PREVALENCE OF MALARIA TRENDS AND CONTROL PRACTICES IN MELKA BELO WOREDA, EASTERN HARARGHE ZONE, OROMIA REGIONAL STATE, ETHIOPIA

MSc THESIS

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APPROVAL SHEET
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As Thesis Research advisors, we hereby certify that we have read and evaluated this thesis prepared, under our guidance, by Ambaye Shimelis, entitled ***Prevalence of Malaria Trends and control practices in Melka Belo Woreda, Eastern Hararghe Zone Oromia Regional State, Ethiopia***.

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I dedicate this thesis to my father Shimelis Workineh who lost his life when I was in grade 9 and made me stand by two legs.

STATEMENT OF AUTHOR

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BIOGRAPHICAL SKETCH

The author was born in Oromia Regional State, Eastern Hararghe Zone, Meta Woreda, Kore Mute, farmers association in 1983. He attended his primary school education in Kore Mute Primary School. After the completion of grade 1- 8 from 1996-2002, he attended his Secondary and Preparatory education in Chelenko Secondary and Preparatory School from 2003-2005 in Chelenko. Then he joined Wollo University previously named Dessie Kombolcha University in 2006 and obtained Bachelor of Education (B.Ed.) degree in 2009 in Biology. Following this, he had been teaching Biology in Harewacha High School for six years from 2009 to 2014 and Harewacha Preparatory School for 2015(2008), until he joined Haramaya University for his M.Sc.in Biology 2013.

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ACRONYMS AND ABBREVIATIONS

ACAT	Artemisinin-based combination therapies
CDC	Center for Disease control
CSA	Central Statistical Agency
DHS	Demographic and Health Surveys
ESS	Environmental Software and Services
EPHI	Ethiopian Public Health Institution
FMOH	Federal Ministry of Health
FDREMH	Federal Democratic Republic Ethiopia Ministry of health
HEW	Health extension worker
HDA	Health Development Army
HSCS	Health and Safety Code Section
KAP	Knowledge, Attitude and Practice
MIS	Malaria Indicator Survey
NSP	National Strategic Plan
PMI	President's Malaria Initiative
RBM	Roll Back Malaria
RDT	Rapid diagnostic test
WHO	World Health Organization
WMR	World Malaria Report
USAID	United States Agency for International Development

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ABSTRACT

Malaria is one of the major public health problems in many tropical and subtropical developing countries such as Ethiopia. The objective of this study was to determine malaria trends, prevalence and to assess the control practices practiced by people in Melka Belo Woreda, in Eastern Hararghe Zone, Oromia Regional State, Ethiopia. A cross sectional survey study was carried out from April to May 2016. Health records of malaria for the last eight years (2008-2015) were obtained from Melka Belo Health Offices. A cluster random sampling technique was carried out to select representative study participants from community members. Structured and pretested questionnaires (n=404) and blood film examinations were used for data collection. All data were analyzed using Microsoft excel 2010. The overall prevalence of malaria was 12.9%. The major Plasmodium species identified in this study were P. falciparum (65.4%) and P. vivax (34.6%). The signs and symptoms resulting from malaria were; shivering 216(53.5%); fever, 80(19.8%); headache, 24(5.9%); Chills, 22(5.5%); loss of appetite, 20(4.95%); vomiting, 16(3.96%); backache, 15 (3.7%); and joint ache, 11(2.7%). On average, 93.6% of the participants had knowledge of at least one sign and symptom of malaria. The prevalence of malaria significantly associated with control and prevention method (P=0.021), educational level (P =0.021), whereas age group (P =0.243), marital status (P =0.189), occupation (P =0.083), health education (P =0.105), sign and symptoms (P =0.099) were not. Hence, a continuous health education and promotion of community education should be given to ensure individual households use insecticide treated nets and indoor residual spray correctly, adapt integrated vector control approach and continuous sanitary programs, to avoid misconception. This together with low prevalence in the current parasitological survey suggests the effectiveness of ongoing control practices in Melka Belo Woreda. The researcher recommends focusing on improving misconceptions about malaria causes, modes of transmission and clinical manifestation through health extension workers and community involvement practice as a main strategy.

Key words: Community, Knowledge, Malaria, Practice, Prevalence

1. INTRODUCTION

Malaria is one of the most severe parasitic infectious disease caused by the protozoan genus *Plasmodium*. There are five species of *Plasmodium* causing the disease in humans. These are *P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae* and *P. knowlesi.* More specifically, *P. falciparum* and *P. vivax* are the most common, accounting for about 60% and 40% of the infection, respectively (Adugna *et al.*, 2012; Weidong and Robert, 2005; Adefioye *et al*., 2007; Dawit *et al.*, 2012; Dadi *et al*., 2010).

Plasmodium parasites have a complex life cycle alternating between an insect vector (i.e. the genus *Anopheles mosquitoes*) and a human host. In order to complete the life cycle, they must move from mosquito to human and then back to mosquito again. Malaria infection is principally transmitted by major malaria vectors *Anopheles (A.)* Known as *A. arabiensis* followed by *A. pharoensis* and other secondary vectors *A. funestus* and *A. nili* (Abebe *et al*., 2011; CDC, 2012).

In Ethiopia, the Ministry of Health (MoH) classified the country into 3 levels with respect to malaria transmission. These are non-malarious (25% of the country), highland with unstable malaria about two thirds of the country, and endemic transmission with seasonal peaks accounting for remainder of the country. Malaria transmission is seasonal and unstable, causing frequent epidemics (Adhanom *et al*., 2006; Abebe *et al*., 2011; Newman *et al*., 2003 and NSP, 2010). The two peak seasonal transmissions of malaria occur during the months of September to December and March to May (FMoH, 2004). However, prevalence varies among locations because of heterogeneous topography and weather variables (Adhanom *et al.,* 2006; Abeku *et al*., 2003; cheung *et al.*, 2008).

The midlands of Ethiopia experience seasonal transmission of malaria with sporadic epidemics every few years (MIS, 2007). Similarly as a recent report showed epidemics have expanded up to 2,400m above sea level in areas where previously free of malaria (CDM, 2015). However, central highlands of Ethiopia are free of malaria mainly due to the low temperatures, which slows the development of the vector and the parasite (CSA, 2006). Consequently, some reports recently showed malaria cases in Addis Ababa are in the rise (Adugna *et al*., 2012).

On the other hand, rainfall, temperature and humidity play a significant role in the transmission of malaria. Temperature is the most important factor in the highlands while rain fall and humidity determine its transmission in midland and lowland areas of the region. As a result, climatic factors are the most important variables that influence malaria transmission in different parts of Ethiopia (Deressa *et al*., 2004).

As the World Health Organization (WHO) reported, in young children, pregnant women, immune suppressed persons and elderly travelers are particularly at risk of severe malaria disease. Particularly infection with *P. falciparum*, in pregnant travelers increases the risk of maternal death, miscarriage, still birth and neonatal death (WHO, 2015).

The basic approaches for control of malaria include treatment of human illnesses, parasite surveillance and effective resource delivery (FDREMH, 2012). Despite the recent scale up of controlling programs, malaria continues to be a major public health problem in most tropical countries. As a result, control of malaria becoming increasingly difficult due to the spread of resistance of the parasite to anti-malarial drugs, resistance of vector to insecticides and land use changes (Seid *et al*., 2013).

The most important components for reducing burden of malaria include: more sensitive diagnostic tools, effective use of anti-malarial drugs and improved personal protection and mosquito vector control (FDREMH, 2012). Generally, the main vector control activities implemented in Ethiopia includes; Indoor Residual Spray (IRS), Long Lasting Insecticide Treated Nets (LLIN's) and mosquito larval source reduction (Dadi *et al*., 2010).

The current study area, Melka Belo is the place where the local administration of the Woreda under Oromia Regional State in Eastern Hararghe zone that have altitude ranges between 600-3138m above sea level and experiences all forms of malaria transmission. However, there was no previous study regarding malaria trends, prevalence and control practices in the study area. This was what motivated the researcher to conduct the MSc thesis research on malaria trends, prevalence and control practices in Melka Belo Woreda, Oromia Regional State.

General objective was

- To determine malaria trends, prevalence and asses its control practices practiced by local people in Melka Belo Woreda, in Eastern Hararghe Zone Oromia Regional State, Ethiopia.

Specific objectives were

1. To determine *Plasmodium* species in blood samples of study participants visiting Melka Belo Health center in the study Area
2. To determine the prevalence of malaria parasite among the study participants visiting Melka Belo Health center in the study Area
3. To assess the knowledge, awareness and practices of the local people on control and prevention of malaria in the study Area
4. To examine trend of malaria over the last eight years in the study area
5. To identify clinical manifested signs and symptoms of malaria among study subjects in the study area

2. LITERATURE REVIEW

2.1. History of Malaria

Malaria parasites were discovered since 1880 in Algeria. Naming of human malaria parasites appeared in 1890 and 1897. For the first time *P. vivax* and *P. malariae* was introduced since 1890. The malignant tertian malaria parasites *P. falciparum named* since 1897. The first documented human malaria with *P. knowlesi in* 1965 (www.cdc.gov/malaria/about/history/).

The World Malaria Report (WMR) summarizes the information received from 106 malaria endemic countries and updates the analyses presented in the 2009 Report. It is estimated that the number of malaria cases rise from 233 million in 2000 to 244 million in 2005 was decreased to 225 million in 2009. The number of deaths due to malaria was estimated to decreased from 985,000 in 2000 to 781,000 in 2009 (WMR, 2010). The decreases in malaria burden have been observed in all WHO Regions, with the largest proportional decreases in the European Region, followed by the Region of Americas. The largest decreases in deaths were observed in Africa (WMR, 2010). However, the disease still continues to bring much more pain and sorrow in African continent and beyond (Edet *et al.*, 2015).

Ethiopia shows progress in the fight against malaria to attain MDG 6c: halt and begin to reverse the incidence of malaria by 2015. Recently the country achieved remarkable result through strong preventive and case management interventions with involvement of health extension workers (HEWs), Health development army (HAD) and volunteers providing community based cares at the house hold level (Banteyarga, 2011). In Ethiopia, Malaria admissions and deaths decrease from 81% in 2001 to 73% in 2011 for children <5 (Worku, 2015).

Malaria control and prevention is one of the core interventions of the country's primary health care. The percentage of children under the age of five that sleep under insecticide treated nets increased from 3% in 2005 to 33% in 2010/11 (MIS, 2011).

2.2. The Malaria Parasites

The current distribution of malaria parasite in the world was highly variable from country to country. As World Health Organization (WHO), 97 countries and territories had ongoing malaria transmission. There is usually less risk at altitudes above 1500m above sea level (WHO/UNICEF, 2015). Malaria parasites with their characteristics behavior's explained as follows. These are:-

Plasmodium falciparum; It found worldwide in tropical and subtropical areas responsible for the majority of malaria deaths globally and is the most prevalent species in sub-Saharan Africa. Approximately one million estimated people killed every year. Most highly virulent species and is responsible for almost all of 1.7 –2.5 million deaths worldwide. This was the dominant malaria parasite in Ethiopia accounts about 65-75% among total reported cases (Dadi *et al*., 2010).

