PREVALENCE OF MALARIA AND ITS ASSOCIATED RISK FACTORS AMONG SUSPECTED INDIVIDUALS ATTENDING GAMBELLA REGIONAL HOSPITAL, GAMBELLA TOWN, WESTERN ETHIOPIA

MSc. THESIS

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JUNE 2019

HARAMAYA UNIVERSITY

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Prevalence of Malaria and Its Associated Risk Factors among Patients Attending Gambella Regional Hospital, Gambella Town, Western Ethiopia

A Thesis Submitted to the College of Natural and Computational Sciences, School of Biological Sciences and Biotechnology, Postgraduate Program Directorate, HARAMAYA UNIVERSITY

In Partial Fulfillment of the Requirements for the Degree of
MASTER OF SCIENCE IN BIOLOGY

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June 2019

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DEDICATION

I dedicate this thesis manuscript to my family for encouraging me and nursing me with affection and love and for their dedicated partnership in the success of my life.

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this Thesis is the result of my own work. I have followed all ethical and technical principles of scholarship in the preparation data collection, data analysis and compilation of this Thesis. Any scholarly matter that is included in the Thesis has been given recognition through citation.

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ACKNOWLEDGEMENTS

First of all I would like to give limitless thanks for the omnipotent and benevolent almighty God who kept and guided me from the beginning of my life and till this success.

Next my deepest gratitude goes to my advisors Dr.Misrak Kebede and Dr. Sissay Menkir for their unreserved guidance and encouragement on every stage of this thesis work. I appreciate their nice approach, constructive comments, experience share and smooth treatments.

My special thanks go to Gambella Health Office and Gambella Regional Hospital for providing me the necessary information, allowing the laboratory facilities and technical supports. Next I would like to thanks the MOE and Haramaya University for sponsoring and providing financial support. All the community members in the study area are deeply acknowledged for their cooperation in my work and voluntarily supplying blood samples and the necessary response for Questionnaire, without whom the study would not have been successful. Lastly, my thank goes to my family, my uncle G/Eyesus Brhane and his wife ‘Ehit’ Almaz Tesfaye who were always from on side and encouraging me.

LIST OF ABBREVIATIONS AND ACRONYMS

CDC	Centers for Disease Control and Prevention
EHNRI	Ethiopian Health and Nutrition Research Institute
ENMIS	Ethiopian National Malaria Indicator Survey
EPHI	Ethiopian Public Health Institute
FMOH	Federal Ministry of Health
GMCS	Global Malaria Control Strategy
ICHA	International Centre for Humanitarian Affairs
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Nets
LLINs	Long-Lasting Insecticide-Treated Nets
MDG	Millenium Development Goal
PMI	President’s Malaria Initiative
SGM	Society for General Microbiology
UNICEF	United Nations Children’s Fund
WHO	World Health Organization
WMR	World Malaria Report

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ABSTRACT

Globally malaria remains among the deadliest leading cause of morbidity and mortality. In Ethiopia the public health and socio-economic impact of this disease is huge.This study was aimed at assessing the current situation of malaria and its associated risk factors among patients attending Gambella Regional Hospital. The study was done in a time when malaria prevalence is high: during September to October, 2018. It involved hospital based cross-sectional survey of malaria cases, use of retrospective malaria records of patients from Gambella Regional Hospital and metrological records of the last ten years. Furthermore,a structured and pretested questionnaires were used to assess the respondents' socio-demographic characteristics, knowledge, awareness related to the ways of transmission, prevention and their practice and use of insecticide treated nets. The collected data were analyzed using SPSS version 20. Thick and thin blood films were prepared from 400 individuals to determine malaria prevalence which was 23.8%. P.falciparum and P.vivax were the two major malaria species in the study area accounting for 87.4% and 12.6% respectively. The results of the study confirmed that there was a significant difference in prevalence of malaria between age groups ($p<0.050$). Additionally, more males (29%) were infected than females (19.6%). Regarding the trends of malaria in the last ten years, it was al most fluctuating. The study showed that, most respondents replied that stagnant water (91%) was the main place were mosquito breed The study participants had high level of knowledge about the sign and symptoms, ways of transmission and prevention methods of malaria. However, they had misconception about causative agent of malaria and a problem of practice and utilization of ITN.Gender, level of education and occupation were significantly associated with prevalence of malaria.The present study also showed that maximum temperature was negatively correlated while minimum temperature, rain fall and relative humidity were positively correlated with malaria prevalence.Malaria was serious puplic health ptoblem in the present study area. Further study on Community based utilization of long lasting insecticide treated nets is importan.

Keywords: Gambella, Malaria, Plasmodium species, Prevalence, Risk factors

1. INTRODUCTION

Malaria is the oldest and cumulatively the deadliest of the human infectious diseases, caused by the five types of *Plasmodium (Plasmodium falciparum, P.vivaxs, P.ovale, P.malariae and P.knowlesi*) (WHO, 2015) . It is usually transmitted to humans by the bite of an infected female *Anopheles* mosquito that previously sucked the blood from a person with malaria (Louis *et al.,* 1994; WHO, 2010).

Malaria is a major public health problem because both the pathogenic agents and the vectors are found in areas where almost half of the world's population lives. It affects more than 300,000,000 individuals per year. In particular, it severely impacts the African continent and affects more than one million people per year in the Amazon countries in South America (WHO, 2010; Ferreira *et al.,* 2012;). It is also a major public health problem in parts of Asia, Latin America, the Middle East, Eastern Europe and the Pacific. Its situation is serious and getting worse from time to time and threatens the lives of 40% of the world's population. Malaria is estimated to kill more than 1 million people annually, the majority of whom are young children. Ninety percent (90%) of malaria cases in the world occur in Africa, south of the Sahara. Children under 5 years of age and pregnant women, non-immune individuals and migrants are the worst affected by malaria. (WHO, 2006; WHO, 2015; Ghana Statistical Service *et al.,* 2015).

Malaria is not only affecting our health but also our socio-economic development (the parasite causes poverty and the poverty exacerbates the malaria situation). It typically strikes its victims not once but repeatedly. As a result, workers' output is diminished, and children miss school, often for periods of a week or more at a time. The economic loss from malaria was estimated at US$2 billion in Africa alone in 1997. Taken together, the effects of malaria on lives and livelihoods are devastating for economic progress in hard-hit countries (WHO, 2010).

The World Health Organization and the World Bank ranked malaria as the largest single component of the disease burden in Africa, causing an annual loss of 35 million future life-years from disability and premature mortality and responsible for about 20-30% of hospital admissions and about 30-50% of outpatient consultation (Okwa, 2012).

Globally, the four main malaria prevention and control strategies (use of insecticide treated nets, indoor residual house spraying, biological control and early detection and prompt treatment) resulted in a great reduction of malaria burden. President's Malaria Initiative (PMI) was launched in June 2005 to rapidly scale up malaria prevention and treatment interventions and reduce malaria-related mortality by 50% in selected high-burden countries in sub-Saharan Africa (PMI, 2014) .Regarding to this, the 2015 World malaria report estimated that, malaria control interventions in the sub-Saharan Africa ,accounted for 70% of the 943 million fewer malaria cases occurring between 2001 and 2015 , averting 663 million cases (range: 542-753 million). Of the 663 million cases averted due to malaria control interventions , it is estimated that 69% were averted due to use of insecticide treated mosquito nets (ITNs), 21% due to artemision based combination therapy (ACT), and 10% due to indoor residual spraying (IRS) (WHO, 2015).

The World Malaria Report (WHO, 2015) (from 2000-2015 G.C) noted that despite the reductions on morbidity (from 262 million to 214 million (18%) and mortality (from 839000 to 438000 (48%) in all ages and mortality in children under 5 decreased from 723,000 to 306,000, it remain well below the original Abuja Declaration target of 80% by the year 2010 (WHO, 2015).

Ethiopia is one of the South-Saharan countries and highly affected by malaria parasite. As it has described by the Federal Ministry of Health (FMOH), malaria is a major public health problem in Ethiopia and has been consistently reported as one of the three leading causes of morbidity and mortality (FMOH, 2012). About 75% of the landmass of Ethiopia is considered at risk of malaria, and also approximately 68% (84.3 million) of the its population live in areas below 2,000m of altitude and, thus, are considered to be at risk of maaria (PMI, 2014).The main malaria parasites are *Plasmodium falciparum* and P.vivax, accounting for about 60% and 40% of all cases respectively (FMOH, 2010).

Malaria is the leading cause of outpatient visits in Ethiopia, accounting for 15% of all visits, and health facility admissions, with 15% of all admissions (President's Malaria Initiative (PMI), 2014). It is one of the top ten causes of in-patient deaths among children less than five years of age and adults (FMOH, 2010; FMOH, 2012).

Malaria is seasonal in most parts of Ethiopia, with variable transmission and prevalence patterns affected by the large diversity in altitude, rainfall, and population movement. Most of the malaria transmission occurs between September and December, after the main rainy season from June to August. Certain areas, largely in the western and eastern parts of the country, experience a second "minor" malaria transmission period from April to May, following a short rainy season from February to March (PMI, 2017).

Generally, areas located less than 2,000 meters above sea level (<2,000m) in altitude are considered malariaus areas (MOH, 2017). Since peak malaria transmission often coincides with the planting and harvesting season, and the majority of malaria burden is among older children and working adults in rural agricultural areas, there is a heavy economic burden in Ethiopia (PMI, 2017).

With support of PMI and that of other donors, the Government of Ethiopia (GoE)'s has been able to dramatically scale-up its efforts in malaria prevention and control in the last decade (PMI, 2014). Massive scale-up of malaria control interventions, including case diagnosis and treatment, distribution of long-lasting insecticidal nets (LLIN), and indoor residual spraying of households with insecticides (IRS) have preferentially targeted to malarious places in Ethiopia (EHNRI ,2012 ; WHO, 2015; PMI, 2017). The average IRS coverage was approximately 20% (i.e. about 1 million unit structures sprayed each year) until 2007, though this has varied across the years, and great improvement has been made since that time. At present, coverage is about

50%, with some variation among regional states (FMOH, 2012). Ethiopia National Malaria Indicator Survey(ENMIS) of 2015 which was large, nationally representative survey of coverage of key malaria control interventions, treatment-seeking behavior, and malaria prevalence found that two-thirds (64 %) of households in malarious areas own at least one long-lasting insecticidetreated net (LLIN), and 32 % of households have at least one LLIN for every two people that stayed in the house . About half of the household population (49 percent) have access to an LLIN, so 49 % of the population could sleep under a mosquito net if every net in a household were used by two people , 40% of the population slept under an LLIN, while 45 % of children and 44 % of pregnant women slept under LLIN (MOH,2017) . From these findings it had concluded that 69% of households owned an LLIN in 2007 compared with 64% reported in the 2015 but 55 % for 2011. Household ownership of LLINs has improved compared to the malaria Indicator Survey (MIS) 2011 but declined in relation to MIS 2007 and did not meet universal LLIN coverage. In non-targeted areas (> 2000 m) reported (34% of household) owning at least one LLIN which has impact on overall LLIN distribution. Thirty-four percent of households owned LLINs in areas >2,000m and ≤2,500m above sea level where malaria prevalence in children under five is negligible (MOH, 2017).

Gambella is one of the areas of Ethiopia with high malarial endemicity with transmission being seasonal. Peak transmission is usually reached between September and November, April to May shortly after the big and small rainy season respectively (MOH, 2017). Gambella Town is one of the three Zones (Nuwer, Agnua, Mezeng) and one special District known as Itang of Gambell Region and as different studies show that Gambella had the highest malaria prevalence compared to the other regions of Ethiopia (Damte *et al.*, 2013).

Morbidity record of the Regiona Health Office showed that, malaria stands the first among the ten top diseases (Gambella Health office, 2017). Hospital records indicate that in 1998, 20% of outpatient morbidity and 26% of deaths in this region were due to malaria (Betemariam, and Yayeh, 2002). The hospital record shows that, the total malaria cases and death percentages (2000 -2009 E.C), are almost increasing continuously (but some reduction in 2006 and 2009) (Gambella Health office).This might be due to different factors: that had contributed to the continued high malaria transmission level in the area. These may include climate, altitude (topography), anthropogeny, deficiencies in the health systems in implementing control programs, low compliance in utilizing malaria intervention tools, low level community awareness and participation or any other factors. Thus it is very imperative that operational research should be conducted to identify the gaps.

Therefore, this study aimed to analyze factors associated with the occurrence of malaria in patients who are attending Gambella Town's Hospital.

Objectives

The general objective of the study was to investigate malaria prevalence and associated risk factors among patients attending Gambella Regional Hospital, west Ethiopia.

The specific objectives of the study were.

- To determine the prevalence of malaria among patients attending Gambella Regional Hospital.
- To identify the major *Plasmodium* species in the study population.
- To assess the extent of Insecticide Treated Bed Net Utilization among the study participants.
- To assess the major risk factors associated with malaria infection.
- To analyze the trend and pattern of malaria over the past ten years (2009-2018).

2. LITERATURE REVIEW

2.1. Malaria

Malaria is a disease caused by plasmodium species, which infects a person's red blood cells. It is transmitted from one person to another by the bite of female *Anopheles mosquitoes* (WHO and UNICEF, 2015 and WHO, 2010).Malaria is an ancient disease – written accounts of similar fevers first appeared around 6000BC. It was originally thought that malaria was contracted by breathing in bad air from stinking sulfurous marshes, hence the name mal, which means bad, in Italian, and aria, which means air (SGM, 2012).

Five species of the single-celled protozoan parasite *Plasmodium* can cause malaria in humans*: P. falciparum, P. vivax*, *P. ovale, P. knowlesi and P. malariae*. Of these, *P. falciparum*, the dominant species in Africa, is the deadliest and is responsible for approximately 90% of malaria deaths per year. However, it has been estimated that more people worldwide live at risk from *P. vivax* than *P. falciparum* differs in phenotype, immune response, geographical distribution, relapse pattern and drug response and as a result suffer increased morbidity from *P. vivax*. Each species of the *Plasmodium* parasite differs in phenotype, immune response, geographical distribution, relapse pattern and drug response (SGM, 2012).

Malaria is a vector-borne disease transmitted from one person to another by certain species of blood-sucking mosquitoes of the Anopheles genus which includes *A. gambiae* – the primary vector for transmission of *P. falciparum* malaria in sub-Saharan Africa (WHO, 2006)

2.2. Global Epidemiology, Distribution and Prevalence of Malaria

Malaria epidemics can occur when climate and other conditions suddenly favour transmission in areas where people have little or no immunity to malaria (Okwa, 2012). Malaria transmission occurs in large areas of Africa, Central and South America, parts of the Caribbean, Asia (including South Asia, Southeast Asia, and the Middle East), Eastern Europe, and the South Pacific(figure 5) (Arguin and Tan, 2014).

Malaria transmission in Sub-Saharan Africa and parts of Oceania is stable and this is related to presence of high rate of malaria inoculations (>10 per a year), but unstable in much of Asia and Latin America and remaining parts of the world where malaria is endemic and the rate of inoculation fluctuate greatly over seasons and years (<5 per a year and often <1 per year). This retards the acquisition of immunity and results in people of all ages, adults and children alike, suffering acute clinical malaria, with a high risk of progression to severe malaria if untreated (WHO, 2010).

In 2016, 91 countries reported a total of 216 million cases of malaria, an increase of 5 million cases over the previous year (2015). Similarly the numbers of cases in 2014 were increased. The incidence rate of malaria globally declined steadily from 76 to 63 cases per 1000 population at risk from 2010 to 2016, representing an 18% decline. In the WHO African Region, malaria incidence reduced (20 %) from 256 to 206 cases per 1000 population at risk from 2010 to 2016. Among other regions, the WHO South-East Asia Region registered the largest decline (48%), followed by the WHO Region of the Americas (22%) and the WHO Western Pacific Region (12%) . Between 2014 and 2016, however, the malaria case incidence rate remained unchanged globally and increased in all WHO regions except in the WHO European Region (WHO, 2017).

In 2016, there were approximately 216 million cases of malaria and 445,000 deaths (about the same number reported in 2015) from malaria worldwide. Sub-Saharan Africa is the hardest hit region in the world (WHO, 2017 and Fact Sheet, 2018). Although malaria case incidence has fallen globally since 2010, the rate of decline has stalled and even reversed in some regions since 2014. Mortality rates have followed a similar pattern. The WHO African Region continues to account for about 90% of malaria cases and deaths worldwide, followed by the WHO South-East Asia Region (3%) and the WHO Eastern Mediterranean Region (2%). Fifteen countries, all but one in sub-Saharan Africa: carry 80% of the global malaria burden. Of the 91 countries reporting indigenous malaria cases in 2016, 15 countries, all in sub-Saharan Africa, except India, carried 80% of the global malaria burden.Nigeria accounted for the highest proportion of cases globally (27%), followed by the Democratic Republic of the

Congo (10%), India (6%) and Mozambique (4%). In 2016, 85% of estimated *vivax* malaria cases occurred in just five countries (Afghanistan, Ethiopia, India, Indonesia and Pakistan) (Frew *et al.*, 2018; WHO, 2015; WHO, 2017).

The deterioration of health systems, growing resistance to drugs and insecticides, environmental changes and human migration, which have led to an increase in epidemics, all contribute to the worsening global malaria problem (Assembly, 2001). Therefore, despite incredible progress in fighting malaria in all regions affected by the disease, malaria remains an acute public health problem. During the course of 2015, it is estimated that malaria will have caused 214 million cases and 438 000 malaria deaths; most of these cases (89%) and deaths (91%) occur in sub-Saharan Africa. Children aged less than 5 years bear the largest burden, with more than two thirds of all malaria deaths occurring in this age group (WHO; UNICEF, 2015).

Globally the geographical distributions of *Plasmodia* species are not the same: It is a focal disease whose distribution is influenced by literally dozens of factors related both to human, mosquito, and parasite populations and to the environment (the species of parasite present, the level of endemicity, and the biologic, behavioral, and socioeconomic characteristics of the human population determine the prevalence of infection and the distribution of disease). It exists throughout much of tropical and sub-tropical regions of Africa, Asia, and South and Central America and found mostly in poor, tropical, and subtropical countries. *Plasmodium falciparum* is endemic to Sub-Saharan Africa, Latin America and South-East Asia; *Plasmodium vivax* found outside Africa (South-East Asia, Middle east , Aceania and Latin America) rarely in horn Africa; *Plasmodium ovale* and *P.malariae* are generally less prevalent, but they are distributed worldwide, especially in the tropical areas of Africa. *Plasmodium malariae* malaria is endemic to West Africa, Guyana and India (Institute of Medicine, 1991; CDC, 2008; Castelli *et al*., 2010; WHO, 2010).

