STATUS OF MALARIA AND UTILIZATION OF INSECTICIDE-TREATED BED NETS AMONG RURAL PEOPLE IN HABRU *WOREDA*, NORTH WOLLO ZONE, AMHARA REGION, ETHIOPIA

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I dedicate this thesis manuscript to my role model prophet Mohammed Ibn Abdellah (peace be upon him) and my Brothers Esmael Kassa and Yimer Getnet.

STATEMENT OF THE AUTHOR

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

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BIOGRAPHICAL SKETCH

The author of this thesis, Mr. Anwar Molla Tefera, was born on June 28, 1991 in Habru district, North Wollo Zone of the Amhara National Regional State, Northern Ethiopia, from his father Ato Molla Tefera and his mother W/ro Yalga Yimam. He attended his primary school (Grade 1-6) education (2000-2006) at Tingo Amba Primary School, Grade 7-8 (2007-2008) at Srinka Gerado Primary School, grade 9-10 at Srinka High School (2009-2010), and Preparatory education (Grade 11-12) at Mersa Secondary and Preparatory School (2011-2012). He then joined Dire Dawa University in 2013 and graduated with BSc degree in Biology in June 2015. After his graduation, in 2015 he joined the Postgraduate Program of Haramaya University to pursue his MSc study in Microbiology in regular program.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACIPH	Addis Continental Institute of Public Health
API	Annual Parasite Incidence
CDC	Centre for Disease Control
CSA	Central Statistical Agency
FMOH	Federal Ministry of Health
GHEC	Global Health Education Consortium
GMP	Global Malaria Program
HBI	Human Blood Index
IRS	Indoor Residual Spraying
ITNs	Insecticide Treated Nets
KAP	Knowledge Attitude and Practice
LLIN	Long Lasting Insecticide Net
MFS	Malaria Fact Sheet
MIS	Malaria Indicator Survey
MOP	Malaria Operational Plan
NIAID	National Institute of Allergy and Infectious Diseases
NMG	National Malaria Guide
NSP	National Strategic Plan
PMI	President's Malaria Initiative
RBM	Roll Back Malaria
RDT	Rapid Disease Test
SSA	Sub-Saharan African
TCC	The Carter Centre
WHO	World Health Organization
WMR	World Malaria Report

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Status of Malaria and Utilization of Insecticide-Treated Bed Nets among Rural People in Habru *Woreda*, North Wollo Zone, Amhara Region, Ethiopia

ABSTRACT

Human malaria is a common and life-threatening disease in many tropical and sub tropical areas. Consequently, malaria epidemics are serious public health emergencies. ITNs (Insecticide Treated bed Nets) are the most powerful malaria control tool. The utilization of ITNs is still unacceptably low among rural people. Thus, the objectives of the present study were to assess the prevalence of malaria, to determine the predominant Plasmodium species among the study participants and to assess peoples' knowledge about utilization of ITNs among rural people in Habru Kebeles community. A across sectional survey study was conducted. A systemic random sampling method was used to select 403 study participants for questionnaire and parasitological blood examination. The study was conducted during October to December 2016 in Habru Kebeles. Clinical records of malaria were used to analyse the trends of malaria in the last five years (2011-2015). Diagnosis of malaria infection was done using microscopic examination of thick and thin Giemsa stained blood smears for the presence of malaria parasite and plasmodium species identification. Additionally, structured and pretested questionnaires were used to assess the socio demographic characteristics, respondents' knowledge about ITNs utilization and knowledge about malaria in the study area. The results showed that 76.7% of the study participants had ITNs; the knowledge about utilization of ITN was not high, where 51.6% of the study participants scored greater than 50% of the assessment questions; and the study participants knowledge about sign and symptoms of malaria were high. Microscopic examinations of blood samples showed that, the prevalence of malaria parasite was 16(4.0%) in study area and P. vivax and P. falciparum were the dominant malaria parasites accounting for 2.5% and 1.5% respectively, in the study population. The prevalence of malaria is more in males than in females. Data obtained from the health centre records about malaria outpatients in study area showed that malaria infections were frequently occurring almost throughout the year and every month.

Key words: Habru, Infection, ITNs, Malaria, *Plasmodium*, prevalence, Utilization

1. INTRODUCTION

Malaria is a life threatening parasitic disease, which is caused by different *Plasmodium* species. It is the most highly prevalent tropical disease with high morbidity and mortality (*Adefioye et al.,* 2007). Malaria is an ancient disease which people knew it before 2000 B.C. The word malaria comes from the Italian word mal'aria meaning spoiled air (Cox, 2010). Malaria is caused by five species of the parasite belonging to the genus *Plasmodium*. Four of these, *P. falciparum, P. vivax, P. malariae* and *P. ovale* are human malaria species. In recent years, human cases of malaria have also been recorded due to *P. knowlesi* species that normally causes malaria among monkeys, occasionally cause infection to human and occurs in certain forested areas of South-East Asia (Nicholas *et al*., 2012).

Malaria transmitted from person to person mainly through the bite of an infected female mosquito of the genus *Anopheles*, which requires blood to mature her eggs. Occasionally, transmission occurs by blood transfusion, organ transplantation, needle sharing, or congenitally from mother to fetus (CDC, 2014). The dominant vectors in Africa are *A. gambiae, A. funestus, A. pharoensis, A. nili* and *A. arabiensis,* and in Ethiopia, *A. arabiensis* (Aynalem, 2014).

The *Plasmodium vivax* and *P. falciparum* are predominant *Plasmodium* species. *Plasmodium vivax* is responsible for the 25-40% of malaria cases worldwide (Lemu *et al*., 2015). *Plasmodium vivax* widely distributed, causing infection in Latin America, Asia, and parts of Africa (Boundeng *et al*., 2015). *Plasmodium falciparum* is the most dangerous of all *Plasmodium* species. The 2013 World Malaria Report estimated that *P. falciparum* is responsible for 91% of all malarial infections and 90% of deaths worldwide and predominates in Sub Saharan African countries (Lia, 2014).

Uncomplicated malaria disease can be caused by all four *Plasmodium* species and are characterized by periodic fever, chills, mild anemia and splenomegaly (Abhay *et al*., 2009). Complicated malaria disease is mostly caused due to *P. falciparum* is potentially lethal and its infection characterized by severe chills, nausea, fever, vomiting, diarrhea, brain (cerebral) malaria, kidney damage, etc (Dawit *et al.*, 2009).

Malaria remains one of the major killers of humans worldwide, threatening the lives of more than one-third of the world' population in many parts of the world, especially in countries of tropics and subtropics such as in Africa, South East Asia, Haiti and Dominican Republic, and the Indian sub-continent, Middle East, Oceania and Latin America (NIAID, 2007). Estimation has shown that 1.2 billion people are at risk of malaria of this, 300-500 million people are infected and more than 1million are dying each year globally (Dash *et al.*, 2007).

The malaria burden is heaviest in the African region, where an estimated 90% of all malaria deaths occur, and in children aged less than 5 years, who account for 78% of all deaths (WHO, 2014). SSA is the hardest hit region in the world. Globally estimated 80% cases and 90% death of malaria occur in this area each year (NMG, 2012). Countries with higher proportions of population living in poverty have higher death rates of malaria. Poorer populations are more prone to infection and disease, because they are more likely to live in rural areas, in housing that offers little protection against mosquitoes and they are generally less likely to have access to preventive measures such as insecticide treated bed nets (ITNs) or Indoor Residual Spraying (IRS) (WHO, 2012).

Malaria in Ethiopia found in about more than three-quarters (75%) of the land mass (altitude <2000 m) of the country is either malarious or potentially malarious, and an estimated 68% (>50 million people) of the total population resides in areas at risk of malaria infections (ACIPH, 2009). This makes malaria number one health problem in Ethiopia with an average of 5 million cases per year. The disease causes 70,000 deaths each year and accounts for 17% of outpatient visits to health institutions (Belayneh, 2014). Malaria prevalence in Ethiopia is relatively low compared to most SSA malaria-endemic countries in Africa, where in 2012; malaria was the leading cause of outpatient visits, accounting for 17% of all outpatient visits, and 8% of health facility admissions among all age groups (MOP, 2015).

In Ethiopia, malaria is mainly seasonal with unstable transmission in the highland fringe areas and of relatively longer transmission duration in lowland areas, river basins and valleys (Mulugojjam *et al*., 2014). Malaria transmission patterns and intensity vary throughout the country due to differences in altitude, rainfall and population movement. These make Ethiopia prone to focal and multifocal epidemics that have on occasion caused catastrophic public

health emergencies (MIS, 2011). Protective immunity in Ethiopian populations is relatively low due to unstable transmission and all age groups are at risk of infection and disease (TCC, 2013).

The major malaria transmission season in Ethiopia is between September to December, following the main rainy season and from July to September. There is a shorter transmission season from April to May following the short rain season in some parts of the country (NSP, 2010). Temperature also plays an important role in the variability of malaria transmission by regulating the development rate of mosquito larvae, influencing the survival rate of adult mosquitoes. In higher temperatures, mosquitoes develop faster, feed earlier in their life cycle and at a higher frequency. The *Plasmodium* parasite multiplies more rapidly in the mosquito in warmer conditions. *P. falciparum* accounts for 65-75% of infections, while *P. vivax* accounts for 25-35%. *P. ovale* and *P. malariae* are rare (Aynalem, 2014).

The main malaria interventions comprise vector control which reduces transmission by the mosquito vector to humans, achieved using ITNs or IRS, chemoprevention which prevents the blood stage infections in humans and case management which includes early diagnosis and treatment of infections (WHO, 2014). Prevention and control activities of malaria in Ethiopia comprise, four major intervention strategies have been applied in the country to combat malaria are: early diagnosis and prompt treatment, selective vector control that involves use of indoor residual spraying (IRS), insecticide-treated mosquito nets (ITNs) and environmental management (Mengistu and Solomon, 2015).

The effectiveness of anti-malaria intervention is dependent on the local people's level of understandings, perceptions and household behavioral practices towards malaria and its control. The local socio-cultural context, social and economic factors coupled with poor health service coverage and low community awareness and participation may lead to poor treatment seeking behavior and inappropriate utilization of the currently available cost-effective preventive health interventions such as ITNs and IRS (ACIPH, 2009).

The Ethiopian National Malaria Strategic Plans recognizes the use of ITNs as a major intervention for malaria disease prevention in the country. The strategy is targeted to provide Long Lasting Insecticide Nets (LLINs) to all population groups living in endemic (high,

moderate, and low malaria risk) areas to reach and maintain 100% ownership and utilization of LLINs (100% of households in LLIN targeted areas own at least one LLIN per 1.8 persons). Between 2005 and 2013 more than 64.2 millions of ITNs were distributed in Ethiopia (MOP, 2015). However, the success of ITNs utilization depends on several factors such as, willingness of people to use nets, and behavior of the local vector (Zewdneh *et al*., 2011). Factors influencing ITNs utilization are: malaria knowledge of household, knowledge of appropriate ITNs use, ITNs care practices, net-hanging skills, household size, the number of children less than five years of age in the household, intra-household sleeping arrangements, and household structure and spaces (Graves *et al.*, 2011). Thus, the purpose of this study was to know the current status of malaria and utilization of ITNs rural people in Habru *woreda*, Amhara Regional state, Northeast Ethiopia.

The specific objectives were:

1. To determine the prevalence of malaria infection among rural people in the study area.
2. To identify the predominant *Plasmodium* species causing malaria infection in the study area.
3. To assess peoples' knowledge and utilization of insecticide treated bed net in the study area.
4. To analyse the trend and pattern of malaria cases over the past five years (2011-2015) in the study area.

2. LITERATURE REVIEW

2.1. The Malaria Parasite

Malaria is a disease caused by *Plasmodium* species which is transmitted to humans from infected female *Anopheles* mosquitoes .The protozoan parasites of the genus *Plasmodium* infect the red blood cells (RBCs) (GHEC, 2013). Malarial infections are one consequence of a complex series of ecological interactions between malaria parasites, mosquitoes and humans. The female *Anopheles* mosquito is considered the definitive host for the malaria parasites because the sexual cycle of parasite reproduction takes place within the mosquito's gut. The human being who is injected with the parasites by an infected mosquito is considered the intermediate host (James, 2008). Common means of *Plasmodium* species transmission is by bite of *Anopheles* mosquito. Very unusual means of transmissions are congenital malaria (from mother to infant), blood transfusion and sharing intravenous needles. In non-endemic areas, mosquitoes infected after biting infected immigrants/travellers (GHEC, 2013) can transmit it.

Five species of blood protozoan parasites cause human malaria, the potentially lethal and often drug-resistant is *P. falciparum*, the relapsing parasites *P. vivax* and *P. ovale, P. malariae*, which can persist at low densities for years and *P. knowlesi*, a monkey parasite that causes occasional infections in humans in tropical forests in Southeast Asia. *P. knowlesi* resembles *P. falciparum* and *P. malariae* priority microscopically but is identified definitively by molecular methods (Nicholas *et al.*, 2012).

Infection by parasitic protozoa of the genus *Plasmodium* is known as malaria. Ettore Marchiafava and Angelo Celli described the genus *plasmodium* in 1885. Currently over 200 species of this genus are recognized. These known *Plasmodium* species infect humans and other species. It infects animals including monkeys, rodents, and reptiles. The parasite always has two hosts in its life cycle a mosquito vector and a vertebrate host (John and Igweh, 2012).

According to WHO (2014) malaria report, malaria caused by five species of the parasite belonging to the genus *Plasmodium*. Four of these *P. falciparum, P. vivax*, *P. malariae* and *P. ovale* are human malaria species, which are spread from one person to another by bite of

female mosquitoes of the genus *Anopheles*. In recent years, human cases of malaria have also been recorded due to *P. knowlesi,* a species that causes malaria among monkeys, and occurs in certain forested areas of South-East Asia. *P. falciparum* and *P. vivax* malaria pose the greatest public health challenge.

2.2. Life Cycle of *Plasmodium* Species

The human malaria parasite has a complex life cycle that requires both a human host and an insect host (figure 1). In *Anopheles* mosquitoes, *Plasmodium* reproduces sexually (by merging the parasite's sex cells). In people, the parasite reproduces asexually (by cell division), first in liver cells and then, repeatedly, in red blood cells (RBCs). When an infected female *Anopheles* mosquito bites a human, it takes in blood. At the same time, it injects saliva that contains the infectious form of the parasite, the sporozoite, into a person's bloodstream. The thread-like sporozoite then invades a liver cell during the next week or two (depending on the *Plasmodium* species), each sporozoite develops into a schizont, a structure that contains thousands of tiny rounded merozoites. When the schizont matures, it ruptures and releases the merozoites into the bloodstream (NIAID, 2007).

