1%. Plasmodium falciparum cases totals more than 28% of all malaria disease in Kenya among women. (Atieli, *et al.,* 2015; Eugene, *et al.,* (2020). The most malaria vectors in Kenya are from the *anopheles gambiae* complex. The infections spread varies due to variation in climatic factors, specifically in altitude, rainfall and temperature (Walker, *et al.,* 2014).

2.2.3 Transmission of malaria in pregnancy

Malaria transmission rely on biotic and abiotic factors. Mosquito transmission tend to be seasonal with dependence on climatic conditions like rainfall patterns, humidity and temperature (Eisele, *et al.,* 2010). Mosquito transmission increases during and after rainy season, when conditions are conducive for mosquito reproduction. More also malaria transmission is dependent on human immunity, people living in areas of high exposure to malaria can develop partial immunity which reduces the risk of developing severe disease. However, such partial immunity may obscure symptoms of disease hindering control or elimination gains (MPHS, 2015).

The life cycle of the malaria parasite has got two phases: - sporogony and schizogony phase. During sporogony phase (Sexual phase) the malaria parasites takes place in the mosquito; thus, the mosquito is considered the definitive host. When mosquito bites at night between 11 p.m and 2 a.m an infected human, it ingests gametocytes plus blood meal (MPHS, 2015). The male and female gametocytes fuse the gut of mosquito resulting in a zygote later on developing into

ookinetes. The ookinete develops into oocytes then later to sporozoites (Moya, *et al.*, 2015).

The mosquito once they become infected with the ingested blood meal parasites, it bites uninfected humans whereby the sporozoites are transported into the liver a few hours and this is part of second phase of malaria life cycle known as schizogony phase (Jenny, *et al.,* 2014). The sporozoites multiple and later on develop into schizonts which contain merazoites. Being Pre- Erythrocytic phase, the process takes place in the liver. The merazoites are released into the blood stream depending on the plasmodium species involved (Noor, *et al.,* 2015).

The released merazoites enters the red blood cells then develop and multiple in cycles releasing fresh parasites that have the capacity of invading more red blood cells. More so, the erythrocytic phase varies depending on the parasite (Botto, *et al.*, 2016).

2.2.4 Presentation of malaria in pregnancy

Malaria in pregnancy is characterised by fever, headache, rigors, sweating, body aches, nausea, prostration, chills and it can be very difficult to notice as malaria (EIsele, *et al.*, 2010). Moreover, severe malaria can develop into severe anaemia, acidosis and cerebral malaria hence a life-threatening disease. This feature is associated with *P. falciparum* infection with high morbidity, mortality and high economic impact (USAID, 2017). More so, the impact of malaria in pregnancy it causes premature birth, uterine foetus grwoth restriction and infant death (Krause, 2015).

2.2.5 Detection of malaria in pregnancy

To diagnose malaria, is very simple and easy to manage, though it claims more lives than any other infection diseases today in women who are pregnant. Malaria as a disease of greatest interest, to reduce its prevalence globally and in Africa sub Saharan countries the WHO proposes immediate intervention. Furthermore, according to a survey carried out by Von, *et al.*, (2016), it affirms that all cases of suspected malaria in women with pregnancy be ascertained by using parasite-based diagnostic testing. In addition, treatment based on symptoms should be accepted only if parasitological diagnosis is not available USAID (2017).

2.2.6 Management of malaria in expectant women

Management of malaria in pregnancy is basically based on laboratory test. WHO recommends treatment of uncomplicated malaria by use of first line treatment was a 7-day therapy of oral quinine and if not available artemether-lumefantrine (AL) is given. Whereby three doses of the drug is issued to the mother (2 tablets at 0 hours, at 8 hours then switch to 12 hourly for 2 days (MOH 2016).

In case of severe malaria, parenteral Artesunate is given 2.4 mgs/kg stat, at 12 hours and 24 hours then full course treatment of AL (Choonora, *et al.*, 2015). In the absence of artesunate, Artemether or quinine is used to treat malaria. The dosage for artemether is 3.2 mgs/kg stat then reduced to 1.6 mgs/kg with a full course treatment of AL is given. The regimen for quinine is 20 mgs/kg as loading dose to run for four hours in 500mls of 5% dextrose solution to prevent hypoglycaemia, maintenance dosage of 10 mgs/kg 8 hourly for two doses then a full course treatment with AL (Walker, *et al.*, 2014).

2.2.7 Prevention of malaria in pregnancy

The WHO Global malaria program recommends use of the three strategies of control of malaria so as to attain United nation Sustainable Development Goal (UNSDG) number three which is good health and well-being by 2030 (Eisele, *et al.*, 2010). Three-pronged approach include: - Early intervention with anti-malarials, provision of insecticide treated nets (ITNs) specifically long-lasting insecticide treated net (LLITNs), Intermittent preventive treatment prophylaxis-Sulfadoxine pyrimethamine (IPTp-SP) and Indoor residual Spraying (IRS). Provision of ITNs and IPTp-SP are said to be cost effective in reducing maternal mortality, neonatal mortality and low birth weight Furthermore, WHO recommend provision of SP to be directly observed treatment (Odhiambo, *et al.,* 2010).

2.3 Patient related determinants

These determinants include the following; age, level of education, employment, place of residence, ownership and ITN's use of the study participants.

2.3.1 Age

Malaria is a life-threatening disease that is transmitted from one individual to another by a bite of female anopheles' mosquito. The disease is responsible for 1 out 4 women deaths in Africa because women have lowered immunity (Hill, *et al.,* 2013). A survey carried out in In Sri Lanka, demonstrates young pregnant women of age especially primigravida contributed significantly to the variations in malaria prevalence (Noor, *et al.,* 2016). In addition, the risks of severity associated with this age big due to low immunity hence increased vulnerability to the disease during pregnancy. More so pregnant women have high chances of developing severe disease than their non-pregnant women and hence encouraged to take IPT (Yaya, *et al.,* 2018).

In Gambia, there is empirical evidence demonstrating risks of malaria is higher in young pregnant women than non-pregnant women and this is due to changes in immunological status, increased progesterone and oestrogen (Ebako, *et al.*, 2015). More also, parity affects the risks of malaria as primigravidae are more susceptible than multigravidae. However, it is less in low transmission areas although in epidemic regions the risk is not affected by parity (Ebako, *et al.*, 2015).

2.3.2 Education

The level of education of pregnant women is a key determinant to up take of malaria preventive services especially ITN's use and IPTp-Sp use. More also several studies have suggested that both compliance to malaria treatment and uptake of malaria control measures is directly related to level of education thus low level contribute significantly to MIP (Petra, *et al.,* 2011). Moreover, in Nigeria peer education has demonstrated to be an effective vehicle to improve knowledge in larger groups of people in relation to malaria preventive services especially in areas where probability for modern education methods such as radio adverts or education is limited. In relation to success of the examples mentioned, peer education campaigns were initiated in order to increase level of knowledge about adverse effects of malaria during pregnancy and up take of malaria control measures in pregnant women (Petra, *et al.,* 2011).

In Kenya, particularly in Bungoma County study shows that majority of women have primary education as compared to secondary education (Wekesa, *et al.,* 2019). Following this observation, knowledge on adverse effects of malaria in pregnancy is low. Nonetheless due to peer education of pregnant women, up take of malaria preventive and control measures is really motivating (Makokha, 2016).

2.3.3 Employment

In Africa, 30 million mothers residing in malaria endemic and epidemic areas conceives yearly. Due to conception and pregnancy, their activity of daily living and income is compromised because of adverse health outcomes associated with malaria infection to the mother and the growing foetus (Odikamnoro, *et al.,* 2014).

A study carried out in Ghana, indicates that many women lived below poverty line in relation to illiteracy. This translated to inability to prevent and control malaria as it was required (Dako & Kofie, 2015). Further, wealthy pregnant women are more likely to have higher levels of education hence have awareness of malaria preventive services and capacity to secure anti-malarial drugs that lower the rate of malaria infection. This observation suggests that in communities where malaria prospers least, it indicates that malaria and poverty are closely related (Dako & Kofie, 2015). In addition, since malaria is associated with poverty and poor housing conditions, however wealthy pregnant women could protect themselves from malaria infection. Pregnant women with higher education are mostly likely to be wealthy hence ability to access healthy facility and buy malaria drugs (Kyu 2016).

In Nigeria most of the expectant mothers are civil servants and artisans working in public institution. More so, some pregnant women were housewives, professionals, traders and students. However according to this study, the investigator noted that many pregnant women who were professionals had higher malaria prevalence together with traders. This was due to many hours they spend away from home till late hours looking for basic needs for their family where they were bitten up by mosquitoes (Efunshile, *et al.,* 2011).

In Kenya, four Sub-Counties namely Bondo, Gucha, Kwale and Makueni indicate that most pregnant women with high malaria prevalence are housewives and those involved in farming, fishing. The investigator suggested that this could be associated with more hours spend in their farming fields where mosquitoes hide in plantation and hence exposed to bites by plasmodium falciparum (Chuma, *et al.,* 2010).

2.3.4 Place of residence

In Brazil, despite Manaus considered a low risk to malaria transmission, but still malaria in pregnancy is responsible for a significant economic burden particularly both to the patient and health provider point of view who stayed in rural and were very far away from the healthy facilities. Costs increases remarkable when patient admission is needed prior to previous infection and especially for expectant women who stayed in local area as compared to towns. Most investigations have focused on either on value approximate of production time lost in relation to malaria among miners or the costs and costs effectiveness of specific preventive malaria strategies. Nonetheless, malaria prevention measures are free to patients indicating great burden on the public money of health care. However even though the patient doesn't shoulder the medical costs but other costs are more likely to have relevant effect on household budget like transportation and indirect costs like food, phone calls (Botto, *et al.,* 2016).

In Colombia, Sicuri, *et al.,* (2018) study postulated that although the Ministry of health system pregnant women gets free treatment of malaria, albeit, pregnant women who lives in rural areas still shoulder other burden costs related to malaria infection. In Ghana, malaria sucks a large portion of economic costs that is related to treatment of malaria. It puts pressure on the productivity and wealth of households.

In addition, malaria causes loss of health life days as it contributes to 50% of all hospital attendances (Usman, *et al.*, 2016).

Moreover, in Ghana due to poverty that has stricken pregnant women in relation to lack of employment, it enables this woman not to visit health facilities simple because they live in rural areas. However, many women have resorted to traditional herbal medicines because the costs associated with anti-malarial is very expensive as compared to herbal medicines (Usman, *et al.*, 2016). In relation to this study, other studies have demonstrated that place of residence is associated with malaria in pregnancy (Kyu 2013). However, there is tremendous reduced malaria via intensified measures sine mid 2000's onwards, these dynamics in environment might put population in the highlands of east Africa to an increased risk of malaria in pregnancy and its outbreaks particularly if the current interventions are not maintained (Yousif and Eliningaya 2016). Further, even in malaria low transmission areas, repeated malaria positive smears after initial intervention is observed. Albeit this survey did not contradict the aetiology of this occurrence (Lawpoolsri, *et al.*, 2019).

In Nigeria some studies have shown that those individuals who lived in rural areas were more at risk of having malaria due to poverty (Okoronkwo, 2015). It has noted that malaria causes adverse consequences on socio-economic of the national economy, individual and community at large.

In Tanzania, 30% of the National disease burden is due to malaria the place of residence especially in rural as compared to urban had economic burden to malaria infection and it was associated with indirect costs of malaria that widely affect pregnant women in relation to productivity. Furthermore, the transmission period of

malaria conforms to the planting season which further lowers agricultural productivity (Sicuri, *et al.,* 2018).

In Kenya, malaria burdens household economy in malaria endemic areas. In addition, there is evidence that economic challenge is noted among poorest populations who stay in rural areas and the costs burden varies between wet and dry season. However, despite of scanty data, there is recognition of geographical and epidemiological differences in the approximation of the social and economic burden of malaria (Chuma, *et al.*, 2010).

2.3.5 Ownership and ITN's use

The mainstay in intervention of malaria is through vector control WHO (2017). The three methods of vector control are ITN's, antimalarial drugs and spraying in the houses with insecticides. The WHO has recommended Long-Lasting Insecticide Nets (LLINs) and ITNs as the preventive measures against MiP. As a cost-effective strategy it has been made successful by providing free of charge LLINs alongside effective behaviour change communication (BCC) approach to ensure all expectant mothers and children under five years sleep under treated nets every night and the net is well sustained (Hill, *et al.*, 2014; Noor, *et al.,* 2016).

