ADDIS ABABA UNIVERSITY

COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES

DEPARTMENT OF ZOOLOGICAL SCIENCE

PREVALENCE OF PLASMODIUM SPECIES AMONG PATIENTS ATTENDING MOTTA HOSPITAL WITHIN THE LAST TEN YEARS (2006-2015)

BY

TILAHUN ALMAW

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A THESIS PRESENTED TO THE SCHOOL OF GRADUATE STUDIES OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQIREMENT OF THE DEGREE OF MASTER OF SCIENCE IN BIOLOGY

APPROVED BY:

Fassil Assefa (PHD) (Advisor)

---------- (PHD) (Examiner)

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Acronyms

ACT- Artemisinin-based Combination Therapy

CDC- Centre for Disease Control and Prevention

FMOH- Federal Ministry of Health

HSDP- Health Sector Development Program

IRS- Indoor-Residual Spraying

LLIN- Long Lasting Insecticidal Net

ITNs- Insecticide- Treated Nets

MIS- Malaria Indicator Survey

MOH- Ministry of Health

MOP- Malaria Operation Plan

PCR- Polymerase Chain Reaction

PMI- President's Malaria Initiative

RBM- Roll Back Malaria (global partnership to reduce malaria)

RDT- Rapid Diagnostic Test

UNESCO- United Nations Educational, Scientific and Cultural organization

USAID- United States Agency for International Development

WHO- World Health Organization

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ABSTRACT

Malaria is caused by protozoan parasites of the genus Plasmodium. It is one of the leading causes of illness and death in the world. It is a major health problem in Ethiopia. The aim of this study was to determine ten-year slide positive rate of malaria at Motta Hospital. A retrospective study was conducted to determine the prevalence of malaria parasite infection from peripheral blood smear examinations in Motta Hospital. The case notes of all malaria cases reported between 2006 and 2015 were carefully reviewed and analyzed. Within the last decade (2006-2015) a total of 37180 blood films were requested for malaria diagnosis in Motta Hospital and 4289 (11.53%) microscopically confirmed malaria cases were reported with a fluctuating trend. Regarding the identified Plasmodium species, *Plasmodium falciparum* and *vivax* accounted for 60.1% and 34.9% of malaria morbidity respectively and mixed infection of both P. faliciparum and P. vivax was 5%. Malaria was reported in all age groups and both sexes. But the 15-29 year age group and males were more affected. The prevalence of malaria parasite infection between males and females was not significantly associated (P. value>0.05), whereas the prevalence among age groups was significantly associated (P. value<0.05). Despite the apparent fluctuation of malaria trends in the area, the highest peak of malaria cases was reported during Spring (September-December), followed by Summer (June-August) within the last ten years. Control interventions should be continued in a strengthened manner in the study area, considering both *falciparum* and *vivax*.

a/Key words: Blood film, Diagnosis, Morbidity, Motta Hospital, Prevalence, Retrospective study

1. Introduction

Malaria is a life threatening infectious disease caused by the protozoan parasite called Plasmodium. Four main species of Plasmodium infect humans: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale*, and *Plasmodium malariae*. *Plasmodium falciparum* is the most highly virulent species and and is responsible for almost all of the 1.7-2.5 million deaths worldwide caused by malaria (Getachew et al, 2013).

Malaria mostly affects children under the age of five years and pregnant women in developing countries (Alemu et al, 2012).Pregnant women are more vulnerable because the experience depressed immunity during pregnancy, endangering both the lives of mother and the child (Getachew et al, 2013). A similar problem arises with children below the age of five as their immunity systems are not fully developed. It is estimated that every 45 seconds a child dies of malaria worldwide (WHO and UNICEF, 2008).

It is a leading public health problem in Ethiopia where an estimated 68 % of the population lives in malarious areas and three-quarters of the total land mass is regarded as malarious (FMOH, 2006) with two-thirds of the population at risk . This makes malaria the number one health problem in Ethiopia with an average of 5 million cases per year (Getachew et al., 2013). The disease causes 70,000 deaths each year and accounts for 17 % outpatient visits to health institutions (PMI, 2008).