P. vivax and *P. ovale* have a dormant stage called hypnozoites that can persist in liver and cause relapses by invading the bloodstream weeks, or even years later. After this initial replication in the liver (exo-erythrocytic schizogony) the parasites undergo asexual multiplication in the erythrocytes, merozoites infect red blood cells (figure 1) and develop in to ring stage trophozoites which mature into schizonts again rupture and releasing merozoites. Some parasites differentiate into sexual erythrocytic stages (gametocytes). Blood stage parasites are responsible for the clinical manifestations of the disease. An *Anopheles* mosquito ingests the gametocytes, male (microgametocytes) and female (macrogametocytes) during a blood meal (GHEC, 2013). A male gamete fuses with a female gamete to produce a cell known as zygote. The zygote enters the wall of the mosquito's gut and develops into an oocyst. The oocyst multiplies to produce thousands of cells known as sporozoites. The sporozoites leave the wall of the gut and migrate to the mosquito's salivary glands. The mosquito phase of the malaria parasite's life cycle is normally completed in 10 to 14 days. This development process occurs more slowly in areas with cooler temperatures (Tulip,

2004). In the mosquito's stomach, the microgametes penetrate the macrogametes generating zygotes. The zygotes in turn become motile and elongated (ookinetes) which invade the mid-gut wall of the mosquito where they develop into oocysts. The oocysts grow, rupture and release sporozoites (figure 1), which make their way to the mosquito's salivary glands. Inoculation of the sporozoites into a new human host perpetuates the malaria life cycle (GHEC, 2013).

When an infected mosquito bites a susceptible vertebrate host, the *Plasmodium* life cycle begins again (Hisashi and Masamichi, 2002). The *P. ovale* has the exoerythrocytic cycle in the liver, similar to the *P. vivax* and the hypnozoites situated in the liver can cause a relapse. *P. malariae* has no an exoerythrocytic cycle and is similar to *P. falciparum*. However, malaria *P. malariae* is benign types where as the one caused by *P. falciparum* is severe and malignant types. Malaria due to *P. falciparum* associated with mortality and morbidity and *P .vivax* due to the morbidity and high infection. The big two logically have also become the target for prevention, eradication, treatment and diagnostics (Tulip Group, 2004). *P. falciparum* and *P. knowlesi* infections can cause rapidly progressive severe illness or death while the other species *P. vivax, P. ovale*, or *P. malariae* are less likely to cause severe manifestations (CDC,2013).

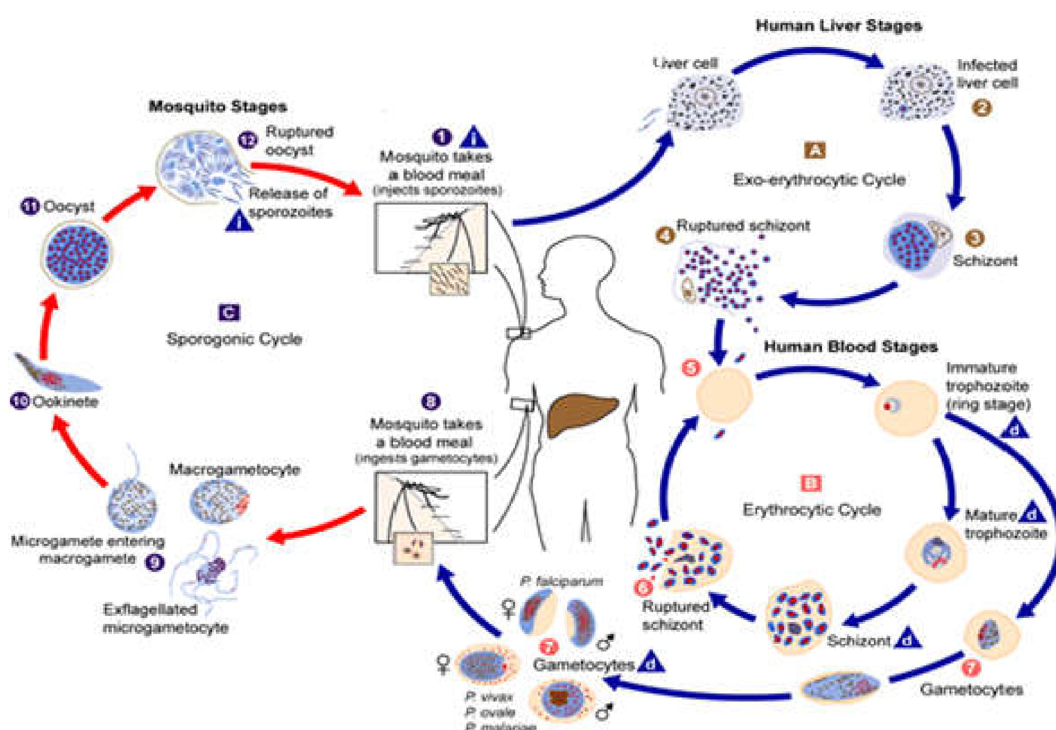

Figure 1. Life Cycle of *Plasmodium* species (Source: GHEC, 2013)

2.3. The Malaria Vector

Malaria is transmitted through the bite of an infected, female *Anopheles* mosquito. Although many different kinds of mosquitoes exist, only female *Anopheles* mosquitoes transmit malaria parasites. Its upturning tail can recognize the *Anopheles* mosquito. They need blood meals to produce eggs. The eggs are very small but can be seen as small (2-5mm wide) black spots on the surface of water. Malaria transmitting mosquitoes choose stagnant or slow-flowing water in which it laid her eggs (The prescriber, 2000).

Human malaria species are spread from one person to another by female mosquitoes of the genus *Anopheles*. There are about 400 different species of *Anopheles* mosquitoes, but only 30 of these are vectors of major importance (WHO, 2014). The host-seeking behaviour of *An. arabiensis* varies, with the human blood index (HBI) collected from different areas ranging between 7.7 and 100%. *An. funestus*, a mosquito that prefers to feed on humans (MOP, 2015).

Anopheles arabiensis is the only species from the *An. gambaie* complex known to be prevalent across malaria-endemic areas in Ethiopia. *An. Pharoensis* is a widely distributed *anopheline* mosquito in the country and is considered to play a secondary role in malaria transmission, along with *An. funestus* and *An. nili. Anopheles funestus* occurs frequently in localities along the swamps of the Baro and Awash rivers and the shores of Lake Tana in the north, and the Rift Valley in the south; *An. nili* is found in Gambella Regional State (FMOH, 2014). The malaria vector requires water to complete its life cycle from egg to larva to pupa, and finally an adult mosquito. While between 200-1000 eggs can be laid, the quantity is influenced by the amount of blood taken in. Blood feeding usually starts at dusk and continues until dawn (Aynalem, 2014).

2.4. Clinical Manifestation of Malaria

After being bitten by a malaria-infected *Anopheles* mosquito, the first symptoms appear after an incubation period ranging from 7 to 30 days. A shorter incubation period is most frequently observed with *P. falciparum*, whereas the incubation period for *P. malariae* can be quite lengthy. Typical symptoms include fever, chills, sweats, rigors, headache, nausea and vomiting, body aches and general malaise. These symptoms may be seen in all types of malaria and sudden shaking chills typically accompany the malaria paroxysm. This may last 10 to 15 minutes or longer. During this stage, the patient complains of feeling extremely cold, despite a steady elevation of body temperature. Chills may be followed by severe frontal headache and myalgia (muscular pain) in the limbs and back. This stage lasts 2-6 hours in *P. vivax* and *P. ovale* infections, 6 hours or more in *P. malariae* infection and considerably longer in *P. falciparum* malaria (Abhay *et al,* 2009).

Symptoms of malaria are generally non-specific and most commonly consist of fever, malaise, weakness, gastrointestinal complaints (nausea, vomiting, and diarrhoea), neurologic complaint (dizziness, confusion, disorientation, and coma), headache, back pain, myalgia, chills, and cough (CDC, 2013). The typical intermittent fevers of malaria are caused by the repeated cycles of parasite replication inside red blood cells, which ultimately result in the rupture of the red blood cells, releasing parasites into the blood stream to then invade other cells. Repeated malaria infections lead to severe anaemia, especially in children and pregnant women (TCC, 2013).

Nearly all the people who live in endemic areas are exposed to infection repeatedly especially those who survive malaria in childhood gradually build up some immunity. They may carry the infection, serving as reservoirs for transmission by mosquitoes without developing severe disease. In other areas where the infection rate is low; people do not develop immunity because they rarely are exposed to the disease (NIAID, 2007).

2.5. Global Epidemiology of Malaria

The *Plasmodium* species that infect humans worldwide are; *P. falciparum*, *P.vivax, P. ovale, P. malariae* and *P. knowlesi* (GHEC, 2013). The distribution of *P. ovale* is limited to tropical Africa and to discrete areas of the Western Pacific. Most West Africans are negative for the Duffy blood type, which is associated with receptor sites for *P. vivax* merozoites on the RBC. Therefore, many West Africans are not susceptible to infection with *P. vivax*. *P. falciparum* malaria is generally confined to tropical and subtropical regions, particularly in sub-Saharan Africa, the Amazon region of South America, rural forested areas of Southeast Asia and urban and rural areas of the Indian subcontinent and *P. malariae* has a wide, but spotty distribution throughout the world (Abhay *et al.*, 2009).

According to WHO malaria report *plasmodium* species, *P. falciparum* is most prevalent on the African continent, and is responsible for most deaths from malaria. *P. vivax* has a wider geographic distribution than *P. falciparum* because it can develop in the *Anopheles* mosquito vector at lower temperatures, and can survive at higher altitudes and in cooler climates. It also has a dormant liver stage that enables it to survive for long periods as a potential reservoir of infection. Although *P. vivax* can occur throughout Africa, the risk of infection with this species is quite low, because of the absence in many African populations of the Duffy gene. In many areas outside Africa, infections due to *P. vivax* are more common than those due *to P. falciparum* (WHO, 2014).

Approximately 90% of the estimated 655,000 deaths caused by malaria each year occur in Africa. Twenty percent of all deaths in African children less than five years of age are thought to be due to malaria. Overall, malaria constitutes 10% of the continent's disease burden (TCC, 2012). Malaria deaths rates decrease by approximately 42% globally. However, almost half of the world’s population remains at risk from malaria. WHO reports that malaria

continues to cause approximately 207 million cases of infection around the world each year and killing an estimated 627,000 people. Around the world, a child still dies from malaria every minute (RBM, 2014).

Malaria transmission occurs worldwide; 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 2) (CDC, 2014). Malaria occurs in 99 countries worldwide and more than 3 billion people are at risk of acquiring the disease (WHO, 2012). These countries found in six WHO regions; Africa, South-East Asia, Eastern Mediterranean, Western Pacific, Americas, and Europe (Fact Sheet, 2013).

In 2013, an estimated 198 million cases of malaria occurred worldwide. Most of these cases (82%) were in the WHO African region, followed by the WHO South-East Asia region (12%) and the WHO Eastern Mediterranean region (5%). About 8% of estimated cases globally are due to *P. vivax*, although outside the African continent this proportion increases to 47%. In this year estimated 584,000 malaria deaths worldwide.

It is estimated that most (90%) of these deaths of malaria worldwide were in the WHO African region, followed by the WHO South-East Asia region (7%) and the WHO Eastern Mediterranean region (2%). About 453,000 malaria deaths were estimated to occur in children aged less than 5 years, equivalent to 78% of the global total. An estimated 437, 000 of deaths occurred in children aged less than 5 years in the WHO African region (WHO, 2014).

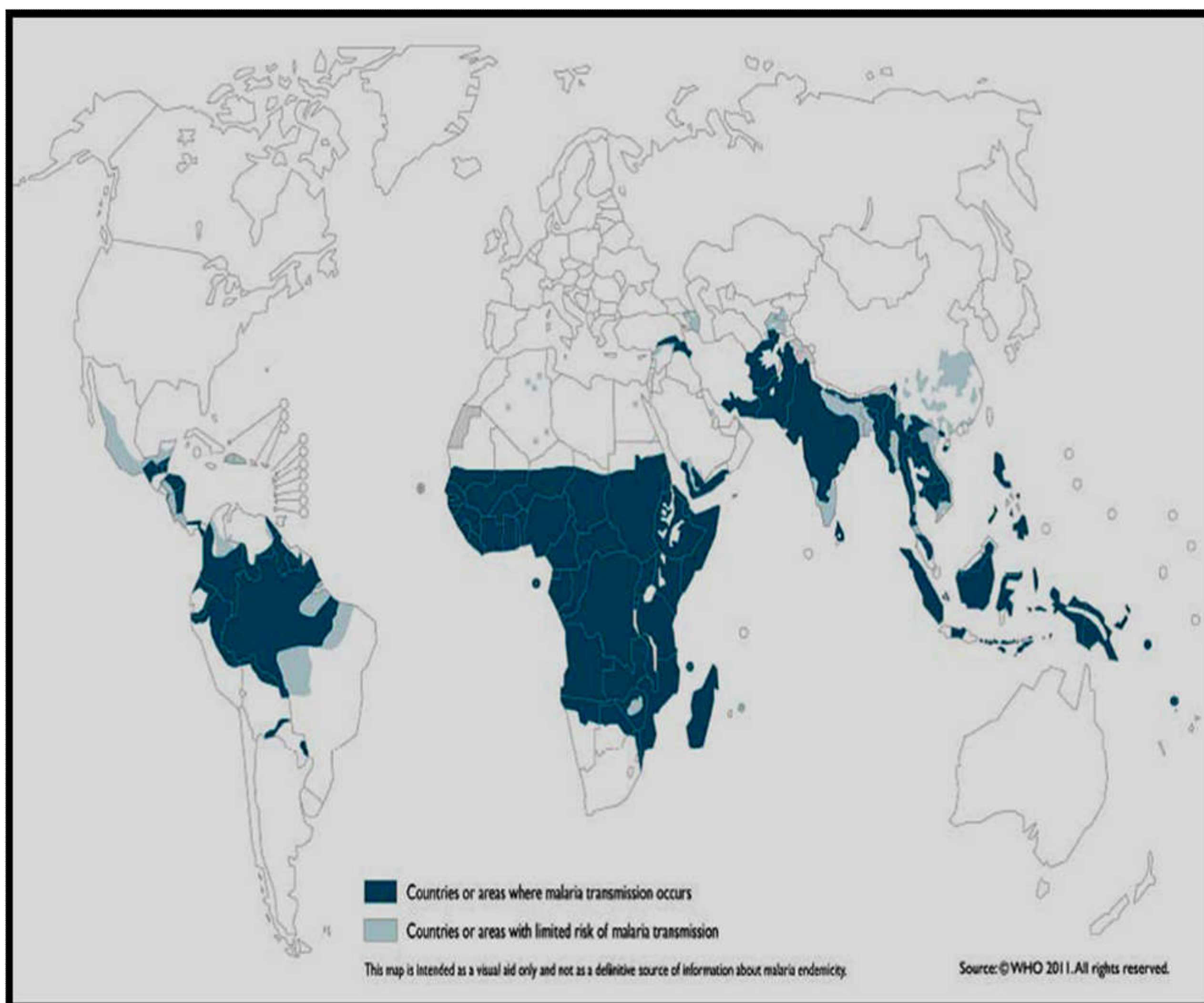

Figure 2. Global distribution of malaria in 2010. (Source: WHO, 2011)

2.6. Epidemiology and Distribution of Malaria in Ethiopia

Malaria is a major public health problem in Ethiopia despite a relatively low malaria prevalence compared to most other malaria endemic countries in Africa. Unstable malaria transmission patterns make Ethiopia prone to focal and multifocal epidemics that have on occasion caused catastrophic public health emergencies (MIS, 2011). An estimated (68%) of the population are at risk for malaria and approximately 80% of the 736 *Woredas* (districts) in Ethiopia are considered malarious as seen on (figure 3) (TCC, 2013). Over (60%) of the total Ethiopian population of 84.2 million live in areas at risk of malaria as of 2014, generally at elevations below 2,000 meters above sea level. In 2014, FMOH stratified Ethiopian malaria

transmission risk within 835 districts by population (%) and by annual parasite incidence per thousand (API): High (>100/1000, 11 million (13%)); Medium (5 to 99.9/1000; 28.1 million (34%)), Low (0.1 to 4.9, 11.1 million (13%)), and Malaria-Free (0, 33.6 million (40%)). In 2011/2012, malaria was the leading cause of outpatient visits, accounting for 17% of all outpatient visits, and 8% of health facility admissions among all age groups. In 2012/2013, there were 57,503 public sector malaria hospitalizations, 4,984,266 malaria outpatient cases, and 2,942,031 laboratory-confirmed *P. falciparum* outpatient malaria cases, and 1,258,131 *P. vivax* cases (MOP, 2015).