Moreover, in Myanmar, they used Insecticide Treated Nets (ITNs) and long-lasting insecticide treated nets (LLINs) approaches in control of malaria in pregnancy. Bed nets that were rectangular in shape they were accepted more by pregnant women than any other type of ITN. This was contrary to study done by Baume *et al.,* (2016) where participants who were using conical shaped nets were more likely to have used the nets the previous night compared to rectangular ITNs because they are easier to hang. However, in another study conducted in Zanzibar, the preference of nets was

not associated with the use of the net the former night by mothers and children below five years (Beer, *et al.,* 2015).

The nets assisted in malaria prevalence reduction by inhibiting mosquito vector by trying to interrupt the transmission of malaria (Eisele, *et al.,* 2010). Some studies in Myanmar have also demonstrated that rectangular ITNs decreased cases of malaria by 50% in areas of endemicity (Lengeler, *et al.,* 2017). More so, Myanmar as a country its main goal is to achieve and maintain 100% acquisition and utilization of rectangular nets at household with ongoing monitoring and evaluation through researches by NMCP (New, *et al.,* 2017).

Malaria prevalence in some countries such as Senegal, malaria is the leading contributor of childhood demise with negative birth outcomes to pregnant women following birth (USAID, 2017). Additionally, owning and using a rectangular or conical ITNs was highly acceptable than any other ITN and demonstrated reduction in malaria incidence by 50% and death by 55% in pregnant women. (Flaxman, *et al.,* 2010). In 2016 in Senegal, there was country wide distribution campaign that led to 8 million ITNs distribution across the country. Moreover, Senegal national malaria control program in its mandate to achieve elimination of malaria, it has earmarked an extraordinary achievement of 80% of the expectant women utilizing mostly rectangular nets to push Senegal towards attaining its pre-elimination by 2020 (PND, 2013- 2016).

According to an investigation done in Nigeria, it demonstrated utilization of blue and both rectangular and conical ITNs especially LLINs against malaria during pregnancy is the foundation for the realization of the malaria control targets in Nigeria, (Jenny, *et al.,* 2014). It has been observed to be generally below expectation in all the six geo-political regions of the country. Furthermore, lack of preventive

malaria strategies use has led to severe morbidity and mortality impact on pregnancy and children whose age is under five years old (Akaba, *et al.,* 2013).

In Uganda, the government has increased the quantity of nets for each and every family from one net to more than two nets to at least over 80% thus ability to curb the menace of malaria infection. Further, this facilitated the number of pregnant women who rested in a rectangular treated net the other day to be over 80% by 2020 (Adoke, *et al.,* 2012). For the success of the strategy, the government has resorted to free mass distribution of nets in relation to household members via mass campaigns, ANC visits, community base organization and private sector. Due to this approach, there is remarkable ownership of 2-3 ITNs especially in North of Uganda as compared to central Additionally, there is tremendous increase to use of ITNs with over 50% families having treated nets, over 40% with ITNs and 46% at least one LLITNs (UBS, 2017).

However, despite the marked increase in net ownership in Uganda, it seems very unlikely that 2010 targets have been met (Adoke, *et al.,* 2012). Usage of nets is higher in towns than local region in expectant women. More importantly, having a net did not translate to proper utility. The study showed over 10% families did not utilise one net the other night. Further this under use was associated with pregnant women inability to hang the net, harsh weather, ownership of both old and damaged net (Adoke, *et al.,* 2012 and UBS, 2015).

“Mbu Nje Sisi Ndani” was an upgrade approach for communications campaigns launched in August 2009 that addressed lag between net ownership and usage in Kenya (MPHS, 2015). This strategy was facilitated by radios, road shows and wall branding. This targeted endemic and epidemic regions where pregnant women were staying (Noor, *et al.,* 2016). Nonetheless despite the efforts made, currently the

average blue rectangular ITN coverage is one net to five people contrary to universal coverage target of one net to four people (MPHS, 2015).

Furthermore, the Kenyan aim was over 79% expectant women to get a blue rectangular ITNs by 2020. Kenya among countries in Sub Saharan it has adopted the malaria preventive strategies targeting reduction of the infection in pregnancyin order to reduce malaria prevalence especially among pregnant women (Noor, *et al.,* 2016, Choonora, *et al.,* 2015). Good example was noted in western Kenya whereby there was lower rates of placental malaria among women with pregnancy and who received blue rectangular ITNs in an intense malaria transmission especially in western highlands of Kenya specifically Mt. Elgon Sub County. Nonetheless, despite the efforts and benefits of mass distribution of free net according to household number of occupants, Kenya epidemics areas, curbing malaria infection in pregnancy has not been accomplished despite the available resources hence ownership and use of ITN is below 40% (Shakira, *et al.,* 2015).

2.4. Environmental Determinants

The researcher looked at the following key areas such as type of housing and environment around the house and the type of fuel used for cooking.

2.4.1 Housing Conditions

Globally malaria being one of the oldest diseases, is associated with many factors that facilitate its transmission specifically in endemic and epidemic regions (WHO, 2015). In Sub Saharan it is noted that in rural areas, people are very poor whereby they stay in mud walled and roof made of sticks houses thus housing mosquito parasites. Further water that is used at home is not covered with lids but left open providing breeding points for mosquitoes (WHO, 2015).

A study done in Ethiopia demonstrate that malaria transmission is seasonal that is in March and May experiencing long rains then short rains in September and November. Additionally, some studies show that female anopheles' mosquito is associated with poor housing especially houses that are semi-permanent (Noor, *et al.,* 2016). As regards Uganda survey, it showed that human biting rate was greater in homes with mud walls, thatched roofs and open eaves (Njie, *et al.,* 2016).

According to Wekesa *et al.,* (2019) study, it shows that majority of pregnant women who tested positive smear, were from rural areas. They lived in semi-permanent houses build of mud walls, earthen floors and iron-roofed. This clearly indicated poverty hence greatly influence malaria prevalence in rural areas unlike urban areas where pregnant women lived in permanent houses with cemented floor, walls and iron sheets roof. Additionally, a study carried out in Rusinga Island Mbita Sub-County shows that malaria prevalence was associated with bushes around house, vegetation, stagnant water from rivers. More so, agriculture has provided conducive environment for mosquitos breeding sites (Noor, *et al.,* 2016 & WHO, 2015). As much as modern agriculture its benefits to increase food security by reducing malnutrition and poverty nonetheless, it fosters conducive environment for mosquito breeding sites facilitating more spread of malaria infection in pregnancy (Prathiba, *et al.,* 2012).

2.4.2 Environment around the house and type of fuel used for cooking

Improper use of land and erroneous water system management influence significantly to malaria transmission. Agricultural activities that determines the economy of a country in one way or the other determine prevalence of malaria, Dzinjalamala (2018). These activities include applying water on crops in the gardens, fishing, grazing, and poultry keeping among others promoting multiplication of the

parasites. The interaction between pregnant women and mosquitoes occurs in the irrigation schemes where we have crops that provides hiding places for mosquitoes. Thus, enhancing upward trend of MiP.

Additionally, in Malawi the primary source of energy is from biomass. This has led to increased deforestation as a result of upsurge in demand of firewood in relation to increased population (Noor, *et al.,* 2015). Deforestation led to altered landscape thus necessitating flooding which immediately creates terraces on the ground and eventually creation of stagnant water for propagation of the mosquito parasites. This provides nurturing sites for mosquitoes, ballooning the spread of the infection in rainy period (Dzinjalamala, 2018). This study correlates to a study conducted by Nthiga (2018), which shows that agricultural activities and irrigation schemes positively influenced malaria prevalence in Kenya especially in rural areas.

2.5 Institutional Related Determinants

The institutional determinants associated with malaria prevalence involved the following: health education and policy on intermittent preventive prophylaxis (IPTp-SP).

2.5.1 Health education

Globally half of the population is at risk of suffering from this preventable and treatable disease more especially to pregnant women who resides in both epidemic and endemic areas. There is greater disparity as regards patterns of this infection in African countries especially in areas where it's regular amounting to more than 80% of global associated mortality (Noor, *et al.,* 2015).

In African countries malaria challenge is still elusive among the low income and middle level countries. However, the institutional care system have a very crucial responsibility concerning decreasing constantly upward trends of prevalence of malaria among pregnant women and the related cases in Sub Saharan (Ankomah, *et al.,* 2014). Inadequate knowledge and awareness about a particular disease its crucial setback to implementation of health concern and this can be put into reality via mass media (Ankomah, *et al.,* 2014).

In Nigeria, Ministry of health public address is via mass media and have been utilized for creation of awareness especially to expectant mothers on the advantage of frequent use of treated nets. Both electronic media and print have been majorly used in behavioural change communication (BCC) in low income countries in Africa (Ankomah, *et al.,* 2014). More also other means of creation of awareness in the community like health education is via community role plays and religious institutions; paper (poster, billboards, newspaper) and digital (Radio, Television) media have been of driving force behind imparting of health knowledge and have been the area of interest in relation to surveys as public health behaviour agents (Do, *et al.,* 2018; Sultan, *et al.,* 2017). Ideas on seriousness and risks of MIP greatly influenced uptake of interventions: the availability and perceived comfort of sleeping under ITN were imperative determinants of usage. This was compounded by in-adequacy of health staff's message about MIP (Erin, *et al.,* 2015).

In Kenya, health facilities ensure information regarding malaria prevention in pregnancy reaches its citizens through health education by the health providers. Additionally, there is discussion on malaria prevalence in pregnant women on local media-radio and TV's. More so during ANC, there is mobile clinics, outreaches,

where mothers are supplied with hand outs that contain health information concerning malaria control in pregnancy (WHO, 2016).

2.5.2 Policy on Sulfadoxine pyrimethamine (SP) use

According to WHO (2017); Maria, *et al.,* (2016) reports, advocates for expectant mothers staying in minimal to greater transference regions to be given and use IPTp-Sp at each time they visit ANC unlike those who live in epidemic areas. In Myanmar despite resistance to Artemisinin the country has resorted to Artemisinin resistance containment program (ARCP) to prevent resistance, reducing conveyance, cases and death related to this infection to those sites threatened by AL compliance. Although with the introduction of three dose IPTp-Sp in endemic areas as a preventive approach of malaria in pregnancy, there is drastic reduction of the total number of malaria cases in pregnancy however this is dependent on how many times a mother has had malaria during the current pregnancy (Flaxman, *et al.*, 2010).

In Senegal, it indicates that provision of SP was initially a 2-dose regimen but after WHO recommendations in 2013, the country switched to 3 dose IPTp regimen starting in the second trimester. This shift in regimen facilitated drastic decline in malaria infection in pregnancy. The treatment is spaced at least one month a part interval for maximum pharmacodynamics to take place. In Tanzania, over 90% of the people are vulnerable to malaria infection (WHO, 2017).

Further, Plasmodium claims up to 125,000 deaths and contributes to more than two fifths of expectant mother death in Tanzania (Mpogoro, *et al.,* 2014). Additionally, according to some studies done in Tanzania, demonstrates that the policy on SP covers endemic areas and the coverage of SP 1 and 2 provision is at least 60% and 32% which is much below the WHO recommended 80% up take (Tanzania HIV/AIDS MIS, 2012).

Uganda adopted the policy of IPTp-SP use during 2nd and 3rd trimester for pregnant women in ANC, (Adoke, *et al.,* 2012) especially in endemic areas. The SPs are provided by directly observed treatment to reduce lack of compliance. However, despite of Uganda recording high ANC visits, at 95%, nonetheless, UDHS (2015) indicates low uptake of SP among expectant mothers with 53% (UBS, 2015). More importantly it was noted that usage of SP was more in urban than rural areas because of more education and wealth quintile. Moreover, despite of WHO recommendation of SP use on every scheduled ANC visit after quickening, some reports indicate that there are inadequate uses of 2 doses of SP to 33%, (Nankabirwa, *et al.,* 2016). Provision of IPTp-SP to pregnant women is more confined to endemic unlike epidemic areas of Uganda where the government has declared to be free from malaria, (Adoke, *et al.,* 2012).