The WHO and UNICEF reported that five species of Plasmodium (*P. falciparum, P. vivax, P. ovale, P. knowlesi* and *P. malaria*) can infect human beings; two of these: *P. falciparum* and

P. vivax, pose the greatest threat. Although *P. vivax* can cause severe illness and death, *P. falciparum* is the most dangerous malaria parasite, the most prevalent on the African continent and responsible for most malaria related deaths. *P. vivax* has a wider distribution than P. falciparum, and predominates in many countries outside of Africa. Although *P. vivax* can occur in Africa, the high frequency of a genetic trait known as Duffy negativity among African populations makes many individuals resistant to infection with *P. vivax* (WHO; UNICEF, 2015).

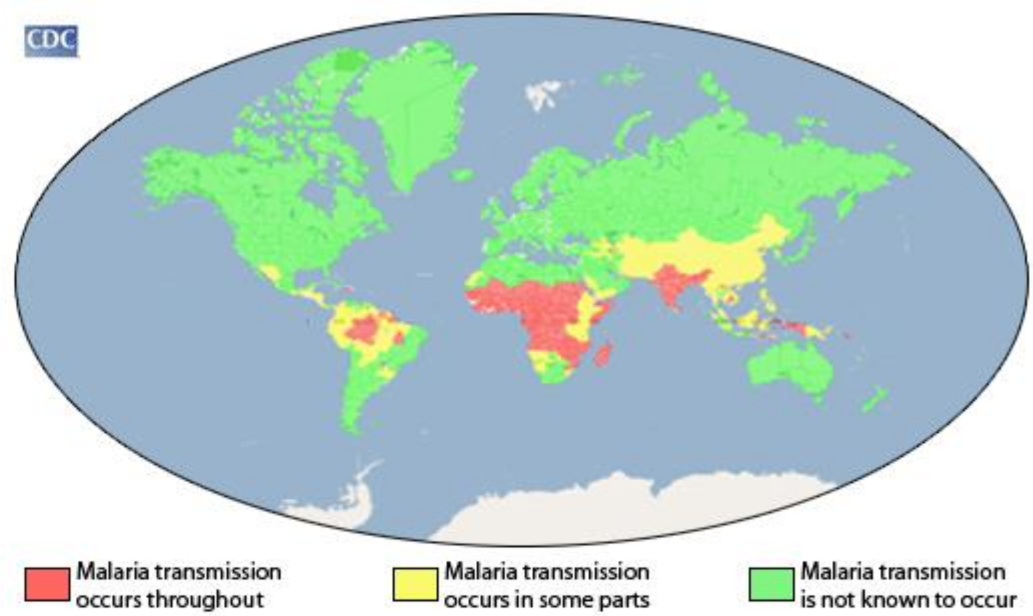

Figure 1**. Global distribution of malaria transmission risk (Source : CDC, 2017)**

2.3. Epidemiology, Distribution and Trends of Malaria in Ethiopia

Malaria is the leading communicable disease in Ethiopia accounting for approximately 30% of the overall disability adjusted life years (DALYS) lost (PMI, 2008). Malaria transmission peaks bi-annually from September to December and April to May coinciding with major harvesting season with serious consequences for the subsistence economy of Ethiopia’s countryside, and for the nation in general (PMI, 2008; FMOH, 2010).

As it is shown in figure 5, the distribution and transmission of malaria varies from place to place (Aschalew and Tadesse, 2016). Its transmission exhibits a seasonal and unstable pattern, with transmission varying with altitude and rainfall. The major malaria transmission season in the country is from September to December, following the main rainy season from June/July to September. There is a shorter transmission season from April to May following the shorter rainy season in some parts of the country.

Approximately 52 million (68%) live in malaria risk areas in Ethiopia, primarily at altitudes below 2,000 meters and 75% of its land mass is considered at risk of malaria (FMOH, 2012). Currently, areas <2,000 meters of altitude are considered malarious (FMOH, 2010; FMOH, 2016).

In Ethiopia major epidemics occur every 5 - 8 years, but focal epidemics were occurring every year (Aschalew and Tadesse, 2016). Repeated epidemics in highland areas, which were not previously vulnerable, are due to high rainfall patterns (unusually) and degraded environment ,that allow vector mosquito to develop: non immune populations may be at risk of infection and sever and often fatal malaria (Institute of Medicine, 1991). Health officials emphasized that malaria epidemics were a common phenomenon in many parts of Ethiopia following floods (Samson, *et al*., 2009).

Historically, there have been an estimated 10 million clinical malaria cases annually. Since 2006, however, cases have reduced substantially (FMOH, 2010*). Plasmodium falciparum* and *P. vivax* are the two most dominant parasite species in Ethiopia. The 2007 Malaria Indicator Survey (MIS) indicated that parasite prevalence (as measured by microscopy) in Ethiopia was 0.7% and 0.3%, respectively, for *P. falciparum* and *P. vivax* below 2,000 meters altitude. The 2011 MIS indicated that 1.3% was positive for malaria using microscopy and 4.5% were positive for malaria using RDTs below 2,000 meters, with only 0.1% prevalence above 2,000 meters elevation. *Plasmodium falciparum* constituted 77% of infections detected below 2,000 meters elevation. The 2011 MIS demonstrated a remarkable demarcation of malaria risk at an altitude of 2,000 meters, with a13-fold higher malaria prevalence at lower altitudes compared to higher elevations. There was essentially no *P. falciparum* detected by microscopy among persons surveyed within households having measured elevations above 2,000 meters in the

2011 MIS. The 2015 MIS data indicated that parasite prevalence in Ethiopia was 0.5% for all ages by microscopy and 1.2% among all ages by RDTs for areas below 2,000 meters and less than 0.1% prevalence above 2,000 meters and the aver all prevalence is very low (MOH,2017 ;FMOH,2010; PMI, 2017).

In 2016, Public Health Emergency Management (PHEM) data have shown an increase in malaria transmission relative to previous years. According to the most recent Epidemiological Bulletin from the Ethiopian Public Health Institute (EPHI), malaria cases are trending upwards and in fact have surpassed 2014 and 2015 case levels (PMI, 2017).

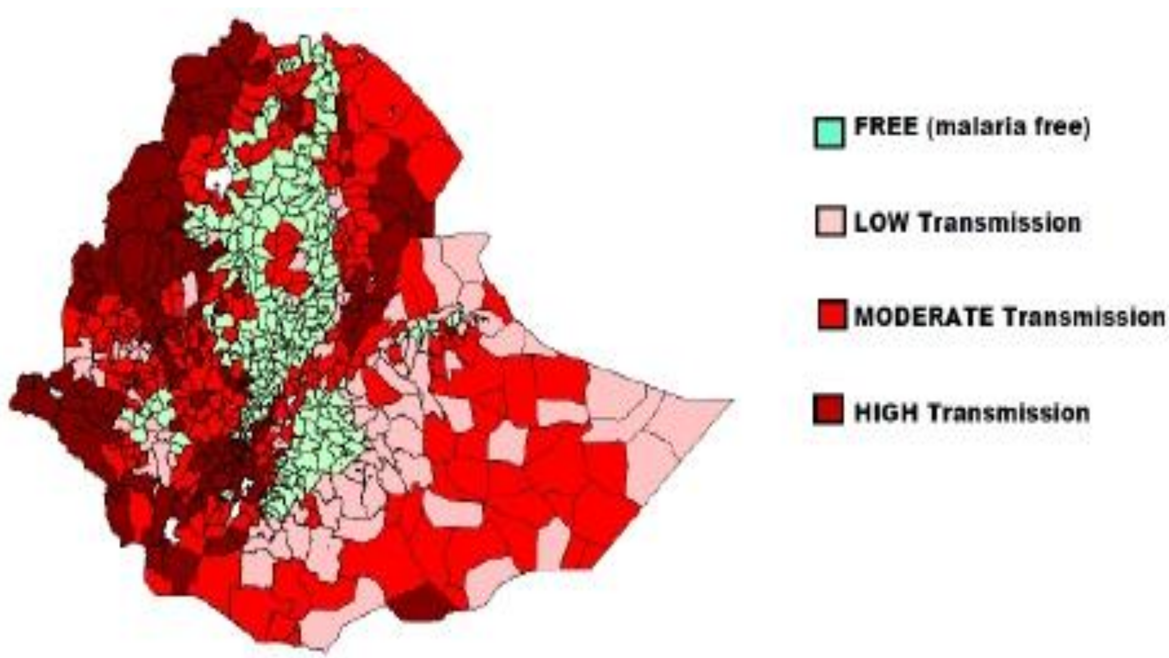

Figure 2. The distribuion of malaria in Ethiopia (PMI, 2017).

2.4. Malaria Prevention and Control Strategies

Vector control consists of two methods. Natural control: which deals with environmental management and land use planning, and: artificial control (use of ITNs and IRS) (Charles and Godfray, 2013 and Tuyishimire, *et al*., 2016). Malaria prevention and control efforts in

Ethiopia have focused on the ownership and use of long-lasting insecticide-treated nets (LLINs) and indoor residual spraying (IRS) (FMOH, 2012).

2.5.1. Vector Control

Vector control remains the most generally effective measure to prevent malaria transmission and is therefore one of the four basic technical elements of the Global Malaria Control Strategy (GMCS) (WHO, 2006). Vector control measures vary considerably in the scope of their applicability .The currently available control measures according to their effect and indication for community or personal protection (Table 1).

Table 1. Malaria vector control measures

Action	For individual and family protection	For community protection
Reduction of human-mosquito contact	Insecticide-treated nets, repellants, protective, clothing, screening of house	Insecticide-treated nets Zooprophylaxis
Destruction of adult mosquitoes		Insecticide-treated nets, Indoor residul spraying, Space spraying,Ultra low Volume sprays
Destruction of mosquito larvae	Peri-domestic sanitation	Larviciding of water ,Surfaces, intermittent irrigation ,sluicing, biological control
Source reduction	Small-scale drainage	Environmental sanitation ,Water management, drainage
Social participation	Motivation for personal and family protection	Health education Community participation

2.5.1.1. Insecticide Treated Materials/Nets (ITNs)

Use of long-lasting insecticide-treated nets (LLINs) is the primary prevention strategy for reducing malaria transmission in Ethiopia. By protecting people from being bitten by infected mosquitoes, LLINs are an effective tool to significantly reduce morbidity and mortality due to malaria. Additionally, when coverage rates are high and if a large proportion of human biting by local vectors takes place after people have gone to sleep, LLINs also can have an impact on vector populations. A LLIN has three main functions: i) When mosquitoes are in contact with the net, it has a knock-down effect, temporarily incapacitating or even killing mosquitoes; ii) It has a repellent effect; and, iii) It reduces contact between the person sleeping under the net and mosquitoes by acting as a physical barrier (WHO, 2006; FMOH, 2012).

2.5.1.2. Indoor Residual House Spraying (IRS)

IRS is one of the most effective methods for obtaining rapid large-scale impact on both vector populations and malaria morbidity/mortality. It is the application of long-acting chemical insecticides on the walls and roofs of all houses and domestic animal shelters in a given area. This is applied in order to kill adult vector mosquitoes that land and rest on these surfaces so that reduce and interrupt malaria transmission. It also Reduces the life span of vector mosquitoes (can no longer transmit malaria parasites from one person to another) and the density of vector mosquitoes (WHO, 2006; FMOH, 2012; EPHI, 2016).

2.5.2. Biological Control

Potential biological control agents such as fungi (e.g., *Laegenidium giganteum*) or mermithid nematodes (e.g., *Romanomermis culicivorax*), parasitize and kill larval mosquitoes. Bacterial larvicides and larvivorous fish that target and kill vector larvae without generating the ecological impacts of chemical use are also used as biological vector control. (WHO, 2006; CDC, 2015; WHO, 2018).

2.5.3. Treatment

Malaria can normally be treated with antimalarial drugs (WHO, 2010 and The Society for General Microbiology (SGM), 2012). The type of drugs and length of treatment depend on which kind of malaria is diagnosed, where the patient was infected, the age of the patient and how ill the patient was at the start of the treatment. Travellers visiting endemic areas can take antimalarial drugs to prevent infection. Depending upon the drug prescribed, they may need to be taken up to 2 weeks before travelling, during the period the person is away and for 4 weeks afterwards to be effective. Artemisinin-based combination therapies (ACTs) are now the standard treatment for uncomplicated malaria. These therapies combine artemisinin or one of its derivatives with another antimalarial or antimalarials of a different class. Current recommended drugs for ACT are: Artemether-lumefantrine, artesunate-amodiaquine, artesunate-mefloquine artesunate-sulfadoxine/pyrimethamine, and ihydroartemisinin-piperaquine (WHO, 2010).

P. vivax malaria is treated with chloroquine. However, in areas where resistance has developed an ACT is advised; a 14-day course of another drug, primaquine, is also recommended in addition to ACT to prevent relapse. In cases of severe *P. falciparum* malaria, drugs are administered by intramuscular or intravenous injection of quinine followed by a complete course of an effective ACT as soon as the patient is able to take oral medication. In situations where injections are not feasible, patients can be treated with artemisinin suppositories (CDC, 2013; SGM, 2012).

2.6. Symptoms and Signs of Malaria

The first symptoms of malaria are nonspecific and similar to the symptoms of a minor systemic viral illness. They comprise: headache, lassitude, fatigue, sweats, abdominal discomfort, and muscle and joint aches, usually followed by fever, lethargy, lassitude, fatigue , loss of appetite (in older children and adults), poor feeding (in young children) , chills, perspiration, anorexia, vomiting and worsening malaise. Severe malaria usually manifests with one or more of the following: coma (cerebral malaria), metabolic acidosis, severe anaemia, hypoglycaemia, acute renal failure or acute pulmonary oedema (WHO, 2010).

2.7. Malaria Vector Mosquitoes and their Geographical Distribution

As the World Health Organization (WHO) report, there are about 400 different species of *Anopheles* mosquitoes, but only 30 or 60 of these are vectors of major importance. All of the important vector species bite between dusk and dawn (Institute of Medicine, 1991; WHO, 2015; WHO, 2017). The principal vectors, *Anopheles gambiae, An. funestus*, and *An. arabiensis* are efficient transmitters of the malaria parasite and are found in abundance in savanna region particularly in South of Sahara Africa (Institute of Medicine, 1991).

Anopheles gambiae, (Originating in Africa) one of the primary vectors of malaria in Africa, breeds in numerous small pools of water that form due to rainfall. The *Anopheles gambiae* complexes of mosquitoes include the most efficient malaria vectors on Earth. This is because they have adapted well to human habitation, and feed almost exclusively on human blood for egg production. It has a wide distribution, and usually occurs in large numbers wherever found. It is also highly susceptible to the parasite. The female bites mainly at night, but in several studies, 12% of bites occurred after sunrise. The maximum temperature at which *An. gambiae* larvae can survive is 41°C. Rarely does this temperature occur in nature, even in the intense heat of equatorial Africa (CDC, 2015). The main reason why malaria in tropical Africa is much worse malaria than in other parts of the world is because two of the world's most efficient vectors (*An. funestus* and *An. gambiae* complex) of malaria alternate in abundance seasonally throughout the savannahs (WHO, 2006).

President's Malaria Initiative (PMI) noted that *Anopheles arabiensis*, a member of the *An. gambiae* complex, is the primary malaria vector in Ethiopia, with *An. funestus, An. pharoensis* and *An. nili* secondary vectors. The sporozoite rate for *An. arabiensis* has been recorded to be as much as 5.4%. The host-seeking behavior of *An. Arabiensis* varies, with the human blood index collected from different areas ranging between 7.7 and 100%. *An. funestus*, a mosquito that prefers to feed on humans, can be found along the swamps of Baro and Awash rivers and shores of lakes in Tana in the North and the Rift Valley area. *An. pharoensis* is widely distributed in Ethiopia and has shown high levels of insecticide resistance, but its role in malaria transmission is unclear. *An. nili* can be an important vector for malaria, particularly in Gambella Regional State (FMOH, 2012; PMI, 2014).

Regarding to their breeding habitat *An. arabiensis* prefers breeding in small, temporary, and sunlit water collections such as rain pools; however, it can also breed in a wide variety of other types of water bodies. *An. pharoensis* are usually preferred large, permanent water bodies with emergent vegetation, such as swamps and the edges of lakes. Though its abundance is scarce at present, *An. funestus* shares the breeding habitat of *An. pharoensis*. *An. nili* breeds in brackish water and is much more localized in its distribution (FMOH, 2012).

2.8. The Life Cycle of *Plasmodium*

The life cycle of the malaria parasite is complex (Figure 2). The sporozoites are transmitted to the vertebrate host by the bite of infected female mosquitoes (Fujiokaa and Aikawab, 2002) and the parasite cycle starts when humans are bitten by infected female *Anopheles* mosquitos. Infection is detected when the parasite multiply quickly in non-immune people (Tuyishimire *et al.,* 2016).

All species of *Plasmodia* undergo two forms of replication: asexual and sexual. During the asexual stage, the organism enters the bloodstream of the host through the bite of an infected female anophelene mosquito. At this point, it is spindle shaped and motile, and termed the sporozite. After being introduced into the human intermediate host, it enters the bloodstream and is carried to the liver. There, it penetrates an hepatocyte and undergoes growth and multiplication. In the case of *P. vivax* and *P. ovale,* some sporozoites transform to the dormant hypnozoite instead, and remain so for varying lengths of time up to 5 years. This stage is responsible for relapses when it re-enters its developmental cycle. Multiple cycles of division result in the production of thousands of new parasites (merozoites). As the result, the host cell ruptures, releasing them into the bloodstream. They can no longer return to the liver and infect hepatocytes, and now must infect red blood cells in order to remain viable (WHO, 2010).

Merozoites enter the bloodstream, attach to and penetrate red cells. This begins the erythrocytic stage of the life cycle. *Plasmodia* ingest, and then digest hemoglobin, thereby acquiring amino acids needed for protein synthesis. They discard heme and a small peptide side chain, creating a compound known as hemazoin. Hemazoin molecules become stacked, one on top of the other, inside the food vacuole with the aid of a specialized enzyme, forming a crystalline deposit. The drug chloroquine interferes with that process by inhibiting the stacking enzyme. The parasites divide and lyse open the red blood cell, re-entering the bloodstream as merozoites and the cycle continues. Hemazoin accumulates inside the host cell and is also released at the time of cell lysis. This material is known as “malarial pigment” and is visible under the light microscope. As the RBC ruptures toxins are released from the merozoites. It is believed that these toxins directly stimulate the host’s immune system and a highly complex immune response is initiated, resulting in bouts of chills, fever and sweats. In *P. vivax* malaria this can occur once every 48 hours, corresponding to the RBC cycle. Some of the trophozoites develop into male and female gametocytes, the sexual stages of the parasite. These circulate in the blood and are taken up by the female mosquito when it takes a blood meal. Inside the mosquito’s stomach the gametocytes develop into gametes, fertilization occurs and a zygote is formed. Within 24 hours the zygotes transform into motile ookinetes that burrow into the stomach wall. Ookinetes encyst and become oocysts that divide to produce approximately 1,000 sporozoites each. After about 7 days the oocysts rupture, releasing their sporozoites which make their way to the salivary glands ready to infect another human (Miller *et al.*,, 1994; Fujiokaa and Aikawab, 2002; WHO, 2010; SGM, 2012).