Plasmodium vivax; Occur mainly in areas with seasonal transmission that represent normal seasonal peaks in temperate and subtropical areas. The second most significant species are prevalent in South East Asia and Latin America. Add complication of a dormant liver stage, which can be reactivated in absence of a mosquito bite, leading to clinical symptoms. It is rare in most part of the African continent (Tsige *et al*., 2009).

Plasmodium ovale; It *is* found mostly in Africa (especially West Africa) and the islands of the western Pacific (WHO, 2015).Infect individuals who are negative for the Duffy blood group, which is the case for many residents of sub-Saharan Africa. That explains the greater prevalence of *P. ovale* in most of Africa and causes tertian malaria in humans (Mohapatra *et al*., 2008).

Plasmodium malariae; Found worldwide and wide spread throughout sub-Saharan Africa. In endemic regions, prevalence ranges from less than 4% to more than 20 % (Bruce *et al*., 2006). However, evidence from different study shows that its infections under reported. The only human malaria parasite species that has a quartan cycle (Mohapatra *et al*., 2008).

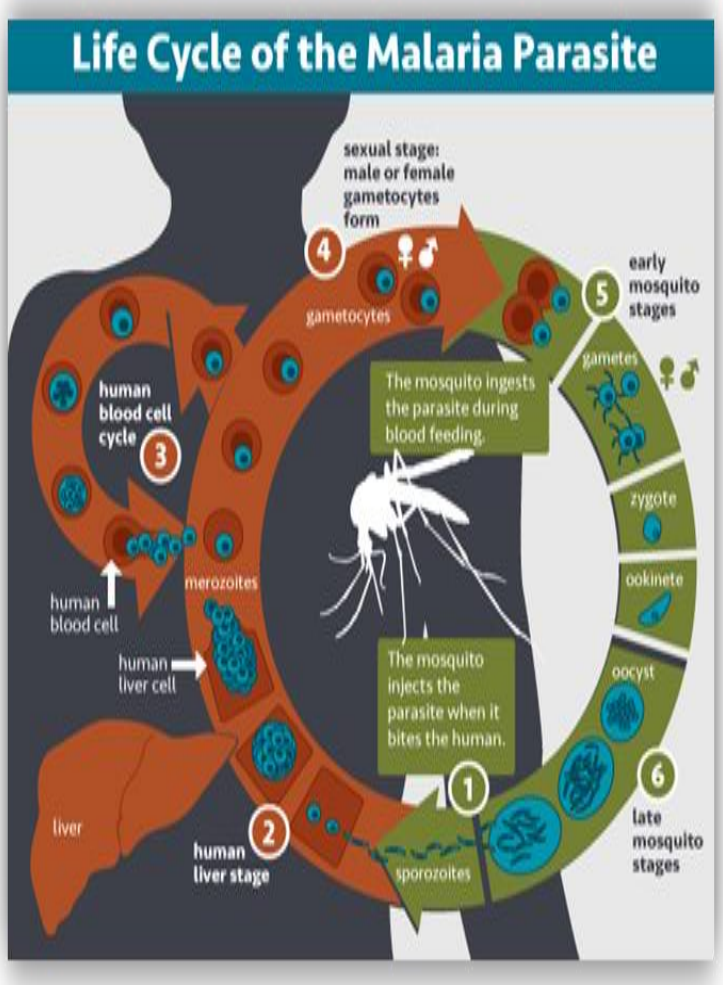
Plasmodium knowlesi; It is found throughout Southeast Asia as a natural pathogen of long-tailed and pig-tailed macaques. It has recently been shown to be a significant cause of zoonotic malaria in that region, particularly in Malaysia (CDC, 2012).

2.3. Life Cycle of Malaria Parasites

Malaria parasites have a complex life cycle. All species exhibit a similar life cycle with only minor variations. The life Cycle of *Plasmodium* can be divided into two distinct phases. These are, asexual cycle in humans and sexual cycle in mosquito (NIAID, 2012).

Asexual Cycle begins as infected female *Anopheles* mosquito carrying malaria causing parasites feeds on a human and injects the parasites in the form of sporozoites into the bloodstream. The sporozoites travel to the liver within 30 - 40 minutes and invade liver cells. This begins the exoerythrocytic stage of the life cycle asexual multiplication occur (https://en.wikipedia.org/wiki/).

Over 5-16 days the sporozoites grow, divide and produce tens of thousands of haploid forms called merozoites per liver cell. Some parasite species remain dormant for extended periods in the liver, causing relapses weeks or months later. The merozoites exit the liver cells and re-enter the bloodstream, beginning a cycle of invasion of red blood cells, asexual replication and release of newly formed merozoites from red blood cells repeatedly over 1-3 days. This multiplication can result in thousands of parasite infected cells in the host bloodstream, leading to illness and complications of malaria that can last for months if not treated.



Keys

1. Mosquitoes injects parasite when it bites human

2. Human liver stage

3. Human blood cell cycle

4. Sexual stage

5. Early Mosquitoes stage

6. Late Mosquitoes stage

Figure 1. Life Cycle of the Malaria Parasite (Source:www.niaid.nih.gov/topics/malaria/pages/lifecycle.aspx).

Some of the merozoites infected blood cells leave the cycle of asexual multiplication. Instead of replicating, the merozoites in these cells develop into sexual forms of the parasites called male and female gametocytes, which circulate in the bloodstream. It is blood stage parasites responsible for the clinical symptoms of malaria (John *et al*., 2006). When a mosquito bites an infected human, it ingests the gametocytes. In mosquito gut the infected human blood cells burst, releasing the gametocytes, which develop further into mature sex cells called gametes. Male and female gametes fuse to form diploid zygotes, which develop into actively moving ookinetes that burrow into the mosquito mid gut wall and form oocytes. Growth and division of each oocyst produces thousands of active haploid forms called sporozoites.

After 8-15 days the oocyst bursts, releasing sporozoites into the body cavity of the mosquito, from which they travel to and invade the mosquito salivary glands. The cycle of human infection re-starts when the mosquito takes a blood meal. Injecting the sporozoites from its salivary glands into the human blood stream

2.4. The Malaria Vector Mosquitoes

There are three most important African malaria vectors. These are *An. Gambiae* s.s, *An. arabiensis* and *An.funestus* (Braack *et al*., 2015). *Anopheles gambiae* giles is the most efficient vector of human malaria in the Afro tropical Region. Thus, commonly called African malaria mosquito and considered to be the world's most important human malaria vectors (CDC, 2010). Members of *Anopheles* gambiae complex are found throughout tropical Africa (WHO, 1989). However across the horn of Africa, the dominant vector is *Anopheles Arabiensis* (Noor *et al*., 2008).

Seasonal abundance of *Anopheles gambiae* varies depending on location, but generally the population decreases during the dry season and increases the wet season (Yaro *et al*., 2012). Sub-Saharan African countries have scaled-up insecticide treated mosquito nets, indoor residual spraying (IRS), improved diagnosis of malaria and treatment with Artemisinin-based combination therapy (ACT). Moreover mortality in children under five years of age has fallen dramatically. Reductions in all-cause mortality rates of children fewer than five years in Ethiopia reached 28% (PMI, 2015). In Sub-Saharan Africa proportion of the population protected by at least one vector control method has increased in recent years and reached 48% in 2013 which range 44-51% (WHO, 2014).

2.5. Pathogenesis and Clinical Manifestation of Malaria

Clinical manifestations of malaria vary with geography, epidemiology, immunity and age. The initial manifestations of malaria common all are high fever, headache, severe chills, profuse sweating and general body pains (www.wikipedia.com). Still some patients may develop vomiting, cough, diarrhea and anemia.

The clinical manifestation of malaria was affected by anti-malarial medicines used reduces the parasite density to very low levels. So, care must be needed to avoid over dose when diagnosed and self-prescription (WMR, 2010). The signs and symptoms of malaria typically begin 8-25 days following infection. Based on World Health Organization (WHO) guide lines the disease is reasonably easy to recognize in people who have not had malaria before (WMR, 2010). All the clinical symptoms associated with malaria are caused by the asexual blood stage parasites (CDC, 2010).

In a non-immune individual, symptoms may appear up to seven days or more (usually 10-15 days) after the infective mosquito bite. In malaria endemic areas, persons may develop partial immunity that develop asymptomatic infections to occur. For both *P. vivax* and *P. ovale* clinical relapses may occur weeks to months after the first infection, even if the patient has left the malarias area. These new episodes arise from dormant liver forms known as hypnozoites (absent in *P. falciparum* and *P. malariae*), special treatment targeted at liver stages required for a complete cure (WHO, 2015).

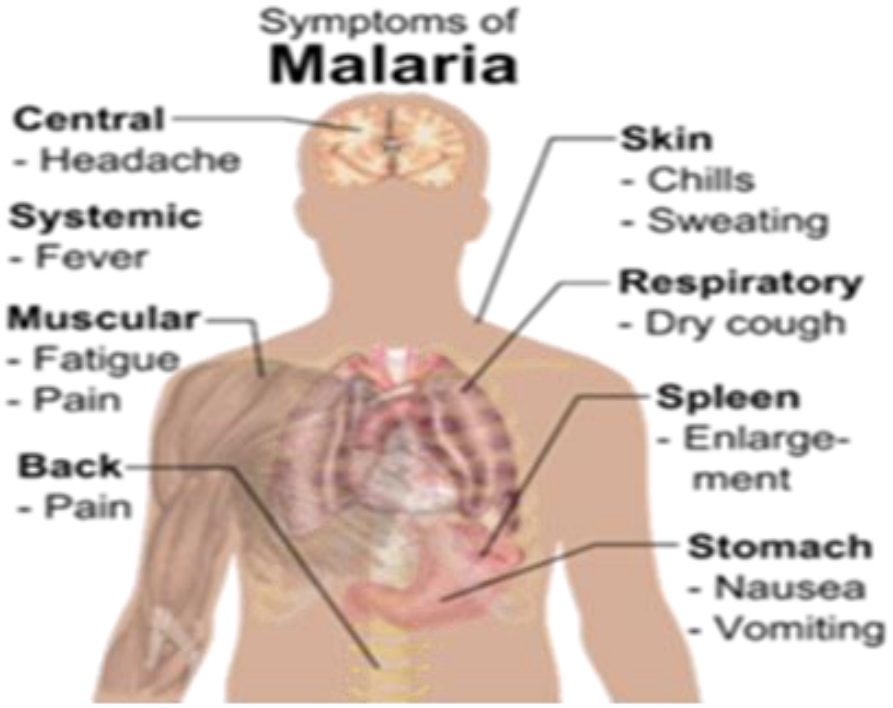


Figure 2. Signs and symptoms of malaria
SOURCE:www.niaid.nih.gov/topics/malaria/pages/lifecycle.aspX

2.6. Epidemiology of Malaria

2.6.1. Global epidemiology of malaria

Epidemiology of malaria is highly dependent on the transmission pattern of the parasite. An area supporting active malaria transmission is termed endemic whereas sporadic outbreak determine epidemic areas (WHO, 2000). Malaria is the most important parasitic disease in the world and remains highest public health importance. Malaria parasites distributed worldwide throughout the tropics and subtropics with high morbidity and mortality, also impose economic and social impact (WHO, 2000).