In Kenya the WHO has recommended that malaria epidemic highlands areas are free from malaria hence the malaria preventive measures that are provided include ITNs and residual indoor spraying (Noor, *et al.,* 2015). However, IPTp-SP as one of the preventive measures, it is not issued to pregnant women, such areas MT. Elgon Sub-County, Bungoma County though it is used to treat malaria infection in pregnancy once a mother has been diagnosed with malaria infection. Nonetheless, in endemic areas there is provision of SP to pregnant women with at least 3 dose regimens. The coverage of SP 1 is high as compared to 2nd, 3rd and 4th. The uptake of SP 1 is high because of influence of community volunteer's ability to look for pregnant women in the villages and referring them accordingly (Makokha, 2016). More so, utilization of SP it is approximated to decrease the occurrence of low birth weight, placental malaria and antenatal parasitaemia (Nthiga, 2018).

2.6 Summary of Literature Review and Research Gaps

The literature concentrated more on the determinants of malaria prevalence during pregnancy basically in malaria epidemic areas of western highlands of Kenya. Some studies carried in Mt. Elgon Sub-County, have looked at other factors such as ITN use and indoor residual spraying that determine malaria prevalence in pregnancy. Previous studies have indicated the burden of malaria to be associated with various socio-economic and demographic among others. Notably, it is not clear which predictors are related with MiP in the highland epidemic prone areas in Western Kenya (Nthiga, 2018). Therefore, this study will form the foundation of information on IPTp-SP use especially in Mt. Elgon Sub-County as a preventive measure during pregnancy as opposed to when it is utilized only as a means of treatment in pregnancy in this study area.

Furthermore, the literature data in other surveys has little information on institutional related issues, hence investigator motivated to find out more information concerning ownership of ITN's, health education and health workers understanding on SP use in pregnancy are in any way associated with malaria prevalence in pregnancy in malaria epidemic areas of western highlands of Kenya specifically Mt. Elgon Sub County.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Overview

The section highlights research methods that were applied by the investigator in determining factors influencing malaria prevalence during pregnancy in malaria epidemic areas of western highlands of Kenya. It was specifically discussing the research design to be used, the study area, the target population, the inclusion and exclusion criteria, sampling procedure and sample size estimation to be used, the research instruments to be employed and the procedure of collecting data, data analysing, data storage and management. In addition, the study addressed the issues of validity and reliability, and ethical consideration.

3.2 Research Design

Research design is a well thought plan for collecting and utilizing data so that desired data can be obtained with enough consistency (Miles and Huberman, 2015). This study employed a cross-sectional analytical design in order to determine the association between independent variables and malaria prevalence during pregnancy in malaria epidemic areas of western highlands of Kenya. This approach was adopted because it gave data on the variables in a specific point in time and go further to make inferences into the relationship that exists thus giving meaning to the investigation. The researcher linked a particular outcome which was either a pregnant woman having infected or not infected with malaria infection with various independent variables. Secondary data on malaria prevalence was gathered from the DHIS (2018) **See Appendix IV.**

3.3 Study Area

The study area was conducted in epidemic area of western highlands of Kenya specifically Mt Elgon Sub County. This sub county is situated within Bungoma County and it is inhabited with Sabaot, Bukusu and Teso's. It neighbours Trans-nzoia County to the north, Cheptais and Kimilili sub counties to the southern, to the east it borders Webuye and Tongaren sub counties, borders Mount Elgon forest and Mount Elgon National game reserve to the western. Most of the residents are involved in farming especially agriculture with the main cash crop being Maize. The staple food in the area is Ugali. Furthermore, it has got one Sub County Hospital, two health centres and two faith-based organization (FBO) health centres namely Sambocho and Kaptama and 4 dispensaries. These health facilities have got working laboratories and well equipped with instruments, reagents for testing samples and qualified laboratory technologists. Additionally, according to KNBS (2018), the estimated total population is 20,454. The total females comprise of 49% (20,454) of the total population. Finally, mothers who are of fertile age include 24.3% of the total population and that is equivalent to 4,970 (KNBS, 2018) **See Appendix VIII.**

3.4 Target Population

The target population for this study was 4,970 women of reproductive age who had come for their ANC visit during the month of May 2019 to August 2019, the known malaria transmission season in Mt Elgon Sub County. Hospital medical superintendent, Sub County malaria control co-ordinator, nursing officer in charges, laboratory in charge, and MCH/FP in charge, in this study area were included as key informants.

3.5 Inclusion and Exclusion Criteria

3.5.1 Inclusion Criteria

- All expectant women who came for their ANC visits and were aged between 15-49 years old.
- All pregnant women who had consented
- Pregnant women who had resided in the study area at the time of the study in order to avoid imported cases of malaria from somewhere else.

3.5.2 Exclusion Criteria

- Pregnant women who are severely ill and who would not be able to be interviewed
- Pregnant women who were mentally ill.
- Pregnant women who were non-residents and visited the area during the survey.

3.6 Sample Size Determination

Following the identified population under the study, determination of the sample size employed the formula at 95% CI:

$n= Z^2 pq/d^2$

Where,

n – Sample size

Z- The standard normal deviate (1.96 for a 95% CI)

d- 0.05 as the level of desired accuracy

P- The proportion of the population with malaria prevalence and since it was not known *p* was set to 0.50 which was the highest variability

q- The proportion of the population that does not have the characteristic (E.g. 1-*p*)

Substituting these figures into above formula

$n = (1.96)^2 x (0.5)(0.5)/(0.05)^2$

$=384$

Since the target population was less than 10,000, the sample size was adjusted using the Finite population correction Facto (FPC) formula

$$nf = \frac{n}{1+\frac{n-1}{N}}$$

Where

nf= the desired sample size after Finite Population Correction Factor was used'

n= the desired sample size (384) from the above calculation, (when the population <10,000)

N= the estimate of the population, include 4970 women of reproductive age

Hence, the desired sample size for pregnant women was

$$nf = \frac{384}{1+\frac{384-1}{4970}}$$

$$= \frac{384}{1+0.08}$$

$$= \frac{384}{1.08}$$

$$=356$$

To cater for any attrition, loading population of 10% was added to 356

$$10/100 x 356 + 356$$

$$n = 392$$

3.7 Sampling Procedure

This study used simple random method to select three healthy facility from the entire nine health facility because they were situated within Mt. Elgon sub County. This was conducted by writing on nine pieces of paper indicating the name of each health

facility. They were then folded, dropped in a cup and the researcher shook it before they were picked up. Three participants were allowed to pick only one piece and unfold it. The three participants ended up picking Mt. Elgon Sub County hospital, Sambocho and Kaptama.

Systematic sampling method was adopted to select study participants in antenatal clinic in Mt. Elgon Sub-county from the chosen health facility. The MOH 405 ANC register were used as a sampling frame to assist in obtaining the pregnant women. The initial respondent was selected randomly from the entire subjects. The N^{th} pregnant woman participated in the study, where N was the sample interval. Sample interval=WRA who comes for ANC/Sample size=4970/392=13 as sample interval.

3.8 Data Collection Tools

This study adopted interviewer-based semi-structured questionnaire which were administered either by self-administered or filled in by a trained research assistant for those pregnant women who were neither unable to read or write. This was after obtaining informed consent. The questionnaire was used to gather both qualitative and quantitative data. The questions formulated by the researcher in the questionnaire were both open and closed ended questions (Wekesa, *et al.,* 2019).

The questionnaires were designed to obtain information on socio-economic and demographic variables, malaria preventive services variables and institutional related variables. More also the ANC cards were reviewed to ascertain information such as gravidity and gestational age of the subjects. Since this study used both qualitative and quantitative data collection approaches, therefore quantitative data was collected mostly from expectant mothers in this study area by use of questionnaire. However qualitative data was obtained from key informant interview who works in these health facilities (Nthiga, 2018).

Laboratory tests were done using Rapid Diagnostic Test (RDT) and Microscopy to determine if pregnant women had malaria or not. These tests were carried out by qualified laboratory technologists who worked in this study area (Makokha, 2016).

3.9 Pre-test

Pretesting involved data collection using questionnaire on a small scale from the nearby Kimilili Sub-County to get feedback on whether or not the instrument worked as expected. In this study, a total of 39 (10% of 392 respondents) pregnant women from Kimilili Sub County summated to the small study. This enabled the researcher to review and refine the study tools before the major study. The pre-test of the instrument was used to correct errors in questions that respondents do not understand.

3.10 Validity of the Instruments

Validity as per this study, was the degree to which results obtained from the data actually represents the phenomena under the investigation. Content validity was determined by pre-test of the questionnaire. This involved collection of data from a small scale in the nearby Sub-County on a few respondents to get feedback on whether or not the instrument was likely to work as expected.

3.11 Reliability of the Instruments

In this study, reliability was assessed for internal consistence by use of test-retest technique. Test-retest reliability is the degree to which scores are consistence over time. Reliability was improved by standardizing the conditions under which measurement takes place. Time taken between the first set of tests and next was short so as to ensure a high reliability co-efficient. Reproducibility of the results was ensured by use of Rapid diagnostic test at first then confirmed by microscopy as a golden standard method. These tests for pregnant women were employed in order to

ensure sensitivity or specificity of the results by giving either true positive or true negative (Aung, *et al.,* 2017).

3.12 Data Collection

Training of Research Assistants

The investigator first identified research assistant and trained for three days before continuing with data collection. The research collectors were given sufficient background knowledge about the nature of the study and how and why some information was being collected in the transcription form. The issue of ethics during data collection was emphasized when handing mother child booklet and samples of the pregnant women. Further, collection of data involved use of Questionnaire and laboratory test for pregnant women. Key informant guide were used to obtain information from the key informant. The researcher reached out to each informant and explained to them about the questionnaire before they could tackle the questions. The researcher allowed them to attempt the questions and later on, the questionnaires were then collected for analysis (Wekesa, *et al.,* 2019).

Questionnaire was adopted to collect information on patient related variables, trends and environmental variables and institutional related variables. This study had a researcher who was responsible for coordinating the study team, three research assistant who assisted in collecting data and interpretation of the questionnaire to pregnant women who were unable to read and write. The existing ANC nurse staff issued mothers with informed consent to sign.

Laboratory test particularly microscopy was carried out by a qualified Laboratory Technologist with a diploma were by it was conducted in the laboratory after referring pregnant women from ANC clinic. Rapid Diagnostic Test (RDT) were

conducted by a qualified nurse in the ANC clinic in order to determine accurately malaria prevalence in pregnant women.

Procedure for blood sample collection

Pregnant women blood samples were collected. Their fingers were wiped using dry small cotton wool ball. A prick was done using a sterile disposable blood lancet. The first drop of blood was wiped off. Thick and thin films were made on the same slide. A drop of blood was put at one end of the glass slide, a circle was created by use of a clean spreader blood. Another drop of blood was put at the centre of the same slide using a clean spreader; blood was spread at an angle of 35-45 degrees to make a thin film covering 75% of the slide. Both thick and thin films were preferred because thick blood film concentrates malaria parasites for easier viewing while thin film facilitate Plasmodium species identification by their morphological features. For microscopy giemsa reagents were used while for RDT a buffer was used. The test results were positive for RDT if there was presence of both control band at the C mark and the test band at the T mark for plasmodium falciparum malaria. Microscopy test if positive then trophozoites were counted against WBC's until 200 WBC's were counted and if negative it was reported no parasites noticed. For those mothers who turned out positive, they were first reassured in order to accept the results and they were either treated as an outpatient if at all the results did not indicate severe malaria. However, for those who had severe malaria they were admitted and put on treatment.

3.13 Data Management

The study questionnaire was having unique numbers attached to the lab results of either RDT or microscopy. The information that would had been attained from the study area was sorted out, checked and cleaned as required. The information

procured from the questionnaire were coded and edited. This involved conducting out screening of the data to check on correctness and precision of the data by the researcher and research assistant before entry. To ensure maximum security of data, the investigator kept data under lock and key.

3.14 Data Analysis

The data obtained from the questionnaire and the laboratory results were entered and analysed using Statistical Programme for Social Science version (SPSS) 25.0, (IBM, California, USA). The study employed both descriptive analysis and inferential analysis. Descriptive analysis used percentages, mean, standard deviation and range on independent variables. Further, the researcher used inferential analysis to demonstrate that patient related determinants, environmental determinants and institutional related determinants statistically significantly determined malaria prevalence during pregnancy in malaria epidemic areas of western highlands of Kenya. Bivariate logistic regression analysis was used to test association between independent variable that included patient related determinants, environmental determinants, institutional related determinants and malaria prevalence as dependent variable and $p \leq 0.05$ was considered statistically significant. Qualitative data from the key informants was categorized and was translated into themes analysed by use of tests analysis that helped to draw conclusions.