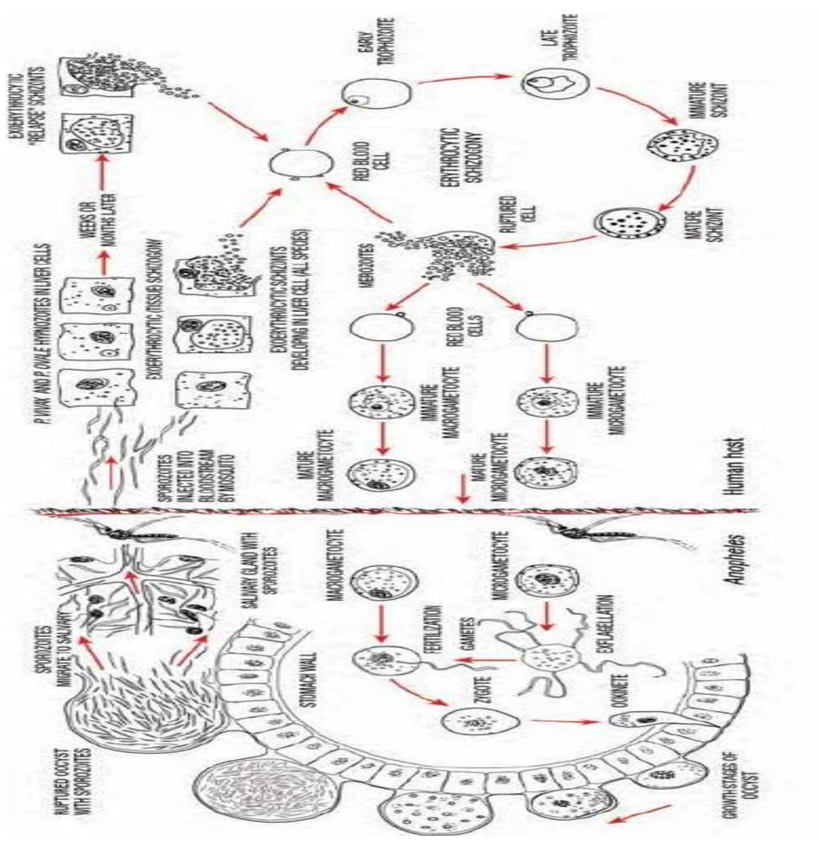

Figure 3. The life cycle of malaria parasites (WHO,2010)

2.9. Factors that Affect the Epidemiology of Malaria

2.9.1. Climatic Factors

Malaria transmission intensity, along with its temporal and spatial distribution in Ethiopia, is mainly determined by the diverse eco-climatic conditions. Climate is a key determinant in the geographic distribution and the seasonality of malaria.

Climatic factors including rainfall, temperature and humidity show high variability (WHO, 2006 and FMOH, 2010). Climate variability is widely considered to be a major driver of inter-annual variability of malaria incidence in Ethiopia (Addisu Workineh and Belay Bezabih , 2014).Climate is affected by altitudinal limits and altitude is used to describe the climate zones in Ethiopia: *kola* or hot lowlands (<1500m above sea level; mean annual temperature 23-33^{O}C*), weyna dega* (1500-2400m above sea level; mean annual temperature 16-29^{O}C) and *dega* or cool highlands (>2400m ASL; mean annual temperature 10-16^{O}C) (FMOH, 2014).

Rainfall is strongly correlated with altitude and thus varies significantly across the country. Temperature, and to a lesser extent rainfall and humidity, varies as a function of altitude. In Ethiopia areas below 2,000m altitude are considered at risk of malaria (WHO, 2006 and FMOH, 2010). Temperature and humidity have a direct effect on the longevity of the mosquito. Each species can thrive at an optimal level as a result of ecological adaptation. The spread of malaria requires that conditions that are favorable for the survival of both the mosquito and the parasite. Temperatures from approximately 21°-32°C and a relative humidity of at least 60% are most conducive for maintenance of transmission (Okwa, 2012).

Rainfall can create collections of water (“breeding sites”) where *Anopheles* eggs are deposited, and larvae and pupae develop into adulthood, a process that takes approximately 9-12 days in tropical areas. Such breeding sites may dry up prematurely in the absence of further rainfall, or conversely they can be flushed and destroyed by excessive rains.

Once adult mosquitoes have emerged, the ambient temperature, humidity, and rains will determine their chances of survival. To transmit malaria successfully, female *Anopheles* must survive long enough after they have become infected (through a blood meal on an infected human) to allow the parasites they now harbor to complete their growth cycle (“extrinsic” cycle). That cycle takes 9-21 days at 25°C or 77°F. Warmer ambient temperatures shorten the duration of the extrinsic cycle, thus increasing the chances of transmission. Conversely, below a minimum ambient temperature (15°C or 59°F for *Plasmodium vivax*, 20°C or 68°F for *P. falciparum*), the extrinsic cycle cannot be completed and malaria cannot be transmitted. This explains in part why malaria transmission is greater in warmer areas of the globe (tropical and semitropical areas and lower altitudes), particularly for *P. falciparum* (CDC, 2015)

Precipitation is linked to the prolonged occurrence of water bodies for female mosquitoes to lay their eggs and for successful larval development. These egg-laying sites are most common in deforested regions, such as agricultural fields (Vajda and Webb, 2017).

In general changes in temperature, humidity, altitude, population density of humans, and deforestation are just a few ecological factors that play essential part in the transmission of malaria.

2.9.2. Non- Climatic Factors

Entomological and Human Population Dynamics (human factors) are determinant factors for malaria transmissions (Vajda and Webb, 2017).These include population growth (direct correlation with mosquitoes density, thus increase malaria transmission) and movements, urbanization, water development schemes and proximity to breeding sites, agricultural development and the attendant consequences of the emerging drug-resistant malaria parasites. Construction of water control projects can also lead to shifts in vector mosquito populations. Reservoirs, irrigation canals, and dams are closely associated with the increase of a variety of parasitic diseases that are water dependent (Aynalem, 2009). As people move and change environments, they introduce new technologies to the area and increase their own likelihood of acquiring or spreading an infectious disease. Ecological disturbances (deforestation which is one of the most disruptive changes affecting mosquito populations) allow for the proliferation of mosquitoes that prefer human habitation to natural settings.

Malaria transmission also related to biological factors: The mosquitoes density their bite mankind, their sensitivity to the parasite, life span of mosquito (pproximately 1 week), the growth of the parasite in mosquito which depend on independent climatic factors. Mosquito longevity affects malaria transmission, because it takes time (for the parasite to develop. Typically, female mosquitoes live 2.5-3 weeks. The minimum length of development is temperature dependent in all mosquito habitats, even the tropics (CDC, 2015, Mehammadkhani *et al.*, 2016).

Human immunity is another important factor, especially among adults in areas of moderate or intense transmission conditions. Immunity is developed over years of exposure, and while it never gives complete protection, it does reduce the risk that malaria infection will be severe (Institute of Medicine, 1999 and Okwa, 2012). Economic conditions may force nonimmune highland populations to search for work in lower highland fringe areas, where they may be exposed to intense malaria transmission (Institute of Medicine, 1999).

As Gudissa (2016) stated, quoting Schicker *et al.,* (2015) socio-economic situation of a country is also playing a pivotal role in expansion of malaria infection: Individuals with poor socio-economic conditions are positively associated with malaria infection (Dawit *et al.*, 2012).

The level of vulnerability is associated with demographic variables (household size, age and gender), socioeconomic variables (income, education) (Tuyishimire *et al.*, 2016).As it is depicted in figure 3, population dynamics geography , anthropogey (population movements , population settlement, etc.), ecological changes (land use) , demographic effects , irrigation , and dams have an important implications for malaria transmission , distribution and its epidemiology (Institute of Medicine,1999 ;Deressa *et al.*, 2006 and WHO, 2006) .

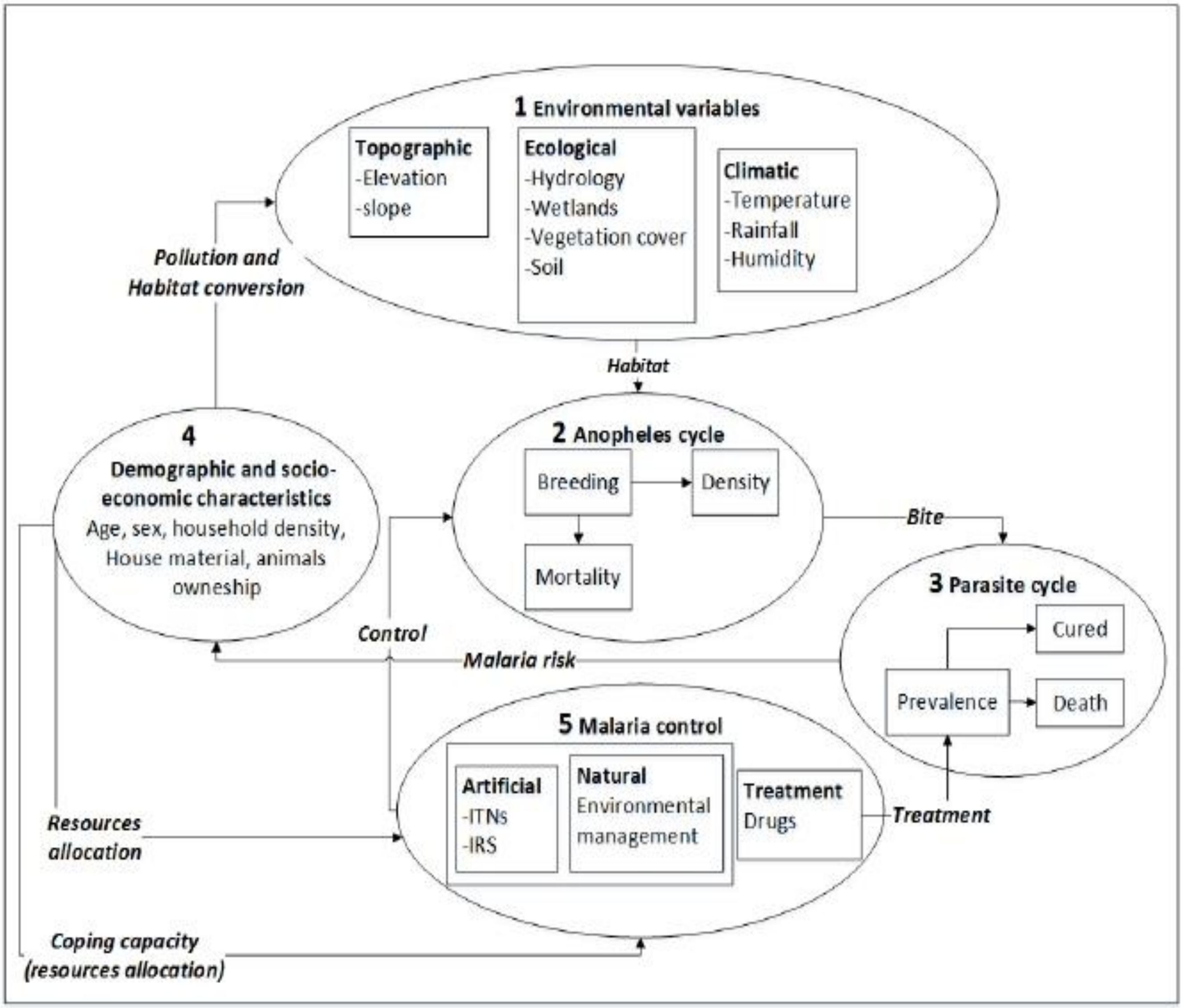

Figure 4. Conceptual framework (Tuyishimire *et al.*, 2016)

3. MATERIALS AND METHODS

3.1. Description of the Study Area

The study was conducted in Gambella Regional Hospital (Gambella Town). Gambella Town is the name for both the region and capital city of Gambella Regional State .It is located 777kms from Addis Ababa (Figure 6). The town is founded at the banks of Baro River, which is Ethiopia’s widest river and the only river used for both navigation and fishery activities. It has one Regional Hospital and serves nearly 390,590 people, which is the the population of the region, while the Hospital is visited annually by 44,269 health service seekers (Asebe Getahun *et al.*, 2015).

The area is found at 300-500 meters above sea level which is generally lowland. Regarding its climate, the annual temperature is 37^{o}c. The mean annual rain fall is 1200mm (Betemariam and Yayeh, 2002). These environmental factors might con-tribute to the endemicity of malaria in the region.Regarding the health care services, Gambella region has one hospital, 27 health centers, and 104 health posts, 34clinics, and 16 drug venders (Damte et *al.*, 2013).

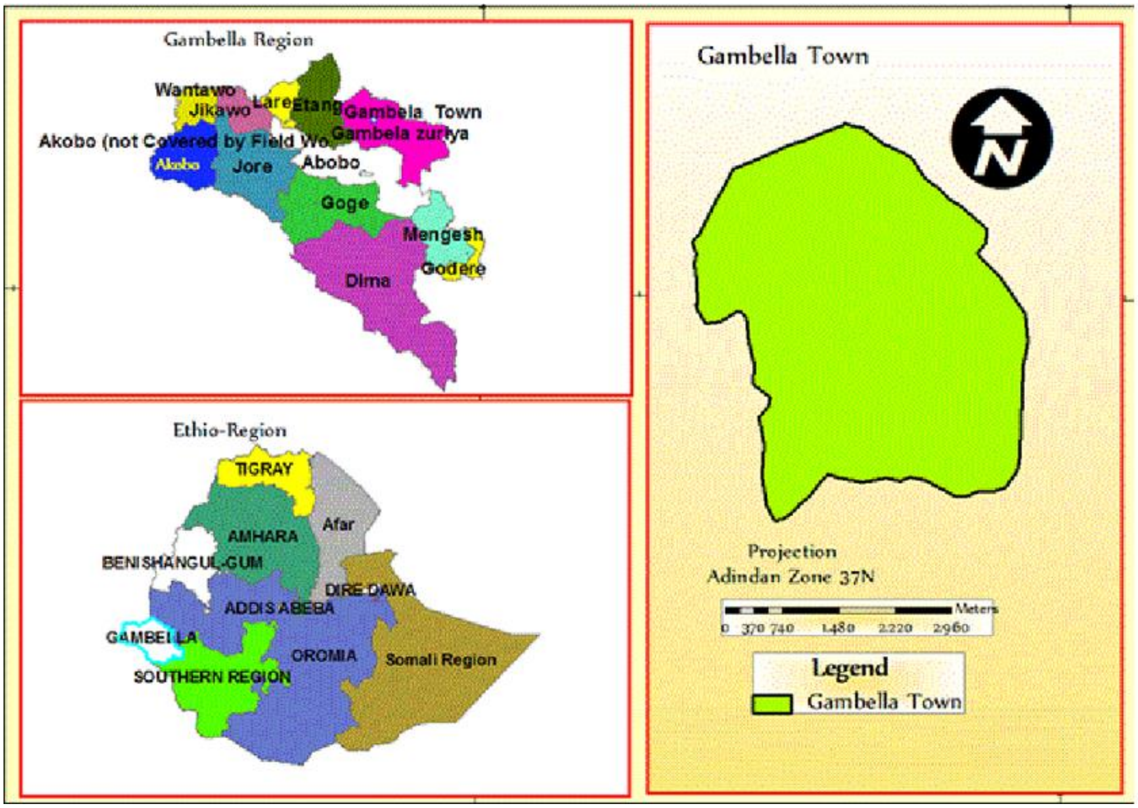

Figure 5. Map of the study area (Source: Asebe *et al.,* 2015)

3.2. Design of the Study

The study design was hospital based cross-sectional survey. The study period was from September to October 2018.

3.3. Study Population

Malaria suspected patients attending medical services were considered as study population

3.3.1. Inclusion criteria: Malaria suspected Patients, attending for medical services were included at their follow up visits during the study period

3.3.2. Exclusion criteria: Malaria patients who take antimalarial drugs before coming to the Hospital and those who have no malaria symptom patients visiting for other parasites or disease were excluded from the study.

3.4. Sample Size Determination and Sampling Techniques

The minimum number of the study participants were estimated by using minimum sample determination formula; $n= Z^2 P(1-P)/d^2$ Where n= the sample size ,Z= 1.96 at 95% Confidence Interval(CI) ,d=margin of error , p is the average prevalence p = 0.5 was used, as this value gave us sample size sufficiently large to guarantee an accurate prediction, at 95% confidence interval and 5% error of estimat p= expected malaria prevalence rate with 95% CI and margin error (d) at 5% (standard value of 0.05). Then $n= Z^2 P (1-P)/d^2 = 384.16$ by adding 4% for non response individual's rate, it becomes 400 () (Naing *et al* 2007).

A simple random sampling method was used. Patients were randomly recruited till the sample size (400) wasreached.

3.5. Blood Sample Collection and Blood Film Preparation

Before blood sample collection, a finger from a study subject was cleaned with alcohol moistened cotton. Then a drop of blood approximately 5µl (capillary blood from fingertip) was collected. The blood slides each composed of thick (to determine the positivity of the parasite) and thin films (to determine the type of parasite species) were taken from each study subject according to the standards operating procedure (WHO, 2010).

The slides were labeled and air dried horizontally in a slide tray , and the thin films were fixed with methanol after drying .Then slides were stained with 3% of Giemsa for 30-45 minute at laboratory unite (WHO,2010).

3.6. Laboratory Malaria Diagnosis Procedures

The presence of malaria parasite on thick blood smear was examined by using high power magnification objective (40x) and the identification of *plasmodium* species from the thin blood smear was through oil immersed objective (100x). These activities were done with the help of experienced laboratory technician and technologist .All procedures will be constructed based on the standard protocol of WHO (WHO,2010).

3.7. Questionnaire Survey for Malaria Risk Assessment

Structured and pretested questionnaires were developed in English and Amharic version (appendix III and IV) and administered to gather information on socioeconomic status (income, level of education, awareness about malaria symptoms, transmission and prevention ,nature of housing), anthropogenic ,demographic (age, gender, family size) and of selected sample (participants).This task was carried out by the researcher.

3.8. Collection of Malaria Health Record

Data that show the past trend and prevalence of malaria as well as the type of species of malaria detected from 2001-2010 E.C /2009-2018/ (Table 6) were collected from the Hospital record office.