Malaria transmission in Ethiopian is generally seasonal and unstable, though patterns and intensity of transmission vary throughout the country due to differences in altitude, rainfall and population movement. Protective immunity in Ethiopian populations is relatively low due to unstable transmission and, unlike large parts of sub-Saharan Africa; all age groups are at risk of infection and disease. *P. falciparum* accounts for 65-75% of infections, while *P. vivax* accounts for 25-35%. *P. ovale* and *P. malariae* are rare (TCC, 2013).

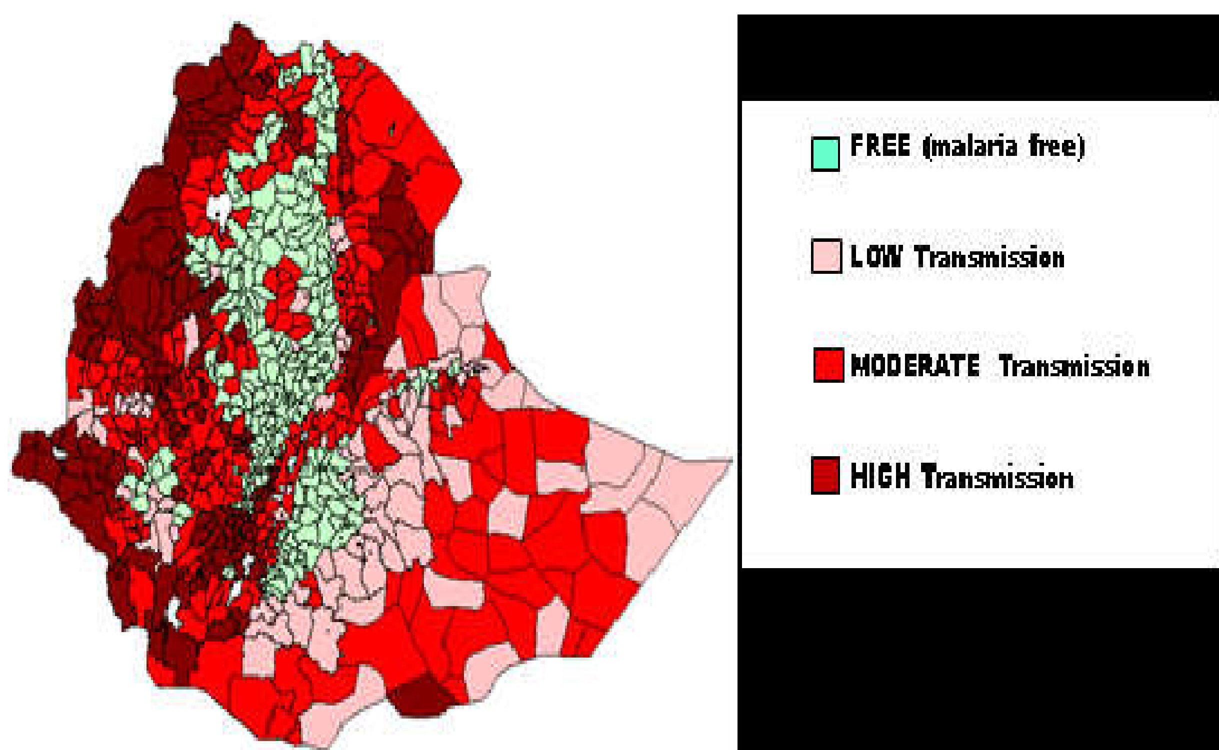

Figure 3. Malaria Incidences in Ethiopia (source: MOP, 2015)

Malaria transmission intensity, along with its temporal and spatial distribution in Ethiopia, it is mainly determined by the diverse eco-climatic conditions. Climatic factors including rainfall, temperature and humidity show high variability. Temperature, and rainfall and humidity, varies as a function of altitude (NSP, 2010). Malaria epidemiology of Ethiopia in 2013 the High transmission (>1case per 1000 population) 941000, Low transmissions (0–1 cases per 1000 population) 62,100 the major *Plasmodium* species cause malarial cases and death, *P. falciparum* (64%) and *P. vivax* (36%). Major *Anopheles* species transmit parasite were, *An. arabiensis*, *An. pharoensis*, *An. funestus* and *An. nili* (WHO, 2014).

2.7. Factors Affecting the Epidemiology of Malaria

Many biological and environmental factors affect malaria transmission in a given location. Climate affects both parasites and mosquitoes. Mosquitoes cannot survive in low humidity, rainfall expands breeding grounds, and in many tropical areas, malaria cases increase during the rainy season. Mosquitoes must live long enough for the parasite to complete its developmental cycle within them. Therefore, environmental factors that affect mosquito survival can influence malaria incidence these are city conditions which can create new places for mosquito larvae to develop, agricultural practices also can affect mosquito breeding areas, draining and drying of swamps gets rid of larval breeding sites, water-filled irrigation ditches may give mosquitoes another area to breed (NIAID,2007).

In Ethiopia, malaria is highly seasonal in many communities, but may have nearly constant transmission in other areas malaria transmission occurs between September and December in most of Ethiopia, after the main rainy season from June to August. Certain areas experience a second minor malaria transmission period from April to June, following a short rain season from February to March. January and July typically represent low malaria transmission seasons (MOP, 2015).

Temperature and humidity have a direct effect on the longevity of the mosquito. Each species can thrive at an optimal level because of ecological adaptation. The spread of malaria requires that conditions are favourable 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 (Aynalem, 2014). *Plasmodium* parasites

are affected by temperature their development slows as the temperature drops. *P. vivax* stops developing altogether, when the temperature falls below 60 ^{0}F. *P. falciparum* stops at somewhat higher temperatures (NIAID, 2007). In Ethiopia, the interaction of mountainous terrain with variable winds, seasonal rains, and ambient temperatures creates diverse microclimates. Ethiopian weather is also influenced by tropical Indian Ocean conditions and global weather patterns, including El Nino and La Nina. When a micro-climate creates local puddles, flooding conditions, and warm ambient temperatures that persist for several weeks within a malarious area with low population immunity, the resulting *Anopheles* mosquito proliferation may cause focal malaria transmission to accelerate, sometimes explosively (MOP, 2015).

2.8. Prevention and Control Strategies of Malaria

Because of the nocturnal feeding habits of *Anopheles* mosquitoes, malaria transmission occurs primarily between dusk and dawn. Contact with mosquitoes can be reduced by remaining in well-screened areas, using mosquito bed nets, preferably insecticide treated nets, using an effective insecticide spray in living and sleeping areas during evening and night time hours, and wearing clothes that cover most of the body (CDC, 2014).

Malaria is an entirely preventable and treatable disease. Currently, recommended interventions are; (i) vector control through the use of ITNs, IRs and in some specific settings, larval control (ii) chemo prevention for the most vulnerable populations, particularly pregnant women (iii) confirmation of malaria diagnosis through microscopy or RDTs for every suspected case and (iv) timely treatment with appropriate medicines (WHO, 2011).

The main malaria interventions comprise vector control (which reduces transmission of *Plasmodium* by mosquito vector from humans to mosquitoes and then back to humans), achieved using insecticide-treated mosquito nets (ITNs) or indoor residual spraying (IRS). Chemo prevention (which prevents the blood stage infections in humans); and case management (which includes diagnosis and treatment of infections).Therefore malaria elimination refers to the reduction of the incidence of infection to zero in a defined geographical area as a result of deliberate efforts. ITNs have been shown to reduce the incidence of malaria cases by 50% in a variety of settings. When pregnant women use the nets,

they are also efficacious in reducing maternal anaemia, placental infection and low birth weight (WHO, 2014). The WHO Global Malaria Programme recommends the following three primary interventions for effective malaria control; (i) diagnosis of malaria cases and treatment with effective medicines, (ii) distribution of insecticide-treated nets (ITNs), more specifically long lasting insecticidal nets (LLINs) to achieve full coverage of populations at risk of malaria, and (iii) indoor residual spraying (IRS) to reduce and eliminate malaria transmission (GMP, 2007).

Plasmodium parasite that causes malaria and is transmitted through bites from female *Anopheles* mosquito's vector control is important intervention in the prevention of malaria infection. Ethiopia is implementing a range of malaria control interventions that aim to improving access and equity to preventive as well as curative health services, which include prompt and effective malaria treatment, selective vector control using insecticide treated nets (ITNs) and indoor residual spraying (IRS). Effective and timely prevention and control of malaria epidemics is also part of the main strategies (ACIPH, 2009). The national malaria control and prevention program Interventions against malaria in Ethiopia first started in the late 1950s in response to the 1958 epidemic. The service was organized by what was then called the Malaria Eradication Service, a pilot project established for 15 years (MIS, 2007).

The distribution and use of insecticide-treated bed nets (ITNs) is one of the central interventions for preventing malaria infection. National policy aims to provide one ITN for every sleeping space (approximately one net per 1.8 persons in malaria-endemic areas <2,000m). The current internationally recognized standard for malaria protection from mosquito bites is the LLIN. Proper use of LLINs protects the entire local community from malaria for at least three years without need for additional insecticide reapplication (MIS, 2011). Recent national malaria prevention strategy state that by the end of 2015, 100% of households in malarious areas own one LLIN per sleeping space, at least 80% of people at risk of malaria use LLINs, and 90% of households in IRS-targeted areas will be sprayed with IRS (FMOH, 2011).

2.9. Insecticide Treated Bed Net (ITN)

An insecticide-treated net is a mosquito net that repels, disables or kills mosquitoes being exposed to insecticide on the netting material. There are two categories of ITNs: conventionally treated nets and long-lasting insecticidal nets. A conventionally treated net is a mosquito net that has been treated by dipping in a WHO-recommended insecticide to ensure its continued insecticidal effect. The net should be re-treated after three washes, or at least once a year and long-lasting insecticidal net is a factory-treated mosquito net made with netting material that has insecticide incorporated within or bound around the fibres. The net must retain its effective biological activity without re-treatment for at least 20 WHO standard washes under laboratory conditions and three years of recommended use under field conditions (GMP, 2007). The world malaria report states that, ITNs have been shown to reduce the incidence of malaria cases by 50% in a variety of settings. When pregnant women use the nets, they are also effective in reducing maternal anaemia, placental infection and low birth weight (WHO, 2014).

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 has gone to sleep, LLINs also can have an impact on vector populations. 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 (NMG, 2012).

All mosquito nets act as a physical barrier, preventing access by vector mosquitoes and thus providing personal protection against malaria to the individual using the nets. Pyrethroid insecticides, which are used to treat nets, have an excito-repellent effect that adds a chemical barrier to the physical one, further reducing human–vector contact and increasing the protective efficacy of the mosquito nets. Most commonly, the insecticide kills the malaria vectors that meet the ITN (GMP, 2007).

2.10. Knowledge about the Use of ITN

Insecticide treated nets (ITNs) are the main stay in malaria prevention. As a vector control intervention, they are effective in preventing malaria morbidity and mortality in a range of epidemiological settings. In reducing densities and infectivity of malaria vectors; they reduce overall transmission and protect all individuals within the community (NMG, 2012). Factors that influence ITNs utilization are: malaria knowledge of household, knowledge of appropriate ITNs use, ITNs care practices, net-hanging skills, household size, the number of children less than five years of age in the household, intra-household sleeping arrangements, and household structure and spaces/ sleeping area (Graves *et al*., 2011). Mosquito nets have been advocated for as the most preventive tools against the malaria especially in sub Saharan Africa. However, low community awareness and poor utilization of the ITNs pose serious challenges for the malaria control programs. Studies conducted in different parts of Africa showed that the low usage of ITNs to practical and technical difficulties related to the fixing of the net above the mat, perception about net and the design of the house, etc (Amare *et al*., 2012).

3. MATERIALS AND METHODS

3.1. Description of Study Area

Habru is one of the *woreda*s in North Wollo Zone, Amhara Region. It is bordered on the south by the Mille River which separates it from South Wollo Zone; on the west by Guba Lafto; on the North by the Alewuha River which separates it from *Kobo*; and on the east by the Afar Region. The towns in Habru District include Mersa and Wurgesa. It has a total of 35 *kebeles*. The altitude of this woreda ranges from 700 meters above sea level, where the Mille enters the Afar Region, to 1900 meters at its western most point. In this district, the major and minor malaria transmission peak seasons are from September to December and from April to May, respectively (Svein, 2002). Habru, as well as the other seven rural *woredas* of this Zone, has been grouped amongst the 48 *woredas* identified as the most drought prone and food insecure in the Amhara Region (Seid, 2002).

Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA), this *woreda* had a total population of 192,742, showing an increasing of 14.61% over the 1994 census, of whom 96,874 are men and 95,868 women; 21,600 or 11.21% of the residents are urban inhabitants. With an area of 1,239.79 square kilometers, Habru has a population density of 155.46, which is greater than the Zone's average (i.e. 123.25 persons per square kilometer).

3.2. The Study Design

The study design was a community based cross-sectional household survey. The study was conducted during the period of October to December 2016 in three rural *kebeles*, Habru *Woreda*. The three *kebeles* were selected, namely; *Girana*, *Haro* and *Dire Roqa* to carry out this study on the basis of presence of high population and high prevalence of malaria. The study participants were rural people selected using systematic random sampling technique from the three rural *kebeles.* The study was carried out to determine the prevalence of malaria and ITNs utilization among rural people in those kebeles. Data were collected using laboratory based blood film diagnosis, questionnaire survey and malaria health record of people from Mersa Health Centre.