Malaria is seasonal in most parts of Ethiopia, with variable transmission and prevalence patterns affected by the large diversity in altitude and rainfall with a lag time varying from a few weeks before the beginning of the rainy season to more than a month after the end of the rainy season (Deressa et al., 2003). Malaria transmission picks biannually from September to December and from April to May, coinciding with the major harvesting seasons (Deressa et al, 2003).

Studies have shown that the plasmodium species compositions and the number of malaria cases vary over time due to different factors, such as previous weather conditions or intervention measures. A hospital based retrospective study done in Ethiopia revealed decrement of *Plasmodium vivax* whereas *plasmodium falciparum* increases over a five- year period (Lelisa et al., 2014). Another ten year trend study carried out in Jimma Town, Ethiopia, showed not only

fluctuation of number of malaria cases but also changes in the species of Plasmodium composition following climatic variables Alemu et al, 2011).

Understanding how malaria varies in a community as a result of seasonal or year-to-year changes is essential for planning national malaria control programmes. The temporal analysis of relevant malaria data of health care system gives essential information needed to measure achievements of national malaria programmes and scrutinize remaining malaria hot spots. It also gives important insight into the malaria situation, which might guide adjustments of malaria programmes activities and the prioritization of malaria research. Therefore, the changing malaria situation requires an updating description of malaria trends (Lelisa, 2014).

Demographic and health surveys were carried out in Ethiopia in 2000 and 2005 and included a malaria module. Recognizing the low coverage and use of malaria interventions in the country, in 2005 the Government of Ethiopia's Federal Ministry of Health developed a 5-year National Malaria Prevention and Control strategy (Daddi et al., 2010). The strategy outlined an ambitious national goal of 100% household ITN (Insecticide Treated bed Nets) coverage in malarious areas with a mean of two LLIN (long Lasting Insecticidal Net) per household through distribution of about 20 million LLINs by the end of 2007. Moreover, the strategy stated that IRS (indoor Residual Spray) should be scaled up to cover 30% of households targeted for IRS and also included the rapid scale-up of provision of RDTs (Rapid Diagnostic Test) and ACT(Artemisinin-based Combination Therapy) to newly established community health posts (Daddi, 2010).

Despite recent efforts to control the disease, malaria remains the leading cause of mortality and morbidity in the country (FMOH, 2006). A major challenge for malaria epidemiologists is to evaluate the strengths and weaknesses of both methods in estimating malaria incidence and time trends, especially as malaria control programmes are intensified worldwide (Alemu et al., 2012).

Malaria remains to be the major public health challenge in the Amhara region. Among ten zones and three town administrations in Amhara region, East Gojjam zone is one of the malaria risk zones. Hulet Eju Enesse woreda is one of the largest woredas in East Gojjam zone with a population of 321,325. It constitutes 46 rural kebeles and 4 urban kebeles. 11 of the 50 kebeles in the woreda are considered to be malaria risk areas.

This research is intended to analyze ten years records of malaria prevalence in Motta Hospital which are important sources of malaria data, because they are readily available and can provide useful indicators on the situation of malaria in the study area. Moreover, they are useful to evaluate the current national malaria control activities on malaria prevalence in this area. If properly utilized, this information will urge the decision makers to act timely to strengthen malaria control interventions effectively and efficiently.

1.1. Statement of the Problem

Malaria remains the leading communicable disease seen at health facilities in Ethiopia. Historically, malaria has forced people to inhabit the less agriculturally productive highlands. Given that the country's economy is based on agriculture and peak malaria transmission coincides with the planting and harvesting season, this has placed a heavy economic burden on the country.

There could be several reasons for this problem including the deficiencies in the health system that lead to lack of access to malaria control interventions and low effectiveness of these interventions than expected. Therefore, this research involves hospital-based study to confirm the prevalence of malaria among people attending Motta Hospital, determining the risk factors such as socio-demographic factors and meteorological factors in the study area.