3.9. Collection of Climate Data

Regarding average annual temperature (^oC) and average annual rainfall (mm), and humidity (%) of the last ten years /2001-2010 E.C /2009-2018/ of the study area were collected from Gambella Town Metrological Station (appendix VI) .

3.10. Data Analysis

Coded data were exported into SPSS version-20 for analysis. The program was used to produce frequency distribution, calculate percentages, chisquere and p-value to ascertain the association between dependent and independent variable as appropriate. To determine the extent of relationship between climate factors and malaria prevalence, Pearson's correlation analysis was used (Table 14 and/or appendix VII Figure 2)

3.11. Data Quality Control

Before blood sample collection, slides were properly soaked in hot water, washed with distilled water, rinsed in denatured alcohol and cleaned with gauze. In addition, the glass slides were labeled in the field in such a way that the slide code was matching with the file of that particular individual. During blood sample collection one sterile lancet was used per person. The quality of the Giemsa staining solution, fixation chemical (methanol) and the microscope were checked before using directly. To ensure quality, the staining techniques and blood film examination were conducted according to standard protocols of World Health Organization (Garcia, 2001).

3.12. Ethical Consideration

Ethical approval was obtained from the institutional review board of the Ethical Committee Gambella Hospital. Before conducting the investigation, the investigator has discussed with concerned bodies in the study area and their agreement were obtained after the objectives and purposes of the study were explained. All the study participants were clearly informed about the purpose of the study and kindly asked to participate and permission were obtained before the actual investigation. They were insured that any information concerning them were never be used by anybody or institution. For those found positive, I have advised them to visit the physician (Doctor).

4. RESULTS AND DISCUSSIONS

4.1. Socio-Demographic Characteristics of the Respondents

A total of 400 respondents were included in the present study, of which 176(44%) were male and the rest 224(56%) were female (Table 2). Of thes total study participants, 243(60.8%) were never married, 149(37.3%) were married, 2(0.5%) were widowed, 6(1.5%) were divorced. One hundred twenty nine (32.3%) individuals were <5 years old, 105(26.3%) belong to the age group 5-19, 117(29.3%) in 20-34 years, and 49(12.3%) were belong to ≥35 years old.

Regarding family size, 201(50.3%) respondents had <5 persons and 199(49.8%) had ≥5 persons per family. Of the total respondents, 305(76.3%) were low land dwellers, while the rest 85(21.3%) and 10(2.5%) were midland and highland dwellers respectively. There was high population movement 390(97.5%) in the study area which may be significant factor for the prevalence of malaria in the study area (as people move from one place to another place and change the environment, they introduce new technologies to the area and increase their own likelihood of acquiring or spreading malaria transmission. As it was depicted in the Table 2, 7(1.8%) people lived less than one year, 124(31%) 1-5 years, 82(20.5%) 6-10 years, 77(19.3%) more than ten years and 110(27.5%) people were lived since birth. One hundred thirty two (33%) respondents were illiterate, 100(25%) attended school grade 1-4, 10(2.5%) atteneded grade 5-8, 80(20%) grade 9-12 and the rest 78(19.5%) were attended above grade 12. With regard to the monthly income of the study participants, most 313(78.3%) had less than 500 Ethiopian Birr, while the rest 78(19.5%) more than 1000 and 9(2.3%) had 500-1000 Birr.

As it is shown in Table 2, 188(47%) were students, 4(1%) were farmers, 19(4.8%) were merchants, 96(24%) were government employees, 27(6.8%) were house wives, 10(2.5%) were daily laborers, 51(12.8%) had no job and the rest 5(1.3%) study participants were private workers.

Table 2. Some socio-demographic characteristics of study participants in Gambella Regional Hospital, Gambella town, South Western Ethiopia during September-October, 2018

Characteristics	Categories	Frequency	Percent
Gender and Age Group	Male	176	44
	Female	224	56
	<5	129	32.3
	5-19	105	26.3
	20-34	117	29.3
	≥35	49	12.3
Marital status	Single	243	60.8
	Married	149	37.3
	Widowed	2	0.5
	Divorced	6	1.5s
Family size	<5	201	50.3
	≥5	199	49.8
Current place of residence	Lowland	305	76.3
	Midland	85	21.3
	Highland	10	2.5
Population movement	Yes	390	97.5
	No	10	2.5
How long have you lived in the area	<1	7	1.8
	1-5	124	31
	6-10	82	20.5
	≥10	77	19.3
	Since birth	110	27.5
Level of education	Illiterate	132	33
	1-4	100	25
	5-8	10	2.5
	9-12	80	20
	>12	78	19.5
Occupation	Farmer	4	1
	Merchant	19	4.8
	Government employee	96	24
	Student	188	47
	House wife	27	6.8
	Daily lobor	10	2.5
	Has no job	51	12.8
	Private	5	1.3
Monthly income(Ethiopian Birr)	<500	313	78.3
	500-1000	9	2.3
	≥1000	78	19.5

4.2. Respondents’ Knowledge and Awareness about Transmission of Malaria

Most participants 383(95%) replied that they had malaria but fewer 17(4.3%) did not have malaria in their life time (Table 3). Similarly 289(75.1%) responds had malaria in the last 6 months while 96(24.9%) replied that they had no malaria. In relation to their age and tendency to have malaria, of two hundred eighty nine, 272(94.1%) had malaria who belonges to the age <5 years old and the rest 17(5.8%) belong to age group ≥5 years old. This was in agreement with report of WHO (2015): in which Children under 5 years of age and pregnant women, non-immune individuals and migrants are the worst affected by malaria.

With respect to the cause of malaria, 194(48.5%) replied sanitation, 10(2.5%) hot weather, 177(44.3%) by mosquito and 19(4.8%) said due to *Plsmodium*. This shows that they had little knowledge about the cause of malaria. This result is different from a study done in Jima (Alemu *et al.*, 2011a) but similar to the qualitative study done in Oromia and Amhara Regional States (Addis Continental Institute of Public Health (ACIPH), 2009).That means the majority of respondents’ knew that malaria is caused by a mosquito bite without specifically identifying any biological causative agent. As it was reported, 238 (59.5%) respondents replied that they heard health related education and 162(40.5%) did not (Table 3).

Regarding the transmission of malaria, 383(95.8%) of the study participants replied that, malaria was transmissible from one person to another by the bite of infected female mosquitoes, while the rest 12(3%) and 5(1.3%) [much smaller to the study conducted in Jima town (11.3% and 21.3% respectively) (Alemu *et al.*, 2011a)] showed that malaria could not be transmitted and had no knowledge about it respectively.

In relation to modes of transmission of malaria, 361(90.3%) of the respondents replied that it was transmitted through mosquito bite. This was relatively higher figure compared to the reports made (88%) from Hadero Town, Southern Ethiopia (Zemede, 2015). This showed that they had a good knowledge about how malaria is transmitted. While the rest replied that malaria is transmitted through body contact 7(1.8%), 9(2.3%) unprotected water, 2(0.5%)

polluted environment, 4(1%) cold environment, and 17(4.3%) had no knowledge how it was transmitted.

Regarding to the mosquito biting time, 341(85.3%) replied that mosquito bites at night time which was higher the report from Pawe General Hospital 78.6% (Habtamu Amsalu, 2017). This showed that on average they had a good knowledge about the mosquito biting time. In addition, the respondents replied about mosquito biting time as day time 25(6.3%), day and night 18(4.5%), and the remaining did not know 16(4%).

With respect to the breeding sites of mosquito, most 365(91.3%) were replied that stagnant water was the main place where mosquitos breed. This was somewhat higher than a similar research (78.4%) done in Jima (Alemu *et al.*, 2011). However, 18(4.5%) in soil, 11(2.8%) in running water, 6(1.5%) did not know where it breed. When compared to the report from Adama district, Oromia Regional State, Ethiopia (Gezahagn, 2013), it is much smaller (7.3%, 20.7% and 25.3% respectively). In order to eliminate malaria, it is important to have understunding about the breeding sites of malaria vector/ mosquito: then eliminate these sites so that significantly reduce the mosquito population. As a result the rate of malaria transmission becomes reduced.

Table 3. Level of Knowledge and awareness about transmission, seeking behavior of respondent about malaria of in Gambella Regional Hospital, Gambella town south weastern Ethiopia, 2018.

Variable	Categories	Number	Precent
Have you ever had malaria?	Yes	383	95.8
	No	17	4.3
Is there anybody who had malaria in the last 6 month?(385)	Yes	289	75.1
	No	96	24.9
Family members who had malaria in the last 6 month(289)	<5	272	94.1
	≥5	17	5.9
Cause of malaria	Sanitation	194	48.5
	Hot weather	10	2.5
	Mosquito	177	44.3
	Plasmodium	19	4.8
Have you ever heard of health related education	Yes	238	59.5
about malaria?	No	162	40.5
Is malaria transmissible disease?	Yes	383	95.8
	No	12	3
	I don't know	5	1.2
Mode of transmission	Through mosquito bite	361	90.3
	Through body contact with patients	7	1.8
	Use of unprotected water	9	2.3
	Polluted environment	2	0.5
	From cold environment	4	1
	I don'n know	17	4.3
Mosquito biting time	Day time	25	6.3
	Night time	341	85.3
	Day and night	18	4.5
	I don't know	16	4
Mosquito breeding site	In soil	18	4.5
	Running water	11	2.8
	In stagnant water	365	91.3
	I don't know	6	1.5

4.3. Level of Knowledge and Awareness about Prevention and Treatment Seeking Behavior of Respondent about Malaria

Out of the total respondents, 371(92.8%) replied that malaria was preventable disease which is almost same as the crossesectional study conducted at East Shewa Zone of Oromia Regional State (Tadesse *et al*.,2018), but fewer participants, 14(3.5%) replied that it was not preventable and 15(3.8%) did not know whether it was preventable or not (Table 4).

In relation to methods used in preventing malaria, out of total respondents, 143 (35.8%) replied that by using ITN [smaller than from the study (75.7%) conducted at Habru Woreda, North Wollo zone,Amhara Region, Ethiopia (Anwar,2015)], 82(20.5%) by taking tablet, 9(2.3%) were by spraying household with insecticide, 93(23.3%) environmental sanitation. Similarly 61(15.3%) respondents replied malaria prevent by burning animal dung and tree leaves and the rest 12(3%) did not know how to prevent malaria. With regard to getting heath service from the hospital, most of the study participants 267(66.8%)s said that the health service was not good but 133(33.3%) replied that there was good health service in the study area.

As it was reported from PHI (2015) the prevalence of malaria and vector growth were affected by climate (rain fall, temperature and humidity). With regard to this, 234(58.5%) respondents were supported it, while 74(23%) did not support and 92(23%) replied that it could not be determined whether it affect or not. In relation to rainy season and number of mosquito, 216(54%) were replied that during rainy season the number of mosquito increase. The rest 83(20.8%) were did not, and 101(25.3%) participants could not determinene. Rain may prove beneficial to mosquito breeding if moderate, but it may destroy breeding sites and flush out the mosquito larvae when it is excessive. In geneneral the rainy season and number of mosquito have direct relationship (Tong *et al.*, 2003).

It was reported that most 290(72.5%) respondents confirmed the availability of suitable place for mosquito breeding.

As it is shown in Table 4, most 279(69.8%) have chosen health center/hospital, 72(18%) and 49(12.3%) have chosen traditional healers and private clinic for treatments respectively.

Table 4. Level of Knowledge and awareness, prevention and treatment seeking behavior of respondent about malaria of in Gambella Regional Hospital, Gambella town south western Ethiopia, 2018

Variable	Categories	Number	Precent
Is malaria preventable disease?	Yes	371	92.8
	No	14	3.5
	I don't know	15	3.8
Methods of preventing malaria	Take tablete	82	20.5
	House hold spray with insecticide	9	2.3
	Environmental sanitation	93	23.3
	Use of ITN	143	35.8
	Burning animal dungs andtree leaves	61	15.3
	I don't know	12	3
Does the Hospital provide good service?	Yes	133	33.3
	No	267	66.8
Are rain fall, temperature and humidity influence vector growth?	Yes	234	58.5
	No	74	18.5
	Unknown	92	23
Does rainy season increase the number of mosquitoes ?	Yes	216	54
	No	83	20.8
	Unknown	101	25.3
Are there suitable place for mosquito breeding	Yes	290	72.5
	No	110	27.5
Distance of the house from mosquito breeding site (mainnly Baro river)	<1000m	200	70.4
	1000-2000	65	22.9
	≥2000	19	6.7
Choice of treatment center	Traditional healer of villages	72	18
	Health center(Governmental)	279	69.8
	Private clinic	49	12.3

Figure 7 shows the levels of study participants' knowledge and awareness about symptoms of malaria in the study area. Of the respondents, majority were replied fever was the main symptoms of malaria. This is agreed with study on malaria prevention and control in Ethiopia done by Degene (2014). Generally, the respondents' report showed fever, headache, chills and joint ach were the common symptoms of malaria. Some also said loss of appetite, vomiting, shivering.

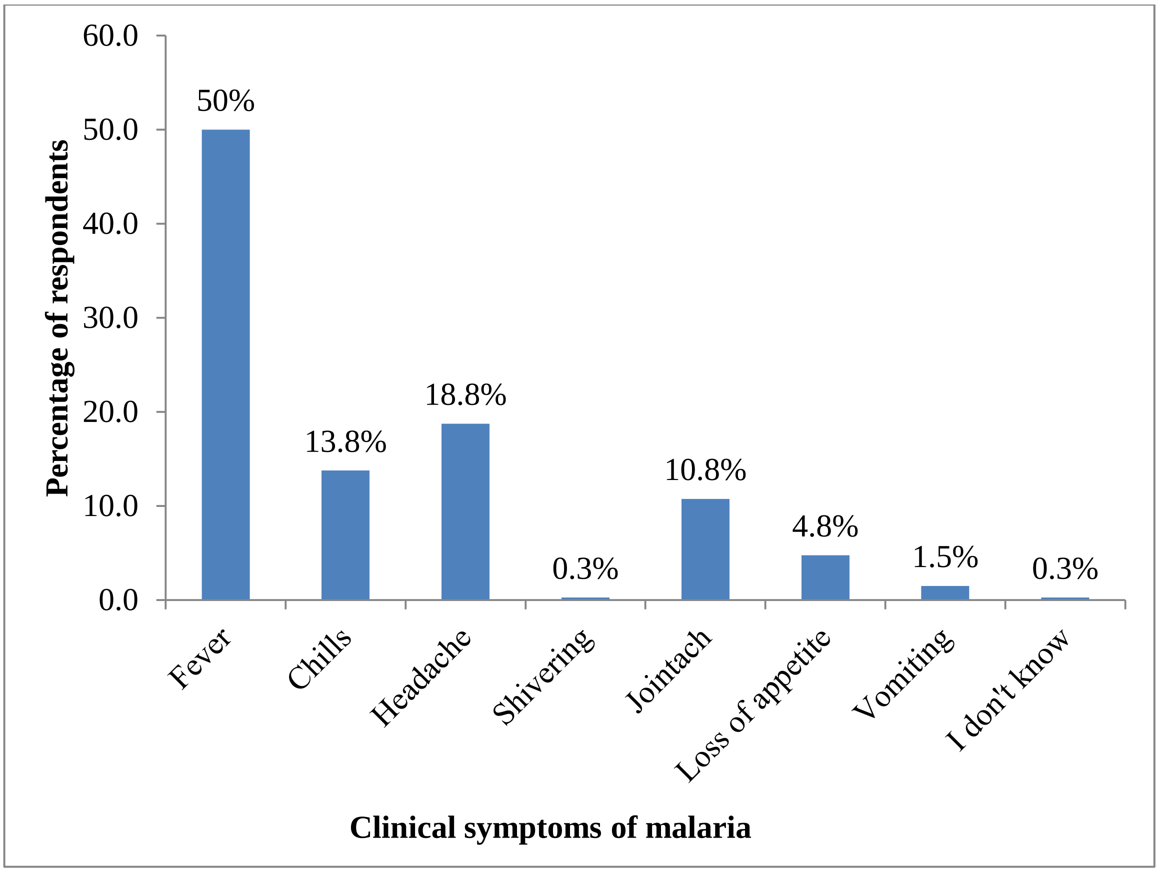

Figure 6. Levels of study participants' knowledge and awareness about symptoms of malaria in the study area

4.4. ITN Possession, Utilization and Practice by Respondents

Almost all 380(95%) participants owned ITN but the rest 20(5%) didn't. Out of total study participants, 228(60%) using ITN which was higher than that of the region's ownership a comparing to the report of Ethiopian national malaria indicator survey (42%). The remaining 152(40%) did not use the ITN. This was similar to a study conducted in Oromia and Amhara

Regions (ACIPH, 2009). Regarding the number of bed net possession, most had (49.5%) one ITN per a family which was smaller than the regional ownership 59% (MOH, 2017). In relation to who used ITN, 211(92.5%) study participants replied that ITN was used by all family members. As the respondents gave different reason for not using ITNs: 3(2%) unable to understand, 2(1.3%) expensive, 147(96.7%) affect the body (Table 5).

Regarding the source of ITN, most have obtained it from market [as the respondents replied, the number of ITN free distributed by the Government is not enough as compared with population size of the town]. With respect to duration of using ITN and frequency, most (44.3%) of the study participants had used it for one year and use every night (71%). Of the total study participants 319(83.9%) were washing the ITN and 61(16.1%) were not. However, all study participants did not re-treate their ITN .Three hundred four (80%) could hang their ITN correctly.

Table 5. ITN possession, utilization and practices of the respondents

Variable	Categories	Number	Percent
ITN possession(400)	Yes	380	95
	No	20	5
Are you using ITN now?(380)	Yes	228	60
	No	152	40
Number of ITN(380)	1	188	49.5
	2	120	31.6
	3	72	18.9
Who use ITN in your home?(228)	All family members	211	92.5
	Father and mother only	1	0.4
	Children only	8	3.5
	Pregnant	8	3.5
Reason for not using ITN(152)	Unable to understand	3	2
	Since it is expensive	2	1.3
	Affect the body	147	96.7
Where did you get the ITN?(380)	Freely from the government	141	37.1
	Purchased	165	43.4
	From NGO	74	19.5
For how long have you used the ITN?(228)	For the last 6 month	50	21.9
	For the last one year	101	44.3
	For the last two years	57	25
	For more than two years	20	8.8
How frequently do you use the ITN?(228)	Every night	162	71.1
	Most of the night	14	6.1
	Occasionally	14	6.1
	Only during malaria epidemics	38	16.3
Have you ever washed your ITN?(380)	Yes	319	83.9
	No	61	16.1
Have you ever retreated your ITN?(380)	Yes	0	0
	No	380	100
Can you hang ITN correctly(380)	Yes	304	80
	No	76	20

4.5. Trends of Malaria Infection among Patients Admitted at Gambella Regional Hospital Hospital over the past ten (2009-2018)

As it was shown in appendix VI, Table 7, with in the last ten years, 202,664 individual attended the Hospital. Of which 47,968(23.67%) were microscopically confirmed malaria cases. This report was six times more higher (35.8%) than the report from Mersa Health center, Habru Wereda, North Wollo (Anwar, 2017) but smaller (3.5%) compared to the similar study conducted in Hadero Health Center, Hadero town, southern Ethiopia (Zemede, 2015).This difference might be due to environmental and climate differences, topography variation and other related factors that affect the prevalence of malaria.