3.15 Ethical Consideration

Ethical approval was sought prior to commencement of the study from the Institution Ethics Review Committee (IERC) of MMUST **(See Appendix VI)** and a permit from the National Commission for Science, Technology and innovation (NACOSTI) **(See Appendix VII)**. The researcher then proceeded on to MT Elgon sub-county

medical officer of health where he soughed permission to carry out the research thus he was able to observe the following ethical issues;

3.15.1 Principle of beneficence

The investigator observed the principle of beneficence whereby participants were free from any harm. However, there were minimal physical harm by pricking pregnant women in order to obtain a sample. In addition, participants were free from exploitation whereby subjects were not at a disadvantaged or by exposing them to an anticipated situation. More so the participants were assured that the benefits from the study accrued to the society in general.

3.15.2 Principle of respect of human dignity

Furthermore, the researcher observed the principle for respect of human dignity whereby the participants would have the right to self-determination meaning that they would have the right to decide voluntarily whether to participate in the study without risking any penalty or prejudicial treatment. The prospective participants would have the right to full disclosure whereby the researcher was fully describing nature of the study and the right to refuse to participate. Both formed the platform for informed consent for the participant.

3.15.3 Principle of justice

Finally, the investigator ensured justice was followed up to the latter. There was fair and non-discriminatory selection of participants such that risks and benefits were equitably shared. Additionally, respect of pregnant women culture and other forms of human diversity was respected. Confidentiality and privacy were achieved through anonymity whereby even the researcher was not able to link participants to their data.

CHAPTER FOUR

RESULTS

4.1 Overview

The chapter reports findings and displays a detailed analysis of the data collected from the respondent in line with study objectives. The main aim of the study was to determine prevalence and associated determinants of malaria infection among pregnant women in malaria epidemic areas of western highland of Kenya. The first specific objective of the study sought to determine patient related determinants of malaria prevalence in pregnancy. The second objective sought to assess environmental determinants of malaria prevalence in pregnancy while the third objective was to examine institutional related determinants of malaria prevalence in pregnancy.

4.2 Socio-demographic characteristics of the study participants

Table 4.1 presents data on socio-demographic characteristics of respondents. A total of 389 respondents took part in the study out of 392 who had to take part in the study. This was because the three respondents did not answer the questionnaire completely. Two-thirds (67.3%) of the respondents were between ages of 20-24 years distantly followed by age group of 25-29 years (25.5%). The overall mean age was 24.1 with a standard deviation of ±3.2 and ranged between 20.0 to 38.0 years this implied that average age for majority was 24 years which was either plus 3.2 or minus 3.2. More than half (227; 58.5%) of the respondents were single while (34.5%) were married. As regards level of education, most of the respondents (64.5%) had attained secondary education compared with 32.5% who had tertiary education. Only 2.6% had reached primary education. Results on employment status show that more than two-thirds (68.6%) were engaged in some form of employment as compared to 31.5% who were unemployed. Further analysis revealed that, more

than half (54.8%) of the respondents were Sabaot followed by (43.7%) Bukusu. Nearly 60% (59.9%; 233/389) were residents of Mt. Elgon while 20.3% were from Sambocho and 19.8% were from Kaptama. Regarding where respondents sought ANC services, slightly more than half (51.7%) attended their clinic at Mt. Elgon Sub County Hospital with more than a quarter (28.5%) going to Sambocho Health Centre. Less than one in five (19.8%) attended Kaptama Health Centre.

Table 4.1: Socio-demographic characteristics of the respondents

Variables	Categories	n	%
Age group in years	20 - 24	262	67.3
	25 - 29	99	25.5
	30 - 34	22	5.7
	≥35	6	1.5
Mean age±SD (Range)		24.1±3.2 (20.0 – 38.0)	
Marital status	Single	227	58.5
	Married	134	34.5
	Widowed	22	5.7
	Divorced	5	1.3
Level of education	Primary	10	2.6
	Secondary	251	64.5
	Tertiary	128	32.9
Employment status	Employed	267	68.6
	Unemployed	122	31.4
Tribe	Sabaot	213	54.8
	Bukusu	170	43.7
	Teso	6	1.5
Location	Elgon	233	59.9
	Kaptama	77	19.8
	Sambocho	79	20.3
Name of facility	Mt. Elgon Sub-County Hospital	201	51.7
	Kaptama Health Centre	77	19.8
	Sambocho Health Centre	111	28.5

4.3 Pregnancy history

Table 4.2 shows pregnancy history of the female respondents. More than half (56%) had been pregnant before as compared to 44% who were primigravida. Among those who had previous pregnancy, 60.2% had one child while 31.6% had two children. Regarding the number of household members, those with three members were the leading with 40.1% followed by households with four or more members (32.9%). The gestational age of 52.1% of the respondents was less than four months compared to 42% whose gestational age was between 4 and 7 months.

Table 4.2: Pregnancy history

Variables	Categories	n	%
Has had previous pregnancy	Yes	171	44.0
	No	218	56.0
Number of children	1	103	60.2
	2	54	31.6
	3	14	8.2
Number of household members	1	41	10.5
	2	64	16.4
	3	156	40.1
	≥4	128	32.9
Gestational age in months	<4	203	52.1
	4 – 7	163	42.0
	> 7	23	5.9

4.4 Previous Malaria Infection

Table 4.3 illustrate respondents' previous history of malaria infection. Respondents were first asked whether or not they have ever suffered from malaria in the last two years. It was established that (41.4%) had suffered from malaria in the referenced period as compared to 58.6% who had not. Among those with previous pregnancy, 34.7% had malaria during previous pregnancy while nearly two-thirds (65.3%) had not. Fifty-three percent of the former group sought treatment in hospital while 38.3% got drugs from chemists. A smaller proportion (8.3%) relied on herbal treatment. The

main reason for the choice of treatment source was for blood test (53.3%) and to get correct treatment (45%).

All those who went to hospital had blood test done with the results having been positive. Most of the respondents with malaria during previous pregnancy were put on quinine (38.3%) while more than a third (36.7%) were given SP with less than one in five (18.3%) having been put on AL. A quarter of those with previous malaria infection during pregnancy could not perform their daily living activities with a smaller proportion having had complications (10%) such as stillbirth (33.3%) and preterm labour (33.3%), among others.

Table 4.3: Previous malaria infection

Variables	Categories	n	%
Has had malaria in the last two years	Yes	161	41.4
	No	228	58.6
Ever had malaria during previous pregnancy	Yes	60	34.7
	No	113	65.3
Where sought treatment	Hospital	32	53.3
	Chemist	23	38.3
	Herbal	5	8.3
Reasons for choice of treatment source	Went to hospital for blood test	32	53.3
	Went to hospital for correct treatment	27	45.0
	Herbs are drugs	1	1.7
Had blood tests done	Yes	60	100.0
	No	0	0.0
Result of blood test	Positive	60	100.0
	Negative	0	0.0
Given treatment	Yes	60	100.0
	No	0	0.0
Drugs given	SP	22	36.7
	AL	11	18.3
	Quinine	23	38.3
	Artesunate	4	6.7
I was affected and could not perform my activities of daily living	Yes	15	25.0
	No	45	75.0
Had complications during previous pregnancy	Yes	6	10.0
	No	54	90.0
Type of complication	Stillbirth	2	33.3
	Preterm labour	2	33.3
	Infections	1	16.7
	High blood pressure	1	16.7

4.5 Knowledge on Malaria in Pregnancy

Table 4.4 shows respondents' knowledge on malaria in pregnancy. Asked about what causes malaria in pregnancy, all the respondents were aware and mentioned correctly mosquitoes as the main cause. They were also asked about the presenting signs and symptoms. Most of them mentioned headache (40.9%) followed by fever (17.7%).

Less than 10% mentioned chills (5.4%), nausea (3.9%), diarrhoea (3.6%) shivering (2.8%), vomiting (2.6%) and sweating (0.5%).

Majority (97.4%) perceived malaria either as very serious (7.7%) or serious (89.7%). The leading complication frequently mentioned by respondents was pre-term birth (60.4%) followed by abortion (23.4%) and anaemia (14.4%). They were aware of the peak malaria transmission season falling between March and May (90.2%). Sleeping under ITNs (49.4%), clearing of bushes (24.9%) and use of mosquito repellents (18.5%) were the three leading ways of prevention as mentioned by respondents. Most of them get information on control measures from chief's barazas (30.8%) and ANC (27%).

Table 4.4: Knowledge on malaria in pregnancy

Variables	Categories	n	%
Knows what causes malaria in pregnancy	Yes	389	100.0
	No	0	0.0
Causes malaria in pregnancy	Mosquitoes	389	100.0
	Cold weather	0	0.0
	Eating mangoes	0	0.0
Signs and symptoms of malaria infection	Headache	159	40.9
	Fever	69	17.7
	Sweating	47	12.1
	Fatigue	41	10.5
	Chills	21	5.4
	Nausea	15	3.9
	Diarrhoea	14	3.6
	Shivering	11	2.8
	Vomiting	10	2.6
	Sweats	2	0.5
How serious malaria in pregnancy is	Extremely serious	30	7.7
	Serious	349	89.7
	Neutral	1	0.3
	Somehow	8	2.1
	Not at all serious	1	0.3
Complications associated with malaria in pregnancy	Abortion	91	23.4
	Preterm birth	235	60.4
	Anaemia	56	14.4
	Others	7	1.8
Peak of malaria season in the area	March to May	351	90.2
	June to August	38	9.8
Ways of preventing mosquito bites in pregnancy	Mosquito repellent	72	18.5
	Sleeping under treated mosquito nets	192	49.4
	Clearing of bushes	97	24.9
	Draining stagnant water	28	7.2
Where I get the information regarding control measures of malaria in pregnancy from	Community health workers	84	21.6
	Chiefs meeting	120	30.8
	Antenatal clinic	105	27.0
	Radio	25	6.4
	Television	37	9.5
	Road show	18	4.6

4.6 Ownership and use of ITN's in pregnancy

Table 4.5 illustrates ownership and use of ITN's in pregnancy. As per the findings, all of the respondents own ITN that are still in good condition. All the respondents confirmed having slept under ITN the night before the survey. Three-quarters of the

households have between 1 and 3 ITNs with an average of 3 with a range of 1 to 6 ITNs. The ratio of ITNs per number of household members was 1.1 which is more than the recommended ratio of 1:2. As regards the preferred colour of ITN, more than half (55.8%) mentioned (blue) followed by white (35.2%). The predominant shape that is mostly preferred is rectangular ITNs (86.6%). More than three-quarters (77.6%) were confident hanging the nets with the majority (75.3%) saying that it is extremely important for pregnant women to sleep under a treated net. Thus the study deduced that blue rectangular ITN was the most preferred.

Table 4.5: Ownership and use of ITN's in Pregnancy

Variables	Categories	n	%
Household has mosquito nets	Yes	389	100.0
that can be used while sleeping	No	0	0.0
Number of nets in the	1	89	22.9
household	2	104	26.7
	3	99	25.4
	4	3	0.8
	5	63	16.2
	6	31	8.0
Mean household nets ±SD (Range)		2.9±1.6 (1 – 6)	
Number of household members per ITN*		1.1	
Number of ITNs per household		3	
Slept under ITN last night	Yes	389	100.0
	No	0	0.0
Number that slept in the house last night under ITNs	One	72	18.5
	Two	185	47.6
	Three	111	28.5
	Four	13	3.3
	Cannot tell	8	2.1
Preferred color of net	Blue	217	55.8
	White	137	35.2
	Green	23	5.9
	Colour does not matter	12	3.1
Preferred shape of the net	Conical	32	8.2
	Rectangular	337	86.6
	Shape does not matter	20	5.1
Confident hanging mosquito net in house	Yes	302	77.6
	No	87	22.4
How important it is for pregnant women to sleep under a treated net	Extremely important	293	75.3
	Very important	96	24.7

*Total number of household members = 1206
Total number of ITNs = 1107

4.7 Perception about malaria risk and safety of ITN's

Table 4.6 presents respondents' perception about malaria risk and safety of ITN's. It was noted that all of the respondents agreed that treated nets were safe to sleep under. Further, the findings revealed that, more than three-quarters (87.4%) agreed that most people in their community slept under an insecticide treated net every night while all disagreed that people are at risk of getting malaria only during the rainy season.