As the World Health Report (WHR) declared malaria to be one of the two priority health issues at international level (WHO, 1999). Globally, 3.4 billion people live in areas at risk of malaria in 106 countries and territories. In 2010 there were about 219 million malaria cases and 660,000 estimated malaria deaths all over the world. Approximately 90% of all malaria deaths occurred in WHO African region mostly cause of children under-five mortality (20%) and constitutes 10% of the continent's overall disease burden (WHO, 1999, 2002).

According to World Health Organization (WHO), the region was home to 89% of malaria cases and 91% of malaria deaths. All deaths in children aged less than 5 years account for 78%. As a report released in September 2015 shows about 214 million cases and 438,000 deaths of malaria occurred (WHO, 2015). Malaria epidemics affect non-immune populations in many highland and semi-arid areas of Africa. Most malaria epidemics follow abnormal weather conditions often in combination with other causes, including increased resistance of the parasite to antimalarial drugs, population movement and reduced malaria control operations (Abeku, 2007). In 2010, 2.4 million confirmed malaria cases were reported in WHO South-East Asia Region. In the WHO European Region, the number of malaria cases decreased from 32.394 in 2000 to 176 cases are now attributable to *P. vivax* infection, no *P. falciparum* cases occurred since 2008.

In the WHO Eastern Mediterranean Region, Islamic Republic of Iran and Saudi Arabia are in the elimination phase. As many as 262.000 confirmed cases were reported from the WHO Western Pacific Region in 2010 (Autino *et al.*, 2012).

2.6.2. Epidemiology of Malaria in Ethiopia

The epidemiological pattern of malaria transmission is generally unstable and seasonal in Ethiopia. The transmission level vary from place to place because of differences in altitude and rainfall patterns. Although, malaria distribution largely determined by altitude through its effect on temperature (MIS, 2007; 2011). About 75% of the landmass of Ethiopia is malarias and 68% of population at risk. These are 54 million people lives in malaria risk areas (Abebe *et al*., 2011). As World Health Organization (WHO) estimates 198 million clinical cases in 2013 and 500,000 deaths appeared by malaria. Globally 2000 to 2015, 37% incidence, 60% death rates among all age groups and 65% among children under age 5 decreased. However, Sub-Saharan Africa carries a disproportionately high share of the global malaria burden.

Malaria epidemics have been documented since the 1930s and 1940s in Ethiopia. The most devastating epidemic were 1958 which resulted in a estimated three million cases and 150,000 deaths (Lelisa *et al*., 2014). Comparatively fewer epidemics since 2003 and 2004 in Ethiopia with reduced severity and mortality (WMR, 2008). Until recently, malaria has been the leading cause for morbidity and mortality in Ethiopia (FMoH, 2004 and MIS, 2007).

Epidemics of malaria are relatively frequent as World Health Organization (WHO), 2006 in highland or highland fringe areas of Ethiopia, mainly areas 1,000 to 2,000 m above sea level. But, exist everywhere except the central highlands (FMoH, 2006). Areas less than 2,000m altitude considered malarial endemic in Ethiopia.

Additionally epidemics, in highland areas of Africa have shown a trend of increasing malaria transmission in recent years (MIS, 2011). On the other hand, malaria epidemics can be categorized on the basis of their main causal factors. These are climate anomalies (rainfall in Semi-arid areas worm climates, causes increases in vector breeding and survival), inter-annual variation caused by normal variations in climatology and sudden population movements, war and political instability (Abeku, 2007).

In line with causal factors in endemic areas, malaria is usually diagnosed clinically and only rarely confirmed by presence of the parasite in the peripheral blood. There are many more asymptomatic carriers of the parasite. Recent work has provided a quantitative framework for the analysis estimating probabilities that fever episodes are indeed of malaria etiology as a function of parasite density (Smith *et al*., 1994b; 1995). The current methods for epidemic detection in Ethiopia rely on passive case detection of clinically diagnosed cases at health posts and health centers (PMI, 2015).

2.7. Factors that Affect the Epidemiology of Malaria

Ethiopia is a tropical country which is located in the horn of Africa. The Carter Centre reported, about 55.7 million people faced the risk of malaria and approximately 80% of 736 districts considered malarias (Eshetu and Basha, 2015). Factors that may cause outbreaks of malaria was an increase in vector breeding sites, migration of infected people into vector rich area populated with susceptible individuals, arrival of new efficient vectors, breakdown of vector control measures, resistance of the parasites to treatment and resistance of the vectors to insecticides (Gemechu *et al*., 2015).

2.7.1. Climatic Factors

For transmission of malaria parasite climatic factors are important determinants. Climatic factors greatly influence the pattern and level of malaria transmission in Ethiopia, Africa and the world. The most important climatic factors that directly affect malaria transmission are temperature, rainfall and humidity (MIS, 2007 and 2011). The distribution of malaria in Ethiopia is largely determined by altitude. Altitude also affects the pattern of malaria distribution in Ethiopia through its effect on temperature (MIS, 2007 and 2011).

Temperature is a determining factor, malaria transmission often occurs in areas below 2,000m below sea level. Whereas area between 2000 -2500m may affected during epidemics. Whereas hot land malaria intensity and duration mainly influenced by the amount and duration of rainfall (Aynalem, 2009).

Temperature to a lesser extent with rainfall and humidity varies as a function of altitude (NSP, 2010). Changes in temperature, rainfall and relative humidity due to climate change are expected to influence malaria directly by modifying the behavior and geographical distribution of malaria vectors and by changing the length of the life cycle of the parasite (Abebe *et al*., 2011).

Climate has three main elements. These are temperature, rainfall and humidity strongly associated with altitude and relief. Moreover, the location contributes to seasonal variation of rainfall and temperature in the country (Ashenafi, 2008). Climatic factors are important determinants for transmission of malaria parasite and greatly influence its pattern and level. Climate change is also expected to affect malaria indirectly by changing ecological relationships important to organisms involved in malaria transmission (the vector, parasite and host) (Abebe *et al*., 2011).

2.7.2. Non-Climatic Factors

Factors that affect malaria transmission not related to climate. These are type of vector and parasite, environmental development and urbanization, population movement and migration, irrigation, agricultural practices, deforestation, the level of immunity to malaria in human hosts, insecticide resistance in mosquitoes, drug resistance in parasites and malaria control efforts, all have a role in affecting the severity and incidence of malaria (Abebe *et al*., 2011).

The city conditions, such as stagnation of water facilitates, open wells and uncovered water tanks, and water logging at construction sites can create new places for mosquito larvae to develop (WHO, 2010). In Ethiopia man made breeding places including quarries, blocking natural drainage systems, road building, irrigation in agriculture, water conservation or storages are among activities that enhance the incidence of malaria (MoH, 2002c).

2.8. Diagnosis of Malaria

The clinical diagnosis where malaria is suspected based on the history, symptoms and clinical findings must be confirmed by laboratory technicians. The microscopic examinations were done in Jaja health center by laboratory technician assisted by investigator. Microscopy remains gold standard for laboratory confirmation of malaria (WHO, 2014).

A drop of patient's blood collected by finger prick from a larger venous blood. The specimen spread on glass slide (blood smear), dipped in a reagent that stains the malaria parasites (Giemsa stain), and examined under a microscope at 1000-fold magnification (WHO, 2014). Then microscopic examination of blood film was used for determination of malaria infection prevalence and malaria parasite prevalence in the study area.

2.9. Prevention and Control Strategies of Malaria

2.9.1. Treatment

Malaria can be severe, potentially fatal disease especially when caused by *P. falciparum* the treatment should be initiated as soon as possible. The patients take oral medications should be given the treatment by continuous intravenous infusion. The most drugs used in treatment was active against the parasite in the blood. These are chloroquine, atovaquone-proguanil (Malarone), artemether-lumefantrine, mefloquine, quinine, quinidine, doxycycline, clindamycin and others (Getachew *et al*., 2013). Ethiopia's treatment guide lines recommend artemether lumefantrine as the first line treatment for *P. falciparum* and chloroquine for *P. vivax* malaria (Getachew *et al*., 2013).

The malaria parasite is capable of becoming resistant to the action of anti-malaria drugs. This is due to small changes in the parasite DNA (point mutations), over prescription of anti-malaria (due to confusion with other febrile diseases) and uncontrolled selling of poor quality drugs contribute to the increase in drug resistant parasites (CDC, 2006). As a result, the widespread and increasing occurrence of *P. falciparum* resistant against affordable anti-malarial drugs. Chloroquine and sulphadoxine-pyrimethamine increasingly hampering the fight against malaria. This are the most widely used drugs for treatment in most of Africa, because of low cost and availability (CDC, 2006).

The drug resistant problem of malaria has dual faces. The resistance of the *Plasmodium* and resistance of the *Anopheles* mosquito. According to World Health Organization (WHO), origins of drug resistance to *Plasmodium's* are inadequate regimens, poor drug supply, poor quality and misuse of drugs (WHO, 2012). This imposes great difficulty in treatment and

control of malaria (Ashenafi, 2008). Recently, Ethiopia reported resistance to all four classes of insecticides. These are DDT, pyrethroids, Malathion and bendio-carb (WHO, 2012).

2.9.2. Vector Control

Vector control is an essential component of malaria control programs and a fundamental element of existing global strategy to fight malaria (WHO, 2008). Vector control, if well planned, targeted and timely, can make contribution to reducing the risk of malaria infection and saving lives (WHO, 2004a). Vector control used to reduce level of mortality and morbidity by reducing transmission of the disease (Toure, 2001).

The most frequent type of vector control is mosquito control using a variety of strategies (WHO, 2012). Malaria control efforts involve a combination of prevention and treatment strategies and tools. These are insecticide-treated bed nets (ITN), Indoor Residual Spraying (IRS) with insecticides, diagnosis and treatment with anti-malarial drugs. Artemisinin-based combination therapy (ACTs) and intermittent preventive treatment in pregnancy (IPTp), although access to prevention and treatment services has grown over time (WHO, 2015). However, many challenges continue to complicate malaria control efforts in countries with ongoing malaria transmission. These are poverty, poor sanitation, weak health systems, natural disasters, armed conflict, migration, climate change, and the presence of counterfeit and/or sub-standard antimalarial drugs (WHO, 2014). The main reason for the lack of additional evidence for a change in the malaria burden has been weak disease surveillance systems (WMR, 2009).

2.9.2.1. Insecticide Treated Nets

Insecticide treated Nets and LLINs are now essentially synonymous in Ethiopia. Insecticide-treated mosquito and other materials (ITMNs) was options combining one aspect of personal protection (mosquito nets) with insecticides (Jacklyn *et al*., 2015). The use of insecticide-treated nets (ITNs) is effective in reducing malaria related morbidity and mortality (MoH, 2002a). The distribution of insecticide treated bed nets has been a major factor in reducing malaria deaths, where deaths have fallen by over 50% since 2007/08 (Banteyarga *et al*., 2011).