The retrospective record of the hospital showed that the highest and lowest prevalence of malaria was observed in year 2016(33.43%) and 2009(6.27%) respectively. As general overview, the trend of malaria prevalence in the last ten years was fluctuating (Figure 7): In the first three years (2009- 2011) it was continuously increasing (this might be due to increase annual rain fall, temperature, humidity and it might also associated with population movement and/or rapid urbanization) and then fluctuating in the next four years (2012-2015) and thenincreased in 2016 and finally decreasing continuously in the remaining two years (2017-2018).As Zemede (2017) stated quoting Abebe's reports (2012) this decrease in malaria prevalence might be related to availability of antimalarial drugs for treatment and increased attention to malaria control and prevention by the Government and other other bodies. The present study also showed that, the incidence of malaria was significantly affected by climatic variables (temperature, rainfall and relaive humidity): lowest incidence of malaria was seen in the year 2009 following the decrease in humidity and rain fall.The reason might be humidity was less than 60%: when humidity decreased to less than 60%, the life span of mosquito decreases and malaria transmission does not occure (Akinbobola and Omotosho, 2012).This showed that malaria transmission was directly related with relative humidity and rain fall (Appendix VI, Table 7).

The major plasmodium species identified in examined individual at Gambella Regional Hospital during the last ten years (2009-2018) were *Plasmodium falciparum and Plasmodium vivax* 96.92% and 3.08% respectively (appendix VI, Figure 7).

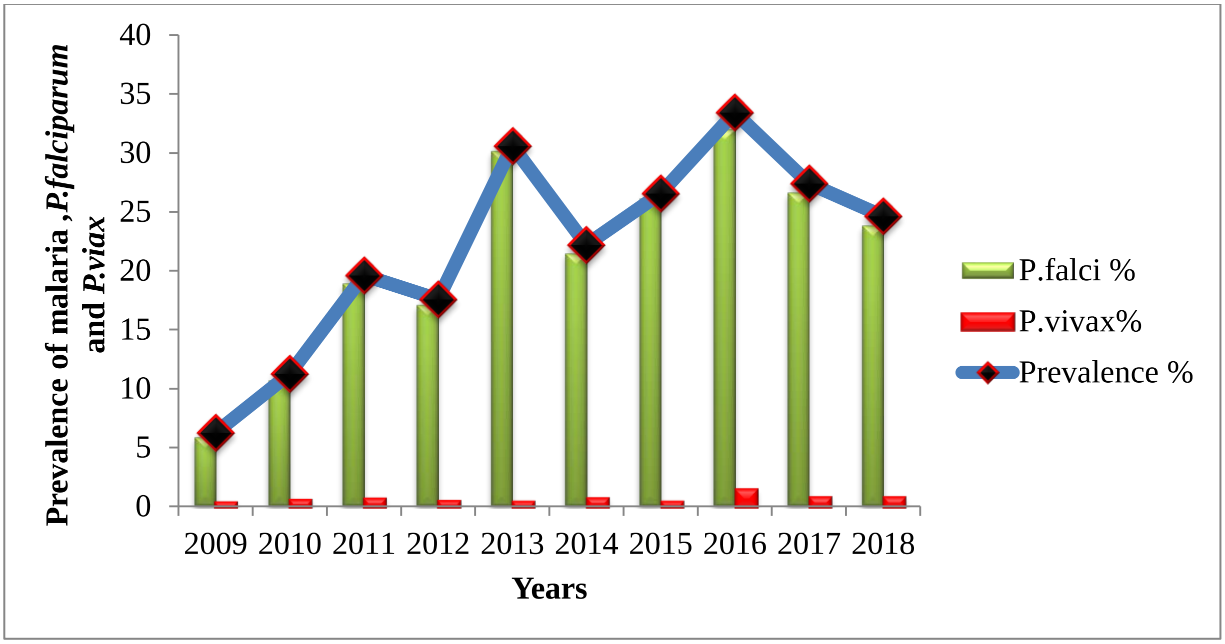

Figure 7. Trends of malaria prevalence in the past ten years (2009-2018)

4.6. Prevalence of Malaria among Individuals Who Visited Gambella Regional Hospital during the Study Period

In relation to malaria infection with age groups (Table 6) observed a relatively higher prevalence was seen in both genders in the age groups of 5-19 and 20-34: with prevalence of 36(34.3%) and 43(36.8%) respectively. However, smaller prevalence of *plasmodium* species were observed in the age group <5 years and in ≥35 age groups: 11(8.5%) and 5(10.2%) respectively.

Over all 95(23.8%) individuals were microscopically confirmed positive. Compared to national (10.4%-13.5%) and the region's prevalence (6%) as described by Aschalew and Tadesse (2016) and FMOH (2016) respectively, the study area was characterized by higher malaria prevalence. Of ninety five, 51(29%) were males and the remaining 44 (19.6%) were females which much higher from the regional prevalence (0.6% male, and 0.5% female) (MOH, 2017). Furthermore, this report was less than from a study done in Chichu and Wango Health centers, Southern Ethiopia (Belete and Roro, 2016) with 28.1% of prevalence. A comparison study of the 2012 and 2014 Malaria Indicator Surveys (MISs) conducted in Malawi (Zgambo *et al.*, 2017) had the prevalence of 28% and 33% respectively. However, it was three fold (7%) higher than the study conducted by Belayneh (2014).The observed difference might be due to the seasonality of malaria and the different control measures.

As it was shown in Table 6, there was significant difference ($p<0.05$) in the prevalence of malaria among the age groups .This was in agreement with a study conducted in Nigeria found that the difference in prevalence of *Plasmodium* species among the age groups was significant (Ilozumba and Uzozie, 2009). In contrast, a study conducted in Jiga area, Northwest Ethiopia (Seble, 2014) there was no significant difference ($p=0.844$) in the prevalence of malaria parasite between age groups.The report of the current study shows that the highest prevalence of malaria (*Plasmodium* species) was observed in the age group 20-34 years and that fit into conventional characterization of the epidemiology of malaria based on age stratification.

Table 6. Proportion of malaria by age and Gender of patients visiting Gambella Regional Hospital during September-October 2018.

Age (Year)	Male		Female		Both Genders		X^2	P-value
	No. Examined	No. Positive (%)	No. Examine	No. Positive (%)	No. Examine	No. Positive (%)		
<5	53	4(7.6)	76	7(9.2)	129	11(8.5)		
5-19	40	20(50)	65	16(24.6)	105	36(34.3)		
20-34	60	25(41.7)	57	18(31.6)	117	43(36.8)		
≥35	23	2(8.7)	26	3(11.5)	49	5(10.2)		
Total	176	51(29)	224	44(19.6)	400	95(23.8)	4.742	0.02*

* Significant at p<0.05

4.7. Major *Plasmodium* Species Identified among Examined Patients at Gambella Regional Hospital Hospital during (September –October 2018)

As shown in Table 7, *Plasmodium falciparum* 83(87.4%) and *Plasmodium vivax* 12(12.6%) were the major *Plasmodium* species identified during the study period. Similar report was recorded from study done in Ethiopia by Belayneh (2014) and CDC (2017). However, this result was not in agreeing with a study conducted at Chichu and Wonago Health centers, South Ethiopia by Belete and Roro (2016) with *P.falciparum* 35% and *P.vivax* 52.7% prevalence in the study area.

Of the total 95 positive slides, *P. falciparum* accounts for 83(87.4%) and *P. vivax* 12(12.6%) (Table 8) but this report is higher than a study conducted in Arbamich Hospital (Belayneh, 2014) with 64.3% *P. falciparum* and 10.7% *P.vivax* and the regional prevalence with 49% *P.falciparum* and 5% *P. vivax* (FMOH, 2016). This shows that *P. faciparum* was more frequently observed than *P.vivax* (FMOH, 2012).The high abundance of *P. falciparum* might be attributed to high temperature and humidity situation of the study area (Dogara and Ocheje, 2016).On the contrary, higher occurrence of *P. vivax* (70.41%) than *P. falciparum* (23.1%) was reported from Hallaba Health Center, Southern Ethiopia (Girum, 2014). The difference in parasite species occurrence may represent seasonal variations in the epidemiology of the parasite. Apart from seasonal variation, these differences may also relate to differences in clinical manifestation and treatment of infections (more severe symptom or the duration of infection) which affect parasite prevalence in the study (Bødker *et al*., 2006). Furthermore, *P. falciparum* predominates *P. vivax* during the period of increased transmission or epidemic years, while *P. vivax* is the predominant species during low transmission or non-epidemic years. Such temporal variations in the relative frequency of the two parasite species might be related to a decrease in temperature and the effect of antimalarial drugs used (Yeshiwondim *et al.,* 2009 and SGM, 2012).

Table 7. Major *Plasmodium* species identified in among patients at Gambella Hospital from September-October 2018.

Age Groups in years and Gender	No Examine	No Positive (%)	*P. falciparum*	*P. vivax*
			No Positive (%)	No Positive (%)
<5				
Male	53	4(7.5)	4(100)	0
Female	76	7(9.2)	7(100)	0
5-19				
Male	40	20(50)	18(90)	2(10)
Female	65	16(24.6)	14(87.5)	2(12.5)
20-34				
Male	60	25(41.7)	20(80)	5(20)
Female	57	18(31.6)	16(88.9)	2(11.1)
≥35				
Male	23	2(8.7)	2(100)	0
Female	26	3(11.5)	2(66.7)	1(33.3)
All age groups				
Male	176	51(29)	44(86.3)	7(13.7)
Female	224	44(19.6)	39(88.6)	5(11.4)
Total	400	95(23.8)	83(87.4)	12(12.6)

4.8. Association of Major Risk Factors (Socio-Demographic Factors) with Malaria Parasite Infections of Examined Individuals

As depicted in Table 8, the association between malaria positive individuals and some socio-demographic factors presented for the study area. A total of 400 respondents were included in the present study, of which 51(29%) males and 44 (19.6%) females were infected with malaria parasite. This study showed that more males infected than females. This higher prevalence rate for males might be due to the fact that males engage in activities which make them more prone to infective mosquito bite as compared to females counter parts which are mostly stay at home and protected from such infective bite (Andulem, 2009). This study was in proportion with study (males 4% and female 3%) conducted in Arbaminch Hospital, Southern Ethiopia (Belayneh, 2014). However, a cross-sectional study conducted in Hallaba Health Center reported opposite to this study's result: More females (57.4%) had malaria parasite than males (42.6%) (Girum, 2014). Gender had statistically significant association with malaria infection ($p=0.029$). This was in agreement with same study (in Arbaminch Hospital) ($p=0.001$). However, the present study was disagreeing ($p=0.74$) to the survey in Amhara, Oromia and SNNP regional states (Graves *et al*., 2009).

The prevalence of malaria with age groups was different, highest, 43(36.8%) malaria prevalence is the the age group of 20-34 years old and followed by 36 (34.2%), 11(8.5%) and 5(10.2%) in the age group 5-9, <5, and ≥35 years old respectively. The prevalence of malaria infection was strongly associated ($p=0.00$) with age groups of the study participants. This was similar with study done by Girum (2014) ($p<0.05$). In contrast to this report, a study conducted in Hadero Health Center, Southern Ethiopia showed that no significant difference ($p>0.05$) between age groups and malaria occurrence (Zemede, 2015).

As shown in Table 8, there was higher malaria prevalence 52(25.9%) in household with below five family size than a household with five and above family size 43(21.6%).In this study the malaria prevalence did not show significant association ($p>0.05$) with family size. In contrary, a study on spatial modeling of malaria risk factors in Ruhuha sector in the East of Rwanda showed that malaria infection increase with household size and had significant association with each other (Tuyishimire *et al*., 2016). Additionaly, a study conducted to assess risk factors of malaria in Ethiopia showed that malaria prevalence rate was less for household with fewer people in the house (Dawit *et al*., 2013)

Malaria prevalence was similarly associated with geographic factors. The association between malaria and altitude showed that malaria prevalence is higher for households who are living at lower altitudes (Dawit *et al*., 2013).In Ethiopia areas below 2,000m altitude (low land) are considered at risk of malaria (FMOH, 2011).Similarly, the present study showed that, the prevalence of malaria was increasing from highland (10%) to midland (23.5%) then lowland (24.3%).

The study participants who had lived since birth had low prevalence of malaria which was similar with other study (Okwa, 2012). However, there was no statistically significant difference between the place of residence and the prevalence of malaria (p=0.56). Other factors such as work opportunities and resettlement programs in malaria endemic areas can easily attract a huge number of people, making them vulnerable to the disease since migrants from malaria free areas do not have immunity and can easily acquire the disease (Table 8 and WHO, 2006).

Many studies showed that malaria is associated with socio-economic factors, maily influenced by poverity level (Dawit *et al*., 2013). That is why it said to be disease of poverity. This means the wealthier household who can afford to have the three basic human needs (cloth, food and shelter), have sufficient bed nets, less affected by malaria. Even though there was no statistical significant association in malaria prevalence between monthly incomes of the study participants, more cases of malaria were observed in those who had lower income. The present study was not agreeing with the study conducted in Jimma town, South-West Ethiopia (Alemu *et al*., 2011).

Table 8 . Association of major risk factors (socio-demographic factors) with malaria parasite infections of examined individuals in Gambella Regional Hospital during September-October 2018

Risk factors	No_ of examine (%)	Malaria infection Positive Freq(%)	X^2-test	P- value
Gender			4.742	*0.029
Male	176(44)	51(29)		
Female	224(56)	44(19.6)		
Age group			38.83	*0.00
<5	129(32.2)	11(8.5)		
5-19	105(26.2)	36(34.2)		
20-34	117(29.2)	43(36.8)		
≥35	49(12.2)	5(10.2)		
Marital status			10.93	*0.012
Single	243(60.8)	51(21)		
Married	149(37.2)	42(28.2)		
Widowed	2(0.5)	2(100)		
Divorced	6(1.5)	0		
Family size			1.00	0.32
<5	201(50.2)	52(25.9)		
≥5	199(49.8)	43(21.6)		
Current place of residence			1.09	0.56
Lowland	305(76.2)	74(24.3)		
Midland	85(21)	20(23.5)		
Highland	10(2.5)	1(10)		
Population movement			0.085	0.771
Yes	388(97.5)	93(24)		
No	10(2.5)	2(20)		
How long have lived in the area			2.06	0.72
<1	7(1.8)	2(28.6)		
1-5	124(31)	31(25)		
6-10	82(20.5)	20(24.4)		
>10	77(19.2)	21(27.3)		
Since birth	110(27.5)	21(19.1)		
Monthly income(Ethiopian Birr)			5.48	0.07
<500	313(78.2)	74(23.6)		
500-1000	9(2.2)	5(55.6)		
>1000	78(19.5)	16(20.5)		

* Significant at P< 0.05

As shown in Table 9, 32(24.2%) were illiterate, 10(10%) grade 1-4, 4(40%) grade 5-8, 23(28.8%) were grade 9-12 and the rest 26(33.3%) were attained above grade 12.There was significant association between educational level and malaria infection prevalence in the study area (p<0.05). A report from Rewanda indicated that low level of education could be one of the causes of underlying malaria prevalence (Tuyishimire *et al*., 2015).

Occupations may bring people into contact with infected *Anopheline* mosquitoes. In relation to occupation, the present study's report show that there was a significant difference between the prevalence of malaria and occupation (p=0.03) (Table 9). Similar report made from the Sudan indicated that risk of malaria attack was significantly associated with occupation of household (El-Gayoum *et al*., 2009). In contrast, a study conducted in some selected rural villages around Arbaminch town southern Ethiopia, showed that no significant difference (p=0.3) in malaria cases between farmers and non-farmers.

Table 9. Relationship between malaria and level of education and occupation among study participants Gambella Regional Hospital during September-October 2018.

Risk factors	No of examined (%)	Malaria infection Positive Freq(%)	X^{2-}test	P- value
Level of education			16.98	*0.02
Illiterate	132(33)	32(24.2)		
1-4	100(25)	10(10)		
5-8	10(2.5)	4(40)		
9-12	80(20)	23(28.8)		
>12	78(19.5)	26(33.3)		
Occupation			21.7	*0.003
Farmer	4(1)	4(100)		
Merchant	19(4.8)	5(26.3)		
Government employee	96(24)	26(27.1)		
Student	188(47)	33(17.6)		
House Wife	27(6.8)	5(18.5)		
Daily labrer	10(2.5)	4(40)		
Has no job	51(12.8)	16(31.4)		
Ppivate	5(1.2)	2(40)		

* Significant at P< 0.05

4.9. Relationship between Malaria Prevalence and Participants' Knowledge, Practice, and Possession of ITN/Bed Net

By protecting people from being bitten by infected mosquitoes, LLINs are an effective tool to significantly reduce morbidity and mortality due to malaria (FMOH, 2012). A study conducted to assess risk factors of malaria in Ethiopia indicated that having more bed nets was one means of reducing malaria and households which were unable to afford sufficient mosquito nets, due to large family and low incomes are affected by malaria (Dawit *et al*., 2013). ITNs ownership was evidenced among positive malaria cases (23.4%) in the study area. Of total participants 380(95%) had ITNs and 20(5%) did not owne it. The present study was higher compared the study (91%) conducted in Amhara and Oromia Regions (Mark, 2007). The present study showed that those who had no ITN were more infected. However there was no statistical difference ($p>0.05$) in prevalence of malaria between ITNs possession of study participants.

Knowledge about malaria and the importance of sleeping under LLITNs is another the basis for bringing about behavioral change, the next step in public utilization of increasing utilization of rate of LLITNs.With regard to utilization of ITN, 228(60%) replied that they were using ITN [but this was smaller compared to statistics of the region (75%)] (FMOH, 2012) and 152(40%) did not use with different reasons. There was no significant association ($p= 0.77$) between malaria prevalence and utilization of ITNs. Individuals who had and using ITN were less likely to get malaria parasite than those who had not using it (Table 12). The present study was in line with study conducted in Shewa Robit, northern Ethiopia (Andargie *et al.*, 2013) and with the study conducted at Chichu and Wango Health Centers, South Ethiopia (Belete and Roro, 2016).