3.3. Study Population

All members of households in the study area constituted the study population from which study participants were selected for parasitological blood film diagnosis and questionnaire survey.

3.4. The Sample Size Determination and Sampling Technique

As there was no previous study, which reported the prevalence of malaria in the study area the sample size was determined by considering a maximum prevalence of 50% and using the following formula (Naing *et al*., 2007).

$$N= Z^2 P (1-P) /d^2$$

Where, Z= 95% confidence interval (1.96),

P= prevalence of the disease (50%)

d= marginal error = 5% (0.05), and

N= sample size

Accordingly, $N = Z^2 P (1-P)/d^2$

$$N= (1.96)^2 x\ 0.5x\ (1-0.5) / (0.05)^2$$

N = 384 people

Contingency = 5%= (0.05) (384) = 19.2

Hence, the total number of participants used in the present study was 403.

Systematic random sampling method was used to select 403 study participants by moving home to home at the study area. All ages and sexes of household members were included in the study for parasitological blood film diagnosis and questionnaire survey.

The study used systematic random sampling technique to select member of households living in three study *kebeles*. The 403 members of households were selected according to their, sex and their age. Therefore, the number of households included in each *kebele* was fixed by proportional sampling method. However, sample households from each *kebeles* were selected using systematic random sampling technique, i.e. by taking every third (3rd) household from the list of households available in the study area. All the selected households were used for blood sample collection and questionnaire survey.

3.5. Methods of Data Collection

Data were collected using questionnaires, microscopic examinations of blood samples and analysis of malaria records from Mersa Health Centre.

3.5.1. Questionnaire Survey

The study utilized a structured pre-tested questionnaire (local language) that was prepared by the principal investigator. This data collection tools were used to generate information related to the study participants' basic socio-demographic characteristics, their knowledge and utilization of ITNs and their awareness about malaria. Information was obtained from the heads of the households or representatives of the households. According to PMI (2013), the proportion of population that slept under ITNs the previous night is the measures of ITN utilization among all individuals who spent the previous night in surveyed households.

The questionnaire had two sections. The first section included basic socio-economic and demographic background of the study participants. These were age, sex, educational level, occupation, family size, etc. The second part dealt with study participants' knowledge about malaria and their knowledge and utilization of insecticide treated bed nets. The questionnaire was developed in English and later it was translated in to the local language (Amharic). A total of 403 questionnaires were distributed and all were returned completely filled.

3.5.2. Blood Sample Collection and Preparation of Blood Films

Blood samples from 403 rural people were collected by pricking their fingertips using sterilized disposable blood lancet by the help of laboratory technician. The finger was first cleansed with alcohol-moistened swab dried with a piece of dry cotton and punctured with a disposable blood lancet. Using the drop of blood, thin and thick blood smears were made on the same slides side by side that were properly labeled per individual. The smears were air- dried and the thin smears were fixed with 100% methanol for 30 seconds. Following this, the smears were stained with 3% Giemsa for 30 minutes. Duplicate slides were made from each study subject and examined under microscope for presence of malaria and identification of *Plasmodium* species. Laboratory diagnosis of malaria was made through

microscopic examination of thick and thin blood smears. Thick blood smears were used to detect the presence of malaria infection. Thin smears were used to identify parasite species and quantification (CDC, 2013). Blood sample collection and diagnosis were made by laboratory technicians from nearby health centre, Mersa Health Centre and this was done from October to December, 2016.

3.5.3. Malaria Health Records Collection

The health records particularly the laboratory confirmed malaria cases of the last five years, from 2011-2015 were collected retro respectively using the health record review format developed by the principal investigator from Mersa Health Centre. The data were analysed by linking to months, seasons, years, sexes and malaria parasite species.

3.6. Laboratory Examination of Malaria Parasites

Microscopic examination of the thick blood films were used in detecting as few as 20 parasites/µl of blood. Thin blood film stained with Giemsa was useful for identifying the malaria parasite species and has a sensitivity of 20 parasites/µl blood. The presence of malaria parasites on thick blood smears were examined by using high power magnification objective (40x) and the identification of *Plasmodium* species from the thin blood smear was done through oil immersed objective (100x) (CDC, 2013). The microscopic examinations were done in Mersa Health Centre by senior laboratory technician assisted by principal investigator. The microscopic examination of blood film was used for determination of the prevalence of malaria infection *Plasmodium* species in the study area.

3.7. Data Quality Controls

To maintain the quality of data the structured and pre-tested questionnaires were used and checklist was developed and used. Before collecting information on socio-demographic condition of households, training was given to all data collectors and assistants to collect data about study participants' socio-demographic, knowledge about malaria and their knowledge and utilization of ITN. Microscopic examination of *Plasmodium* species and presence of *Plasmodium* was diagnosed by an experienced laboratory technician.

3.8. Data Analysis

Statistical analysis was carried out using SPSS version 16 software. Descriptive statistics were used to describe demography of the participants, the distribution of *Plasmodium* species and previous five years of malaria trends in the study area. Chi-square test and p-value were calculated to determine the association of some socio-demographic characteristics and knowledge about malaria with knowledge about utilization of ITNs and malaria infection. Associations of selected socio-demographic characteristics of the study participants had ITNs and selected malaria knowledge with their knowledge about ITN utilization was examined using Pearson Chi-square tests. Outputs of association between the knowledge about ITNs utilization and socio-demographic variables and some malaria knowledge are presented in table 6. The differences among the means of resulting data determine at 5% level of significance.

3.9. Ethical Considerations

The study was received ethical clearance from district health centre, Mersa Heath Centre, Ethical committee. All participants have had consent to participate in the study. All malaria positive study participants were treated using appropriate anti-malarial drugs by appropriate health workers.

4. RESULT AND DISCUSSION

4.1. Socio-Demographic Characteristics of Study Participants

Summary of socio-demographic characteristics of the study participants are presented in table1. Of the total 403 study participants, 243 (60.3%) were males and 160 (39.7%) of them were females. In relation to the study participants' age, 75 (18.6%) of the study participants were 17-20 years old, 143 (35.5%) were 21-30 years old, 129 (32.0%) were 31-40 years old and 56 (13.9%) were 41- 50 years old. The number and proportions of the study participants by their respective kebeles were, 150 (37.2%), 131 (32.5%) and 122 (30.3%) from *Dire Roka*, *Haro* and *Girana*, respectively. Regarding the occupational status of the study participants, 180 (44.7%) were farmers, 17 (4.2%) were merchants, 99 (24.6) were students, and 107 (26.5%) were housewives (Table 1).

With respect to the educational status of the study participants, 204 (50.6%), 181 (44.9%) and 18 (4.5%) were illiterate, completed elementary school and secondary school, respectively. Regarding the study participants possession of livestock, 353 (87.6%) had livestock and kept in house whereas, 50 (12.4%) had no livestock at all. With regard to family size of study participants, 175 (43.4%) had less than five persons per house and 228 (56.6%) had greater than five persons per house (Table 1).

Most of study participants, 274 (68.0%) were married, 125 (31.0%) were single and 4 (1%) were widowed. Regarding the house type of the study participants, 220 (54.6%) had conventional housing units, which were made of grass roof, wooden wall and with one or more rooms, and houses made of steel roof and wood wall with one room. The remaining 183 (44.4%) had advanced housing units which include steel iron sheet roof, wood or cement wall and had at list two rooms (Table 1).

Table 1. Some basic Socio- Demographic characteristics of study participants (N=403) in the rural people of Habru *kebeles*, from October to December, 2016.

Characters	Response	
	Frequency	Percentage (%)
Sex		
M	243	60.3
F	160	39.7
Age		
17-20 years	75	18.6
21-30 years	143	35.5
31-40 years	129	32.0
41-50 years	56	13.9
Kebeles		
Dire Roka	150	37.2
Haro	131	32.5
Girana	122	30.3
Marital status		
Married	274	68.0
Single	125	31.0
widowed	4	1.0
Family size		
≤ 5 persons	175	43.4
> 5 persons	228	56.6
Educational status		
illiterate	204	50.6
elementary school	181	44.9
secondary school	18	4.5
Occupation		
Farmer	180	44.7
Merchant	17	4.2
Student	99	24.6
house wife	107	26.5
Livestock		
Yes	353	87.6
No	50	12.4
Housing units		
Advanced	183	45.4
Conventional	220	54.6

4.2. Study Participants' Knowledge about Malaria Infection, Transmission, Vector and Prevention Methods

Knowledge and awareness of study participants' about malaria, transmission and vector was assessed using questionnaires and the results are presented in Table 2. Regarding awareness of the presence of malaria in study area, 390 (96.8%) of the study participants have heard about malaria in their area and only 13 (3.2%) of the study participants have not heard about the presence of malaria in their area.

The results indicated that most of the study participants, 314 (77.9%), knew that malaria is transmitted from an infected person to a healthy person. The rest 89 (22.1%) were indicated that either malaria cannot be transmitted from person to person or they had no idea at all (Table 2). This proportion was higher than the rate reported from Kersa, eastern Ethiopia where 57.4% of the respondents knew that malaria was transmitted from person to person (Tesfaye *et al*., 2013). Study participants knowledge about malaria transmission mode was higher in which the majority of the participants, 239 (76.1%) knew that malaria transmitted from person to persons by mosquito bites. Other study participants, 75 (23.9%) were wrongly related malaria transmission with different factors, of them 15% of the respondents was associated the cause of malaria with dirty environment and 8.9% were related malaria transmission with bad season (Table 2).

The number of respondents who had correct knowledge about malaria transmission modes were 59.3% of all 403 study participants and 40.7% had misconceptions about malaria transmission mode. This lack of awareness was probably because of inadequate health education (Table 2). This was relatively lower figure compared to report from Northwest Ethiopia where 67% study participants were agreed that mosquitoes transmit malaria (Habtamu *et al*., 2015). This result were higher than result of study conducted in southern Ethiopia where 15.6% respondents were related malaria transmission with mosquito bites (Terefe *et al.*, 2015), and higher than the study finding from Eastern Ethiopia where 56.1% of study participants associated malaria transmission with mosquito bites (Tesfaye *et al.*, 2013).

Regarding mosquitoes biting time (n=239) majority of the study participants, 191 (79.9%) were respond that mosquitoes bite mostly at night and they were 47.4%. From all study participants whereas, 15 (6.3%) were responded mosquitoes bite mostly at daytime and 33 (13.8%) of them agreed that mosquitoes bite at day and night-time (Table 2). The present study results, where the majority of study participants agreed that mosquitoes bite mostly at night was nearly equal to the study result from North west Ethiopia, where majority of respondents responded that mosquitoes bite mostly at night (Habtamu *et al*., 2015) and similar to the proportion reported from South Ethiopia (Dejene, 2014).

Table 2. Study participants' (N=403) knowledge about malaria, its transmission and vector in Habru *kebeles*, from October to December, 2016.

Characters	Response	
	Frequency	Percent
Have you heard about malaria in your area?		
Yes	390	96.8
No	13	3.2
Is malaria communicable?		
Yes	314	77.9
No	49	12.2
I do not know	40	9.9
If you said 'Yes' in the above, how is malaria transmitted? (n=314)		
Mosquito bite	239	76.1
Bad season	28	8.9
From dirty environment	47	15
If you say mosquito in the above question, what is the mosquito biting time? (n=239)		
Day time	15	6.3
Night time	191	79.9
Day and night	33	13.8

n= number of participants on those specific questionnaires.

In figure, 4 below presented the study participants' knowledge about signs/ symptoms of malaria were presented. The results were showed that knowledge about the symptoms of malaria was high among study participants in which majority of them, 339 (84.0%) have known at least three classical symptoms (fever, chill and headache) of malaria infection. This result was significantly higher as compared to finding of the study done in Pawe District, Northwest Ethiopia where, 71.5% of respondents knew three classical symptoms of malaria (Habtamu *et al.*, 2015). This finding was also in agreement with the study result from Sidama Zone, South Ethiopia (Dejene, 2014). In the present study the most frequently reported malaria symptoms were fever (91.3%) followed by chills (82.4%), headache (78.2%), loss of appetite (31.0%) and joint pain (29.3%) (Figure, 4).

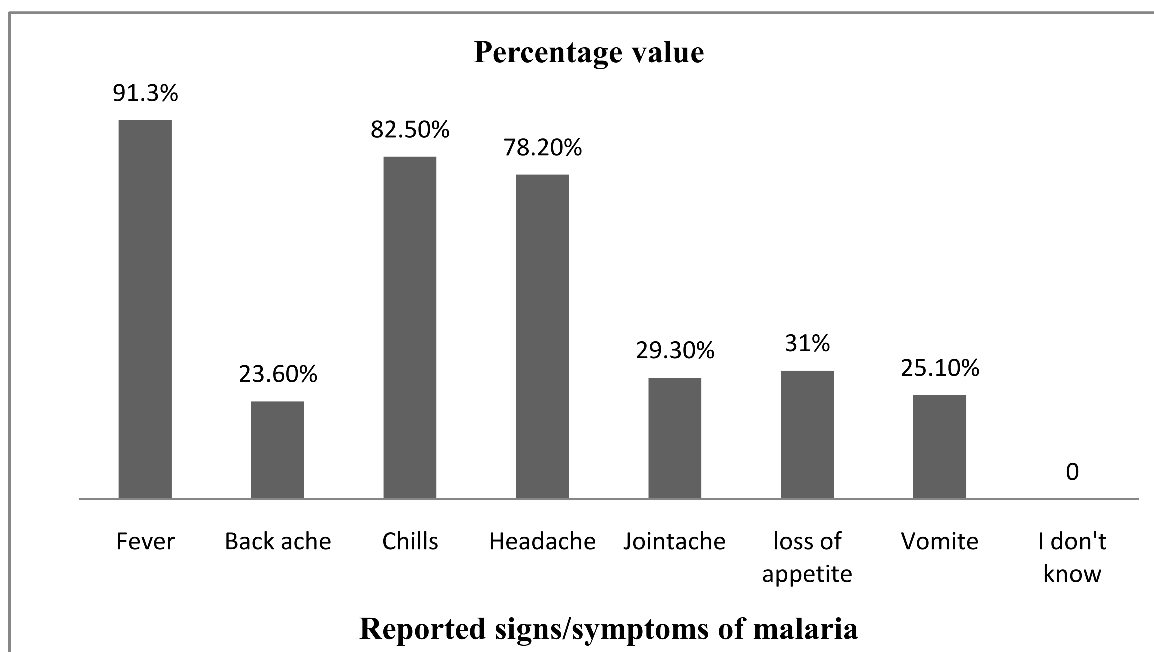

Figure 4. Reported signs/symptoms of malaria by study participants (N=403) in Rural People in Habru Woreda, North Wollo Zone, Amhara Region, Ethiopia, during October to December, 2016.

Table 3 showed that the study participants' knowledge about malaria prevention methods and treatment seeking. Most respondents 82.4% knew that malaria could be prevented and 17.6% of the study participants however did not know whether malaria is preventable or not. This finding was in agreement with the study result from Northwest Ethiopia where most respondents indicated that malaria was preventable (Habtamu *et al.,* 2015).