Table 4.6: Perception about malaria risk and safety of ITN's

Variables	Categories	n	%
Treated nets are safe to sleep under	Agree	389	100.0
	Disagree	0	0.0
Most people in your community sleep under an insecticide treated net every night	Agree	340	87.4
	Disagree	49	12.6
People are at risk of getting malaria only during the rainy season.	Agree	0	0.0
	Disagree	389	100.0

4.8 Housing type and malaria prevention

Table 4.7 presents respondents' type of housing. More than half (64.5%) of the respondents live in semi-permanent house as opposed to less than half (35.5%) who have permanent house. Regarding main material used in making the floor, 36.2% have cemented floor while 34.4% are earth type. Iron sheet is the main roofing material used (66.8%) followed by grass thatched roofs (23.4%). Concerning main wall, most of them (36.2%) are cemented with stones while 34.4% of the households have walls made of stone and mud. Further, more than half (56.3%) had two rooms for sleeping, compared to 31.6% with one room. All of the respondents have houses with windows and ventilations while less than three-quarters (72.7%) have windows and ventilations that are protected with wire mesh to prevent mosquitoes from accessing the house.

Table 4.7: Housing type

Variables	Categories	n	%
Type of house living in	Semi-permanent	251	64.5
	Permanent	138	35.5
Main material of the floor	Earth	134	34.4
	Dung	47	12.1
	Wood planks	29	7.5
	Ceramic tiles	38	9.8
	Cement	141	36.2
Main roofing material	Thatched with grass	91	23.4
	Sticks and mud	38	9.8
	Iron sheets	260	66.8
Main wall material	Stone with mud	134	34.4
	Bamboo	47	12.1
	Plywood	29	7.5
	Cement with bricks	38	9.8
	Cement with stones	141	36.2
Number of rooms in the house used for sleeping	1	123	31.6
	2	219	56.3
	3	24	6.2
	4	23	5.9
House have windows and ventilations	Yes	389	100.0
	No	0	0.0
House has windows and ventilation protected with wire mesh to prevent mosquitoes to access the house	Yes	283	72.7
	No	106	27.3

4.9 Environment around the house and type of fuel used for cooking

Table 4.8 illustrates the kind of environment around the house and the type of fuel used for cooking by the respondents. Asked if the house was surrounded by swamp or stagnant water, 61.9% confirmed this. Majority of the respondents do not have grown vegetation around the house (97.9%). Over three-quarters (83.6%) clear the bush around the house either on weekly or bi-weekly basis. Less than half (48.6%) had their house sprayed in past 12 months to control malaria with most of the houses having been sprayed within the last 11 months (91%). Most of the respondents (47%) do their own spraying. Over half (57.1%) use firewood compared with 27% who use charcoal for cooking.

Table 4.8: Environment around the house and type of fuel used for cooking

Variables	Categories	n	%
House surrounded by swamp or stagnant water near the house	Yes	241	61.9
	No	148	38.1
Has dumping site in the compound	Yes	389	100.0
	No	0	0.0
Grown vegetation around the house	Yes	8	2.1
	No	381	97.9
Number of times clears bushes around the house	Weekly	143	36.8
	After every two weeks	182	46.8
	Monthly	38	9.8
	No bushes around house	26	6.7
Spraying of inside walls has been done in past 12 months to control mosquitoes	Yes	189	48.6
	No	200	51.4
Number of months when the house sprayed	1 - 11	172	91.0
	12 - 36	17	9.0
Who sprayed the house	Government	90	23.3
	Private company	115	29.7
	Household member	182	47.0
Type of fuel used for cooking	Charcoal	105	27.0
	Firewood	222	57.1
	Kerosene	51	13.1
	Natural gas	6	1.5
	Dung	5	1.3

4.10 Institutional participation in control of malaria in pregnancy

Table 4.9 presents participation in control of malaria in pregnancy. All of the respondents reported that health workers educate them on various control measures of malaria in pregnancy. The main method used in delivery of health education is print media (51.8%) followed by posters (23.2%), flip charts (20.9%) and oral (4.1%). All respondents reported that health workers provide free malaria preventive services especially ITNs. They were also asked if health workers provided SP to pregnant women in the study area, less than half (45.8%) confirmed that they were given Fansidar for treatment as opposed to 54.2% who were not given. More than a third (41.9%) are aware that Fansidar is one of the methods of preventing malaria in pregnancy with 90.2% correctly mentioning the two doses required by pregnant

women during pregnancy to protect them against malaria. As regards whether they had malarial attack during the current pregnancy, 13.9% were in agreement.

Table 4.9: Institutional participation in control of malaria in pregnancy

Variables	Categories	n	%
Health workers educate pregnant women on control measures of malaria in pregnancy	Yes	389	100.0
	No	0	0.0
Methods used to deliver health education messages	Print media	201	51.8
	Posters	90	23.2
	Flip charts	81	20.9
	Orally	16	4.1
Health workers provide free malaria preventive services	Yes	389	100.0
	No	0	0.0
Preventive measure offered by health workers	ITNs	389	100.0
Health workers provide Fansidar to pregnant women	Yes	178	45.8
	No	211	54.2
Knows that Fansidar is a method of preventing malaria in pregnancy	Yes	163	41.9
	No	226	58.1
Number of SP doses a pregnant mother supposed to be given	One	16	9.8
	Two	147	90.2
Has had malarial attack during this pregnancy	Yes	54	13.9
	No	335	86.1

4.11 Laboratory Test Result

Table 4.10 presents laboratory test result of the study participants. The findings revealed that 16.2% tested for malaria in pregnancy microscopically by qualified laboratory technologists and all turned out to be positive. The choice of treatment was AL.

Table 4.10: Laboratory test result

Variables	Categories	n	%
Tested for malaria	Yes	63	16.2
	No	326	83.8
Microscopy test results	Positive	63	100.0
	Negative	0	0.0
Treatment given	AL	63	100.0
	Other	0	0.0

4.12 Patient related determinants of malaria prevalence in pregnancy

Patient-related determinants that were examined as probable determinants of malaria in pregnancy included: socio-demographic, knowledge on malaria in pregnancy and ownership of ITN

4.12.1 Bivariate logistic regression analysis of socio-demographic characteristics and malaria prevalence in pregnancy

Table 4.11 shows bivariate logistic regression analysis of socio-demographic factors and malaria prevalence in pregnancy. The study findings revealed that there was statistically significant association between place of residence and malaria infection in the study area (OR: 5.7; 95%CI: 2.6 – 12.4; $p < 0.0001$). This implies that respondents who were residents of Mt. Elgon were almost three times more likely to have had malaria infection compared to their counterparts from Kaptama and Sambocho. Furthermore, the upper limit of the 95%CI OR shows that the likelihood of those from Mt. Elgon having malaria was up to 12 times in contrast to their colleagues. The findings also reveal that those who had had malaria in the last two years were about two times more likely to have had malaria during the current survey (OR: 1.7; 95%CI: 1.0 – 2.9; $p = 0.05$) with the results being statistically significant. Although the following results were not statistically significant, a higher proportion of participants aged less than 25 years (17.6%) had positive malaria results compared to those who were older ($p = 0.3$); participants with primary education, were up to 9 times more likely to have had malaria ($p = 0.2$); and a smaller proportion of those who were married (13.4%) had positive malaria results ($p = 0.3$). On the other hand, employment was not significantly associated with positive malaria results.

Table 4.11: Bivariate logistic regression analysis of socio-demographic determinants and malaria prevalence in pregnancy

Variables	Categories	Total	Malaria test results		OR	95% CI	p value
			Positive	Negative			
		n	%	%			
Age group in years	< 25	262	17.6	82.4	1.4	0.7 – 2.5	0.3
	≥ 25	127	13.4	86.6			
Marital status	Married	134	13.4	86.6	0.7	0.4 – 1.3	0.3
	Single and others	255	17.6	82.4			
Level of education	Primary	10	30.0	70.0	2.3	0.6 – 9.1	0.2
	Secondary and above	379	15.8	84.2			
Employment status	Employed	267	16.5	83.5	1.1	0.6 – 1.9	0.8
	Unemployed	122	15.6	84.4			
Place of residence	Mt. Elgon	233	23.6	76.4	5.7	2.6 – 12.4	<0.0001
	Kaptama or Sambocho	156	5.1	94.9			
Had malaria in last 2 years	Yes	161	20.5	79.5	1.7	1.0 – 2.9	0.05
	No	228	13.2	86.8			
History of malaria in previous pregnancy	Yes	60	15.0	85.0	0.9	0.4 – 1.9	0.8
	No	329	16.4	83.6			
Sought treatment in hospital	Yes	32	21.9	78.1	3.6	0.7 – 19.2	0.1
	No	28	7.1	92.9			
	No	38	10.5	89.5			

4. 12.2 Knowledge and malaria prevalence in pregnancy

Table 4.12 presents bivariate analysis of knowledge on malaria infection and malaria prevalence in pregnancy. Even though all the knowledge factors that were tested in the bivariate analysis yielded non-significant results, a few independent variables posted interesting results. A comparatively smaller proportion of participants who perceived malaria infection as being extremely serious had positive results (13.3%) in contrast to those who thought the infection was serious or not serious (16.4%). The same applied to mothers who had had abortion as a complication associated with malaria where 14.3% had malaria against 16.8% who did not. Respondents who correctly mentioned peak malaria transmission in the study area being between

March – May were upto 5-times more likely to have had positive malaria results compared to their colleagues who cited peak period of June – August (p = 0.3). Knowledge on signs and symptoms being headache, use of ITNs as a way of preventing malaria and source of getting malaria control information, were not significantly associated with positive malaria results.

Table 4.12: Bivariate logistic regression analysis of knowledge on malaria infection and malaria in pregnancy

Variables	Categories	Total	Malaria test results		OR	95% CI	p value
			Positive	Negative			
		n	%	%			
Signs and symptoms of malaria	Headache	159	17.6	82.4	1.2	0.7 – 2.1	0.5
	Others	230	15.2	84.8			
Level of understanding of seriousness of malaria	Extremely serious	30	13.3	86.7	0.8	0.3 – 2.3	0.8
	Serious or not serious	359	16.4	83.6			
Complication associated with malaria	Abortion	91	14.3	85.7	0.8	0.4 – 1.6	0.6
	Other complications	298	16.8	83.2			
Knowledge on peak malaria transmission	March - May	351	16.8	83.2	1.7	0.6 – 5.0	0.3
	June - August	38	10.5	89.5			
Ways of preventing mosquito bites in pregnancy	Use of ITNs	192	16.7	83.3	1.1	0.6 – 1.8	0.8
	Other preventive methods	197	15.7	84.3			
Where gets information regarding control measures of malaria in pregnancy from	ANC	105	13.3	86.7	0.7	0.4 – 1.4	0.3
	Other sources	284	17.2	82.8			

4.12.3 Ownership of ITN's and malaria prevalence in pregnancy

Table 4.13 shows bivariate logistic regression analysis of ownership of ITN's and MiP. Further, findings established that respondents who preferred any shape of ITN were almost four times and up to ten times more likely to have had positive malaria results (OR: 3.8; 95%CI: 1.5 – 9.7; p = 0.008). On the contrary, those who preferred rectangular shape of ITN were 50% less likely to have had positive malaria results, although the findings were marginally statistically significant (OR: 0.5; 95%CI: 0.3 – 1.0; p = 0.06). Likewise, respondents who felt that it is extremely important for pregnant mothers to sleep under ITN were 40% less likely to have had malaria though the significance of the results were close to borderline (p = 0.08). Notably, albeit not significant results, the proportion of those with at least three ITNs or more whose malaria results were positive, was higher (18.4%) than those with less number of ITNs per household (p = 0.2) suggesting that ownership of more ITNs does not translate into use of the same for malaria prevention. The number of household members who slept under ITN the night before the interview, preferred color of ITN and confidence in hanging the net were not related with positive results of malaria test.