The present study indicated that individuals who had more than three ITN per household were less (12.5%) likely to get malaria parasite thansps those who had one and two ITN per households. However, the present study showed that the relation between numbers of ITN owned by household and malaria parasite prevalence was not significant ($p=0.14$). On the contrary to the present study, Seble (2014) reported that households with lesser number of ITNs were significantly at greater risk than with more ITN.

As indicated by FMOH (2012) family size and the number of nets per house are related to the prevalence of malaria. As number of ITN owned by household increase, the prevalence of malaria parasite decrease which was supported or observed in the present study.

As it was shown in Table 10, out of the study participants, 211(95.5%) replied that ITN was used by all family members which is comparable to a study (51%) done by Mark (2007) and resulted in higher malaria parasite prevalence. Similar report was made from a study conducted at Chichu and Wonago Health Center, South Ethiopia (Belete and Roro, 2016).

Table 10 .Relationship between malaria prevalence and participants' knowledge, practice, and possession of ITN/bed net.

Risk factors	No_ of examine (%)	Malaria infection	X^2-test	P- value
		Positive Freq(%)		
ITN possession			0.45	0.5
Yes	380(95)	89(23.4)		
No	20(5)	6(30)		
Do you using ITN now?			0.09	0.77
Yes	228(60)	54(23.7)		
No	152(40)	38(25)		
Number of ITN			4	0.14
1	188(49.5)	50(26.6)		
2	120(31.6)	30(30)		
3	72(18.9)	9(12.5)		
Who use ITN in your house?(228)			5.2	0.15
All family members	211(92.5)	45(21.3)		
Father and mother only	1(0.4)	1(100)		
Children only	8(3.5)	3(37.5)		
Pregnant	8(3.5)	5(62.5)		
Reason for not using ITN(152)			0.41	0.82
Un able to understand	3(2)	1(33.3)		
Since it is expensive	2(1.3)	1(50)		
Affect te body	147(96.7)	36(24.5)		
Where did you get the ITN?(380)			1.59	0.45
Freely from the Government	141(37.1)	30(21.3)		
Purchased	165(43.4)	45(27.3)		
From NGOs	74(19.5)	14(18.9)		

Insecticide-treated bed nets are nets dipped in a pyrethroid insecticide solution. This treatment creates a physical barrier or a “halo” around the net, repelling or killing the mosquitoes. Each ITN can last up to 12 months before needing to be re- treated with insecticide. Long-lasting insecticide treated nets (LLITNs) are increasingly popular, as they last longer than traditional ITNs, repelling mosquitoes for up to four year (Aschalew and Tadesse, 2016).Therefore duration of using ITNs is an important factor that affects the prevalence of malaria.There was significant difference between duration of using ITN and prevalence of malaria ($p<0.05$). Furthermore, the time by which ITNs use is another factor: As it was shown in Table 13, 162(71.1%) individuals had slept under ITN every night. This was larger compared to the studies (53.2%, 65% respectively) conducted by Aschalew and Tadesse (2016) and Mark (2007). Induviduals who used only during malaria epidemics were the most affected (50%). significant association ($p<0.05$) between malaria prevalence and how frequently used ITN was observed and individual who had used every night were less infected compared to others.

It was reported that individuals who had washed their ITNs tend to have malaria parasite, higher (24.1%) than those who did not wash. However, there was no significant relationship between malaria prevalence and use of washed or unwashed ITNs ($p=0.36$). The present study depicted that all individuals who could not re-treated bed net might enhanced their chance of infecting with malaria parasite (23.4%).

As shown in Table 13, individuals who were able to hang ITN corectly less (20.7%) likely to have malaria than those who could not hang correctly (34.2%). There was significant association ($p<0.05$) between skill of hanging ITN correctly and malaria prevalence.

Table 11 .Relationship between malaria prevalence and participants' knowledge, practice, and possession of ITN/bed net.

Risk factors	No_ of examine (%)	Malaria infection	X^2-test	P- value
		Positive Freq(%)		
For how long have you used the ITN? (228)			28.64	*0.00001
For the last 6 month	50(21.9)	1(2)		
For the last 1one year	101(44.3)	17(16.8)		
For the last two years	57(25)	20(35)		
For more than two years	20(8.8)	16(80)		
How frequently do you use ITN?(228)			9.93	*0.02
Every night	162(71.1)	28(17.3)		
Most of night	14(6.1)	4(28.6)		
Occasionally	14(6.1)	3(21.4)		
Only during malaria epidemics	38(16.7)	19(50)		
Have you ever washed your ITN?(380)			0.36	0.55
Yes	319(83.9)	77(24.1)		
No	61(16.1)	12(19.7)		
Have you ever re-treated your ITN?(380)				
Yes	0(0)	0(0)		
No	380(100)	89(23.4)		
Can you hang ITN correctly?			6.17	*0.01
Yes	304(80)	63(20.7)		
No	76(20)	26(34.2)		

* Significant at P< 0.05

4.10. Correlation between Climate and Malaria Cases

Many factors play a role in the distribution of malaria; climate variability has shown to be a major determinant. Rainfall is one of climate factors that play important roles in malaria epidemiology because water not only provide medium for aquatic stage of mosquito life cycle but also increase the relative humidity and then the longevity of adult mosquitoes (Addisu *et al.,* 2014). Temperature is the second climate factor affects that directly the developmental period in the life cycle of mosquitoes; blood feeding rate, gonotrophic cycle and longevity.

As figure 8 shows the maximum humidity and rainfall of last ten years indicated in May-October were the season in which the main malaria transmission of the year occured.

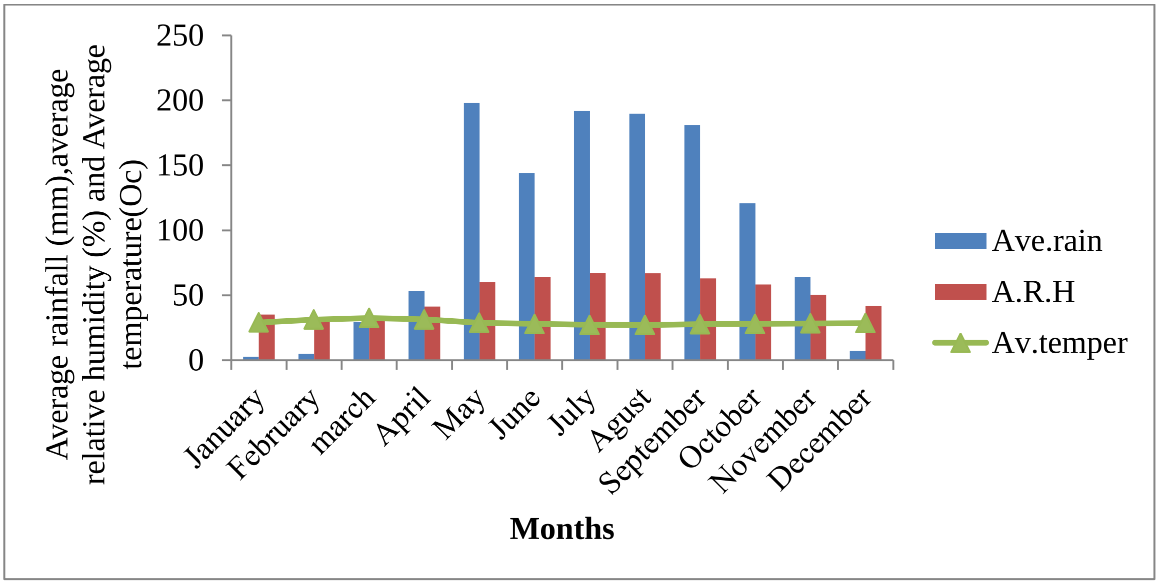

Figure 8. Meteorological data: Average rainfalls (mm) mean monthly relative humidity (%) and average temperature (^{o}C) of the study area (from Gambella Town Meteorological station for ten consecutive years 2009 - 2018).

As it was shown in appendix VI Table 1, the average mean temperature for the whole period of Gambella Town from January to December 2018 was 28.78$^{o}{}_{C}$.The highest and lowest mean temperature were observed in February and July respectively (Figure 9). Highest malaria cases and rainfall was observed in August and lowest in January. This showed that there was positive relationship between malaria prevalence and rainfall. Regarding the monthly maximum temperature, the highest and lowest was seen in February and July respectively (Appendix VI-Table 1).

To determine the extent of relationship between climate factors and malaria prevalence, Pearson's correlation analysis was used. As it was shown in (Table 12 and/or appendix VII Figure 1), maximum temperature was negatively (moderate strength) correlated with prevalence of malaria (r=-0.52, p=0.084). In this report malaria prevalence was observed based on parasitological record for study the area during the study period (September-October, 2018). Similar study conducted in Adama District, Oromia Regional State, Ethiopia, showed that malaria prevalence was negatively associated with maximum temperature in lowlands as Gambella Town also lowland area (Gezahegn, 2013).

As it was depicted in Table 12, there was a weak association between monthly minimum temperature and prevalence of malaria (r=0.3, p=0.35).Similar report was made from Uganda (Niringiye and Douglason, 2010). In contrast, Alemu *et al.* (2011b) have shown that the prevalence of malaria was strongly (positively) associated with minimum temperature. Furthermore, study conducted in Ghana found inverse relationship between malaria prevalence and minimum temperature (Dannour *et al.*, 2010; Mohammadkhani *et al.*, 2016).

With regard to rainfall, it was strongly and positively associated with occurrence of malaria (r=0.66, p=0.02). A study conducted on temporal correlation analysis between malaria and metrological factors done by Huang *et al.* (2011) was inagreement with present study .In contrast,a report made from Ghana (Danour *et al.*, 2010) and Adama District, Oromia Regional State, Ethiopia (Gezahegn, 2013) showed that rainfall in a given month was found to have a negative effect on malaria prevalence. As it was shown in Table 14 relative humidity was positively correlated with the prevalence of malaria (r=0.65, p=0.02). This was similar to the study done by Gezahegn (2013).

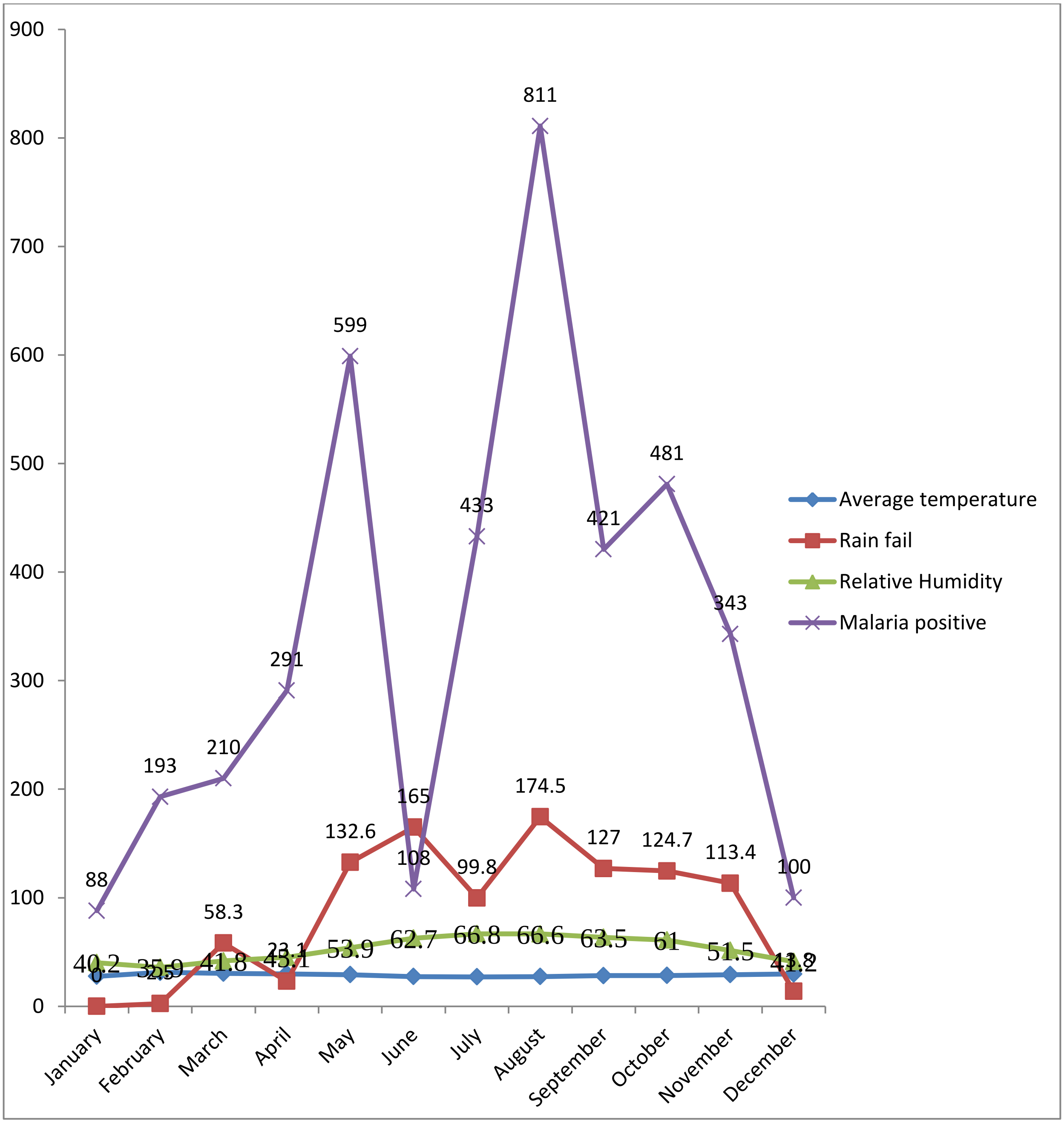

Figure 9. Confirmed malaria cases with Monthly total rain fall (mm), average temperature (^{O}C) and R.H (%) in the study area

Table 12. Correlation between climate factors and monthly malaria cases in Gambella Regional Hospital, January –December,2018.

Variables	Pearson's Correlation (r) of monthly prevalence
Maximum temperature (^{O}C)	-0.52(p=0.084)
Minimum temperature (^{O}C)	0.3(p=0.35)
Rain fall (mm)	0.66(p=0.02)
Relative humidity (%)	0.65(p=0.02)

As it was seen in Table 12, rain fall and minimum temperature showed the the greatest and smalles correlation with malaria prevalence respectively. Among the meteorological variables, relative humidity and rain fall showed showed the greatest correlation with malaria incidence (Table 12). The correlation coefficients for the association for rainfall and relative humidity with malaria incidence were also greater than the other climatic variables. This showed that rain fall and relative humidity are the key climatic variables that affect the transmission of malaria (Huang *et al.*, 2011; CDC, 2015). In general except maximum tempreture, the rest climatic variables were positively correlated with malaria cases (Appendix VII, Figure 1-4).

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary

Malaria is still a major public health and economic problem in many parts of the world, especially in countries of tropics and subtropics such as in Africa, South East Asia, and Latin America. Malaria is a sever disease in Ethiopia, 75% of the land are malarias' areas and more than 52 million people are vulnerable. *Plasmodium falciparum* and *P. vivax* are commonly known species in Ethiopia are to cause malaria accounting for 60% and 40%, respectively. The main objective of the study was to assess malaria prevalence and associated risk factors among patients attending Gambella Regional Hospital, west Ethiopia. The study involved cross-sectional survey for monthly malaria prevalence cases, use of retrospective Hospital records and use of laboratory results. The study was carried out from September-October, 2018. In addition to this, pretested structured questionnaires were distributed to the study participants to assess the socio-demographic characteristics, level of knowledge and awareness of study participants about malaria and their bed net ownership and utilization practice. In order to determine the prevalence of malaria, blood samples were collected from 400 study participants by prinking their figures after cleaning it with alcohol moistened cotton. Thick and thin blood films were made on slides to determine the positivity of the parasite and the specie type respectively. Finally each slide were stained and examined microscopically.

The study showed that the respondents had a good knowledge on how malaria is transmitted (90.3%), prevented and controlled. Additionally, most respondents replied that stagnant water (91%) was the main place were mosquito breed. Regarding health services of the Hospital; it was not good so that the respondents could not get treatment effectively which in turn enhanced the prevalence of malaria in the study area. With respect to the causative agent, almost all respondents replied other than *Plasmodium:* this show that they had misunderstanding knowledge about it. Concerning the owning, practice and utilization of ITN, most owned it. However around 40% did not use in properly due to different reasons. As a result, those who had and used it were less likely to get malaria parasite than those who had not used it. Most of the barriers to utilization of nets owned can be addressed by wellconceived and organized communication integrated into distribution programs and supported by ongoing public communication efforts. A total of 400 blood samples were examined for malaria parasites and the overall parasite prevalence was (23.8%), out of this, the major plasmodium species identified were *Plasmodium falciparum* (87.4%) and *P. vivax* (12.6%).There were 6 times as many people infected with *P. falciparium* than *p. vivax.* There was significant difference ($p<0.05$) in the prevalence of malaria among the age groups. To examine the relationship between the monthly incidence of malaria parasite and monthly maximum and minimum temperature, monthly mean rainfall and mean relative humidity of the year 2018 correlation was done by applying Pearson's correlation analysis. As a result the present study found that the monthly malaria cases was negatively correlated with maximum temperature but, positively related with minimum temperature, rainfall and relative humidity.

5.2. Conclusions

The respondents had a good knowledge about the symptoms, ways of transmission, and methods of prevention of malaria. However, they did not know the causative agent of malaria which is plasmodium.Though almost all respondents had owned ITN but did not use it and those who had ITN and used it were less likely to have malaria parasite than those who did not use it.

In general the trends of malaria prevalence in the last ten years was fluctuating: In the first three years (2009- 2011) it was continuously increasing and then fluctuating in the next four years (2012-2015) and thenincreased in 2016 and finally decreasing continuously in the remaining two years (2017-2018).The present studyalso confirmed that more males were infected by malaria prasite than female.

Plasmodium falciparum and *Plasmodium vivax* were the two major *Plasmodium* species identified in the study area.The study also showed Significant association between gender,age group,marital status, level of education and occupstionand malaria parasite infection

The present study result confirmed that the prevalence of malaria was negatively correlated with maximum temperature but positively associated with minimum temperature, rain fall and humidity.Malaria was serious public health in Gambella town which account for 23.8%.

5.3. Recommendations

Based on the results/findings of the study, the following points might be recommended.

- Stakeholders: the Regional health bureau, health workers must create special awareness about the cause, transmission, control of malaria parasite and appropriate utilization of ITNs.
- Health workers are not only expected to provide ITNs to the community but also continuous follow-up of the practical application (use) of ITNs at individual households.
- To decrease and eliminate malaria, the community should clear out and destroy the breading site of mosquitoes cooperatively and regularly.
- Ecological, entomological and epidemiological studies might be needed to assess the real risk factors that related with malaria prevalence in the study area.
- Further study on Community based utilization of long lasting insecticide treated nets is importan.