The use of ITNs can be extremely beneficial as a preventive measure for pregnant women living an all areas (WHO, 2000a, 2003i; 2004j, PMI, 2015). The demonstrated impact of ITNs on reducing the risk for low birth weight and maternal anemia is important (RBMP, 2008).The major recent efforts to scale-up the availability of ITNs in Africa, yielding impressive results (PMI, 2015).

In World Health Organization (WHO), African region, ITMNs application is recognized as one of the three key elements. These are the appropriate case management, use of insecticide-impregnated bed nets and other materials and strengthening local and national capabilities, which form the basis for intensified malaria control (WHO, 1992). As reported by MoH, Ethiopia has seen a major improvement in LLIN coverage (MIS 2007; MIS, 2011). However, there are many challenges to ITN distribution, acceptance and correct utilization when trying to implement large-scale ITN programs (Kelly-Hope and McKenzie, 2009).

2.9.2.2. Indoor residual house spraying

Indoor residual house spraying was the process of spraying the inside of dwellings with an insecticide to kill mosquitoes that spread malaria (WHO, 2009). A dilute solution of insecticide was sprayed on the inside walls of certain types of dwellings those with walls made from porous materials such as mud or wood but not plaster as in city dwellings. Mosquitoes are killed or repelled by the spray, preventing transmission of the disease. As world health organization (WHO), malaria report shows, 44 countries employed IRS as a malaria control strategy. Several pesticides have historically been used for IRS, the first and most well-known being DDT (WHO, 2008).

The World Health Organization (WHO), recommends IRS as one of three primary way to control malaria (WHO, 2008). While previously the WHO, had recommended IRS only in areas of sporadic malaria transmission. Since 2006 it began recommending IRS in areas of endemic, stable transmission as well (Van den Berg, 2008).

2.9.2.3. Biological Control

As the World Health Organization (WHO) recommended vector control is any methods used to limit or eradicate the mammals, birds, insects or other arthropods, which transmit disease as pathogens. Mosquito control is the most frequent using a variety of strategies. The use of natural vector predators, such as bacterial toxins or botanical compounds, can help control vector populations. Using fish that eat mosquito larvae or reducing breeding rates by introducing sterilized male tsetse flies had been shown to control vector populations and reduce infection risks (WHO, 2006; 2015). Biological control is an approach kill mosquitoes or their larvae in a more targeted manner than chemicals averting certain impacts on health and local environments. The best known of those controls include various species of larvivorous fish and biolarvicides, such as *Bacillus thuringiensis israelensis* and *Bacillus sphaericus* (Walshe *et al*., 2013). Maintenance of larvivorous fish stocks and repeated applications of biolarvicides require substantial community awareness and involvement (van den Berg, 2009; Walshe *et al*., 2013).

2.9.2.4. Environmental Management

Globally 2.4 billion people live under highly unsanitary conditions and have poor hygiene behaviours that their exposure to risks of incidence and spread of infectious diseases are enormous (WHO, 2015). Malaria kills over 1.2 million people annually, mostly African children under the age of five. Poorly designed irrigation and water systems, inadequate housing, poor waste, disposal and water storage, deforestation and loss of biodiversity, all may be contributing factors to the most common vector borne diseases, including malaria, dengue and leishmaniasis (WHO, 2016).

3. MATERIALS AND METHODS

3.1. Description of the Study Area

The study was conducted in Melka Bello Woreda in East Hararghe Zone of Oromia Regional State, Ethiopia. Melka Belo is located at a distance of 487 km from Addis Ababa Capital city of Ethiopia, in Eastern Hararghe Zone. The total area of the Woreda land mass coverage is about 114,725 hectares. Melka Belo Woreda shares common boundaries with three different administrative Woredas of Eastern Hararghe zones namely; northern Deder, Gola Oda in the South-East and Bedeno to Eastern and two of western Hararghe Woreda called Mesela at Western and Kuni in the South West. As a result, Melka Belo Woreda is situated at the border line between Eastern and western Hararghe Zone (CSA, 2006; DHS, 2010). Administratively, the Woreda is sub-divided into 26 kebeles of which 4 are urban kebeles and the rest 22 are rural kebeles (Melka Belo Woreda Agricultural Office, 2014).

The altitude of the study area ranges between 600 and 3138m above sea level. Based on climatic condition, Melka Bello is sub divided into three categories; Dega covering 20% of the area has an average annual rainfall of 1770mm which is assumed to be malaria free, Weyna Dega that covers 39% has an average rainfall of 944mm and experiences high malaria coverage with dense population and kola covers about 41% of the area with sparsely populated nomadists and malaria in addition to an average annual rainfall of 540mm. Totally, the environmental temperature of the study area ranges from 25-30 ^{0}C with average annual rainfall of 1086mm.

According to Melka Bello Woreda Administrative Office, the Woreda has an estimated total population size of 208,903 of which 106,731 were males and 102,172 were females. Among these populations; 11,992, of (6590 male and 5402 females) were found in urban kebeles while 196,911, of (100,141 male and 96,770 female) were found in rural kebeles (Melka Belo Woreda Administrative office, 2014).

Furthermore the area was characterized by the presence of various soil types including sand soil (20%), loam soil (20%), silt loam soil (15%), clay loam soil (30%) and heavy clay soil (10%).

Vegetation type consists of different herbs, shrubs and some common plant species in this area include: *Catha edulis, Coffea arabica, Cordia africana, Croton macrostachyuus, Olea europaea, Acacia species, Eucalyptus species, Justicia chiperiana, Premnas chimperi, Podocarpus falcatus, Juniperus procera*. Some commonly cultivated crop plants in the study area includes Teff (*Eragrotis teff*), Bean (*Vicia faba*), *Sorghum bicolor*, Wheat (*Triticum species*), and Barley (*Hordeum vulgare,* Pea (*Pisum sativum*) and *Zea mays* (Melka Belo Agricultural Office, 2014).

3.2. Design of the Study

A cross-sectional survey was carried out in low malaria transmission seasons; from March-April to measure the prevalence of malaria. The house hold survey was used to assess the knowledge, awareness and practices of the local people on control and prevention of malaria in the study Area.

3.3. The Study Population

The Study population was categorized into sub-populations of different age groups from Melka Belo Woreda for parasitological examination. These were 1-15, 16-30, 31-45 and $\geq$ 46.

3.4. Inclusion criteria and Exclusion criteria

3.4.1. Inclusion criteria

Study participants included the individuals that are permanent member in the community willing to give written informed consent for their children to participate in the study. For malaria prevalence study, all individual visiting health centers except those who are on anti-malaria therapy were included in the study.

3.4.2. Exclusion criteria

Individual who were taking anti-malarial therapy or who had treated with anti-malarial drugs within the past 4 weeks were excluded from the study. Individuals who did not have consent for participating in study visiting the health center.

3.5. Sample Size Determination

The sample size of the study was estimated by taking the prevalence of 50% as there was no reported study in the area. As stated by Daniel, (1999) cited in Naing *et al*. (2006). Sample size was determined by the formula as follows:

n= Z^2 (P) (1-P)/ (d^2) n= expected no of sample

P= prevalence of malaria

Z= 95% confidence interval

d=precision (.05)

n= $(1.96)^2$(.5) (1-0.5)/ $(0.05)^2$

n=385

To minimize an error from the likelihood of non-compliance and non-responsive of the study participants, 5% of the sample size was added to the normal sample. n=385×5/100, n= 404. Therefore, four hundred four (404) individuals or participants were included in the study.

3.6. Sampling Technique

A random sampling method was used in such a way that participants who visited Health Center during the observation were included into the study until the optimal sample size was reached for prevalence of malaria. A cluster random sampling techniques were used to select respondents of the study.

3.7. Method of Data Collection

Random sampling method was employed to select the samples from the population. The basis of selection of the samples was their settlement pattern. The selection was done using a list of the households that were found in Melka Belo Woreda at kebele level. This helped to select different individuals that had different educational background, occupation, attitudes,

knowledge and income. Then, questionnaires were administered to the households in study sites. The primary data consisted of information from questionnaires, interview and field observation. The secondary data consisted of health center reports. Questionnaires prepared for households dealt with background of the household and family members.

They included data regarding the households such as age, sex, place of birth, educational level, occupation, knowledge, income, etc. The second section dealt with prevalence of malaria and control practices. These included the number of malaria infected individuals, major physical, economic, health and social factors that were responsible for the occurrence of malaria and application of control methods practiced.

3.7.1. Blood sample collection

Blood sample were collected by laboratory technicians working at Jaja Health Center by pricking finger-tips of blood donors. First the finger was cleaned with an alcohol-moistened swab; then dried with a piece of dry cotton and punctured with a disposable blood lancet. Then blood samples were collected in to test tube.

3.7.2. Blood films preparation and staining techniques

The blood smears were prepared by a laboratory technician using blood sample collected from finger pricks. Both thin and thick smears had been made on the same slides side by side and properly labeled for each individual with a code (Gulati et al., 2013). A small drop of blood was placed near the frosted end of a clean glass slide and smeared over the slide by clean spreader slide held at 45° angle towards the drop of blood on specimen slide, which was then allowed to air dry. Thin films were fixed with 100% methanol allowed to dry for 30 seconds. However, thick film were not fixed (http: //www.dpd.cdc.). Following this, smears were stained using standard guidelines of WHO, (1991). Both thick and thin films were stained with 3% Giemsa stain at pH 7.0 for 30min as recommended by WHO (Adugna *et al.*, 2012).

Staining and blood film examination was performed by following the standard protocol of World Health Organization (Garcia, 2001). The peripheral blood smear provides comprehensive information on the species, the stages and the density of parasitemia. The

efficiency of the test depends on the quality of the equipment and reagents, the type and quality of the smear, skill of the technician, the parasite density and the time spent on reading the smear. Examination of the peripheral blood smear is an inexpensive but powerful diagnostic tool in both children and adults. It provides rapid reliable access to information about a variety of hematological disorders (Bain, 2005). Microscopic examination remains the "gold standard" for laboratory confirmation of malaria (www.malariasite.com/microscopic-tests/). Thick and thin blood smear becomes the most reliable and preferred for diagnosis of malaria (WHO, 1991; Warhurst and Williams, 1996; Krafts *et al*., 2011).

Thick films were used to determine the parasite densities while thin films were used to identify the parasite species and infective stages. A stained slide was examined under the light microscope using x100 objective lens (Meeusen *et al*., 2001). One hundred microscopic fields should be examined on thick film before smears were considered negative for parasites. The thin film was used for species identification when thick films were positive. Thick smears most likely to demonstrate infection (krafts *et al*., 2011).