The most frequently reported malaria prevention methods by the study participants was the use of insecticide treated bed net (ITN) 75.7%, followed by environmental sanitation 3.2%, 17.4% were no answer about prevention methods of malaria and 3.7% were used smoke from burning leaves and cow dung. In the present study, ITN was mentioned as primary methods of malaria prevention. The finding of present study was higher than the study reported from southern Ethiopia where 62.6% respondents used ITNs as the main preventive measure of malaria (Gashaw and Wakgari, 2008, and Dejene, 2014) in southern Ethiopia. Similar study from Tigray, northern Ethiopia and from Tanzania was reported where majority of respondents used ITNs for the prevention of mosquito bites (Zewdneh *et al.*, 2011; Mazigo *et al.*, 2010). The majority of the study participants, 332 (82.4%) knew that malaria is treatable whereas, 71(17.6%) of them did not know that malaria is treatable or not. The number of study participants who knew that malaria is treatable was relatively large but 17.6% of them who had misconception was not also small (Table 3). Of 403 (82.4%) study participants who were reported that malaria is treatable, 287 (86.5%) of them were seek treatment in health centre located at kebele and 45 (13.5%) of them were used traditional healers and tablets. The finding was higher than the result from Myanmar where only (51.2%) of study participants were seek treatment in health centre (San *et al*., 2013); and higher than study result from Thailand where only 44% of study subjects had seek malaria treatment at health centre (Sonkong *et al.,* 2015).

Table 3. Malaria prevention and treatment seeking of study participants (N=403) among rural people in Habru *kebeles*, from October to December, 2016.

Characters	Response	
	Frequency	Percent
Is malaria preventable?		
Yes	333	82.6
No	46	11.4
I don't know	24	6.0
Which prevention methods of malaria do you use mostly?		
Use of ITNs (bed net)	305	75.7
Environmental sanitation	13	3.2
Smoke from burning leaves and animal product	15	3.7
No answer	70	17.4
Is malaria treatable?		
Yes	332	82.4
No	42	10.4
I don't know	29	7.2
If you said, yes the above question, What malaria treatment do you use? (n=332)		
Traditional healer of village	17	5.1
Health centre of kebele	287	86.5
Administration of tablets	28	8.4

n= number of participants for those specific questionnaires.

4.3. Knowledge and Practice on Utilization ITNs among Study Participants

Among the participants, 87.6% of them knew what ITN was. This result was lower than result from South Ethiopia where 96.5% of the study participants were found to have knowledge of ITNs (Ayalew, 2010). The majority, 81.9% of the study participants had heard 0f about ITNs, whereas, 18.1% of them had no information about ITNs (Table 4). This difference could be because of lower distribution of ITNs among households and lack of enough information about ITNs and its purpose. This finding was higher than the result from Southern Ethiopia by Gashaw and Wakgari (2008) and lower than result of study conducted in southern Ethiopia where (94.7%) study participants were heard about ITNs (Ayalew, 2010).

Regarding the study participants source of information about ITNs, out of 330 the study participants who had information about ITNs, 82.1% of them have received information from health service providers. Others, 17.9% were received information from other source like radio, kebele and school. Of all study, participants only 67.2% of them got information about ITNs from health workers (Table 4). This finding was in agreement with study from northwest Ethiopia where majority of the study participants were heard information from health professionals (Yibeltal *et al*., 2013), and lower than study conducted in southern Ethiopia where, 87.8% of study participants main source of information was health extension workers (Terefe, 2015). In terms of possession of ITNs majority of the study participants, 76.7% reported that they had at least one insecticide treated bed net. In the mean time, 23.3% of the study participants had no any bed net. This figure was in agreement with study conducted in southern Ethiopia by Gashaw and Wakgari (2008), northwestern Nigeria by (Abdullahi *et al*., 2014). The result was higher as compared to study report made by the National Malaria Indicator Survey conducted in Ethiopia (MIS, 2011), and in the study conducted in western Ethiopia by Geletta *et al*. (2014) in which 63.4% of study participants had at least one ITN.

As indicated in table 4 among participants (n=94) those had no ITNs, 63.8% of them claimed that they had no ITNs because their net were old and damaged. The rest 36.2% reported that they had no ITNs at all because of there was no availability of ITNs in their area (Table 4). Regarding number of ITNs per household among (n=309), 62.5% of the study participants respond that had one ITN and the others 37.5% had two ITNs. The finding was agreed to study conducted in northwest Ethiopia where (75%) of study participants had one ITN and (22.7%) had two ITNs (Yibeltal *et al.*, 2013). Another result from western Ethiopia reported that 81.4% had one ITN and 17.2% had two ITNs per household (Geletta *et al.*, 2014).

There was higher knowledge about benefit of ITNs among the study participants, where majority 85.4% of them were claimed that sleeping under ITNs has benefits, however, 14.6% of them did not have not knowledge about benefit of sleeping under ITNs. Out of 344 the study participants aware of benefit of ITNs, 78.5% of them were used ITNs to prevent mosquito bite. Others, 13.1% and 8.4% of them were reported that ITNs used to kill mosquito and to kill other insects respectively (table 4). This study finding was in agreement with the result from northern Ethiopia by Zewdneh *et al*. (2011) and lower than results from southern

Ethiopia where 90.1% of respondents reported that they were used the ITNs to prevention of mosquito bites (Dejene, 2014) .

Table 4. Possession of ITN, knowledge and conditions related to study participants ITNs (N=403) in rural people in Habru *kebeles*, from October to December, 2016.

Characters	Response	
	Frequency	Percent
Do you know what ITN is?		
Yes	353	87.6
No	50	12.4
Have you ever heard of about ITNs		
Yes	330	81.9
No	73	18.1
If your answer 'yes' the above question, what were your sources of information? (n=330)		
Radio	30	9.1
Health workers	271	82.1
Kebele	21	6.4
School	8	2.4
Do you have ITN?		
Yes	309	76.7
No	94	23.3
If you said 'No' the above question, what is your reason for not having ITN? (n=94)		
Old and damaged	60	63.8
No one gave me/no availability of ITN	34	36.2
used for other purposes	0	0
How many ITNs do you have? (309)		
One	193	62.5
Two	116	37.5
Do you know the benefit of sleeping under ITNs?		
Yes	344	85.4
No	59	14.6
If you say 'yes' the above question, what are benefits of sleeping under ITNs? (n=344)		
Don't get bitten by mosquitoes	270	78.5
Kills other insects	29	8.4
Kills mosquitoes	45	13.1

n= number of participant for those specific questionnaires.

4.3.1. ITNs Utilization and Condition Related to the Study Participants' ITNs Utilization

The result showed that out of 309 the study participants owned at least one ITN, 230 (74.4%) were slept under ITNs the night prior to survey whereas 79 (25.6%) were not utilized their ITNs night prior to survey (Table 5). This finding was higher than the result conducted in Western Ethiopia where only 64.9% households were utilized at least one ITN (Geletta *et al.,*2014). From study, conducted in southern Ethiopia where 52.0% of the study participants were not utilized at least one ITN previous night of survey (Terefe *et al*., 2015).

The study participants ITN utilization experience (n=309) among those had ITN, 75 (24.3%) had less than two year utilization of ITN experiences and 234 (75.7%) were used ITN for more than two years. The good ITN utilization experiences among 75.7% of the study participants for more than two years was higher when compared to result from western Ethiopia 70.0% of respondents utilized ITNs more than three years (Geleta *et al.*, 2014).

Frequency of ITN utilization as reported by the study participants those own ITNs majority of them 172 (55.7%) have been utilized ITNs during transmission time and others 68 (22.0%), 46 (14.9%) and 23 (7.4%) have been utilized ITNs regularly, sometimes and rarely respectively. This result was lower when compared to result from southern Ethiopia where 51.6% of respondents were used bed net regularly and only 48.9% were not used ITNs frequently (Dejene, 2014), and from study conducted in northern Ethiopia 57.3% were used bed net regularly and 38.8% were utilized ITNs during transmission time (Zewdneh *et al.,* 2011).

Regarding groups given priority to sleep under ITNs in the family as reported by study participants out of 309 had at least one ITN only 145 (46.9%) of them were claimed that they gave priority for children under five, others 101 (32.7%) and 63 (20.4%) of them were gave priority for pregnant woman and children to utilize ITNs respectively. This result was in contrast from study conducted in northern Ethiopia where 76.6% respondents reported priority given for children under five (Zewdneh *et al.*, 2011).

Out of 309 respondents had ITNs only 101 (32.7%) were retreated their ITNs, whereas 208 (67.3%) not re-treated their bed nets (Table 5). The major reason given (n=208) for not retreating bed nets, 94 (45.2%) were lack of awareness about the importance of treating

mosquito bed nets and 114 (54.8%) were said that had no k-o tab (re-treating kit) to retreat ITNs (Table 5). This finding was good when compared to result from southern Ethiopia, 96.8% who owned ITNs had never re-treated their ITNs (Terefe *et al.*, 2015).

Table 5.Study participants experience and frequency of ITNs Utilization (N=403) in Habru *kebeles*, from October to December, 2016.

Characters	Response	
	Frequency	Percent (%)
Did you/ your family member sleep under ITN last night? (n=309)		
Yes	230	74.4
No	79	25.6
What is your ITNs utilization Experience? (in years) (n=309)		
1-2	75	24.3
>2	234	75.7
When do you/your family use ITN?(n=309)		
Regularly	68	22.0
During transmission time	172	55.7
Sometimes	46	14.9
Rarely	23	7.4
Who utilizes ITN in your family (n=309)		
Mother and Children under five	63	21.4
Only children under five	145	46.9
Pregnant woman	101	32.7
Have you ever treated your ITN? (n=309)		
Yes	101	32.7
No	208	67.3
What is your reason for not treating ITN (n=208)?		
Lack of awareness	94	45.2
Lack of chemical/ k-o tablet (re-treating kit)	114	54.8

n= number of participant for those specific questionnaires.

4.3.2. Study Participants' Knowledge about Utilization of ITN

Effective utilization of ITNs for malaria control comprises three main components including bed net acquisition or ownership, regular retreatment of bed nets with insecticide and using bed nets correctly and consistently (Jane, 2003). In this study to asses study participants' knowledge about utilization of ITNs, those had ITNs questions related to ITNs used. The questions were based on washing and retreating ITNs, utilization experience and utilization

frequency of ITNs, using at least one ITN night priors to survey, know benefit of ITNs and study participants' exposure to ITNs messages. Scores were generated for each question, for questions with two options of Yes (1) and No (0). Nevertheless, for questions like ITN utilization experience (<2 years (1) and >2 years (2)), number of ITNs owned (one ITN =1 and two ITNs=2) and frequency of ITN utilization; for ITN utilization during transmission time awarded two and for regular utilization three and others one.

The average scores were generated for each study participant and a total average score of less than 50% poor/lower knowledge of ITN utilization, score between 50%-79% was rated as medium (good) and score greater than 80% were rated as high knowledge of ITN utilization. The three division of knowledge on ITNs utilization in this study was similar with study done on caregivers' knowledge of ITNs (Esimail and Aluko 2014; Terefe *et al*., 2015).

Study participants' knowledge about ITNs utilization in this study were good where out of 309 participants owing at least one ITN more than half of them 217 (71.1%) were scored greater than 50% of assessment questions and when compared to total study participants it was 53.8%. Only 92 (29.8%) of study participants were scored less than 50% and they were regarded as poor or lower knowledge about ITNs utilization (Appendix V, Table1). Of 217 study participants those scored above 50% of questions about knowledge of ITNs utilization, 130 (42.1%) of them were scored 50%-79% so, they had good (medium) knowledge about ITNs utilization and 87 (28.2%) of them were scored greater than 80% of assessment questions and they had higher knowledge about ITNs utilization (Appendix V, Table 1).

This finding was higher than finding from southern Ethiopia 52.4% of participants had poor practice of ITNs utilization (Terefe *et al*., 2015). This finding was in contrast with result from Nigeria 33.7% of participants had high knowledge about ITN utilization and 56.2% of them had lower knowledge of ITN utilization (Dotimi *et al.,* 2014); and with study from South-Western Nigeria where study participants knowledge of ITNs utilization were; 49.1% good, 40.6% fair and 10.3% poor respectively (Esimail and Aluko, 2014).

4.4. Association between some Selected Socio-demographic Characteristics, Malaria Knowledge and the Study Participants' Knowledge about ITN Utilization

The Ages of study participants were significantly associated with knowledge about ITN utilization where 50.0% were 17-20 years of ages scored high knowledge about ITN utilization and followed by age 31-40 (28.0%) and age group above 41years old, 5 (13.5%) was the last. The study participants age groups had statistically significant association with their knowledge about ITN utilization at (x^2 =32.29, $p<0.001$). This result in which the first and third age groups scored higher knowledge were probably because of their repeated exposure of ITNs education, knowledge of ITNs benefit and knowledge of malaria prevention (Table 6). This finding was similar with study result from Southern Ethiopia where age had a significant effect on the respondents' knowledge about malaria prevention and control and more study participants range age 14-24 years old scored high knowledge level (Dejene, 2014). The educational status of the study participants were associated with knowledge about ITN utilization and it is statistically significant (x^2=13.58, P=0.001).

Elementary and above educational status 76.5% were scored good knowledge about ITN utilization, of these 53.0% and 23.5% of them scored good and higher knowledge about ITN utilization respectively. Only 57.7% of illiterates were scored good knowledge about ITNs utilization. This finding was similar with result of study conducted in southern Ethiopia where educational status of study participants significantly associated knowledge of ITNs utilization (Terefe *et al*., 2015; Ndwiga *et al*., 2014). Regarding family size of the study, participants 31.0% and 26.1% those had less than five persons and greater than five persons were scored high knowledge about ITN utilization respectively. However, this factor has no statistically significant association with knowledge about ITN utilization ($p>0.05$). This result showed that the study participants had less than five persons in their family, 31% of them scored high knowledge about ITN utilization was probably because of ratio of ITNs distribution in the family that range from 1:3 to 1:4 along households with less than five people. In contrast to other socio-demographic factors, i.e. sex, and occupation did not show any significant associations with knowledge about ITN utilization.

Table 6. Association between socio-demographic characteristics and knowledge of ITN utilization, (N=403) in rural people in Habru *kebeles*, from October to December, 2016.