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7. APPINDICES

Appendix I. English consent/assent form

Dear sir/madam,

Greetings

I am Tesfagabr G/Eyesus. I work in Gambella secondary school and an MSc student at Department of Biology, College of Natural Sciences, Haramaya University (H.U). I am here to study about malaria prevalence and associated risk factors in Gambella Regional Hospital for my MSc Thesis. In order to design and implement cost-effective malaria control interventions, up-to-date information on the prevalence, distribution and influencing local factors of the disease is important. The primary objective of this study is, therefore, to assess the current status of malaria in Gambella Regional Hospital thereby to contribute towards informed decision making in malaria control.You or your family are kindly requested to involve in this study.If you are agreed to participate in this study, you will sign in the consent form then to answer the questions related to malaria and provide blood sample for a time only. You are free to accept or decline this invitation to participate in the study. Your participation is totally based on your own decision about yourself. Please be assured that the information will be confidential since participation is based on your willingness.

Are you willing to participate in the study?

Agreed ___________

Not Agreed _____________

Thank you

Appendix II. አማርኛ የስምምነት ቅፅ

ጤና ይስጥልኝ ስሜ ተስፋጋብር ገ/ኢየሱስይባላል፡፡ የምሰራው በጋምቤላ ከተማ በኢሌይ ሁለተኛ ደረጃ ት/ቤት ነው ፡፡ የወባ በሽታ በህዝቡ ጤና ሊይ ያለዉን ጉዳት እና ለበሽታዉ መስፋፋት ተፅዕኖ ያላቸውን ነግሮች ለማወቅ እያጠናሁ እገኛለሁ፡፡ የዚህ ጥናት አለማ በዚህ ሆስፒታል ያለውን የበሽታ ስርጭት እና ተፅዕኖወች ማወቅ በሽታዉን ለመከላከል እና ለመቆጣጠር ያለዉን ለማወቅ ታስቦ ነዉ፡፡ ይህም በሽታዉ በከተማውው ዉስጥ እያደረሰ ያለዉን የጉዳት መጠን እና የሕብረተሰቡ ተሳትፎ በሽታዉን ለመከላከል እና ለመቆጣጠር ያለዉን ጠቀሜታ ለማወቅ ነዉ፡፡ በዚህም መሰረት የሚመለከተው አካል ወደፊት ሚያወጣቸው በሽታን የመከላከል እና የመቆጣጠር ንድፈ ሀሳቦች ይህ ጥናት ጠቃሚ የሆነ መረጃን ይሰጣል፡፡

እርሰዎ ወይም ቤተሰብዎ በዚህ ጥናት ላይ ይሳተፉ ዘንድ በአክብሮት ተጋብዘዋል በዚህ ጥናት ለመሳተፍ ከተስማሙ መስማማትዎን የሚያሳይ ቅፅ ላይ እንዲፈርሙ፣በጥያቄዉ መሰረት መልስ እንዲመልሱ እንዲሁም እርሰዎ አንድ ጠብታ የደም ናሙና ለአንድ ጊዜ ብቻ እንዲሰጡ እጠይቆታለሁ፡፡የደም ናሙናዉ በጤና ባለሙያ ከእርሰዎ ወይም ከቤተሰብዎ ይሰበሰባል፡፡የደም ናሙና በሚወሰድ ጊዜ በእርሰዎ ወይም በቤተሰብዎ ሊይ ጉዳት ከደረሰ አስፈሊጊውን ህክምና ያገኛለ፡፡ በእርሰዎ ወይም በቤተሰብዎ ደም ውስጥ በሽታው ቢገኝ አስፈሊጊውን ህክምና ያገኛለ፡፡ ትብብርዎ ሙለ በሙለ በፈቃደኝነት ሊይ የተመሠረተና ተሳትፎዎን መቃወም፣መተውና በማንኛውም ሰዓት ጥናቱን ማቆም ይችሊለ፡፡

የሚሰጡን ማንኛውም መረጃ ለጥናቱ አላማ ብቻ የሚውል መሆኑነና በአጥኚው እና በቤተ-ሙከራ ባለሙያው ብቻ የሚያዝ መሆኑን እናረጋግጥሎታለን፡፡

በጥናቱ ለመሳተፍ ፈቃደኛ ነዎት ?

እስማማለሁ ---

አልስማማም--

አመሰግናለሁ ፡፡

Apendex III. English version of questionnaires

Instruction: Here are different types of question in three sections, then you are kindly requeste to read each question carefully and choose the answer that explain/describe your knowledge, awareness, attitude and understanding about malaria.

I. Socio-Demographic Characterstics of Study Population

1. Gender

A. male B. female

2. What is your age? A/ <5 B/ 5-19 C/ 20-34 D/ 35 and above

3. What is your marital status?

A. single B. married C. Widowed D. divorced

4. What is the total number of your family size?

Below five years old: ___________

Five and above years old : _________

5. What is your current place of residence?

A. low land B. midland C. high land

6. Is there population movement in your place?

A.yes B. No

7. How long have you lived in the area?

A. less than one year B.1-5 years C. 6-10 years D. above 10 years E. since birth

8. What is your level/status of education?.

A. illiterate B. 1-4 C.5-8 D. 9-12 E. above12

9. What is your occupation?

A. farmer B. merchant C. governmental employee D. student E. house wife

F. daily labor G. has no job H. private sector

10. What is your average monthly income?

A. below 500 birr B. from 500-1000 birr C. >1000 birr

II. Questions about knowledge and awareness related to malaria transmition,prevention and treatment seeking behavior

11. Have you ever had malaria?

A. yes B. no

12. Is there anybody who had malaria in the last 6 month from your family?

A. yes B. no

13. If your answer for question number 12 is yes: below 5 years_________

5 and above year's _________

14. Is malaria transmissible disease?

A. yes B. No C. I don't know

15. How malaria transmitted from person to other person?

A/ through mosquito bites B/ through bodily contact with patients C/ use of unprotected water D/poluted environment E/ from cold environment F/ from rain water G/ I don't know

16. When do mosquitos bite most?

A. day time B. night time C. day and night D. I don't know

17. Where do mosquitos breed?

A. in the soil B. running water C. in stagnant water D. I don't know

18. What are the main symptoms of malaria?

A. fever B. chills C. headache D.backach E. shivering

F. joint ach G. loss of appetite H. vomiting I. I don't know

19. Is malaria can cause of death and preventable disease?

A.Yes B. No C. I don't know

20. If your answer for question number 19 is yes, what kind of method you know to prevent malaria?

A. take tablet B. house hold spray with insecticide C. environmental sanitation D. use of insecticide treated bed net E. burning animal dung and tree leaves F. I don't know

21. Have ever hear health related education

A. Yes B. No

22. Does the health service in your hospital is good?

A. Yes B. No

23. Do rainfall, temperature and humidity influence growth of the vector?

A. Yes B. No C.Unknown

24. Does rainy season increase the number of vectors?

A. Yes B. No C. Unknown

25. What is the cause of malaria?

A. Sanitation problem B. Hot weather C. Mosquito D. Plasmodium

26. Are there suitable places for incubating/breeding malaria mosquitoes near to your residence/home?

A. Yes B. No

27. If your answer for question number 26 is ‘yes’ ,what is the distance of the house from mosquito breeding habitat?

A. <1000 m B.1000m-2000 m C.>2000 m D. Other specify___________

28. Where do you and your family go to seek treatment for malaria?

A. Traditional healer of village B. Health centre of village C. private clinic

<u>Section II: Knowledge about utilization of ITBN and ownership</u>

29. Do you currently have ITN at your home?

A. Yes B. No

30. If your answer for question number 29 is ‘yes’, do you using it?

A. Yes B. No

31. How many bed nets do you have in your house?

A. 1 per house B. two per house C. three per house

32. If there is insecticide treated bed net in your family, who is used it?

A. all the family members B. father and mother only C. children only D. Pregnant

33. If you do not use insecticide treated bed net, what is the main reason for that?

A .unable to understood B. since it is expensive C. affect the body

34. Where did you get the ITN from? A. Freely from the government B. Purchased C. Got from NGOs

35. For how long have you used the ITN?

A. for the last six months B. for the last one year C. for the last two years D. for more than two years

36. How frequently do you use ITN?

A. Every night B. Most of the nights C. Occasionally D. Only during malaria epidemics

37 . Have you ever washed your ITN?

A. Yes B. No

38.Have you ever re-treated your ITN ?

A. Yes B. No

39. Can you hang ITN correctly?

A. Yes B. No

Appendix IV. Amharic Version of Questionnaire

የአማርኛ ትርጉም መጠይቅ

መመርያ፤ ከዚህ በታች የተለያዩ በሶስት ክፍሎች ጥያቄዎች ቀርበዋል:: ጥያቄዎቹን በጥንቃቄ ካነበቡ በሁዋላ በትክክል የኔን ግንዛቤ ፤ እውቀትና እና አመለካከት ይመስላል/ይወክላል/ነው የምትሉትን አማራጭ/ምርጫ በመምረጥ ይመልሱ ። መልስዎ ትክክል እንዲሆን በአደራ እጠይቆታለሁ ።

የሚሰጡትን መልስ በምስጥር ይተበቃል። ለትብብርዎ በቅድሚያ አመሰግናለሁ።

ክፍል አንድ፡ የቤተሰብ ብዛትና ማህበራዊ ባህርያት

1. ፆታ፡ ሀ. ወንድ ለ. ሴት

2. ዕድሜ ፡

ሀ. <5 ለ. 5-19 ሐ. 20-34 መ. 35 እና ከ35 በላይ

3. የጋብቻ ሁኔታ፡ ሀ. ያላገባ ለ. ያገባ ሐ.ባለቤት የሞተችበት/ባት መ.የፈታ/ች

4.የቤተሰብዎ ብዛት ስንት ነው ? ከ5 ዓመት በታች……………..

ከ5 ዓመት በላይ……………..

5. በአሁኑ ወቅት የመኖርያ ቦታህ የት ነው?

ሀ. በዝቅተኛ ቦታ ለ. መካከለኛ ቦታ ሐ. ከፍታ ቦታ

6. በአከባቢዎ የሰው እነቅስቃሴ/መግባትና መወጣት/ አለ

ሀ. አዎ ለ. የለም

7. ለምንያህል ግዜ በአከባቢው ኖረዋል ?

ሀ. ከ አንድ ዓመት በታች ሐ. 6-10 ዓመት በላይ

ለ. ከ 1-5 ዓመት መ. ከ10 ዓመት በላይ ሠ. ከተወለድኩ ጀምሮ

8. የትምህርት ሁኔታ/ደረጃ

ሀ. ያልተማረ ለ. 1-4 ሐ. 5-8 መ. 9-12 ሠ. ከ12 በላይ

9. ሥራዎ ምንድነው ?

ሀ.አርሶአደር ለ.ነጋዴ ሐ.የመንግስትሠራተኛ
መ. ተማሪ ሠ.የቤት እመቤት ረ. የቀን ሠራተኛ ሰ.ሥራ አጥ
ሸ. የግል ተቀዋም

10. አማካይ የወር ገቢዎ ስንት ነው?

ሀ. ከ500 ብር ያነሰ ለ. ከ500-1000 ብር ሐ. ከ1000 ብር በላይ

<u>ክፍል-ሁለት፡ የወባ ክትትል የሚፈልጉባህርያት በተመለከተ የእውቀትና ግንዛቤ ጥያቄዎቸ</u>

11 ወባ ይዞት ያውቃል

ሀ. አዎ ለ. አይ

12. ባለፉት ስድስት ወራት ከቤተሰባችሁ ወባ የያዘው አለ ?

ሀ. አዎ ለ. አይደለም

13. የ 12ኛ ጥያቄ መልስዎ አዎ ከሆነ፡ ከ 5 ዓመት በታች፡ ----------------

ከ5ዓመትና ከዛ በላይ ፡ -------------

14. የወባ በሽታ ተላላፊ ነውን?

ሀ. አዎ ለ. አይደለም ሐ. አላውቅም

15. ወባ ከአንድ ሰው ወደሌላው እንዴት ይተላለፋል?

ሀ/ በወባ ትንኝ ንክሻ ለ/ ከበሽተኛው ጋር በሚደረግ ንክኪ ሐ/ ቆሻሻ ውሃ በመጠጣት መ/ ከቆሸሸ አከባቢ ሠ/ ከቅዝቃዜ ረ/ ከዝናብ ሰ/ አላውቅም

16. የወባ ትንኝ በብዛት የምትነድፊው መቼ ነው?

ሀ. በቀን ለ. በማታ ሐ. በቀንና በማታ መ. አለውቅም

17. የወባ ትንኝ የት ትራባለች ?

ሀ. አፈር ላይ ለ. በሚንቀሳቀስ ውሃ ውስጥ ሐ. በረጋ ውሃ ውስጥ መ. አላውቅም

18. ዋና ዋና የወባ ምልክቶች ምንድናቸው ?

ሀ/ ትኩሳት ለ/ ማንቀጥቀጥ ሐ. ራስምታት መ/ የጀርባ ህመም

ሠ/ ብርድ ብርድ ማለት ረ/ የመገጣጠምያ ህመም ሰ/ የምግብ ፍላጎት ማጣት ሸ/ማስመለስ ቀ/ አላውቅም

19. ወባ የሚገድል ቢሆንም መከላከል የሚችሉት በሽታ ነው ?

ሀ. አዎ ለ. አይ ሐ. አላውቅም

20. ለጥያቄ 19 መልስዎ አዎ ከሆነ፤ምን ዓይነት የመከላከያ ዘዴዎች ያውቃሉ ?

ሀ/ ኪኒን መዋጥ ለ/ ዲዲት መርጨት ሐ/ የአከባቢ ንጽህና መጠበቅ መ/ ፀረ ትንኝ ከሚካል ያለው አጎበር በመጠቀም ሠ/ ኩበትና ቅጠል በማጨስ ረ/ አላውቅም

21.የ ጠየና ትምህርት ሰምተው ያውቃሉ ?

ሀ. አዎ ለ. አይ

22.በአከባቢዎ የጠየና አገልግሎት ትምህርትና አሰጣጥ እንዴት ነው ?

ሀ. ጥሩ ነው ለ. ጥሩ አይደለም

23. ዝናብና ሙቀት በቢምቢ እድገት ላይ ተፅእኖ ያሳድራሉን ?

ሀ. አዎ ለ. አይደለም ሐ. አይታወቅም

24. የዝናብ ወቅት የትንኝን ቁጥር ይጨምራል?

ሀ. አዎ ለ. አይደለም ሐ. አይታወቅም

25. የወባ ጠንቅ/ምክንያት ምን ይመስልዎታል?

ሀ. የንፅህና ጉድለት ለ. ሙቀታማ ሁኔታ ሐ. ቢምቢ መ. ፕላዝሞዴም

26. በአካባቢያችሁ ለወባ ትንኝ መራቢያ አመች የሚሆን ቦታ አለ? ሀ. አዎ ለ.የለም

27. የጥያቄ ቁጥር 26 መሌሱ አዎ ከሆነ ቦታው ከቤትዎ በምን ያህሌ ይርቃሌ ?

ሀ. < 1000 ሜትር ለ. 1000-2000 ሜትር ሐ. > 2000 ሜትር መ. ላሊ (ይግለጹ)

28. እርስዎና ቤተሰብዎ በወባ ስትያዙ ለመታከም ወዴየት ነው የምትሄዱ

ሀ.ባህላዊ ሐኪም ለ. ጠየና ጣብያ/ሆስፒታል ሐ. የግል ክልኒክ

<u>ክፍል ሶስስት. የአጎበር አጠቃቀም እውቀትና ባለቤትነት</u>

29. በአሁኑ ሰአት የተነከረ አጎበር በቤትዎ አለ?

ሀ. አዎ ለ.የለም

30. የጥያቄ ቁጥር 29 መልስዎ አዎ ከሆነ አጎበሩን እየተጠከሙበት/ይጠቀሙታል/ ነው

ሀ.አዎ ለ. አይደለም

31. በቤትዎ ስንት አጎበር አለዎት?

ሀ. አንድ በአንድ ቤት ለ. ሁለት በአንድ ቤት ሐ. ሶስት በአንድ ቤት

32. የተነከረ አጎበር ካለ በቤተሰብዎ ውስጥ ማነው የሚጠቀመው ?

ሀ. ሁሉም የቤተሰብ አባላት ለ. እናትና አባት ብቻ ሐ. ልጆች ብቻ መ. እርጉዝ

33. ይተነከረ አጎበሩን ካልተጠከሙ፡ ያልተጠከሙበት ዋና ምክንያት ምንድነው ?

ሀ. ካለማወቅ ለ. ዋጋው ስለተወደደ ሐ. ሰውነትን ስለሚጎዳ/ስለሚያሳክክ መ

34. የተነከረ አጎበሩን ከየት አገኙት?

ሀ.ከመነግስት/በነፃ ለ.የተገዛ ሐ. መንግስታዊ ካልሆኑ ድርጅቶች

35. የተነከረ አጎበር ለምን ያህልግዜ ተጠቅመውበታል?

ሀ/ ላለፉት ስድስት ወራት ለ/ ላለፈ አንድ ዓመት ሐ/ ላለፉት ሁለት ዓመታት

መ/ ከሁለት ዓመታት በላይ

36. የተነከረ አጎበሩን መቼና እንዴት ይጠቀማሉ? ሀ. በምሽ ሁሌ ለ. በአብዛኛው ምሽት ሐ. አልፎ አልፎ መ. የወባ በሽታ በሚነሳበት ወቅት ብቻ ሠ. ሌላ ካለይጥቀሱ

37 . የተነከረ አጎበሩን አጥበውት ያውቃሉ? ሀ. አዎ ለ.አይ

38. የተነከረ ዘጎበሩን በድጋሜ በከሚካል አክመዉት ያውቃሉ?ሀ. አዎ ለ.አይ

39. የተነከረ አጎበሩን ሲጠቀሙ በትክክል ያንጠለጥላሉ?ሀ. አዎ ለ.አይ

Appendix V Ethical clearance

The Federal Democratic Republic of Ethiopia
Gambella Peoples' National and Regional
Government of Gambella Hospital

Ref.No WH3.8/276/011
Date 6/5/011

Ethical Clearance

To : Mr Tesfagabr G/Eyesus

Subject : ethical clearance

Study Title : Prevalence Of Malaria and Associated Risk Factors among patients attending Gambella Regional Hospital , Gambella Town . Western Ethiopia

We have received a research proposal in the title mentioned above to be undertaken as partial fulfillment for postgraduate MSF Thesis at Haromaya University .

At 6th session , the institutional review Committee (IRC) of Gambella Regional Hospital on 29th September , 2018 has discussed the issue.

We have Plased to inform you that the above research proposal has been approved after Scrutinizing research document and ethically cleared for implementation .