3.7.3. Identification of Malaria Parasites

The presence of malaria parasites on thick blood smear was examined by using high power magnification objective (40x) and the identification of *Plasmodium* species from the thin blood smear was made through oil immersion objective (100x). Thick blood smears were most useful for detecting the presence of parasites, because they allow examination of a larger sample of blood; and thin blood smears were used to identify the type of *Plasmodium* species. The different species were distinguished by their morphological Characteristics on Giemsa stained thin blood smears.

3.7.4. Questionnaire survey

The structured questionnaire were used precoded questionnaires with closed & open ended type of question by administering it to selected head of the household to assess their knowledge attitude and practice about malaria. The questionnaire was first prepared in English, translated to Afaan Oromo language and then translated back to English to check for Consistency.

The questionnaire had three sections, socio-demographic characteristics, knowledge about malaria and preventive methods and practice of prevention and treatment seeking habits. The data was collected from April to May 2016.

3.7.5. Collection of Malaria Records

The clinical records of malaria cases were reviewed for the retrospective study starting from 2008 –2015.

3.8. Data Analysis

Data were analyzed using Microsoft excel 2010. A single factor anova had been used for analysis; to calculate P-value and chinv to calculate chi-square test based on P- value. Significance level were also considered at 95% confidence interval.

3.9. Data Quality Control

Before blood sample collection, slides were properly soaked in hot water, washed with distilled water, rinsed in denatured alcohol and cleaned with gauze. During blood sample collection, only a single sterile lancet had been used per person.

The quality of the Giemsa staining solution, fixation chemical (methanol) and the microscope was checked before using directly. To ensure quality, the staining techniques and blood film examination were conducted according to standard protocols of World Health Organization (Garcia, 2001).

3.10. Ethical considerations

This study was presented to and approved by department of Biology Haramaya University and supporting letters was obtained from Melka Belo Woreda Health Office and Melka Belo Educational Office. The study subject were clearly informed about the nature and aims of the study and told that their participation is voluntarily. They gave written and verbal consent to take part in the study after adequate explanation about the significance of the study.

In addition, potential harm and benefit of the study was explained to the respondents. Those study participants who were found positive for malaria parasite infection have got appropriate treatments by health professional in the Melka Belo Woreda Health Center.

4. RESULTS AND DISCUSSIONS

4.1. The Trend of Malaria in Melka Belo Woreda Health center during 2008 –2015

Based on the clinical record trend analysis of malaria in Melka Belo Woreda Health Center, the major *Plasmodium Species* identified in patients during 2008 to 2015 *P. falciparum, P. vivax* and mixed (64.3%, 34.7%, 0.98%) respectively. The cumulative prevalence of malaria out of the completely clinical record of the past eight years showed was 5.81% (Table 1).

This study report was higher than reports in south-central Ethiopia where monthly prevalence revealed 2.8% (Fisseha *et al*., 2015) and Oromia, Amhara, SNNPR (0.9%, 4.6%, 5.4%) respectively. This study result also smaller than overall prevalence reported in Ethiopia 7% (Belayneh, 2014).

Malaria cases of the last eight years in the study area were showed fluctuating trends. The prevalence of malaria trends were 8.0% in 2008, 7.4%, in 2009, 10.9% in 2010, 8.13% in the year 2011, 3.4% in year 2012, 5.3% in the year 2013, 3.19% in the year 2014 and 1.7% in 2015 (Table 7). The highest annual cumulative prevalence 10.9% of malaria were detected in the 2010. This was much higher than that of other years. In the past eight-year health center record, there was malaria throughout the year. Based on the seasons Belg (locally Badhessa), highest prevalence peaks detected mostly from January to March in 2010. There was successive reduction in malaria prevalence from 2008 to 2015 except for *P. falciparum* in 2010 onwards (Figure 4). The cases of malaria were highly dominant in ages greater than five years (78.5%) and less than five years (21.5%) (Table 1).

Table 1. Malaria Trend and Distribution of malaria by sex and age in Melka Belo Woreda Health centers from 2008-2015

Year	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (%)	M %	F %	< 5	> 5
2008	Nº exa.	53	135	100	132	95	185	214	136	133	176	206	73	3646	1143(59.9)	768(40.2)	355(18.6)	1554(81.4)
	Nº +	10	28	27	34	13	34	35	18	19	31	37	7	293(8.04)				
	P.f	4	15	15	23	10	22	20	11	9	20	27	4	180(3.8)				
	P.v	5	12	12	11	3	12	14	7	10	11	10	3	110(3.01)				
	Mixed	1	1	0	0	0	1	0	0	0	0	0	0	3 (0.08)				
2009	Nº exa.	102	45	42	53	175	108	47	41	41	62	52	124	2901	529(56.4)	409(43.6)	258(27.5)	680(72.5)
	Nº +	21	8	9	22	49	21	1	4	9	10	17	44	215(7.4)				
	P.f	14	5	5	17	35	8	1	3	4	9	15	43	159(5.4)				
	P.v	7	3	4	5	12	10	0	1	3	1	2	1	49(1.7)				
	Mixed	0	0	0	2	3	0	0	2	0	0	0	0	7(0.24)				
2010	Nº exa.	176	65	230	104	151	232	183	111	133	115	252	163	3925	505(58)	366(42.0)	207(23.8)	664(76.2)
	Nº +	51	80	32	30	19	30	23	7	36	30	63	27	428(10.9)				
	P.f	51	30	14	18	11	26	5	6	1	5	29	5	201(5.1)				
	P.v	0	0	18	27	16	6	18	0	36	25	34	22	226(5.8)				
	Mixed	0	0	0	0	0	0	1	0	0	0	0	0	1(0.03)				
2011	Nº exa.	139	165	145	80	152	113	95	64	40	77	123	152	3356	188(55.1)	143(41.9)	93(27.3)	248(72.7)
	Nº +	32	21	35	15	31	23	17	18	19	35	15	12	273(8.1)				
	P.f	7	3	14	5	10	11	10	11	25	24	8	4	132(3.9)				
	P.v	25	18	21	10	11	12	7	7	4	11	7	8	141(4.2)				
	Mixed	0	0	0	0	0	0	0	0	0	0	0	0	0(0)				
2012	Nº exa	100	83	125	49	105	64	23	131	57	105	182	72	3108	60(61.2)	38(38.8)	15(15.3)	83 (84.7)
	No +	14	9	13	9	6	8	9	7	8	11	3	1	98(3.8)				
	P.f	5	3	3	6	2	7	8	5	8	2	1	0	50(1.6)				
	P.v	9	6	10	3	4	1	1	2	0	9	2	0	47(1.5)				
	Mixed	0	0	0	0	0	0	1	0	0	0	0	0	1(0.03)				
2013	Nº exa	31	39	48	65	69	116	117	84	91	120	92	226	3111	92(55.8)	73(44.2)	33(20	132(80)
	Nº +	3	4	1	6	5	16	14	18	26	29	26	17	165(5.3)				
	P.f	2	1	0	2	2	6	8	10	20	26	24	15	116(3.7)				
	P.v	1	3	1	4	3	9	6	8	6	3	1	2	47(1.5)				
	Mixed	0	0	0	0	1	0	0	0	0	1	0	0	2(0.06)				
2014	Nº exa	208	61	262	174	153	144	276	342	270	361	305	371	4942	109(61.1)	56(33.9)	13(7.9)	152(92.1)
	Nº +	3	3	9	2	8	12	35	15	31	8	18	14	165(3.3)				
	P.f	3	1	8	2	7	9	33	13	28	8	16	12	140(2.8)				
	P.v	0	2	1	0	1	3	2	2	3	0	2	2	18(0.36)				
	Mixed	0	0	0	0	0	0	0	0	0	0	0	0	0(00)				
2015	Nº exa	474	366	5007	296	208	260	110	445	186	741	202	138	10448	2735(58.6)	1922(41.2)	1004(21.5)	3661(78.5)
	Nº +	4	11	2	0	21	6	13	38	38	10	16	19	178(1.7)				
	P.F	4	10	2	0	21	6	10	34	32	10	16	17	162(1.6)				
	P.V	0	1	0	0	0	0	3	1	5	0	0	2	12(0.11)				
	MIXED	0	0	0	0	0	0	0	3	1	0	0	0	4(0.04)				

Key: P. f=Plasmodium falciparum P.v= Plasmodium
sNº exa. =Number examined Nº += Number positive

In terms of sex, 2732 (58.8%) malaria cases patients recorded were males and 1912 (41.17%) females (Table 8). This study results agreed to other studies in Ethiopia (Belayneh, 2014). This might have been associated with the place of work, seasons mostly agricultural activities occur and the use of different stimulants (*Khata edulis*) used by males to did their work, which made them immunosuppressed by loss of appetite. As a result males became prone to clinical malaria infection for the past eight years (Table 1).

On the whole, 64.3%, 34.7% and 0.98% of malaria positive were attributed to *P. falciparum, P. vivax* and mixed infections, respectively. The prevalence of *P. falciparum* infection continues to increasing from 2008 to 2015 (61.43%, 73.95%, 46.96%, 48.35%, 51.02%, 70.30%, 88.61% and 91.01%) respectively. The result was significantly highest in 2014 and 2015. It might be Elnino that related to extended drought and high amount of rain fall as the Woreda becomes drought affected. However, *p. vivax* decreased continuously except for the year 2010 and 2011 where the reported cases were higher compared to other years (37.54%, 22.79%, and 52.8%, 51.8%, 47.95%, 28.48%, 11.4% and 6.7%), respectively. Onwards *P. vivax reduced* by half from 2012 to 2015, which agreed with other studies carried in Ethiopia (Belayneh, 2014) (Table 1).

Overall trend analysis of malaria by month and years shows fluctuation mostly in 2010 between months of (Jun, Feb, March) and (Oct, Nov, Dec), these are the two months experiences highest malaria cases in Melka Belo Woreda from 2008 to 2015 (Table 1).

4.2. Socio-demographic Characteristics of Participants

The socio-demographic characteristics of study participants are summarized in Table 2. A total of 404 respondents were included in the present study all respond. Of these 305 (75.5%) were males and the rest 99 (24.5%) were females. Among respondents 276 (68.3%) were married, 75 (18.6%) were single, 32 (7.9%) were divorced and 21(5.2%) widowed. On average the proportion of respondents with ages ranging from 16-35 were 57.4%, 36-45 (26.9%). Others above 46 were (10.6%) and 1-15 (4.95%) years old.

As shown in Table 2, most of the respondents, 53.96% were farmers, followed by government employee (16.8%), students (13.6%), merchants (5.5%), house wives and others (2.7%), daily laborer (1.2%) and about (0.7%) had no job. About 45.3% of the respondents had no formal education, 21.0% had primary education, 19.6% had secondary education and 14.1% had higher education.

Regarding the monthly income of the respondents majority of them (60.6%) had monthly income of more than 1000 ETB whereas 16.1% had 600 -1000 ETB and 23.3% had monthly income of 100-500 ETB (Table 2).