Characters	Freq	Knowledge of Utilization of ITN			X^2	p-value
		Poor n=92	Good n=130	High n=87		
Sex						
Male	172	48(29.0)	75(43.6)	49(27.4)	1.355	0.508
Female	137	44(32.1)	55(40.1)	38(27.8)		
Age						
17-20	72	16(22.2)	20(27.8)	36(50.0)		
21-30	113	22(19.5)	73(64.6)	18(15.9)	32.29	<0.001*
31-40	87	34(39.1)	25(28.7)	28(32.2)		
41-50	37	20(54.1)	12(32.4)	5(13.5)		
Family size						
Less than five peoples	129	34(26.4)	55(42.6)	40(31.0)	2.048	0.35
Greater than five peoples	180	58(32.2)	75(41.7)	47(26.1)		
Occupation						
Farmer	113	45(39.8)	35(30.9)	33(29.3)	0.414	0.525
Non-farmer	196	47(23.9)	95(48.5)	54(27.6)		
Educational status						
Illiterate	134	54(40.3)	60(44.8)	20(14.9)	13.58	0.001*
Elementary and above	175	38(21.7)	70(40.0)	67(38.3)		
Malaria transmission method						
Mosquito bite	219	49(22.4)	112(51.1)	58(26.5)	56.34	<0.001*
Others	90	43(47.8)	18(20.0)	29(32.2)		
Malaria is treatable						
Yes	256	72(28.1)	120(46.9)	64(25.0)	22.45	<0.001*
No	53	20(37.7)	10(18.9)	23(43.4)		
Malaria is preventable						
Yes	245	75(30.6)	115(46.9)	55(22.5)	32.8	<0.001*
No	64	17(26.6)	15(23.4)	32(50.0)		

X^2= chi-square, others = bad season and dirty environment, n= number of participant for those specific questionnaires.

4.5. Prevalence of Malaria Infections among Study Participants

Blood film samples were collected in October to December 2016 from 403 study subjects and examined in Mersa Health Centre. Among the total participants who were provided blood for malaria infection test, 16 (4.0%) of them were confirmed microscopically positive for malaria parasite infection (Table 7). The prevalence of malaria among the study participants was significantly low as compared to the findings 5.4%, from Southern Ethiopia, Dejene (2014).

From study done in western Ethiopia, where malaria prevalence was 6.3% (Teshome *et al.,* 2015. The difference could be explained by the fact that the control and prevention strategies that were in practice in study area particularly indoor residual sprays (IRS) or weather condition of the area (Table 7).

Of 16 malaria infected study participants, 10 (62.5%) and 6 (37.5%) of them were males and females, respectively. In this study, the prevalence of malaria was found to be higher among males 2.5% as it compared to 1.5% malaria infected females. A similar result reported from Arba Minch showed that the prevalence of malaria parasite was higher in males than in females and prevalence of *plasmodium* decrease with increase of age (Belayneh, 2014). The difference might arise because of males' greater occupational risk of getting the disease than women. The males usually work in fields or farm until evening, or this might be because adult males are engaged in outdoor activities during night: like irrigation farming which mostly done during night in the study area or because of other behavioural risk factors that could increase the risk of mosquito bites among males (Table 7).

Regarding prevalence of malaria infection by age, 17-20 age group was contributed for 5 (31.3%) of malaria prevalence and followed by 21-30 age group, 4 (25.0%). The prevalence of malaria found to be higher among the young age group as compared to old age group study participants. This might be activities of youngsters like irrigation farming activity in night or old age group obtained immunity from repeated exposure for malaria parasite (Belayneh, 2014). Table 7 showed that as age in year increases among study participants prevalence of *Plasmodium* decrease and young males were more infected by malaria parasite than young females because of their outdoor activities. A similar finding reported by Adugna *et al*. (2013), where prevalence of malaria infections was higher among young age group than adult individuals in Butajira area and in contrary from result of study conducted in North Western Nigeria, age 18-29 had high (40.5%) of malaria prevalence (Abdullahi *et al.*, 2014). Malaria affects mainly children in highly endemic areas where adults can develop partial immunity to the disease in contrast to the areas of low endemic where the disease may affect all age groups. In such malaria low endemic areas, changes in weather conditions may lead to major epidemics (Geletta *et al.*, 2014).

In the present study, out of 16 malaria positive individuals, 9 (56.3%) and 7 (43.7%) were *P. vivax* and *P. falciparum* respectively (Table7). Present study result in contrast in *Plasmodium* species distribution with study conducted in Arsi Negelle. *P. vivax* (74%) and *P. falcifarum* (19.8%) infection were reported by Mengistu and Solomon (2015); and with study conducted in South-Central Ethiopia where *P. vivax* (86.5%) and *P. falciparum* (12.4%) infection were reported Adugna *et al*.(2013). *P. falciparum* and *P. vivax* are the two predominant malaria parasites, distributed all over the Ethiopia accounting for 60% and 40% of malaria cases, respectively. This ratio of *P. falciparum* to *P. vivax* fluctuated between years but remained the same overall around 60:40%. However, current studies indicated that in some areas of Ethiopia the ratio of *P. falciparum* to *P. vivax* is changed (FMOH, 2014).

Table 7. Prevalence of *Plasmodium* species infection by age and sex (N=403) among rural people in Habru *kebeles*, from October to December, 2016**.**

Age group(years) & sex		No examined	Malaria Parasites *Pv* Nº pos (%)	*Pf* Nº pos (%)	Total No. of pos. (%)	X^2	p-value
17-20	M	45	3(6.7)	2(4.4)	5(11.1)	0.16	0.983
	F	36	2(5.6)	1(2.8)	3(8.3)		
21-30	M	84	2(2.4)	2(2.4)	4(4.8)	0.746	0.659
	F	60	1(1.7)	0	1(1.7)		
31-40	M	74	0	1(1.4)	1(1.4)	2.174	0.327
	F	54	1(1.9)	1(1.9)	2(3.7)		
41-50	M	40	0	0	0	0	0
	F	10	0	0	0		
	M	243	5(2.1)	5(2.1)	10(4.1)		
	F	160	4(2.5)	2(1.3)	6(3.8)	1.027	0.343
Total		403	9(2.2)	7(1.7)	16(4.0)		

Pf= Plasmodium falciparum, Pv = Plasmodium vivax x^2=chi-square

4.6. Trends and Patterns of Malaria Infections in Habru Rural Kebeles from (Year 2011-2015) in Mersa Health Centre

In the last five years (2011-2015), 3005 malaria suspected patients diagnosed for malaria in Mersa health centre. Of them 105 (3.5%) were microscopically confirmed malaria positive .The prevalence of malaria out of the whole clinical records of the past five years showed that 3.5% malaria cases in the study area. The malaria infection rates were vary among the gender

year to year in general, 54 (3.7%) and 51 (3.3%) of males and females were affected respectively in the past five years. This rates of infection showed that more males were infected than females in five years in study area (figure 5).

Malaria cases of the last five years in the study area were showed fluctuating trends. The significant rise in malaria prevalence was observed in 2014 where 5.2% of people were detected positive. Despite the apparent fluctuation of malaria trends in the study area, malaria cases were occurred in almost every month and season of the year. The highest peak of malaria cases in almost all years was observed during spring (September, October and November). This result probably the season found next to main rainy months and this may create conducive environmental condition for mosquitoes to transmit malaria in the study area and the minimum malaria prevalence peak were observed during winter (December, January and February) seasons (Appendix V, Table 2). The overall record review within the past five years indicated that both *P. vivax* and *P. falciparum* species were the common malaria parasite reported each year in the study area. The predominant malaria species were *P. vivax* followed by *P. falciparum* accounting for 63.8% and 36.2% of malaria infection respectively in the area during the years 2011-2015.

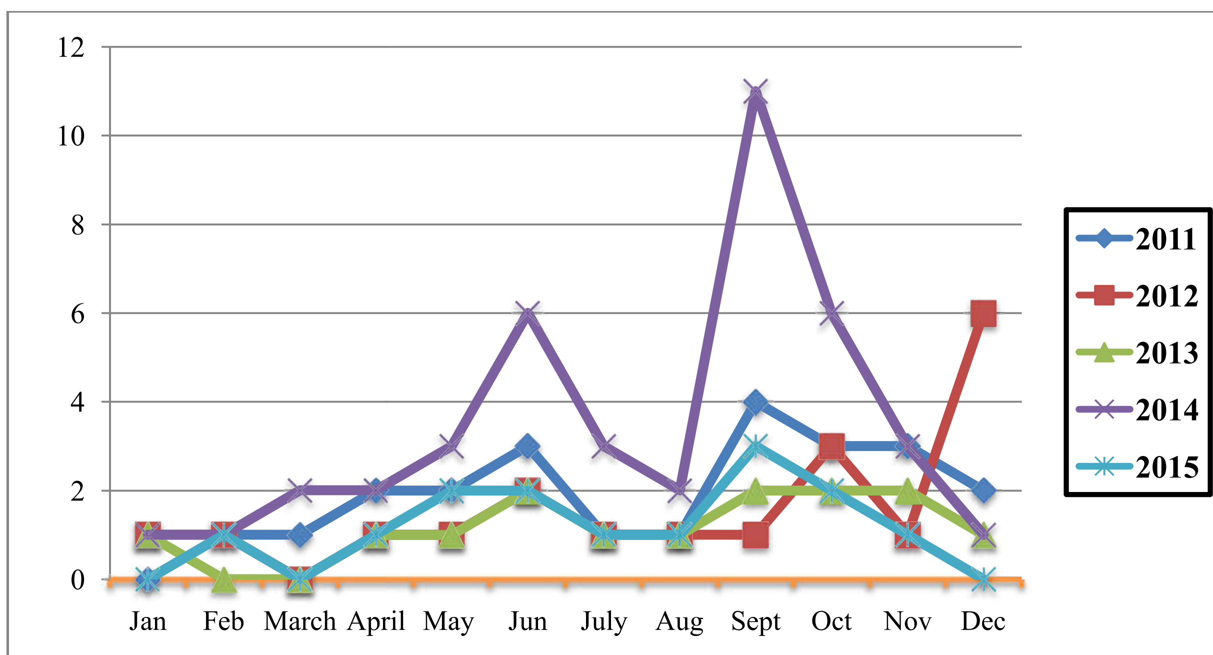

Figure 5. Yearly and Monthly prevalence of malaria in outpatients at Mersa Health Centre between 2011 to 2015 in Habru kebeles.

4.7. Associations of Some Socio-demographic Characteristics with Malaria Incidence among Study Participants

Table 8 showed the association of some socio-demographic characteristics with malaria infection. More than half of the study participants 60.3% were male and the rest 39.7% were females. The prevalence of malaria was higher in males than females. But the association of malaria infection with the sexes was not statistically significant (P>0.05). Regarding the age of study participants, two age groups 17-20 (first age group) and 21-30 (second age group) years had statistically significant association with malaria infection.

Of 16 malaria infection within study participants, 5 (31.3%) of them were belong to the first age group and 4 (25.0%) of them were the second age group. These age groups had statistically significant association with malaria infection at (p<0.001, OR=4.837, OR=1.899). This result was similar with finding from Arba Minch where malaria infections reported in the study area where age groups were 15–19 years old significantly affected and followed by 20–29 years old. These groups had statistically significant association with malaria infection (Belayneh, 2014).

In relation to educational status of the study participants, 12 (4.4%) and 4 (1.2%) illiterate and others educational status (primary school and above) respectively, were positive for malaria. The educational status of study participants had statistically significant association with malaria infection (p=0.040, OR = 4.409). The illiterate group of the study participants had higher prevalence of malaria. Similar finding was reported from Southwest Nigeria where malaria infection was higher among illiterate study participants than educated study participants (Adefioye, 2007).

In this study the occupations of the study participants were grouped into two these were farmers and non-farmer groups which includes; housewives, students and merchants. The study participants 12 (4.8%) and 4 (0.9%) farmers and non-farmers respectively were malaria infected groups (Table 9). The occupation of the study participants had statistically significant association with malaria infection (P=0.015, OR = 5.523).

In this study, farmers were infected more than other groups this was probably because of their work that, they stay outside at night. Because of high temperature in this area, mostly farmers accomplished their daily activities especially during night. According to MOP (2015), malaria transmission may also sometimes occur outdoors related to night-time work or social activities, or may be associated with temporary overnight travel to other districts.

Table 8. Associations of socio-demographic characteristics of the study participants with malaria infections (N=403) among the rural people of Habru Woreda, from October to December, 2016.

Factor	Malaria cases		P-value	OR (95% C.I)
	Yes (n=16)	No (n=387)		
Sex of study participant				
Male	10	233	0.79	0.846(0.244-2.939)
Female	6	154		1.0
Age of study participant				
17-20	8	67	<0.001*	4.837(8.277-2.309)
21-30	5	138		1.899(3.419-1.054)
31-40	3	126		1.0
41-50	0	56		
Educational status				
Illiterates	12	192	0.04*	4.409(0.94-20.669)
Elementary and above	4	195		1.0
Occupation				
Farmers	12	168	0.015*	5.523(1.178-25.89)
Non farmers	4	219		1.0
Family size				
Above 5 persons	11	217	0.203	2.335(0.610-8.932)
Less than 5 persons	5	170		1.0
Livestock in house				
Yes	10	343	0.278	0.507(0.145-1.770)
No	6	44		1.0
Housing unit				
Conventional	6	214	0.338	0.549(0.158-1.904)
Improved	10	173		1.0

*Significant at P< 0.05, OR= Odds Ratio, C.I= Confidence Interval, n= number of participant for those specific questionnaires.

4.8. The Association of Malaria Infection with Study Participants' Selected Knowledge about Malaria

Association of selected malaria knowledge of study participants' with malaria infection was examined using Pearson Chi-square tests at p-value <0.05 and odd ratio (OR). These presented in table 9. Knowledge about malaria significantly influenced the malaria prevalence among study participants. Malaria prevalence was high among study participants who related malaria transmission with other environmental conditions, 4.2% of them were infected than those aware transmission method and this knowledge had statistically significance association with malaria infection (p=0.030, OR=3.99).

Regarding study participants' knowledge about treatability of malaria majority of study participants who knew that malaria is treatable only 1.5% of them were infected whereas those not knew about treatability of malaria, 9.2% of them were infected. This knowledge had statistically significance association with malaria infection (p=0.001, OR=6.037). Malaria prevalence was high among study participants who had a poor knowledge about malaria (Yadav *et al.,* 2014).

Study participants methods of malaria prevention and their knowledge about benefit of ITNs also significantly influenced the prevalence of malaria parasite among study participants. Prevalence of malaria was 1.1% less among study participants used ITNs and it was 7.1% among those use other methods of malaria prevention. This factor has statistically significance association with malaria infection (p=0.002, OR=5.788). Study participants those related benefit of ITNs with prevention of mosquito bite were less 1.01% infected by malaria parasite but high malaria infection 7.5% among participants not correctly related ITNs with its function. This factor had statistically significance association with malaria infection (p<0.001, OR=7.89) (Table 10). This study finding was similar with study in titled "Prevalence and risk factors of malaria in Ethiopia" where households who were using mosquito nets were found to be at a lower risk of malaria compared to the households who were not using mosquito nets (Dawit *et al.*, 2012).

Table 9. Associations of malaria infection with knowledge about malaria (N=403) among the rural people of Habru kebeles, from October to December, 2016.