Regards,

CC:

Institutionly Review Committee (IRC)

OJAY OBANI OPARA
Human Resource
Development, Work
Management Supportive
Core process Coordinator

Appedix VI: Apendix Tables

Table 1. Prevailing meteorological conditions in Gambella town 2018.

Months	Maximum temperature	Min.temperature	Average temperature	Rain fail	Relative Humidity	Malaria positive
January	37.6	17.5	27.55	0	40.2	88
February	39.8	22.7	31.25	2.5	35.9	193
March	39	21.8	30.4	58.3	41.8	210
April	37.1	22.7	29.9	23.1	45.1	291
May	35.2	22.9	29.05	132.6	53.9	599
June	32.5	22.3	27.4	165	62.7	108
July	32.2	21.9	27.05	99.8	66.8	433
August	33.3	21.5	27.4	174.5	66.6	811
September	34.5	21.9	28.2	127	63.5	421
October	35.2	21.4	28.3	124.7	61	481
November	36.5	21.8	29.15	113.4	51.5	343
December	38.2	21.3	29.75	13.8	41.2	100
Annual average	35.93	21.64	28.78	86.23	52.5	

Table 2: Average relative humidity (%) of ten consecutive rears (2009-2018)

	Years									
Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
January	35.2	26.9	40.5	36	36.8	35.6	32.8	38.7	29.2	40.2
February	35.6	29.3	27	28.8	31.4	26.9	29.7	24.6	33.9	35.9
March	31.5	32	32.2	27.4	31	36	36.3	32	27.6	41.9
April	54.4	33.9	39.1	35	34.1	44.8	41.4	40.6	43.4	45.1
May	58.8	60	58.5	60.8	62.3	58.6	62.4	64.4	60.2	53.9
June	59	61.6	68.1	66	64.5	63.4	68.5	67.4	61.9	62.7
July	63.5	67.8	64.4	70.2	65.2	65.9	68.8	66.7	71.2	66.8
August	59.9	68.8	70.4	70.8	64.5	66.8	65.9	67.4	69.2	66.6
September	54.3	67.8	65.6	67.3	63.4	62.3	61.2	61.6	62.4	63.5
October	57.5	59.9	58.6	50.5	57	63.5	57.7	53.9	63.4	61
November	38.8	56.8	55.1	52.1	47	55.2	52.1	40.2	56	51.7
December	36.3	44.9	37.9	38.1	39.8	42.9	41.4	34.2	40.9	60.2

Table 3. Maximum temperature of the study areas for the last ten years (2009-2018)

	Years									
Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
January	38.03	40.16	38.56	38.37	33.27	37.7	37.19	38.52	41	37.6
February	39.05	41.22	41.53	40.59	40.61	39.65	40.76	41.47	40.17	39.8
March	40.26	41.54	41.09	41.48	40.88	39.91	39.82	42.03	41.35	39
April	36.76	41.45	40.78	39.95	40.18	36.98	38.31	39.31	38	37.1
May	34.66	35.47	35.97	34.73	34.2	34.7	34	34.66	34.84	35.2
Jun	34.21	34.63	32.95	32.62	33.5	33.67	33.55	34.2	34.41	32.5
July	33.39	32.59	33.5	31.96	32.03	32.77	32.45	33.23	32.6	32.2
August	33.5	32.71	32	31.58	31.64	32.38	33.71	33.34	33.1	33.3
September	34.87	32.73	32.71	33.87	33.22	32.86	34.05	34.26	33.67	34.5
October	34.47	34.42	34.45	34.71	34.02	33.71	35.41	36.09	33.45	35.2
November	37.27	35.58	33.87	34.5	34.21	34.47	34.98	37.51	34.72	36.5
December	37.38	36.63	36.37	36.4	36.11	36.15	35.86	39.42	37.22	38.2

Table 4. Minimum temperature of the study areas for the last ten years (2009-2018)

	Years									
Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
January	21.92	21.35	20.12	19.39	20.52	20.53	18.19	20.19	20.12	17.5
February	23.17	23.89	23.85	21.45	22.48	20	21.89	21.05	20.85	22.7
March	24.32	24.74	24.85	23.91	23.96	24.38	24.5	25.58	24.85	21.8
April	23.34	25.97	24.73	23.18	24	22.94	23.78	25.51	22.25	22.7
May	22.76	23.85	22.6	22.15	21.92	22.25	22.99	22.54	22.66	22.9
Jun	22.03	22.44	22.6	21.84	21.87	22.05	22.02	21.5	22.6	22.3
July	22.11	21.85	21.9	21.63	21.42	22.18	21.91	21.15	21.92	21.9
August	21.92	21.4	22.12	21.18	21.2	20.46	21.77	20.9	22.12	21.5
September	21.92	20.73	21.73	21.22	21.16	21.33	23.04	21.56	21.73	21.9
October	21.89	20.79	21.93	21.14	20.75	21.34	21.35	21.51	21.93	21.4
November	21.53	20.66	21.49	21.4	21.15	21.1	21.51	20.96	21.49	21.8
December	21.45	20.11	19.92	20.2	18.7	20.14	20.1	21.25	19.92	21.3

Table 5. Average rain fall (mm) of the study area for ten consecutive years (2009-20118).

Month	Years									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
January	3.6	0	0	0	0	0	0	22.3	0	0.0
February	11.7	5.8	0.4	0	2	5.4	O	O	12	2.2
March	26.4	2.5	60.1	9.2	9.1	46	31.9	24	27.4	58.3
April	164	2.8	59.3	29	38.5	87.8	20.5	48.5	59.7	23.1
May	136.9	93.4	197.7	266.25	221	234.3	217	267.5	215.7	132.6
June	215	138.7	179.6	66.5	78	56.3	239.3	197.3	105.8	165
July	65.4	276.2	122.3	354	207.3	143	164.3	259.5	227.6	99.8
August	80.3	198.5	297.9	242.4	135.6	242.3	136.8	180	208.8	174.5
September	157.8	238.3	205.8	145.2	238.2	284.5	108.6	68.3	236.1	127
October	99.6	129.6	204.6	112.6	92.3	156.1	100.6	62.9	126	124.7
November	16.2	49	91.3	80	131	61.6	61.1	29.4	8.9	113.4
December	7.9	3.6	2.9	2	1.9	0	13.6	0.4	26.3	13.8

Table 6.Anual average maximum and minimum temperature, rainfall, relative humidity and total malaria positive of last ten consecutive years (2009-2018)

Years	Average maximum temperature	Average minimum temperature	Average rain fall	Average relative humidity	Total malaria positive
2009	36.1	22.4	82.1	48.7	515
2010	36.6	22.3	94.9	50.8	1309
2011	36.1	22.3	118.5	51.5	3305
2012	35.9	21.6	108.9	50.3	4703
2013	35.3	21.6	96.2	49.8	5642
2014	35.4	21.6	109.8	51.8	7322
2015	35.8	21.9	99.4	51.5	4751
2016	37	22	105.5	49.3	9634
2017	36.2	21.9	104.5	51.6	6709
2018	35.9	21.6	86.2	54.1	4078
Average	36.03	21.92	100.0556	50.94	4796.8

Table 7. Trends of malaria prevalence rate related with climatic variables among patients visited Gambella Regional Hospital from 2009-2018.

Parameters	Years									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
T.examain	8213	11638	16843	26769	18429	33005	17893	28821	24492	16561
T. positive	515	1309	3305	4703	5642	7322	4751	9634	6709	4078
%	6.27	11.25	19.6111	17.57	30.61	22.18	26.55	33.43	27.39	24.62
P.falciparu	483	1242	3187	4573	5559	7087	4673	9227	6518	3946
%	5.88	10.67	18.92	17.08	30.16	21.47	26.12	32.01	26.62	23.83
P.vivax	32	67	116	130	83	235	78	407	191	132
%	0.39	0.58	0.69	0.49	0.45	0.71	0.44	1.41	0.78	0.80
Ave.Max.T	36.1	36.6	36.1	35.9	35.3	35.4	35.8	37	36.2	35.9
Ave.Min.Te	22.4	22.3	22.3	21.6	21.6	21.6	21.9	22	21.9	21.6
Ave.men.T	29.3	29.5	29.2	28.8	28.5	28.5	28.9	29.5	29.1	28.8
Ave.Rain f	82.1	94.9	118.5	108.9	96.2	109.8	99.4	105.5	104.5	86.2
Ave.R.H	48.7	50.8	51.5	50.3	49.8	51.8	51.5	49.3	51.6	54.1

Key:

T.examain = Total examain

T.positive = Total positive

Ave.Max.T= Average maximum temperature

Ave.Min.Te = Average minimum temperature

Ave.men.T = Average mean temperature

Ave.R.H = Average relative humidity

Ave.Rain f = Average rainfall

.

Appendix VII. Figures

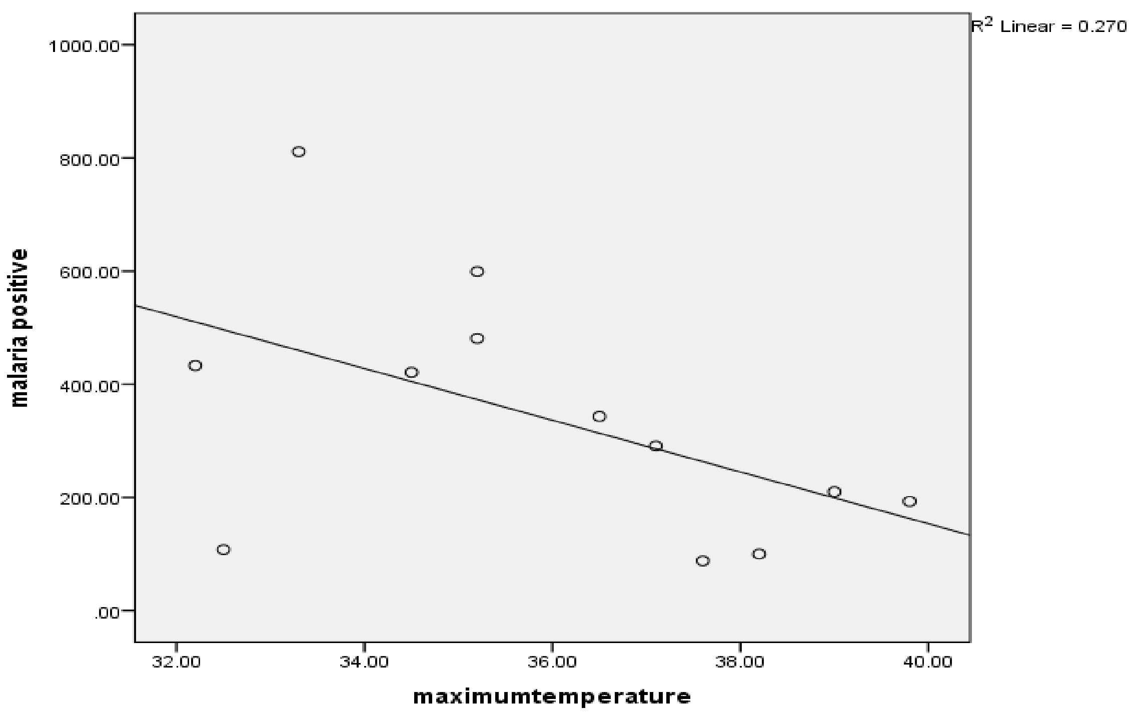

Figure 1. Correlation between maximum temperature and monthly parasite incidence of malaria in the study area

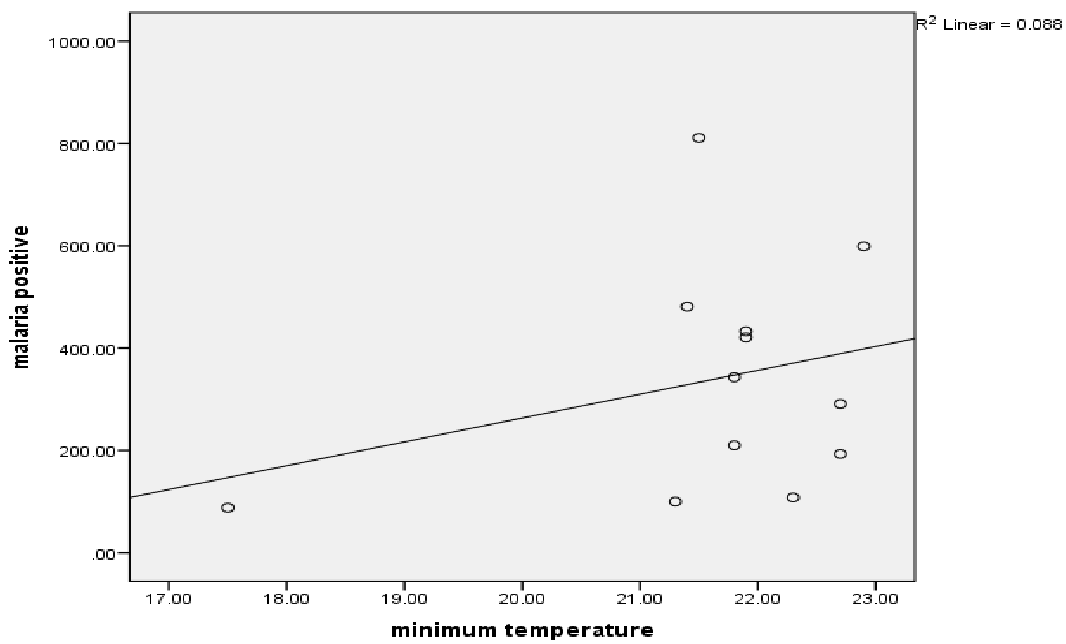

Figure 2. Correlation between minimum temperature and monthly parasite incidence of malaria in the study area

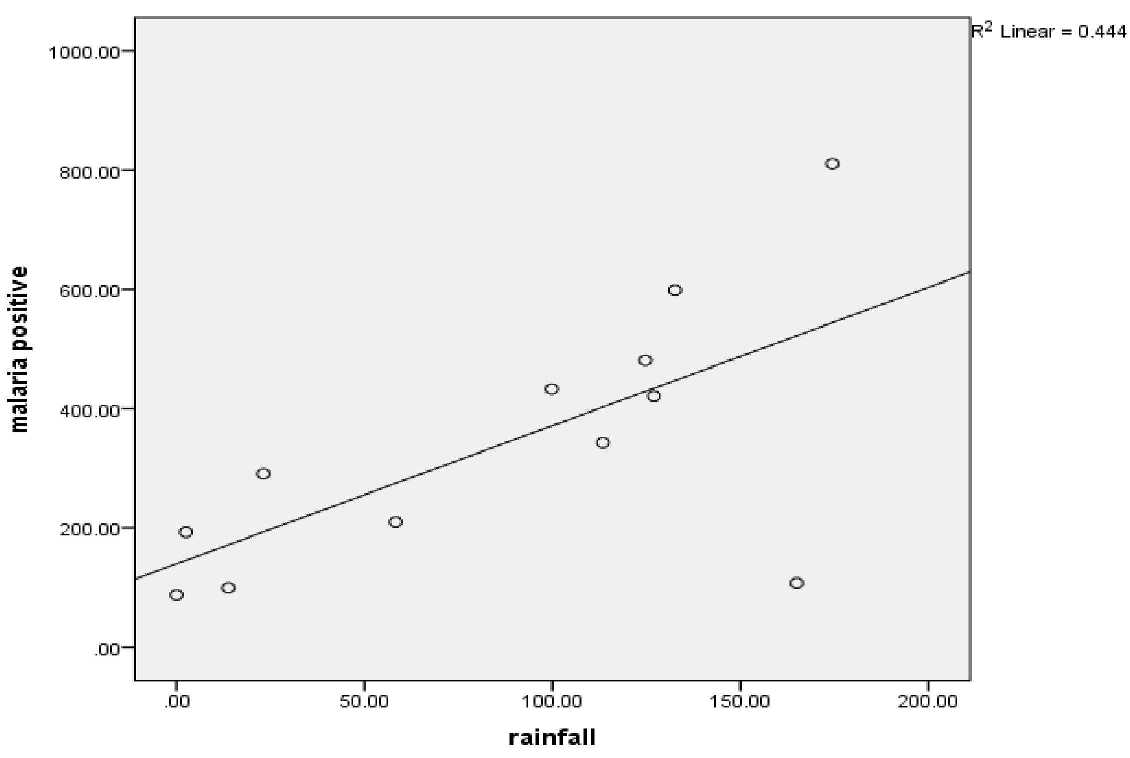

Figure 3. Correlation between rain fall and monthly parasite incidence of malaria in the study area

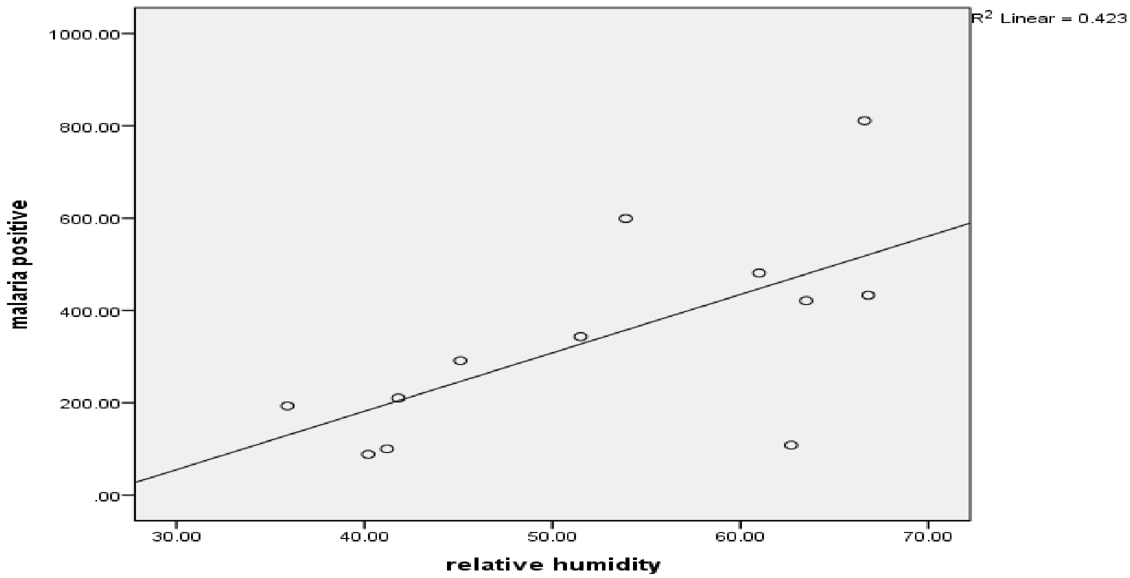

Figure 4. Correlation between relative humidity and monthly parasite incidence of malaria in the study area