On the other hand 49.3% the majority of the respondents were stayed longer than 10 years, followed by 20.1% stayed in the area starting from their birth, whereas 14.9% were stayed for 1-5 years and 9.7% from six to ten. However, 6.2% of respondents was stayed less than one year. Additionally the place of the residence of the respondents majority 41.6% were warm arid low land, warm and semiarid lowland (30.9%), warm sub-moist low land (19.8%) and 7.7% were others (Table 2).

Table 2. Socio-demographic characteristics of Study participant's in Melka Belo Woreda (March-April 2016)

Character	Number (%)	Character	Number (%)
Sex		**Educational level**	
Male	305(75.5)	Illiterate	183(45.3)
Female	99(24.5)	Primary Education(1-6)s	85(21.0)
		Secondary Education (7-12)	79(19.6)
Age groups			
1-15	20(4.9)	Higher Education (12+)	57(14.1)
16-35	232(57.4)		
		Average monthly income	
36-45	109(26.9)	100-500	94(23.3)
46 and above	43(10.6)	600-1000	65(16.1)
		>1000	245(60.6)
Place of Residence			
warm sub moist low land	80(19.8)	**Occupation**	
warm arid low land	168(41.6)	Farmer	218(53.9)
warm and semiarid low warm	125(30.9)	Merchant	22(5.5)
Others	31(7.7)	Gov't employee	68(16.8)
		Student	55(13.6)
No of years live in area(years)			
since birth	81(20.1)	House wife	22(5.5)
<1	25(6.2)	Daily laborer	5(1.2)
1-5	60(14.9)	No job	3(0.7)
6-10	39(9.7)	Others	11(2.7)
>10	199(49.3)		
Marital status			
Single	75(18.6)		
Married	276(68.3)		
Divorced	32(7.9)		
Widowed	21(5.2)		
Family Size (no of people)			
1-5	226(55.9)		
6-10	139(34.4)		
>10	39(9.7)		

4.3. Prevalence of Malaria among Study Participants in the Stud Area

Out of the total (404) blood sample collected and examined, 52 (12.9 %) were found positive for malaria (Table 3). The overall prevalence of malaria in the present study was higher than previous national and regional malaria prevalence reports (USAID/CDC, 2010) which was 0.7% in Ethiopia and (0.3%) in Oromia.

Additionally it was higher than the recent report from Ethiopia (WHO, 2015) which was estimated to be 1.3% (MIS, 2011). It was also higher than the report from Ayira, Arba Minch and Arsi Negelle (Belayneh, 2014; Elias, 2014 and Mengistu, 2015) which were 9.4%, 7% and 11.45%, respectively.

The observed differences might be due to the nature of study settings, seasonality of malaria and method of detection (Eyob, 2015). The prevalence of malaria by age and sex is shown in Table 3. It was much less than that reported in Afdem districts, Hadhramout south-east Yemen (Bamaga *et al*., 2014; Eyob, 2015) which were 17% and 18.8% respectively.

Table 3. Prevalence of malaria by age and sex of study patients in Melka Belo Woreda (March-April; 2016)

Age	Male		Female		Both sexes		X^2	P-value
Years	Nº exa.	Nº + (%)	Nº exa.	Nº + (%)	Nº exa.	Nº + (%)		
<15	31	7(22.6)	27	2(7.4)	58	9(15.5)		
16-30	210	24(11.4)	91	13(14.3)	302	37(12.3)		
31-45	10	2(20)	5	1(20)	16	3(18.8)		
>46	17	2(11.8)	13	1(7.7)	28	3(10.7)	2.47	0.480
Total	268	35(13.1)	136	17(12.5)	404	52(12.9)		

Key: Nº exa. = Number examined, Nº += Number positive

4.4. Manifested Signs and Symptoms of Malaria in Study Participants

Peoples' awareness about signs and symptoms of malaria was also investigated. Majority of the respondents identified shivering, fever, headache, chills, loss of appetite and vomiting as the major signs and symptoms in all age groups. Some of them also noted backache and joint-ache. Almost all of the study subjects had knowledge of at least one symptoms of malaria. This finding was in agreement with the study done from Afdem district, Butajira and Shewa Robit who reported that fever, headache, shivering and chills were understood by the respondents as signs and symptoms of malaria (Abate *et al.*, 2013; Adugna *et al.*, 2012; Eyob, 2015).

The most frequently reported sign and symptom of malaria were fever 80 (19.8%), shivering 216 (53.5%), headache 24 (5.9%), vomiting 16 (3.9%), chills 22 (5.5%), loss of appetite 20 (4.95%), backache 15(3.7%) and joint-ache 11 (2.7%).

The results of this study was lower than report from western Ethiopia, where 84.7% reported fever as the main symptom (Elias, 2014). However, in this study there was no significant association between manifested sign and symptom and malaria prevalence (P =0.099) (Table 4).

Table 4. Manifested sign and symptoms of malaria infection among study Participants from April to May 2016

Variable sign and symptoms	Frequency (%)	Malaria parasite infection	X^2	P-value
		No of Positive (%)		
Fever	80(19.80)	12(15)		
Chills	22(5.45)	9(40.9)		
Shivering	216(53.47)	17(7.9)		
Headache	24(5.94)	4(16.7)		
Backache	15 (3.71)	0(0.0)		
Joint ache	11(2.72)	3(27.3)		
Loss of appetite	20(4.95)	3(15)		
Vomiting	16(3.96)	4(25)	10.67	0.099
Total	404(100)	52(12.9)		

4.5. *Plasmodium* Species Identified among Study Participants in the Study Area

The age and sex wise distribution of *Plasmodium species* identified among study participants in the study area are shown in Table 5. Of the total malaria positive individuals, 34 (65.4%) and 18 (34.6%) were found to be positive for *P. falciparum* and *P. vivax,* respectively. The present study was in contrast with the report conducted at Arsi Negelle, where prevalence of *P. falciparum, P. vivax* and mixed were shown to be 19.8%, 74% and 6.2%, respectively and in central Addis Ababa, *P. vivax, P. falciparum* and rarely *P. malariae,* 62%, 32.5%, 5.2%, respectively (Adugna *et al*., 2013; Mengistu and Solomon, 2015). The study conducted in southeast Yemen, Hadhramout (Bamaga *et al.*, 2014) found that majority of participant were having *P. falciparum* 99.3%, with a low rate of *P. vivax* 0.7%.

Additionally a survey was conducted in Butajira southern Ethiopia and the prevalence of *P. falciparum, P. vivax* and both *P. falciparum and P. vivax* were shown to be 12.4%, 86.5% and 1.1%, respectively (Aynalem *et al.,* 2009).

The recent finding was similar with the results of the community based survey conducted in Afdem district Eastern Ethiopia, where 66.7% and 33.3% found to be positive with *P. falciparum* and *P. vivax*, respectively. The majority of the cases reported in the present study were due to *P. falciparum* (65.4%) which is similar to most reports in Ayira district southern Ethiopia (Elias, 2014; Eyob, 2015; Belayneh, 2014).

This study was consistent with the other previous studies, which showed males were more infected than females (Table 5). In contrast to this study a study conducted in Hawassa detected that females were affected by malaria than males (Getachew, 2006).

Table 5. Major *Plasmodium* species identified in examined participant in Melka Belo Woreda during March - June 2016

Age group	No examined		Sex				Total		X^2	P-value
	M	F	M		F		*P.f (%)*	*P.v (%)*		
			P.f (%)	*P.v (%)*	*P.f (%)*	*P.f (%)*				
<15	31	27	5(16.1)	2(6.5)	2(7.4)	0(0.0)	7(22.5)	2(7.4)		
16-30	210	91	16(7.6)	8(3.8)	8(7.7)	5(6.6)	24(11.4)	13(14.3)		
31-45	16	7	1(6.3)	1(6.3)	0(0.0)	1(14.3)	1(6.25)	2(28.6)		
>46	20	8	1(6.7)	1(6.7)	1(14.3)	0(0.0)	2(10)	1(12.5)	6.511	0.533
Total age groups	277	127	23(44.2)	12(23.1)	11(21.2)	6(11.5)	34(65.4)	18(34.6)		
X^2					7.580					
P- value					*0.371*					

Key: No + = Number of positive, P.v = Plasmodium vivax, P.f = Plasmodium falciparum
P- value was statistically significant at P≤ 0.05, 95% CI

Moreover, in this study higher prevalence was seen in males of age 16-45 years (Table 5). This might be due to greater exposure of males engage in activities (Eyob, 2015; Elias, 2014), which make them more prone to infective mosquito bite and might be associated with their daily activities (Eyob, 2015; Elias, 2014). However, there were no prevalence of malaria in this study for age ≥ 60 years. Even though higher prevalence of malaria was seen in males of age group 16 -45 years, there is no significant difference on prevalence of malaria among age groups (X^2 = 6.511, P =0.533) and with sex of examined individuals (X^2 = 7.580, P =0.371) (Table 5).

4.6. The People's Level of Knowledge and Awareness about Malaria Prevention and Control Practices

The level of knowledge about malaria prevention and control practices of randomly selected households were assessed using questionnaire survey (Table 6). The results indicated that 59.4% of the respondents believed that malaria could be transmitted through mosquito bite, 18.8% of the respondents believed transmitted through body contact with patients or from person to person, 5% use of unprotected water, 5.2% from cold environment and 0.99% from rain water, 2.7% from marshy area, 7.9% had no idea at all.

The results of this study were low compared to study in Abeshge, south central Ethiopia, where 78.8% of the respondents responded that mosquito bite responsible for malaria transmission (Fisseha *et al*., 2015). This study identified that there were misconceptions in the community with regards to the mode of malaria transmission, which were very important for malaria control and prevention. The most common misconceptions were: malaria is transmitted through bodily contact with patients, use of unprotected water and exposure to cold environment. This study agrees with previous reports from Amhara region that showed misconception of malaria transmission as being cold weather, hunger and drinking dirty water (Zewdie and Molla, 2013).

The majority of participants [334(82.7%)] knew mosquitoes bite mostly at night; 28 (6.93%) responded that the mosquito bites were at day and night time and 11(2.72%) said only at day time, whereas 21(5.19%) had no idea of the time when mosquitoes bite humans. The result of this study was higher than the reports from Amhara National Regional State, Ethiopia, where 48% knew mosquito bites at night (Zewdie and Molla, 2013). Although the results was lower than reports in Afdem district and Abeshge, where respondents replied mosquito bites mostly at night 93%, 86%, respectively (Eyob, 2015, Fisseha *et al.,* 2015).

The participant responses for the main breeding site of malaria vector were stagnant water and in the soil 346 (85.6%), 25 (6.2%), respectively, whereas the others 11(2.72%) were in the running water. However, some of the respondents had no idea 22(5.5%) about the breeding site of mosquito (Table 6). The results of this study was higher than those reported from Amhara regional state, Afdem district, Ethiopia, where 72.6% and 65.0% mentioned stagnant water as a principal breeding site and lower compared to study reported in Abeshge, south central Ethiopia, 87.8 % of the interviewees mentioned mosquito breeding site (Fiseha *et al*., 2015, Zewdie and Molla, 2013; Eyob, 2015).