Table 4.13: Bivariate logistic regression analysis of ownership of ITN's and malaria prevalence in pregnancy

Variables	Categories	Total	Malaria test results		OR	95% CI	p value
			Positive	Negative			
		n	%	%			
Number of ITNs in the house	≥3	196	18.4	81.6	1.4	0.8 – 2.4	0.2
	<3	193	14.0	86.0			
Number of members who slept under ITN last night	One or two	257	16.3	83.7	1.0	0.6 – 1.8	0.9
	More than two	132	15.9	84.1			
Preferred colour of ITN	Blue	137	18.2	81.8	1.2	0.7 – 2.2	0.4
	Other colour	252	15.1	84.9			
Preferred shape of ITN	Rectangular	337	14.8	85.2	0.5	0.3 – 1.0	0.06
	Other shapes or any	52	25.0	75.0			
Preferred shape of ITN	Any shape	20	40.0	60.0	3.8	1.5 – 9.7	0.008
	Rectangular or conical	369	14.9	85.1			
Confident hanging mosquito net in house	Yes	302	15.2	84.8	0.7	0.4 – 1.4	0.3
	No	87	19.5	80.5			
Importance of sleeping under a treated net for pregnant mothers	Extremely important	293	14.3	85.7	0.6	0.3 – 1.1	0.08
	Very important	96	21.9	78.1			

4.13 Environmental determinants of malaria prevalence in pregnancy

Generally, environmental determinants of malaria prevalence in pregnancy assessed in were housing type, environment around the house and cooking fuel used by the respondent.

4.13.1 Housing type and malaria prevalence in pregnancy

Table 4.14 shows bivariate analysis of housing type and malaria prevalence in pregnancy. Three factors were correlated with malaria positive results among the respondents were type of floor, type of wall and type of roof, though the latter result was marginally statistically significant. Respondents who had earth floor were about twice as likely to have had positive malaria results compared to those with other type of floors (OR: 1.8; 95%CI: 1.0 – 3.1; p = 0.03). Similarly, those with wall made of stone and mud were two time more likely to have had malaria (OR: 1.8; 95%CI: 1.0 – 3.1; p = 0.03). The same respondents who had earth floors also had houses with walls made of stone and mud. Respondents with roofs made of sticks and mud were 70% less likely to have had malaria (OR: 0.3; 95%CI: 0.1 – 1.1; p = 0.06). Normally, the sticks used to make roofs are tightly interwoven together which prevent any leakage when it rains and also preventing mosquitoes from entering the house through the roof. It is also important to mention that a higher proportion of respondents with semi-permanent houses (17.1%) had malaria compared to those with permanent houses (14.5%), the results not being statistically significant (p = 0.5). Also noted are the results of those with wire mesh to prevent entry of mosquitoes into the house where a smaller proportion of such respondents (12.3%) in comparison to 17.7% without such protective materials had malaria, again the results being not statistically significant (p = 0.2). Number of sleeping rooms was not statistically associated with malaria test results being positive (p = 0.6).

Table 4.14: Bivariate logistic regression analysis of housing type and malaria prevalence in pregnancy

Variables	Categories	Total	Malaria test results		OR	95% CI	p value
			Positive	Negative			
		n	%	%			
Type of house living in	Semi-permanent	251	17.1	82.9	1.2	0.7 – 2.2	0.5
	Permanent	138	14.5	85.5			
Type of floor	Earth	134	21.6	78.4	1.8	1.0 – 3.1	0.03
	Other types	255	13.3	86.7			
Type of roof	Sticks and mud	38	5.3	94.7	0.3	0.1 – 1.1	0.06
	Other types	351	17.4	82.6			
Type of wall	Stone with mud	134	21.6	78.4	1.8	1.0 – 3.1	0.03
	Other types	255	13.3	86.7			
Number of sleeping rooms	Three or more	47	19.1	80.8	1.2	0.6 – 2.8	0.6
	Less than three	342	15.8	84.2			
Presence of wire mesh on windows to protect house from mosquitoes	Yes	283	12.3	87.7	0.9	0.8 – 2.9	0.2
	No	106	17.7	82.3			

4.13.2 Environment around the house and malaria prevalence in pregnancy

Table 4.14 presents bivariate analysis of information on environment around the house and malaria prevalence in pregnancy. None of the independent variables tested against positive malaria result had any statistically significant association with malaria infection. In spite of lack of evidence on the tested variables, it is worth noting that respondents with vegetation around the house were up to 9 times more likely to have had positive results (p = 0.6) compared with those who did not have such vegetation.

Presence of swamp around the house, frequency of clearing of bush, spraying of the house and who sprays the house, as well as type of cooking fuel were not statistically associated with positive malaria test results among the respondents.

Table 4.15: Bivariate logistic regression analysis of environment around the house and malaria prevalence in pregnancy

Variables	Categories	Total	Malaria test results		OR	95% CI	p value
			Positive	Negative			
		n	%	%			
Swamp around the house	Yes	241	16.6	83.4	1.1	0.6 – 1.9	0.8
	No	148	15.5	84.5			
Vegetation around the house	Yes	8	25.0	75.0	1.7	0.3 – 8.9	0.6
	No	381	16.0	84.0			
Frequency of clearing bush	Every week	143	15.4	84.6	0.9	0.5 – 1.6	0.7
	More than one week	246	16.7	83.3			
Sprays the house	Yes	189	18.0	82.0	1.3	0.7 – 2.2	0.3
	No	200	14.5	85.5			
Who sprayed the house	Self	84	15.5	84.5	0.7	0.3 – 1.6	0.4
	Government or private	105	20.0	80.0			
Type of cooking fuel	Charcoal	105	15.2	84.8	0.9	1.5 – 1.7	0.7
	Other fuels	284	16.6	83.4			
	Wood	222	17.1	82.9	1.2	0.7 – 2.0	0.6
	Other fuels	167	15.0	85.0			

4.14 Institutional determinants of malaria prevalence in pregnancy

This independent variable basically examined methods used to deliver health education and policy on SP use in the study area.

4.14.1 Methods used to deliver health education and malaria prevalence in pregnancy

Table 4.15 illustrates bivariate logistic regression analysis of methods used to deliver health education and malaria prevalence in pregnancy. The study findings indicated significant association between methods used to deliver health education messages and malaria infection in pregnancy (OR: 4.4; 95%CI: 1.6 -12.3; p = 0.007). Where oral method was used in delivering key messages on malaria prevention among pregnant mothers, the likelihood of respondents having positive malaria results was four-fold compared to where other methods were used suggesting ineffective medium of delivery. Further results indicate a marginally statistically significant association between having had malarial attach during the current pregnancy and positive results during the survey (OR: 0.4; 95%CI: 0.1 – 1.1; p = 0.06). Mothers who had previous malarial attack were 60% less likely to have had positive results. Probably, the negative results could be attributed to the respondents having had anti-malaria treatment. It is also worthy of noting that a smaller proportion of respondents who agreed that health workers provide free malaria preventive services (12.9%) had positive results unlike those who disagreed (19%) although the results were not significant (p = 0.1). There was no evidence of association between knowledge that Fansidar is a method of preventing malaria in pregnancy, the number of doses for malaria prevention during pregnancy and positive malaria results among respondents.

Table 4.16: Bivariate logistic regression analysis of institutional determinants and malaria prevalence in pregnancy

Variables	Categories	Total	Malaria test results		OR	95% CI	p value
			Positive	Negative			
		n	%	%			
Methods used to deliver health education messages	Orally	16	43.7	56.3	4.4	1.6 – 12.3	0.007
	Other methods used	373	15.0	85.0			
Health workers provide free malaria preventive services	Yes	178	12.9	87.1	0.6	0.4 – 1.1	0.1
	No	211	19.0	81.0			
Knows that Fansidar is a method of preventing malaria in pregnancy	Yes	163	17.8	82.2	1.2	0.7 – 2.1	0.5
	No	226	15.0	85.0			
Knows number of SP doses a pregnant mother supposed to be given	One	147	18.4	81.6	1.6	0.3 – 7.3	0.7
	Two	16	12.5	87.5			
Has had malarial attack during this pregnancy	Yes	54	7.4	92.6	0.4	0.1 – 1.1	0.06
	No	335	17.6	82.4			

4.14.2 SP policy in the study area

A medical superintendent, Sub-County Malaria Co-ordinator, three nurse in-charge of three health facilities and one nurse in charge of MCH/FP clinic and laboratory technologist in the Sub-County Hospital were interviewed on policy regarding malaria prevention and diagnosis in the study area. They confirmed that the policy does not cover Mount Elgon Sub-County while the neighbouring Kimilili Sub-County is covered. This is confirmed by one of the key informants whose comment is reported below:

"*WHO through the Kenyan government declared Mt. Elgon Sub-County as a malaria free zone. In fact what is being provided in this area to pregnant women is only Insecticide treated nets once expectant women start attending their ANC clinics or during mass campaigns. We only provide Fansidar to pregnant women when they are sick of malaria (Key informant 1, Mt. Elgon sub county hospital"*

Another key informant said that:

"This area is not malaria endemic but experience season malaria transmission during rainy season when we have many cases of malaria in pregnancy. Categorising this place as a malaria free zone yet there are several confirmed malaria cases in pregnancy is not justified. We feel that the area is neglected with regard to malaria prevention among pregnant women" (Key Informant 2, MCH/FP Clinic).

Reporting on challenges concerning implementation of malaria control services in the study area, a key respondent pointed out that:

"There is lack of indoor spraying in this area. The last time when houses were sprayed was 2 years ago. Moreover, we have frequent ITN stock out." (Key Informant, 3, 4 and 5 Mt. Elgon, Sambocho and Kaptam).

On inquiring about their recommendations on SP policy, one of the key informants stated that:

"The policy needs to be reviewed by WHO and the national government through Bungoma County government to allow health facilities to dispense SP to pregnant women for preventive purpose even though the sub-county is considered as malaria epidemic area. Besides, nowadays regardless of rainy season, we have cases of malaria in pregnancy that seeks treatment in our facilities." (Key Informant 1, 2, 6 &7, Mt. Elgon Sub-County Hospital).

CHAPTER FIVE

DISCUSSION

5.1 Overview

This segment discusses research findings in the following order: patient related factors and malaria prevalence in pregnancy, environment related factors and malaria prevalence in pregnancy and institutional related factors and malaria prevalence.

5.2 Malaria prevalence in pregnancy

The results of the study show that prevalence of malaria among pregnant women was higher at 16.2% after confirming microscopically by qualified laboratory technologists in the study area. Findings from this study concur with studies with similar studies by (Noor, *et al;* (2016); (Larson, *et al.,* 2016); (KDHS, 2018) who reported a prevalence of 5-20% in epidemic areas of western highlands of Kenya and as the leading cause of morbidity and mortality among pregnant women.

5.3 Patient related determinants and malaria prevalence in pregnancy

The study findings revealed that prevalence of malaria infection was higher among women aged less than 25 years old (67.3%, n=262) as compared to those aged $\geq$ 25 years old (33.7%, n=137). These findings were supported by the findings of Hill, *et al.,* (2014) who reported that younger pregnant women contributed significantly due to variations in malaria prevalence as confirmed also by Ebako, *et al.,* (2015). The authors attributed the higher prevalence in the younger age group due to higher activated steroids levels and depression of lymphocytic activity of which lowers down the immunity system during pregnancy period.

The study findings revealed that there was statistically significant association between place of residence and malaria infection in the study area ($p < 0.0001$). The respondents who were residents of Mt. Elgon were almost three times more likely to

have had malaria infection compared to their counterparts from Kaptama and Sambocho. Furthermore, the upper limit of the 95%CI OR shows that the likelihood of those from Mt. Elgon having malaria was up to 12 times in contrast to their colleagues. Un-moderated dynamics in environment may results in increased temperature making it favourable for the survival of malaria parasites as evidenced by higher prevalence among pregnant women who are residents of MT. Elgon. However, there is tremendous reduced malaria via intensified measures since mid 2000's onwards, these dynamics in environment might put population in the highlands of east Africa to an increased risk of malaria in pregnancy and its outbreaks particularly if the current interventions are not maintained (Yousif and Eliningaya 2016). Further, even in malaria low transmission areas, repeated malaria positive smears after initial intervention is observed. Albeit this survey did not contradict the aetiology of this occurrence (Lawpoolsri, *et al.,* 2019).Besides, participants residing in Mt. Elgon area are much closer to the forest which is a favourable habitat for mosquitoes.

Further, findings show that respondents who had had malaria in the last two years were about two times more likely to have had malaria during the current survey (p= 0.05) with the results being statistically significant. Repeated malaria infection could have negative effects on both individual's health and malaria transmission in the society. Further, even in malaria low transmission areas, repeated parasitaemia after initial treatment is still observed. Albeit this study did not contrast the causes of these recurrent episodes (Lawpoolsri, *et al.*, 2019).