Factor	Confirmed malaria cases Yes (n=16)	No (n=387)	P- value	OR (95% C.I)
Malaria transmission method				
Mosquito	6	230	0.030*	3.99(1.043-15.277)
Other	10	157		1.0
Is malaria treatable?				
Yes	7	327	0.001*	6.037(1.789-20.373)
No	9	60		1.0
Malaria Prevention methods				
ITN	6	301	0.002*	5.788(1.167-13.117)
Others	10	86		1.0
Knowledge of ITNs benefit				
Yes	6	293	<0.001*	7.89(2.054-30.332)
No	10	94		1.0
Knowledge of ITN utilization				
Medium and above	6	200	0.024*	1.0
Poor	10	187		1.724(1.282-2.322)

*Significant at P< 0.05, OR= Odds Ratio, C.I= Confidence Interval, n= number of participant for those specific questionnaires.

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary

Malaria is one of the major killers of humans worldwide, threatening the lives of more than one-third of the world's population and in Ethiopia; malaria is the major health problem with an estimated 65% of the 80 million people exposed to malaria. Malaria parasites are transmitted to humans by the bite of infected female *Anopheles* mosquitoes. Malaria is an entirely preventable and treatable disease by using prevention and control strategies, which involve mainly the use of insecticide-treated nets (ITNs), and ITN is the primary health intervention to prevent infective mosquito bite and reducing mosquito density.

The objectives of this study were to investigate the prevalence of malaria among rural peoples' knowledge about ITNs utilization and trends of malaria transmission among rural people in Habru Woreda, North Wollo Zone, Amhara Region, Ethiopia, from October to December 2016. The study was used cross-sectional community based survey and laboratory investigation to investigate malaria prevalence, to assess study participants knowledge about ITN utilization and use of retrospective clinical records from health centre. Random sampling method was used to select 403 study participants. The data were gathered using structured and pretested questionnaires and parasitological blood examination.

The results of questionnaire survey indicated that the study participants had better knowledge on the method of malaria transmission; majority 76.1% of the study participants were correctly associated malaria transmission with mosquito bites. Though the study also found that misconceptions in transmission 23.9% among study participants, the misconceptions indicted that the way people respond to malaria prevention and control and it related with lack of clear knowledge about the spread of malaria.

The results showed that knowledge about the symptoms of malaria was also high among study participants where majority 84.0% of the study subjects had knowledge of at least one of the classical malaria symptoms and this could be probably they aware symptom because of repeated exposure or had information about it. Community members have different knowledge and practices in relation to malaria prevention: use of ITNs, smoking and environmental

sanitation were from mentioned prevention measures. The majority, 75.7% of study participants were used ITNs as their main prevention method others 24.3% of them had no ITNs, reason for not owing ITNs were no accessibility of ITNs in area during the time of study and their ITNs were old and damaged.

Majority of respondents sources of information about ITNs and malaria prevention were health workers. The variations of results may be due to lack of ITNs, in adequate number of ITNs in family and lack of proper information on how to use ITNs. The participants' knowledge about utilization of ITNs had statistically significant association with some selected factors such as age, education status and with knowledge about malaria such as malaria transmission methods, preventability and treatability of malaria.

The result of parasitological blood examination showed that the prevalence of malaria in the study area was 4.0%. Even though the difference was statistically not significant, there was variation of malaria infection among males and females, 2.5% and 1.5% respectively. This difference could be due to males' activities like irrigation farming which carried out at night in the study area. Major *Plasmodium* species detected in microscope among study participants were, *P. vivax* 56.3% and *P. falciparum* 43.7%) in the study area. A significant variation of malaria infection was seen between age groups where relatively more malaria infection was detected among age groups 17-20 years (6.7%) and 21-30 years (2.4%) than other age groups.

Malaria prevalence was showed statistically significant association with factors: some socio-demographic characteristics (age groups, occupation and education status), knowledge about malaria (transmission methods, treatability and prevention method of malaria), and knowledge of ITNs.

The overall trend of malaria prevalence in the past five years (2011-2015) in study area as it was analyzed from health records review of Mersa Health Centre, within the past five years malaria cases was showed fluctuating trends, occurred almost in all months and seasons of the years. Both species of *Plasmodium, P. vivax* 56.3% and *P. falciparum* 43.7% were the common malaria parasite reported each in year and more males 2.5% were infected than females 1.5% in the study area.

5.2. Conclusions

Malaria prevalence among study participants was 4.0%. Almost all age groups affected but the age group of 17-20 and 21-30 years were infected more than other age groups. The prevalence of malaria in the area shows difference among sexes, more males were infected than females. Both *P. vivax* and *P. falciparum* were dominant *plasmodium* species and *P. vivax* was dominant in the study area. The results also confirmed that, 62.5% of study participants were possessed at least one ITN.

The ratio of ITNs within family is not adequate and there is no accessibility of ITNs in area during the study time. ITN utilization among study participants were good where 85.4% of them were slept under ITNs during study time. The malaria prevalence trend in the study area showed that uneven distributions of malaria infection through all months, seasons and years in the population of the study area. Malaria occurrence appeared to follow different patterns in the study sites, low transmission during dry seasons and high transmission during wet seasons or in months next to main rainy season.

5.3. Recommendations

Despite the efforts made for malaria control international, the malpractices in using ITN is common in the study community. Therefore:

- Adequate health education should be given to increase community knowledge about utilization of ITN.
- Further efforts be made to increase ITN coverage in the study area to maximize the benefit of the intervention.
- Health extension workers should work on environmental management such as avoiding accumulated water along riverside, handling irrigation sites with care by mobilizing the community to prevent malaria transmission.
- The accessibility of bed nets with treatment kits should be considered in the study area and this should have to take into account also family size to avoid imbalance between families.

- Health extension workers should regularly physical inspection or continuous monitoring and evaluation of households' ITNs usage after distribution of bed net to avoid misuses and damages of ITNs and create awareness regarding the proper use of ITN to sustain malaria control and prevention programs in study area.
- The old (worn out) insecticide treated bed nets (ITNs) should be replaced in time by new ones.
- Future study on the prevalence of malaria and its control practices using wider population and on factors affect community knowledge about utilization of ITNs are recommended.

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7. APPENDICES

Appendix I. **Consent Form (English Version)**

Name of study participant ______________________ Age__________ Sex________

Laboratory technician Name___________________________ Site/Health centre ______

Hello, my name is ______________________________ and I work in Haramaya University.

I am here to collect information about the Status of malaria and utilization of insecticide treated bed net among rural people in Habru *Woreda*, North Wollo Zone, Amhara Region, Ethiopia. The purpose of the study is to determine prevalence of malaria infection among rural people in the study area, to assess people's knowledge about utilization of ITNs in the area and to identify predominant plasmodium species causing malaria infection in the study area.

Therefore, I will ask you some question related to malaria and examine a member of your family for the signs of malaria and will take blood sample to examine for malaria parasite. Please be assured that the information will be confidential since participation is based on your willingness besides; you can withdraw from the study anytime. However, your kindly participation would play key role in the success of this study. In addition, no personal identification will be written and we assure you that whatever information you are providing will only be used for the research purpose and the data were be handled only by the researcher. Are you willing to participate in the study?

Agreed ______________________ Not Agreed _________

Thank you

Name of Data collector ___________________ Signature ____________ Date _________

Appendix II: Consent Form (የአማርኛ ትርጉም)

መለያ ቁጥር __________

የጥናቱ ተሳታፊ ስም ___________ እድሜ ___ ፆታ ___

የቤተ ሙከራ ባለሙያ ስም __________________ የጤና ማዕከል _______________

ጤና ይስጥልኝ! ስሜ **አንዋር ሞላ** ይባላል፡፡ የምሰራው በሐረማያ ዩኒቨርሲቲ ነው፡፡ እዚህ በመርሳ ጤና አጠባበቅ ያለሁት በሃብሩ ወረዳ ውስጥ ያለውን የወባ በሽታ ስርጭት እና የዘንዘራን (የአጎበርን) አጠቃቀምን በተመለከተ መረጃ ለመሰብሰብ ነው፡፡

የጥናቱም አላማ የአካባቢውን ማህበረሰብ የወባ በሽታን መከላከልና ቁጥጥርን አስመልክቶ ስላለው ግንዛቤ አመለካከት እና አተገባበር ለመረዳት ነው፡፡ በተጨማሪ ማንኛው የፕላስሞዲየም ዝርያ በብዛት እንደሚገኝ ጥናት ይደረጋል፡፡ ስለዚህ ወባን በተመለከተ የተወሰኑ ጥያቄዎችን እጠይቆታለሁ፡፡ እርስዎ ወይም ልጆዎ የወባ ምልክቶች ምርመራ እንድደረጉ የደም ናሙና ይወሰዳል:: እባክዎትን የዚህ መረጃ ሚስጥራዊነት የተጠበቀ መሆኑን እና ለጥያቄዎቹ በሚሰጡት መልስ ምክንያት ምንም ጉዳት እንደማይኖር አረጋግጥሎታለሁ፡፡ ተሳትፎዎ በፈቃደኝነት ላይ የተመሰረተ ነው፡፡ ከዚህ በተጨማሪ በፈለጉት ጊዜ ከጥናቱ ሊወጡ ይችላሉ፡፡ ነገር ግን የርስዎ ከፍተኛ ተሳትፎ ለዚህ ጥናት እውን መሆን ቁልፍ ሚና አለው፡፡ በተጨማሪም የግለሰብ መለያ አይፃፍም፡፡ የሚሰጡን ማንኛውም መረጃ ለጥናቱ አላማ ብቻ የሚውል መሆኑና በአጥኚው እና በቤተ-ሙከራ ባለሙያው ብቻ የሚያዝ መሆኑን እናረጋግጥሎታለን፡፡

በጥናቱ ለመሳተፍ ፈቃደኛ ነዎት?

እስማማለሁ ___________

አልስማማም ___________

አመሰግናለሁ፡፡

መረጃውን የሰበሰበው ስም ________________ ፊርማ ___________ ቀን ________

Appendix III. Questionnaire (English version)

Haramaya University, School of Graduate Studies, Department of Biology, Masters of Science in Biology 2016

Questionnaire to be answered by household respondents selected from Habru rural *kebeles* to collect data for the research in titled; Status of Malaria and Utilization of Insecticide-Treated Bed Nets among Rural People in Habru *Woreda*, North Wollo Zone, Amhara Region, Ethiopia.

Thank you in advance for your genuine response!

Instruction: please select the appropriate answer you wish to give and circle your answer letter. You can select more than one answer based up on type of question.

Part I: Household identification

Date_______________ kebele ________________ ___House number _________

Part II: Socio-Demographic Characteristics of household

1) Gender of respondent A/ Male B/ Female
2) What is the number of your family? A/ ≤ 5 persons B/ > 5 persons
3) What is your age? A/ <20 B/ 20-30 C/ 31-40 D/ Above 41
4) What is your marital status? A/ Single B/ Married C/ Widowed Divorced/separated E/Other
5) What is your highest level of education? A/ No education B/Only read and write C/ Primary education D/ Secondary education E/ Higher education
6) What is your occupation? A/ Farmer B/Merchant C/Students D/Retired E/House wife F/ No job
7) Do you have livestock? A/ Yes B/ No
8) Status of residential houses A/Mud &grass B/Steel (iron sheet) roof C/ Cemented wall &floor D/ None of these

<u>Part III</u>. Questions about knowledge related to malaria, treatment seeking behaviour and prevention of malaria

9. Have you ever heard malaria in your area? A/ Yes B/ No C/I don't know

10. Is malaria a transmissible disease? A/ Yes B/ No C/ I don't know

11. How does malaria transmit from person to person? A/ by mosquito bite B/ dry season C/ through bodily contact with patients D/ Drinking dirty water E/ from dirty environment

12. When does mosquito bite? A/ Day time B/ Night time C/ Day and night D/ I do not know

13 What are the main Symptoms of malaria you know?

A/ Fever --------
C/Shivering --------
D/Headache --------
E/Backache --------
F/Joint ache --------
G/Loss of appetite --------
H/Vomiting --------
J/ Do not know --------

14. Is malaria treatable? A/ Yes B/ No

15. Where do you and your family go to seek treatment for malaria? A/ Traditional healer of *kebele* B/Health centre of *kebele* C/take tablet D/ other

16. Can Malaria be preventable disease? A/ yes B/ No C/ I do not know

17. If you answer yes the above question, what kind of methods you use to prevent malaria? A/ Take tablets B/ Use insecticide sprays C/ Environmental Sanitation D/ Use of ITNs E/ Use of local cotton sheet F/ Smoke from Burning leaves and animal product G/ No answer H/ Others

Part IV: Study Participants Knowledge of ITNs and possession of ITNs

18. Do you have ITNs in the house? A/ Yes B/ No
19. If you answer No the above question what is your reason? A/ no one gave me ITN in area B/ old and damaged
20. How many ITNs do you have for family? A/one B/two C/three D/four E/ above four F/ I have no ITN
21. Is there availability/supply of ITNs in your *kebel*e in present time?
A/Yes B/No
22. Have you ever heard education about ITNs? A/Yes B/ No
23. If you answer 'yes' the above question, what were your sources of information? A/Radio B/ Posters C/ Health workers D/ News paper E/Mosque / Church F/Kebele / Peasant representative G/ School H/ Friends I/ Others ___
24. Do you think that sleeping under ITNs has benefit? A/ Yes B/ No
25. If you answer 'yes' the above question, what are benefits of sleeping under ITNs? A/ don't get bitten by mosquito B/ don't get bothered by other insects C/ don't get malaria D/ to get warmth E/ Others_______________
26. When do you or your family sleep under ITNs? A/ daily B/ Regularly C/during transmission time D/weakly E/others_________

Part V: household utilization of bed nets.

27. Who sleep under ITNs in your house? A/children under five B/ children >5 years C/adults D/ women F/ father &mother G/ mother & children <5
28. Did you treat your mosquito net by chemical in the last six months? A/ Yes B/ No C/have no ITN
29. If you answer 'No' the above question, what is your reason? A/ lack of chemical B/ lack of awareness C/other--------------
30. Did you ever wash your mosquito net in last six months? A/ No B/Yes

Part VI. Assessment questions of households' knowledge about utilization of ITN

Character	Yes	No
1. Do you know what ITN is		
2. Last night family used ITNs		
3. Family wash ITN in the past six months		
4. retreating ITNs		
5. I know the difference between treated and non-treated bed net		
6. Can you hang ITN correctly?		
7. How long have you used ITN? 1. Not at all 2.1-2years 3.>2 years		
8. ITN utilization frequency. 1. Not at all 3. Regularly 4. During transmission		

Appendix IV: መጠይቅ (የአማርኛ ትርጉም)

በሃብሩ ወረዳ በተመረጡ ገጠራማ ቀበሌዎች መረጃ ለመሰብሰብ በጥናቱ ተሳታፊዎች የሚመለስ መጠይቅ፤ በሃብሩ ወረዳ ውስጥ ያለውን የወባ በሽታ ስርጭት እና የዘንዘራን (የአጎበርን) አጠቃቀምን በተመለከተ ሃብሩ ወረዳ፤ ሰሜን ወሎ ዞን አማራ ክልል ኢትዮጵያ

ለተሳትፏችሁ ልባዊ ምስጋና አመሰግናለሁ!