In this study malaria control and preventive methods were taking tablets (drugs) 64 (15.8%), house hold spray with insecticides 84 (20.8%), environmental sanitation 94 (23.3%), use of mosquito net 144 (35.6%), smoke from burning leaves and animal products 11 (2.7%) and 7 (1.7%) of the respondents replied they did not know. The majority of this study participant response were 35.6% use of bed nets. The results of this study was lower than the study report from Afdem district, 53%. However, similarly bed net use mentioned as primary methods (Eyob, 2015).

This study participants responses for number of bed nets house hold have in their home, where absent, one per house, two per house and three per house,6.9%, 43.6%, 22.5%, 109%, respectively. The result of this study was lower than study reported in rural Tigrai were 85.9% households had a bed net and in Oromia and Amhara 91% owned at least one ITN. Even if, number of bed nets increased from time to time there was problems on proper usage of bed nets as bed nets used as a sheet cover on windows toilet and doors. Also community don't like to use ITN as the Chemicals treated with causes itching, bad smell and created too warm (Paulander *et al.,* 2009, Carol AB, *et al*., 2009).

This study identified that there was traditional methods applied to prevent malaria in the study area that did not still proven scientifically. Nineteen (4.7%) were seeks traditional healer as source of treatment (Table 6). The result of this study was lower than survey collected from Amhara regional state Ethiopia (Zewdie and Molla, 2013), where 40% of respondents used traditional healers to prevent malaria. This result contrasts report from Ayira districts, Western Ethiopia, where no report seeking from traditional healers (Elias, 2014).

Although the majority of respondents had mentioned 269 (66.6%) had good and 135 (33.4%) poor healthy extension services. The results of this study was higher than study report from Afdem district, where 57% believe receive good health extension services (Eyob, 2015). Two hundred seventeenth (66.8%) were heard health education message.

The results of this study was higher than 61.7%, reported (Eyob, 2015). However, 33.2% were never heard. The majority of participant believe health center (clinic) 314 (77.7%) and hospital 55(13.6%) to get treatment. Some of them Pharmacy (drug shop) 3 (0.74%) and the others also 13 (3.22%) did not know.

The results from the majority of respondents (83.9%) had heard of malaria in their area.16.1% there were no malaria in their area. Out of 404 participant of the study 87.9% believe malaria was preventable, 8.4% was preventable, and 3.7% they don't know. The result of this study were smaller than the reports from study in Abeshge, south-central and western, Ethiopia, where 89.8% and 89.7% of participants replied malaria preventable and 16.9% believed that malaria was not preventable (Yimer et al., 2015; Elias, 2014).

The respondents indicated that anti-malarial drugs sprayed per year, 385(95.3%) once, 12(2.9%) twice 5(1.2%) three and 2(0.5%) were four (Table 6). However, as information collected from malaria focal Personnel Mr. Wondu Shawel told as "anti-malarial drug sprayed once per year in Melka Belo Woreda especially at area that is malaria endemic". In Ethiopia, there was regular practice of creating community awareness on health issues through health extension workers which developed regional decrease of malaria. Similarly 42% of the populations were protected by IRS in Ethiopia (WHO, 2014). Although, the majority of the study participant replied no transmittable (58.9%), where as 41% replied malaria was transmittable. This study was lower than reported from Afdem district (Eyob, 2415). This shows there are misconception on knowledge of malaria.

Table 6. People's Level of knowledge and awareness about malaria prevention and Control Practices

Variables	Number (%)	Variables	Number (%)
Mode of transmission		**How to prevent malaria?**	
Through mosquito bite	240(59.4)	Drug	64(15.8)
Through body contact with patients	76(18.8)	Spray insecticides	84(20.8)
Through unprotected water	20(4.95)	Env'tal sanitation	94(23.3)
From cold Env't	21(5.19)	Use of bed net	144(35.6)
From rain water	4(9.9)	Smoke from d/t sources	11(2.7
Marshy area	11(2.7)	I don't know	7(1.7)
I don't know	32(7.9)		
		Number of bed net	
		Zero	28(6.9)
Health post availability			
Yes	262(64.9)	one per home	176(43.6)
No	142(35.1)	two per home	91(22.5)
		three per home	109(28.9)
Mosquito biting time			
Day	11(2.7)	**Health extension services?**	
Night	334(82.7)	Yes	270(66.8)
Day and Night	28(6.9)	No	134(33.2)
Mosquitoes main breeding site		**Treatment sources**	
Stagnant water	346(85.6)	Traditional healer	19(4.7)
In running water	11(2.7)	Health centre/clinic	314(77.7)
on soil	25(6.2)	Hospital	55(13.6)
I do not know	22(5.5)	Pharmacy/drug shop	3(0.74)
		I don't know	13(3.2)
Is malaria transmittable disease?		**How many times anti-malarial drugs sprayed per year?**	
Yes	166(41.1)		
No	238(58.9)	Once	385(95.3)
		Two	12(2.9)
Have you ever had malaria in your area?			
Yes	339(83.9)	Three	5(1.2)
No	65(16.1)	Four	2(0.5)
Is malaria preventable disease?		**Health education messages**	
Yes	355(87.9)	Good	269(66.6)
No	34(8.4)	Poor	135(33.4)
I don't know	15(3.7)		

4.7. Associations of the Prevalence of Malaria with Socio-demographic Characteristics of the Respondents and Level of KAP about Malaria among Study Participants

The results of statistical analysis showed that association of malaria infections prevalence with socio-demographic characteristics of the respondents and level of knowledge about malaria among study participants were listed in Table 7. In this study there were 404 individual respondents from those participant 35(13.1%) were male and 17(12.5%) were female positive for malaria (Table 2). Probably this higher male positive because males might involve outdoor activities than females at night.

The prevalence of malaria was higher in males than females. But the association of malaria with sexes was not statistically significant (P =0.480). In relation to age group 9(12.9%) were <15, 37(14.3%) 16 -30, 3(6.25%) 31 -45, 3(10.7%) > 46. More parasite prevalence was 14.3% detected in the age groups 16-30 and followed by 12.9% in age <15. However malaria prevalence was not statistically association between age and malaria prevalence (P =0.396).

Regarding marital status 11(14.7%) single, 18(6.5%) married, 14(43.8%) Widowed and 9(42.9) are widowed. However, the malaria prevalence was not statistically associated with marital status (P =0.189). This study results agreed with other study report in Ethiopia (Eyob, 2015).

In relation to educational level the study participants were illiterate, primary education, secondary education and higher education, at the time of this study were 32(17.8%), 13(15.1%), 6(6.9%), and 1(0.02) respectively. Although, there is significant association between educational level and malaria infection prevalence in the study area (P =0.021) (Table 7). This study was against study report in Afdem district (P =0.118) and western Ethiopia (P >0.05). Concerning occupation, this study was in contrast with report made from Ethiopia which indicated that risk of malaria was significantly associated with occupation of house hold (Eyob, 2015). In this study significant relationship was not shown between occupation and malaria prevalence (P =0.083) (Table 7).

Based on health education from participants 42(16.0%), and 10(7.0%) were believed receive good and poor, respectively. However, in this study there was no significant association between health education and malaria prevalence. In accordance with malaria prevention and control methods 5(55.6%) don't know, 5(25%) smoke and 9(14.3%) were drugs used (Table 7). In this study there was statistically significantly association between ways to control and malaria prevalence (P =0.021).

Table 7. Association of the Prevalence of Malaria with Socio-demographic Characteristics of the Respondents, level of Knowledge and awareness about Malaria among Study Participants

Major Risk factors	Nº exa.	Malaria parasite infection Nº positives (%)	X^2	P-value
Age group				
<15	70	9(12.9)		
16-30	258	37(14.3)		
31-45	48	3(6.25)	4.17	0.396
> 46	28	3(10.7)		
Marital status				
Single	75	11(14.7)		
Married	276	18(6.5)		
Widowed	32	14(43.8)	4.76	0.189
Divorced	21	9(42.9)		
Educational level				
Illiterate	180	32(17.8)		
Primary education	86	13(15.1)		
Secondary education	87	6(6.9)	9.69	0.021
Higher	51	1(0.02)		
Occupation				
Farmer	205	25(12.2)		
Merchant	37	7(18.9)		
Gov't employee	67	3(0.04)		
Student	50	2(0.04)		
House wife	20	2(10)		
Daily laborer	10	4(40)	11.16	0.083
No job	5	3(60)		
Health education				
Good	262	42(16.0)	2.62	0.105
Poor	142	10(7.0)		
Malaria control ways				
Drug	63	9(14.3)		
Spray insecticides	72	6(8.3)		
Env'tal sanitation	86	19(22.1)		
Use of bed net	156	8(5.1)		
Smoke	20	5(25)	11.52	0.021
I don't know	9	5(55.6)		

Key: Nº exam= number examined, P-value statistically significant at P≤0.05 at 95% CI

5. SUMMARY, CONCLUSION AND RECOMMENDATION

5.1. Summary

Malaria is one of the major causes of disease in people living in tropical and sub-tropical areas. It is a leading public health problem in Ethiopia where an estimated 68% of the population lives in malarias areas. The objectives of this study was to identify the *Plasmodium species* in blood samples of study participants, to determine the prevalence of malaria parasite among the study participants and trends of clinical malaria cases for the last eight years since 2008 and also to assess the malaria control practices by local People in the study area in Melka Belo Woreda Eastern Hararghe Zone Oromia Regional States, Ethiopia.

The data for trends of malaria were collected from Melka Belo health offices for last eight years from 2008-2015. The cumulative prevalence of malaria out of the whole clinical record of the past eight years showed were 5.8%. *Plasmodium falciparum* were the most dominant species (64.3%). The recent laboratory analysis of plasmodium species malaria prevalence in Melka Belo Woreda was 12.9% for both species. However Plasmodium falciparum dominates among malaria positive study participants. The recent prevalence of malaria was higher in relation to the works done by Ethiopian ministry of health. The majority of the current prevalence reported in this study were higher among 16-30 age groups.

The results of questionnaire survey indicated that the study participants had better knowledge on the method of malaria transmission, majority of the participants relate malaria infection with mosquito bites. The results showed most of study participant’s knowledge about the signs and symptoms of malaria were high.

5.2. Conclusion

Ethiopia is a country known by good health policies, which help to control deaths to ensure future development of our country in order to meet millennium development goals in all aspects.

The most basic for life of human becomes health. As a result, the government focus on control of the diseases occurrence by developing and supporting the works of health extension workers and health offices. The two are the main sources of information about malaria prevention and control practices in the study area. However, health extension workers themselves needs continues professional support to ensure our works.

Even though, there are improvements on the knowledge of the community about the causes, modes of transmission, signs and symptoms of malaria. There are common misconceptions on causes, mode of transmission, signs and symptoms and control practices in the community. As a result the community needs to educate continuously before the occurrence of malaria parasite seasons.

This study indicated that there is an improvement on believes that ITN and IRS can control malaria. However, there was incorrect use of ITN and IRS. So it needs to educate people about the correct use of both.