Even though all the knowledge factors that were tested in the bivariate analysis yielded non-significant results, a few independent variables posted interesting results. Respondents who correctly mentioned peak malaria transmission in the study area

being between March – May were up to 5-times more likely to have had positive malaria results compared to their colleagues who cited peak period of June – August (p = 0.3). These results were in line with studies conducted by Larson, *et al.,* (2016); (KDHS, 2018) which show that in Kenya, malaria prevalence varies according to two rainy seasons: long rains that occurs in March-May and short rains from October to December.

The study findings established that respondents who preferred any shape of ITN were almost four times and up to ten times more likely to have had positive malaria results (p = 0.008). On the contrary, those who preferred rectangular shape of ITN were 50% less likely to have had positive malaria results, although the findings were marginally statistically significant (p = 0.06).This position was supported by other studies conducted in Myanmar by (Eisele, *et al.,* (2015); Lengeler, *et al.,* (2017); New, *et al.,* (2017), WHO, 2018) who found out that, ITN's that were rectangular in shape, were accepted more by pregnant women than any other type of ITN. This was contrary to the findings of a study conducted in Ethiopia by Baume, *et al.,* (2016) where participants who were using conical shaped nets were more likely to have used the nets the previous night compared to rectangular ITNs because they are easier to hang, the results being statistically significant [OR = 2.27 (95% CI 1.10–4.68) p < 0.05]. However, in another study conducted in Zanzibar, the preference of nets was not associated with the use of the net the former night by mothers and children below five years (Beer, *et al.,* 2015).

5.4 Environmental determinants and malaria prevalence in pregnancy

Concerning the type of housing, respondents who had earth floor were about twice as likely to have had positive malaria results compared to those with other type of floors (p = 0.03). These results were supported by another study done by Wekesa *et al.,*

(2019) who found out that majority of pregnant women who tested positive smear, were from rural areas. They lived in semi-permanent houses build of mud walls, earthen floors and iron-roofed. This clearly indicated poverty hence greatly influence malaria prevalence in rural areas unlike urban areas where pregnant women lived in permanent houses with cemented floor, walls and iron sheets roof. Traditional earthen floors provide an odorous and moist environment, attracting mosquitoes to the residence.

Similarly, those with wall made of stone and mud were two times more likely to have had malaria ($p = 0.03$). The same respondents who had earth floors also had houses with walls made of stone and mud. These findings agree with the findings of WHO, (2015) which established that in Sub Saharan in rural areas, people are very poor whereby they stay in mud walled and roof made of sticks houses thus housing mosquito parasites. Further water that is used at home is not covered with lids but left open providing breeding points for mosquitoes that infect pregnant women.

Respondents with roofs made of sticks and mud were 70% less likely to have had malaria ($p = 0.06$). Notably, in the study area, residents use split-bamboo sticks to construct the roofs. The sticks used to make roofs are tightly interwoven together which prevents mosquitoes from entering the house through the roof. Study findings suggest that this type of roofing may help protect against malaria in the study area. As regards Uganda survey, it showed that human biting rate was greater in homes with mud walls, thatched roofs and open eaves (Njie, *et al.,* 2016).

5.5 Institutional related determinants and malaria prevalence in pregnancy

There was significant association between methods used to deliver health education messages and malaria infection in pregnancy ($p = 0.007$). Where oral method was used in delivering key messages on malaria prevention among pregnant mothers, the

likelihood of respondents having positive malaria results was four-fold higher compared to where other methods were used suggesting that the method was an ineffective medium of delivery because staff used medical terms while health educating pregnant women on malaria preventive services thus inability to understand how to use available preventive measures. The results were contrary to other studies conducted in Nigeria by Ankomah, *et al.,* (2014); Do, *et al.*, (2018) and Sultan, *et al.*, (2017)) who found that the driving force behind health education on preventive and control measures of malaria in pregnancy was via paper (poster, billboards, newspaper) and digital (radio, television). Report from one of the qualitative studies done in Papau New Guinea on knowledge, attitude and practice on prevention of malaria in pregnancy observed varied messages from health staff about the risks of malaria in pregnancy (MiP). Ideas on seriousness and risks of MIP greatly influenced uptake of interventions: the availability and perceived comfort of sleeping under ITN were imperative determinants of usage. This was compounded by in-adequacy of health staff's message about MIP (Erin, *et al.,* 2015).

Further results indicate a marginally statistically significant association between having had malarial attack during the current pregnancy and positive results during the survey ($p = 0.06$). Mothers who had previous malarial attack were 60% less likely to have had positive results. Results of a study conducted by Flaxman, *et al;* (2016) found out that treatment using SP among pregnant women in endemic areas led to drastic reduction of the total number of malaria cases. However, this was dependent on the number of times a mother had malaria during the current pregnancy. Probably, the negative results could be attributed to the respondents having had anti-malaria treatment.

IPTp-SP policy

According to WHO (2017) recommendations, pregnant women staying in moderate to high transmission endemic areas should be given SP every time they visit ANC unlike those who live in epidemic areas where they are given ITNs. Concerning SP policy use in the study area, it is not implemented because according to key informants said.

WHO through the Kenyan government declared Mt. Elgon Sub-County as malaria free area. This was in line with study done by Noor, *et al.,* (2015). Which postulated that WHO recommended that malaria epidemic highlands areas are free from malaria hence the malaria preventive measures that are provided include ITNs and residual indoor spraying.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Overview

This part provides a wrap up of the study results in the preceding chapters. Relying on the results, conclusions are indicated clearly and recommendations on determinants of malaria prevalence in pregnancy were made.

6.2 Conclusion

6.2.1 Patient related determinants and malaria prevalence in pregnancy

On the basis of these findings it is apparent that there is high prevalence of malaria among pregnant women in Mt. Elgon Sub-County. Patient-related determinants that were associated with MiP were place of residence and having had malaria in the last two years. Participants who were residents of Mt. Elgon were more likely to have had MiP compared to their counterparts from Kaptama and Sambocho. In addition, there was statistically significant association between preferred shape of ITN and malaria prevalence in pregnancy. The study findings established that respondents who preferred any shape of ITN were almost four times and up to ten times more likely to have had positive malaria results compared to those who preferred use of rectangular ITNs. Thus, shape determines the likelihood of malaria infection in the study area.

6.2.2 Environment related determinants and malaria prevalence in pregnancy

As regards housing type, respondents who had earth floor were about twice as likely to have had positive malaria results compared to those with other type of floors. Similarly, those with wall made of stone and mud were two times more likely to have had malaria. Further, respondents with roofs made of sticks were less likely to have had malaria.

6.2.3 Institutional related determinants and malaria prevalence in pregnancy

There was significant association between methods used to deliver health education messages and malaria infection in pregnancy. Use of oral health education in the delivery of malaria prevention messages was not effective. The study also shows a marginal association between malaria infection and the current pregnancy.

IPTp policy has not been implemented in the study area based on the government recommendation regarding malaria transmission in the study area which is considered as malaria-free zone.

The study therefore rejects the null hypothesis that states that, there is no association between patient related determinants, environmental determinants, institutional determinants and malaria prevalence among pregnant women in malaria epidemic areas of western highland of Kenya.

6.3 Recommendations

The study makes the following recommendations having been derived from conclusions;

- Bungoma County Government to promote use of ITNs and preferable rectangular ITN's by ensuring they are translated to appropriate use
- Bungoma County Government should educate and empower the residents on available income generating activities which could enable them to get funds for building improved housing with cemented floor and at least roof made of iron sheets thus play a major role in protection of pregnant women against malaria.

- The County Government through Department of Health should create awareness by use of print media to compliment the current malaria control measures and there is need for WHO and Kenyan government to review SP policy in the study area due to high malaria prevalence in pregnancy. This is in line with the study results and input from key informants interviewed.

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APPENDICES

APPENDIX I: CONSENT FORM FOR PARTICIPANT

Study Topic: Prevalence and associated determinants of malaria infection among pregnant women in malaria epidemic areas of western highlands of Kenya.

If you consent to participate in the study please sign below:

I hereby consent to participate in this study. I have been informed of the nature of the study being undertaken and potential risks explained to me. I also understand that my participation in this study is voluntary and decision to participate or not participate will not affect my status at this facility in any way whatsoever. I may also choose to discontinue my involvement in the study at any stage without any explanation or consequences. I have also been reassured that my personal details and the information that I will relay will be kept confidential. I confirm that all my concerns about my participation in the study have been adequately addressed by the investigator/research assistant and they have asked me questions to ascertain my comprehension of the information provided.

Participants Signature (or thumb print) ……Date……

I confirm that I have clearly explained to the participant the nature of the study and the contents of this consent form in detail and the participant has decided to participate voluntarily without any coercion or undue pressure.

Investigators signature ……..Date……..

For any Clarification, please contact

CYRUS ASHIVIRA BALLY, PHONE NUMBER 0706461147

PREVALENCE AND ASSOCIATED DETERMINANTS OF MALARIA INFECTION AMONG PREGNANT WOMEN IN MALARIA EPIDEMIC AREAS OF WESTERN HIGHLAND OF KENYA

This questionnaire is formulated to collect information on prevalence and associated determinants of malaria infection among pregnant women in malaria epidemic areas of western highland of Kenya.

INSTRUCTIONS

Please neither write your name nor any identity in the questionnaire

Put a response in the code column supplied in the right side of the questionnaire.

APPENDIX II: QUESTIONNAIRE FOR ANC PREGNANT WOMEN

PART I: REPONDENT'S BACKGROUND INFORMATION

SUB-COUNTY NAME: …… ☐☐ NAME OF THE FACILITY THAT RESPONDENT USUALLY ATTENDS ANC ……	
URBAN/RURAL (URBAN=1, RURAL=2)…… DATE OF INTERVIEW……..…… NAME OF INTERVIEWER……	……☐ …….……☐ ☐☐/☐☐/☐☐☐☐ INTERVIEWER CODE……☐☐

PART II: PATIENT RELATED DETERMINANTS

#	Questions	Response	Code
	SOCIO-DEMOGRAPHIC RELATED FACTORS		
201	How old are you? (Years)	……..	
202	What is your marital status?	1.Single 2.Married 3.Widowed 4. Divorced/separated	
203	What is your highest level of education?	1.No education 2.Primary 3.Secondary 4.Post-secondary 5.Vocational education	
204	Are you employed?	1.Yes 2.No	
205	Which tribe do you belong to?	1.Sabaot 2.Bukusu 3.Teso	
206	Which location do you belong to?	1.Elgon 2.Kaptama 3.Sambocho	

	PREGNANCY HISTORY		
207	Have you had any pregnancy before this current one?	1.Yes 2.No	
208	If yes, How many children do you have? RECORD NUMBER OF CHILDREN	……	
209	How many people live in this house?	……	
210	How many months pregnant are you?	1.Below 4 months 2.4-7 months 3.7 months and above	
	PREVIOUS MALARIA INFECTION		
211	Have you ever suffered from malaria in the last two years, when was it? In month.	1.Yes 2.No ……	
212	If you have had a previous pregnancy before this current, have you suffered from malaria during anyone of the previous pregnancy?	1.Yes 2.No	
213	If no, Skip to Qn. 223 and if yes, where did you seek your treatment from?	1.Hospital 2.Bought from chemist 3.Hebal medicine 4. Other specify	
214	What was the reason for your choice of place of treatment?	1.Hospital for exact treatment 2.Herbs are drugs	
215	Did you have blood tests done?	1.Yes 2.No	
216	What were the results?	1.Positive 2.Negative 3. Was not tested 4.Was not given results	
217	Were you given any treatment?	1.Yes 2.No	
218	If yes, which drugs were you given?	1.SP 2.AL 3.Quinine 4.Artesunate 3. Other specify ……	
219	If yes, were you in any way affected to perform your activities of daily living?	1.Yes 2No	