ትዕዛዝ፦ መመለስ የምትፈልጉትን ትክክለኛ መልስ ከመረጣችሁ በኋላ በምርጫነት የቀረቡትን ፊደሎች አክብቡ፡፡ በጥያቄው መሠረት ከአንድ በላይ መልስ መስጠት ትችላላችሁ

ክፍል አንድ ፦ ቤተሰብን መለያ

ቀን________ ቀበሌ______ የቤት ቁጥር_________

<u>ክፍል ሁለት</u>፦ የቤተሰብ ማህበረ-ህዝበ ነክ የሆኑ ባህሪያት

1. የመላሹ ጾታ ሀ. ወንድ ለ. ሴት
2. የቤተሰብ ቁጥርሽ/ህ ስንት ነው? ሀ. ከአምስት ቤተሰቦች በታች ለ. ከአምስት ቤተሰቦች በላይ
3. እድሜህ/ሽ ስንት ነው? ሀ. ከ 20 አመታት በታች ለ. ከ20-30 አመታት ሐ. ከ30-40 አመታት መ. ከ 40 አመታት በላይ
4. የትዳር ሁኔታሽ/ህ? ሀ. ያላገባ ለ. ያገባ ሐ. ባል/ሚስት የሞተችበት/የሞተባት መ. የተፋቱ ሠ. ሌሎች
5. የትምህርት ደረጃ ሀ. ያልተማረ ለ. መጻፍና ማንበብ ብቻ ሐ. የመጀመሪያ ደረጃ ትምህርት/ቤት መ. ሁለተኛ ደረጃ ትምህርት/ቤት ሠ. ከፍተኛ ትምህርት/ቤት
6. የስራ ሁኔታ ሀ. ገበሬ ለ. ነጋዴ ሐ. ተማሪዎች መ. ጥሮታ የወጣ ሠ. የቤት እመቤት ረ. ስራ የለኝም
7. ከብቶች አሉህ/ሽ? ሀ. አዎን ለ. የለኝም
8. የመኖሪያ ቤቶች ሁኔታ ሀ. ከሳርና ከጭቃ የተሰራ ለ. የቆርቆሮ ጣራ ያለው ሐ. ወለሉ በሲሚንቶ የተሰራ መ. ከላይ ከተጠቀሱት ውጭ የሆነ

<u>ክፍል ሶስት፦ </u>ስለ ወባ በሽታ እውቀት፣ ህክምናን ስለመፈለግ ባህሪይና መከላከያ መንገዱን የሚመለከቱ ጥያቄዎች

9. ስለ ወባ በሽታ በዚህ ቦታ መኖሩን ሰምተው ያውቃሉን? ሀ. ሰምቻለሁ ለ. አልሰማሁም ሐ. አላውቅም

10. የወባ በሽታ ከሰው ወደ ሰው ተላላፊ ነውን? ሀ. ይተላለፋል ለ. አይተላለፍም ሐ. አላውቅም

11. የወባ በሽታ ከሰው ወደ ሰው እንዴት ይተላለፋል? ሀ. በወባ ትንኝ በመነከስ ለ. በደረቅ ወቅት ሐ. በወባ በሽታ ከታመመ ሰው ጋር የሰውነት ንክኪ በማድረግ መ. ቆሻሻ ውሐ በመጠጣት ሠ. አካባቢው ከቆሸሼ ሰፈር

12. የወባ ትንኝ የምናከሰው መቼ ነው? ሀ. በቀን ለ. በማታ ሐ. በቀንና በማታ መ. አላውቅም

13. ዋና ዋና የወባ በሽታ ምልክቶችን ያውቃሉን? ሀ. ትኩሳት ለ. ማንቀጥቀጥ ሐ. ራስ ምታት መ. የጀርባ ህመም ሠ. የጅማት ህመም ረ. ምግብን መከልከል ሰ. ማስታወክ ሸ. አላውቅም

14. የወባ በሽታ ሊዲን የሚችል ነውን? ሀ. ይድናል ለ. አይድንም

15. አንተ/አንቺ እንዲሁም ቤተሰቦችሽ/ህ በወባ በሽታ ስተጠቁ ህክምናውን ለማግኘት ወደ የት ትሄዳላችሁ? ሀ. ቀበሌ ውስጥ ወደሚገኘው ባህላዊ ህክምና ሰጪ አካል በመሔድ ለ. ወደ ቀበሌው ጤና አጠባበቅ በመሔድ ሐ. ክኒንን በመውሰድ መ. በሌላ መንገዶች

16. የወባ በሽታን መከላከል ይቻላልን? ሀ. መከላከል ይቻላል ለ. መከላከል አይቻልም

17. ለተራ ቁጥር "16" ጥያቄ *መከላከል ይቻላል* ካላችሁ፣ የወባ በሽታን ለመከላከል የምትጠቀሙባቸው መንገዶች ምንድን ናቸው?

ሀ. ክኒን በመውሰድ ለ. ፀረ-ነፍሳት ኬሚካልን በመርጨት ሐ. የአካባቢን ንጽህና በመጠበቅ መ. ዘንዘራን (አጎበርን) በመጠቀም ሠ. አካባቢያዊ የሆነ ከጥጥ የተሰራ ፎጣን በመጠቀም ረ. ቅጠሎችን በማቃጠል ጭስን በመፍጠር እና የእስሳት ጽዳጆችን በመጠቀም ሰ. መልስ የለም ሸ. ሌሎችም

ክፍል አራት፦ የጥናቱ ተሳታፊዎች ስለ ዘንዘራ ያላቸው እውቀትና ያሏቸው ዘንዘራዎችን በተመለከተ

18. በቤታች ዘንዘራ አለን? ሀ. አለን ለ. የለንም

19. ከላይ ላለው ጥያቄ 18 የለንም ካላችሁ፣ ዘንዘራ ያለመኖሩ ምክንያት ምንድነው? ሀ. በቀበሌያችን የተሰጠን ዘንዘራ የለም። ለ. አሮጌና የተጎዱ ዘንዘራዎች ስላሉን ነው።

20. በየቤታችሁ ስንት ዘንዘራዎች አሏችሁ? ሀ. አንድ ለ. ሁለት ሐ. ሶስት መ. አራት ሠ. ከአራት በላይ ረ. ዘንዘራ የለም

21. በአሁኑ ሰዓት በቀበሌያች የዘንዜራ ስርጭት አለን? ሀ. አለ ለ. የለም

22. ስለ ዘንዜራ ትምህርት ሰምታችሁ ታውቃላችሁ? ሀ. ሰምተናል ለ. አልሰማንም

23. ለተራ ቁጥር ጥያቄ "22" መልሳችሁ *ሰምተናል* ካላችሁ፣ የመረጃ ምንጮቻችሁ ምን ነበሩ?

ሀ. ሬዲዮ ለ. በራሪ ወረቀቶች ሐ. የጤና ሰራተኞች መ. ጋዜጋዎች ሠ. መስጅድ ረ. ቤተ-ክርስቲያን ሰ. በገበሬው ተወካይ አማካኝነት ሸ.ትምህርት ቤት ቀ. ጓደኛ በ.ሌሎች

24. ዘንዜራ ውስጥ መተኛት ጥቅም አለው ብላችሁ ታስባላችሁ? ሀ. አዎ ፤ ይጠቅማል ለ. አይጠቅም

25. ለተራ ቁጥር ጥያቄ 24 ይጠቅማል ካላችሁ፣ ዘንዜራ ውስጥ የመተኛት ጥቅሞች ምን ምን ናቸው? ሀ. በወባ ትንኝ ላለመነከስ ለ. በሌላ ነፍሳት እንዳንረበሽ ሐ. በወባ በሽታ ላለመያዝ መ. ቅዝቃዜን ለመከላከል ሠ.ሌሎችም

26. አንተ/ቺ ወይም ቤተሰቦችህ/ሽ ዘንዘራ ውስጥ የምትተኙት መቼ ነው? ሀ. በየቀኑ ለ. መደበኛ በሆነ ሰዓት ሐ. የወባ በሽታ በሚተላለፍበት ጊዜ መ. በየሳምንቱ ሠ. ሌሎችም

ክፍል አምስት፦ የዘንዘራ አጠቃቀም በቤተሰብ ላይ

27. በቤታችሁ ዘንዘራ ውስጥ የሚተኛው ማነው? ሀ. ከአምስት አመታት በታች ያሉ ህጻናት ለ. ከአምስት አመታት በላይ ያሉ ህጻናት ሐ. ወጣቶች መ. ሴቶች ሠ. አባትና እናት ረ. እናትና ከአምስት አመታት በታች ያሉ ህጻናት

28. የወባ መከላከያ ዘንዘራችሁን በባለፈው ስድስት ወር አካባቢ በኬሚካል አስነክራችሁ ነበርን? ሀ. አስነክረናል ለ. አላስነከርንም ሐ. ዘንዘራ የለንም

29. ለተራ ቁጥር ጥያቄ 28 "አላስነከርንም" ካላችሁ፣ ምክንያቱ ምን ነበር? ሀ. የኬሚካል እጥረት ለ. የእውቀት ችግር ሐ. ሌሎችም

30. የወባ መከላከያ ዘንዘራችሁን በባለፈው ስድስት ወር አካባቢ አጥባችሁት ነበርን? ሀ. አጥበናል ለ. አላጠብንም

ክፍል ስድስት፦ በዘንዜራን አጠቃቀም ላይ የቤተሰቦችን እውቀት የሚዳስሱ ጥያቄዎች

መገለጫዎች	አዎን	አይደለም
1. ዘንዘራ ማለት ምን እንደሆነ ታውቃላችሁ		
2. ቤተሰቡ ባለፈው ማታ ዘንዘራ ተጠቅሟል?		
3. ቤተሰቡ በባለፈው ስድስት ወራት ዘንዘራውን አጥበዋልን?		
4. ዘንዘራን እንደገና ኬሚካል አስረጭተነዋል		
5. በኬሚካል የተረጨና ያልተረጨውን ዘንዘራ ለይቼ አውቃለሁ		
6. ዘንዘራ በትክክል መዘርጋት ትችላላችሁ?		
7. ዘንዘራን ለስንት ጊዜያት ተጠቅማችኋል? ሀ. ሁልጊዜ አንጠቀምም ለ. ከ1-2 አመታት ሐ. ከሁለት አመታት በላይ		
8. የዘንዘራ አጠቃቀም ድግግሞሽ ሀ. ሁልጊዜ አንጠቀምም ለ. በመደበኛ ጊዜ ሐ. የወባ በሽታ በሚተላለፍበት ጊዜ		

Appendix V. Tables

Table 1. Participants' knowledge about utilization of ITNs

Character	Frequency	Percent (%)
Knowledge of ITN benefit		
Yes	344	85.4%
No	59	14.6%
know retreating ITN		
Yes	101	32.7%
No	208	67.3%
Currently use ITN/use ITN last night		
Yes	234	89.8%
No	71	10.2%
Do wash ITN in the past six months?		
Yes	111	64.3%
No	198	35.7%
heard information about ITNs		
Yes	330	81.9%
No	73	18.1%
Frequency of ITN utilization		
Regularly	68	22.0%
During transmission time	172	55.7%
Sometimes	46	14.9%
Rarely	23	7.4%
ITNs utilization Experience of family (years)		
1-2	75	24.3%
>2	234	75.7%

Table 2. Malaria infections history among rural people living in the study area obtained from clinical records of outpatients at Mersa Health Centre from Year 2011-2015

Mon	Description	2011	2012	2013	2014	2015	Total
Jan.	No. exam.	25	45	33	37	19	159
	No.pos.(%)	0	1(0.02)	1(0.03)	1(0.03)	0	3(0.02)
Feb.	No. exam.	41	37	21	47	38	184
	No.pos.(%)	1(0.02)	1(0.03)	0	1 (0.02)	1(0.03)	4(0.02)
Mar.	No. exam.	32	39	15	49	46	181
	No.pos.(%)	1(0.03)	0	0	2(0.04)	0	3(0.02)
Apr.	No. exam.	43	47	35	52	48	225
	No.pos.(%)	2(0.05)	1(0.02)	1(0.03)	2(0.04)	1(0.02)	7(0.03)
May	No. exam.	51	49	43	62	57	262
	No.pos.(%)	2(0.04)	1(0.02)	1(0.02)	3(0.05)	2(0.04)	9(0.03)
June	No. exam.	69	71	56	88	55	339
	No.pos.(%)	3(0.04)	2(0.03)	2(0.04)	6(0.07)	2(0.04)	15(0.04)
July	No. exam.	41	39	45	74	58	257
	No.pos.(%)	1(0.02)	1(0.03)	1(0.04)	3(0.04)	1(0.02)	7(0.03)
Aug.	No. exam.	43	30	43	57	42	215
	No.pos.(%)	1(0.02)	1(0.03)	1(0.02)	2(0.04)	1(0.04)	6(0.03)
Sept.	No. exam.	74	44	44	117	85	364
	No.pos.(%)	4(0.05)	1(0.02)	2(0.05)	11(0.09)	3(0.04)	21(0.06)
Oct.	No. exam.	58	78	51	102	73	362
	No.pos.(%)	3(0.05)	3(0.04)	2(0.04)	6(0.06)	2(0.03)	16(0.05)
Nov.	No. exam.	78	42	57	61	37	275
	No.pos.(%)	3(0.04)	1(0.02)	2(0.04)	3(0.05)	1(0.03)	10(0.04)
Dec.	No. exam.	42	37	49	38	16	182
	No.pos. (%)	2(0.05)	0	1(0.02)	1(0.03)	0	4(0.02)
Total	No. exam	597	558	492	784	574	3005
	No.pos.(%)	23(3.9)	13(2.3)	14(2.8)	41(5.2)	14(2.4)	105(3.5)

Where: No. exam= number of examined, No.pos =Number of positive

Equation 3. Malaria prevalence by years, months, species and in gender obtained from clinical records of outpatients at Mersa Health Centre (Records from the years 2011 to 2015).

months	Years					Mal. Sp		Gender		Total
	2011	2012	2013	2014	2015	*p.v*	*P.f*	Male	Female	
Jan.	0	1	1	1	0	2	1	1	2	3
Feb.	1	1	0	1	1	2	2	3	1	4
Mar.	1	0	0	2	0	2	1	0	3	3
Apr.	2	1	1	2	1	5	2	2	5	7
May	2	1	1	3	2	7	2	5	4	9
June	3	2	2	6	2	11	4	8	7	15
July	1	1	1	3	1	4	3	5	2	7
Aug.	1	1	1	2	1	4	2	3	3	6
Sept.	4	1	2	11	3	12	9	11	10	21
Oct.	3	3	2	6	2	9	7	10	6	16
Nov.	3	1	2	3	1	6	4	3	7	10
Dec.	2	0	1	1	0	3	1	3	1	4
Total	**23**	**13**	**14**	**41**	**14**	**67**	**38**	**54**	**51**	**105**

P.f= Plasmodium falciparum, P.v = Plasmodium vivax