Knowledge, attitude and practice of the community towards malaria prevention and control practices showed improvement. Environmental sanitation in the study area improved people's quality of life standards. This study indicated that Melka Belo Woreda was one in which transmission of malaria is ongoing so further upgrading of control and prevention programs.

5.3. Recommendation

Based on the above conclusion the Researcher recommends the following points

- Prevalence of malaria mostly *Plasmodium falciparum* increases from time to time based on clinical analysis of blood sample with eight years trend. Because *P. falciparum* becomes more and more, drug resistant.

- To control its problems continuing occurrences control of factors affecting prevalence of malaria becomes better in long process not only short-term activities.

- To achieve the intended plan of the intervention program recommended to focus on common misconceptions about malaria causes, modes of transmission and clinical manifestation through healthy extension workers and community involvement practice as a main strategy.

- Even though there are improvements on the importance of ITN and IRS on malaria prevention and control, ITN and IRS utilization rate is still very low. Among many reasons for this, the community uses ITN for other purposes and IRS for its bad smell and effective for short time. Therefore, efforts are needed to increase utilization of ITN and IRS in the community through community conversation and education.

- In addition, IRS has a negative effect on bees and this may reduce the acceptance rate of IRS. Especially IRS sprayed on wall of the house require balanced amount of chemicals mostly to professionals who sprayed. Moreover, collaboration is essential between the agricultural sector and health offices to reduce the effect of chemical on bees and to scale up IRS acceptance rate in the community

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7. APPENDICES

HARAMAYA UNIVERSITY

BIOLOGY DEPARTMENT

1. Consent of the blood donor

Hello? I am_____ from HU, am here with my colleagues to study about Malaria Trends, Prevalence and Control practices in Melka Belo Woreda. We will ask you some questions related to malaria. Please be assured that the information will be confidential since we do not register names and you may choose to stop your participation or refrain from answering any question at any time. If you decide not to participate, your care here will not be affected. At this time do you want to ask me anything about this study?

Do I have your agreement to participate _____

A. Yes B. No

Signature_____

Malaria Trends, Prevalence and Control Practices In Melka Belo Woreda, Eastern Hararghe Zone Oromia Regional States, Ethiopia

2. Part I. Questionnaire (English version)

Haramaya University College of Natural and Computational Sciences, Department of Biology (M.Sc in Biology). A questionnaire to collect data on Malaria Trends, Prevalence and Control Practices Eastern Hararghe Zone Oromia Regional States, Ethiopia.

Instructions please select the most appropriate answer you wish to give and circle it irrespective place.

2.1. House hold Information

Date _____ Woreda _____

Village _____ House hold number_____

2.2. Socio-demographic characteristics of household

1. Sex …… Male …… Female ……

2. Age ……

3. What is your current marital status? A. Married B. Single C. Widowed D. Divorced

4. What is the highest level of educational status you have completed?

A. Illiterate B. Elementary school (grade1-6) C.Secondary school (grade 7-12) D. Higher education (Grade 12 +)

5. What is the total number of your family members? A. Male B. Female

6. Where is your current place of residence?

A.Warm and sub moist B.low land warm and arid low land

C. Warm and semi-arid low warm D. Others

7. How long have you lived in the area?

A.Since birth B. < 1year C.1-5 years D.6 -10 year E. > 10 years

8. What is your occupation?

A. Farmer____ F. House wife____

B. Merchant _____ G. Daily laborer____

C. Government employee_____ H. Has no job_____

D. Student____ I. If Others (specify) ____

E. Employee (private sector) ____

9. What is your average monthly income? A.100-500 B. 600-1000 C.>1000

10. What is the type of housing unit? A. Conventional B. Improved C. Others

Questions about knowledge, control practices and awareness related to malaria and treatment seeking behavior

11. Have you ever had malaria in your area? A. Yes____ B. No___

A. Has anyone in your household had malaria during the past six month?

A. Yes___ B. No_____

12. Is malaria transmissible disease? A. Yes__ B. No___

13. How is malaria transmitted from person to person?

A. Through mosquito bite B. From rain water C. Through bodily contact with patient

D. Marshy area E. Use of unprotected water

F. From cold environment G.I do not know

14. When do mosquitoes bite most?

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

15. Where do mosquitoes breed?

A. In the stagnant water B. In the running water C. On the soil D. I do not know

16. What are the main symptoms of malaria?

A. Fever B.Phils. C. Shivering D. Head ache E. Back ache F. Joint ache

G. Loss of appetite H. Vomiting

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

A. Traditional healer B. Health center/ clinic C. Hospital D. Pharmacy (drug shop) E. I don't know

18. Why do you prefer these sources?

A. Treatment is effective B. Low cost of drugs

C. Closeness to home D. Others (specify)

19. Is there health post in your locality? A. Yes B. No

20. Is there any member of your family who died of malaria? A.Yes B. No____

21. Is malaria can be preventable disease A.? Yes B. No C. I do not know

22. What measures do you take to prevent/control malaria?

A. Drug B. House hold spray with insecticide C. Use of mosquito net (bed net)

D. Use local cotton sheets E. Smoke from burning leaves and animal products (cow dung) F. Environmental sanitation G. I do not know

23. How many beds net do you have in your house?

A. absent B. one per house C. two per house D. three per house

24. How many times spraying of malaria ant-malarial drugs occur in one year? A. Once B. Three C. Four D. Five E. above

25. How is the availability of health extension service in your area?

A. Good B. Poor

26. If good, have you ever seen or heard any health education messages pertaining to malaria and environmental sanitation? A. Yes B. No

3. Part II. Questionnaire (AFFAAN OROMO VERSION)

Kutaa |.Oddeffannoo hirmattootta

Guyyaa_____ Aanaa_____

Aaradaa/magaalaa_____Lakk.manaa_____

Kutaa ||.Oddeeffannoo waligalaa Hirmaattotaa

1. saala Dhi___ Dub____

2. Umrii hirmaattotaa ……

3. Haala gaa'ilaa

A. Kan hinfune/tan hin heerumne
B. Kan fuudhe/tan heerumte
C. Kan haatimanaairraa dute/ tan abbaan manaa irraa du'e
D. Kan hiike/hiikte

4. Seenaa barumsa hirmattootaa

A. Hin baranne
B. Umriin barumsa hin geenye
C. sadarkaa 1ffaa(1_6) kan xumure/te
D. Sadarkaa 2ffaa (7_12)kan xumure/te
E. Sadarkaa ol'aanaa(kutaa 12+)

5. Baayinni miseensota maatii kessannii yeroo ammaa meeqa?

A. Dhi____ B. Dub_____ C. Waliigala____

6. Yeroo ammaa iddoo akkam jiraattan?

A. Badda daree fi jidha giddu gallesa qabu
B. Badda daree fi qillensa gogaa qabu
C. Gammojjii rooba hin qabne fi qillensa gogaa qabu
D. Kan biraa

7. yeroo hangamiff iddoo kana jiraattan?

A. Waggaa 1 gad

B. waggaa 1-5

C. waggaa 6-10

D. waggaa 10 ol E.yeroo dhalootaa

8. Hojii

A. Qotee bulaa E. Daldaalaa…… H. Hojjettaaa mottummaa……

B. Barataa F. Hojjeetaa dhunfaa(private sector) ____

C. Haadha manaa G. Dafqaan bulaa I.Hin qabu _____

D. kan biraa(tarreessi)

9. Ji'atti galii hangaam tokko argattaan?

A. 100-500 B. 600- 1000 C.>1000

10. Ijaarsi mana,keessanii yeroo ammaa maal fafakaata?

A. Mana citaa_____ C. Mana qorqorroo_____

B. Mana simidaa____ D. kan biraa(yoo) jiraate tareessi_____

Kutaa |||. waa'ee beekumsaafi hubaannoo ummata busaa

11. Naannoo keessaan kanattii busaan ni argamti?

A. Eeyee_____ B. hin argamtu_____

12. Busaan dhukkuba dadarbaa dha?

A. Eeyee____ B. Miti____

13. Dhukkubni Busaa Kun haala kamiin namarraa namatti dadarbs?

A. Yeroo busaan nama iditu E. Tuqaattii qaama dhukubsataa waliin godhamuun

B. Bishaan qulqullina hin qabne fayadamuun F. Qillensa qorraa irraaa

C. Bishaan roobaa irraa G. Iddoo riphriphxuu irraa

D. Hin beeku

14. Irraa caalaatti buusaan yeroo akkam nama idditi?

A. Guyyaaa keessa B. Halkaan C .halkanii fi guyyaa D.Hin beeku

15. Bookkeen buusaa eessatti wal-horu?

A. Bishaan ciisuu fi booru ta'e irratti C. Bishaan yaa'uu keessatti

B. Biyyee keessatti D.Hin beeku

16. Mallatooleen dhukkuba buusee maal maal fa'a? Namni tokko dhukkuba kannan qabamuu isaa maaliin beektuu?

A. Ho'aa qaama wal irraa hin cinne D. Qora qoraa jechuu G. Hollachuu

B. dhukkubii mata jechu E. Dhukkubii dugdaa H. Dhukkubi hidhanoo qamaa

C. Fedhii nyaataa dhabuu F. Haaqisaa

17. Sifi maatiin kee walansa argachuuf eessa filattu?

A. Maala aadaan nama walaanuu bira C. Buufata fayyaas D. Hospitalaa

B. Farmasii (drug shop) F. Hin beeku

18. Maalif kana filattee?

A. Salphatti fayisa D. Gatii xiqqaan argama

B. Manatti baay'ee waan dhiyaatuufi

C. kan biraa yoo jiraate tarressi __

19. Sababni guddaan buusaan qabamteef maal jettee yaada?

_____

_____

20. Buufatni fayyaa naannoo keessan ni argama?

A. Eeyeen B. Hin argamu

21. Maatii keesan keessaa namni dhukkuba buusaan du'e ni jira?

A. Eeyee B.hin jiru

22. Dhukkuba busaa kana to'achuun ni danda'amaa?

A. Eeyee B. Hin danda’amu C. Hin beeku

23. Dhukkuba busaa ittisuuf toftaal maal fa'aa fadamtan?

A. Qoricha liqimsuu E. Mana faraa ilbisaa fachaasuu

B. Qulqullina naannoo eeguu F. Agoobara fayadamuu (bed net)

C. Huccuu jibriiraa naannooti hojjatame fayadamuu

D. Aaraa gosa adda addaa itti aarsuu G. Hin beeku

24. Agoobara buusaa meeqa mana keessanii qabdassaniin?

A. hin jiru B. Tokkoo manatti C. Lama manatti D. Sadi manatti

25. Qorichi farra bookee buusaa waggaa tokko keessatti yeroo meeqa biifama?

A. Tokko B. Sadii C. Afur D. Shan E. Sana ol

26. Taajajilli ekisteeshinii fayyaa naannoo keessanitti maal faakkata?

A. Gaarii B. Dadhabaa

27. Yoo gaarii ta'e barumsa waa'ee buusaa/malaria dhagessanii beektu?

A. Eeyeen B. Hin dhagenye