220	Did you have any complications during previous pregnancy?	1.Yes 2.No	
221	If yes, what were the complications?	……	
	KNOWLEDGE ON MALARIA IN PREGNANCY		
222	Do you know what causes malaria in pregnancy?	1.Yes 2.No	
223	If yes, then what causes malaria in pregnancy	1.Mosquitoes 2.Cold weather 3.Eating mangoes 4. Other specify	
224	What are some of the signs and symptoms of malaria in pregnancy?	…… …… …… ……..	
225	How serious do you think malaria is in pregnancy?	1.Not at all serious 2.Somehow 3.Neutral 4.Serious 5Extremely serious	
226	Among the following choices, what are some of the complications that are associated with malaria in pregnancy?	1.Abortion 2.Preterm birth 3.Anaemia 4 Other specify ……	
227	When is the peak malaria season in your area?	1.March -May 2.June-August Others specify…….	
228	What are the ways of preventing mosquito bites in pregnancy?	1.Mosquito repellent 2.Sleeping under treated mosquito nets 3.Clearing of bushes 4.Draining stagnant water	
229	Where did you get the information regarding control measures of malaria in pregnancy from?	1.Community health workers 2.Chiefs meeting 3.Antenatal clinic 4.Radio 5.Television 6.Radio show	
	OWNERSHIP AND USE OF ITNs IN PREGNANCY		
230	Does your household have any mosquito nets that can be used while sleeping?	1.Yes 2.No	

231	How many mosquito nets does your household have?	Number of nets ……..	
232	Did you sleep under ITN last night?	1.Yes 2..No 3. Not sure ……	
233	How many slept here last night under ITNs?	1.One 2.Two 3.Three 4.Four 5. I can't tell ……..	
234	Which color of net would you prefer; blue, white or green?	1.Blue 2.White 3.Green 4. Doesn't matter the colour	
235	Which shape of the net would you prefer; conical or rectangular?	1.Conical 2.Rectangular 3. Doesn't matter the shape	
236	How confident are you that you can hang a mosquito net in your household?	1.Extremely confident 2.Very confident 3. A little confident 4.Not at all confident	
237	How important do you think it is for pregnant women to sleep under a treated net?	1.Extremely important 2.Very important 3.A little important 4. Not at all important	
238	Which malaria prevention methods do you know?	1.SP 2.ITNs 3.Indoor residual spraying 4.Herbal medicines 5. Other specify …….	

Perception about malaria risk and safety of ITN's

239

	Strongly agree 5	Agree 4	Neutral 3	Disagree 2	Strongly disagree 1
Treated nets are safe to sleep under					
Most people in your community sleep under an insecticide treated net					
People are at risk of getting malaria only during the rainy season.					

PART III: ENVIRONMENTAL DETERMINANTS

#	Questions	Response	Code
301	Which type of house do you live in?	1.Semi-permanent 2.Permanent 3. Other specify ……	
302	Main material of the floor	1.Earth 2.Dung 3.Wood planks 4.Ceramic tiles 5.Cement 6 Other specify ……..	
303	Main material of the roof	1.Thatch 2.Sticks and mud 3.Reeed/Bamboo 4.Wood 5.Cement/concrete 6. Iron sheets 7. Other specify ……..	
304	Main material of the walls	1.No walls 2.Bamboo 3.Stone with mud 4.Plywood 5.Carton 6.Cement with bricks 7.Stone with cement 8. Other specify ……..	
305	How many rooms in your house are used for sleeping?	Rooms ……	
306	Does your house have windows and ventilation?	1.Yes 2.No	
307	Are the windows and ventilation protected with wire mesh to prevent mosquitoes to access the house?	1.Yes 2.No	
308	Is the environment at your home swampy with stagnant water?	1.Yes 2.No	
309	Is there dumping site in your compound?	1.Yes 2.No	
310	Are there over grown vegetation around the house?	1.Yes 2.No	
311	How often do you clear bushes around your house?	1.Weekily 2.After two weeks 3.Monthly 4. Other specify ……..	

312	At any time in the past 12 months, has anyone come into your dwelling to spray the inside walls against mosquitoes to control?	1.Yes 2.No 3. Don't know	
313	Who sprayed the house?	1.Government 2.Private company 3.Household member 4. Other specify ……	
314	Which type of fuel does your family use for cooking?	1.Natural gas 2.Firewood 3.Kerosine 4.Biogas 5.Charcoal 6.Dung 7. Other specify ……..	

PART IV: INSTITUTIONAL RELATED DETERMINANTS

#	Questions	Response	Code
401	Do health workers educate pregnant women on control measures of malaria in pregnancy?	1.Yes 2.No	
402	Which methods of health education do they use to deliver their health messages?	1.Print media 2.posters 3.Flip charts 4 Orally…….	
403	Do health workers provide free malaria preventive services?	1.Yes 2.No	
404	If Yes, which malaria preventive measures do they offer?	1.SP 2.AL 3.Quinine 4.Other specify……	
405	Do health workers provide Fansidar (SP) to pregnant women in this health facility?	1.Yes 2.No	
406	Do you know fansider as a method of preventing malaria in pregnancy?	1.Yes 2.No	
407	If so, how many SP is a pregnant mother supposed to be given?	1.One dose 2.Two doses 3.Three doses Others specify……	
408	During this pregnancy have you suffered from malaria attack?	1.Yes 2.No	
	LABORATORY TEST		

409	RECORD RESULT CODE OF MALARIA TEST	1.TESTED 2.NOT TESTED	
410	RESULT OF MALARIA TEST FOR RDT	1.POSITIVE 2.NEGATIVE 3.INVALID	
411	RESULT OF MALARIA TEST FOR MICROSCOPY	1.POSITIVE 2.NEGATIVE 3.INVALID	
412	WHICH TREATMENT IS GIVEN	…….	

APPENDIX III: KEY INFORMANT GUIDE FOR IN-CHARGES

Date ……
Health facility name and level……..

1) Does SP policy cover this area?

2) What are the reasons that made the Kenyan government not to use SP in this area?

……

……

……

……

3) How does this impact malaria among pregnant women?

……

……

……

……

4) What is your recommendation on SP policy?

……

……

……

5) What is the challenge in implementation of malaria control services in this area?

……

……

…….

6) Do you have any cases of death attributed to malaria in pregnancy?

Yes [ ] No [ ]

7) If yes, how do you quantify?

……

……

…….

APPENDIX IV: TRANSCRIPTION FORM FOR MIP

MONTHS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OC	NO	DE
YEAR												
2018	**5**	**4**	**6**	**12**	**24**	**27**	**37**	**30**	**15**	**7**	**4**	**1**
2017	**2**	**3**	**4**	**19**	**21**	**28**	**42**	**29**	**14**	**6**	**3**	**2**
2016	**1**	**3**	**7**	**13**	**18**	**28**	**30**	**27**	**25**	**6**	**5**	**3**

Source: Mt. Elgon Sub County DHIS (2016-2018)

APPENDIX V: APPROVAL LETTER FROM DIRECTORATE OF POSTGRADUATE STUDIES

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

Tel: 056-30870
Fax: 056-30153
E-mail: directordps@mmust.ac.ke
Website: www.mmust.ac.ke

P.O Box 190
Kakamega – 50100
Kenya

Directorate of Postgraduate Studies

Ref: MMU/COR: 509099

29th April, 2019

Cyrus Ashivira Bally,
HNR/G/01-56581/2016,
P.O. Box 190-50100,
KAKAMEGA.

Dear Mr. Ashivira,

RE: APPROVAL OF PROPOSAL

I am pleased to inform you that the Directorate of Postgraduate Studies has considered and approved your Masters Proposal entitled: ***"Prevalence and Associated Determinants of Malaria Infection among Pregnant Women in Malaria Epidemic Areas of Western Highland of Kenya"*** and appointed the following as supervisors:

1. Dr. Mary Kipmerewo - SONMAPS, MMUST
2. Mr. John Arudo - SONMAPS, MMUST

You are required to submit through your supervisor(s) progress reports every three months to the Director of Postgraduate Studies. Such reports should be copied to the following: Chairman, School of Nursing & Midwifery Graduate Studies Committee and Chairman, Department of Clinical Nursing and Health Informatics and Graduate Studies Committee. Kindly adhere to research ethics consideration in conducting research.

It is the policy and regulations of the University that you observe a deadline of two years from the date of registration to complete your master's thesis. Do not hesitate to consult this office in case of any problem encountered in the course of your work.

We wish you the best in your research and hope the study will make original contribution to knowledge.

Yours Sincerely,

SCHOOL OF GRADUATE
MASINDE MULIRO UNIVE

Dr. Consolata Ngala
ASSOCIATE DEAN, DIRECTORATE OF POSTGRADUATE STUDIES

APPENDIX VI: APPROVAL LETTER FROM IERC

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY
Tel: 056-31375 P. O. Box 190-50100
Fax: 056-30153 Kakamega, Kenya
E-mail: ierc@mmust.ac.ke
Website: www.mmust.ac.ke
Institutional Ethics Review Committee (IERC)

Ref: MMU/COR: 403012 vol2 (22) **Date:** 19th June, 2019

Cyrus Ashivira Bally
Masinde Muliro University of Science and Technology
P.O. Box 190-50100
KAKAMEGA

Dear Mr. Ashivira

RE: Prevalence and associated determinants of malaria infection among pregnant women in malaria epidemic areas of Western Highlands of Kenya- MMUST/IERC/38/19

Thank you for submitting your proposal entitled as above for initial review. This is to inform you, that the committee conducted the initial review and approved (with minor revisions) the above Referenced application for one year.

This approval is valid from **19th June, 2019 through to 19th June, 2020**. Please note that authorization to conduct this study will automatically expire on 19th **June, 2020**. If you plan to continue with data collection or analysis beyond this date please submit an application for continuing approval to the MMUST IERC by **19[14h] May, 2020.**

Approval for continuation of the study will be subject to submission and review of an annual report that must reach the MMUST IERC secretariat by **19th May, 2020**. You are required to submit any amendments to this protocol and any other information pertinent to human participation in this study to MMUST IERC prior to implementation.

Please note that any unanticipated problems or adverse effects/events resulting from the conduct of this study must be reported to **MMUST IERC**. Also note that you are required to seek for research permit from **NACOSTI** prior to the initiation of the study.

Yours faithfully,

Dr. Gordon Nguka (PhD)
Chairman, Institutional Ethics Review Committee

Copy to:
- The Secretary, National Bio-Ethics Committee
- Vice Chancellor
- DVC (PR&I)
- DVC (A & F)

APPENDIX VII: APPROVAL LETTER FROM NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471,
2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/19/74864/31780** Date: **31st July, 2019.**

Cyrus Ashivira Bally
Masinde Muliro University of Science
And Technology
P.O. Box 190-50100
KAKAMEGA.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Prevalence and associated determinants of Malaria infection among pregnant women in Malaria epidemic areas of Western highland of Kenya."*** I am pleased to inform you that you have been authorized to undertake research in **Bungoma County** for the period ending **29th July, 2020.**

You are advised to report to **the County Commissioner, the County Director of Health Services, and the County Director of Education, Bungoma County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

GODFREY P. KALERWA., MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Bungoma County.

The County Director of Education

THIS IS TO CERTIFY THAT:
MR. CYRUS ASHIVIRA BALLY
of MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY, 0-50100 KAKAMEGA, has been permitted to conduct research in Bungoma County

on the topic: PREVALENCE AND ASSOCIATED DETERMINANTS OF MALARIA INFECTION AMONG PREGNANT WOMEN IN MALARIA EPIDEMIC AREAS OF WESTERN HIGHLAND OF KENYA

for the period ending:
29th July,2020

Permit No : NACOSTI/P/19/74864/31780
Date Of Issue : 31st July,2019
Fee Recievnd :Ksh 1000

Applicant's
Signature

Director General
National Commission for Science,
Technology & Innovation

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

CONDITIONS

1. The License is valid for the proposed research, location and specified period.
2. The License and any rights thereunder are non-transferable.
3. The Licensee shall inform the County Governor before commencement of the research.
4. Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
5. The License does not give authority to transfer research materials.
6. NACOSTI may monitor and evaluate the licensed research project.
7. The Licensee shall submit one hard copy and upload a soft copy of their final report within one year of completion of the research.
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice.

National Commission for Science, Technology and Innovation
P.O. Box 30623 - 00100, Nairobi, Kenya
TEL: 020 400 7000, 0713 788787, 0735 404245
Email: dg@nacosti.go.ke, registry@nacosti.go.ke
Website: www.nacosti.go.ke

REPUBLIC OF KENYA

National Commission for Science, Technology and Innovation

RESEARCH LICENSE

Serial No.A 26244

CONDITIONS: see back page

APPENDIX VIII: A MAP OF STUDY AREA

Source: National road network, Republic of Kenya (Kenya Roads Board, 2013)