This study was then designed to investigate the changing epidemiological data of malaria. The ten years collected data from Motta Hospital provides the understanding on the factors that influence the high prevalence of malaria parasite in this hospital. The information that was collected is an essential component in the effectiveness of malaria control. Hence it is used to realign the effectiveness of malaria control measures so as to effectively reduce malaria burden.

1.2. Research Questions

1. What is the prevalence of malaria in the area for the last 10 years?
2. Is there any variation in the prevalence of malaria between sexes and age groups?
3. What is the distribution of Plasmodium species infecting patients attending Motta Hospital within the last ten years?
4. What meteorological factors influenced the prevalence of malaria?

1.3. General Objective

The general objective of this study was to assess the prevalence of malaria infection and associated risk factors among patients attending Motta Hospital from 2006 to 2015.

1.4. Specific Objectives

The specific objectives of this study were:

1. To identify the relative distribution of plasmodium species in the study area.
2. To determine the prevalence of malaria with regard to age and sex.
3. To determine the prevalence of malaria with respect to meteorological factors.

2. Literature Review

2.1. Causes of Malaria

Malaria is caused by infection of red blood cells with protozoan parasites of the genus Plasmodium. The parasites are inoculated into the human host by a feeding female anopheles mosquito. The four Plasmodium species that infect humans are *Plasmodium falciparum*, *Plasmodium vivax, Plasmodium ovale*, and *Plasmodium malariae*. (MOH, 2006).

The four human plasmodium species are found in tropical and sub-tropical regions throughout the world and exhibiting overlapping geographical distribution (CDC, 2006). The four species belong to the same genus and each one has a distinctive appearance under the microscope and each one produces some what a different pattern of symptoms. *P. falciparum* is widespread in tropical and sub-tropical areas of Central and South America, Africa and Asia. It results in most severe infections and is responsible nearly 90% of for malaria related deaths in Sub Saharan Africa (CDC, 2006). While P. falciparum predominates in warmer regions close to the equator, P. vivax predominates in more temperate regions. Since P. vivax can tolerate cooler temperatures, it is more geographically wide spread than *P. falciparum, although transmission is usually low because it is season dependent (CDC, 2006).*

2.2. Geographical Distribution of Plasmodium Species

P. falciparum is found mainly in the hotter and more humid regions of the world. It is the main species found in tropical and sub-tropical Africa and parts of Central America and South America, Bangladesh, Pakistan, Afghanistan, Nepal, Sri Lanka, Southeast Asia, Indonesia, Philippines, Haiti, Solomon Islands, Papua New Guinea, and many islands in Melanesia. It also occurs in parts of India, the Eastern Mediterranean and Middle East. *Plasmodium falciparum* is the most commonly encountered species in West Africa including Nigeria (Mbanugo and Ejims, 2000).

P. vivax is capable of developing in mosquitoes at lower temperatures than *P. falciparum,* and therefore has a wider distribution in temperate and sub-tropical areas. *P. vivax* is the main plasmodium species in South America, Mexico and Middle East, India, Pakistan, Sri Lanka,

Papua New Guinea and Solomon Islands. It is also found in parts of Southern Asia, Indonesia Philippines, Madagascar, tropical and sub-tropical Africa, China and Korea.

Plasmodium malariae has a much lower prevalence than *P. falciparum* and *P. vivax*. It accounts for up to 25% plasmodium infection in tropical Africa. It is also found in India, Guyana, Malaysia, and Sri Lanka. In these countries, it accounts for less than 10% of Plasmodium infections.

Plasmodium ovalae has a restricted distribution and of low prevalence. It is found mainly in West Africa where it accounts for up to 10% of malaria infections. It has also been reported from other parts of the Far East, South East Asia and South America (Umeh, Jude Mmaduka, 2009)

2.3. Global Malaria Epidemiology

Currently more than 40% of the world's population lives in areas of high malaria risk and the great majority are found in Sub-Saharan Africa (WHO, 2000). Malaria occurs in more than 100 countries throughout Africa, Central and South America, Asia, Haiti, Dominican Republic, and Turkey (WHO, 1996). An estimated 500 million clinical cases are reported each year with over 2.6 million deaths worldwide. Over 90% of these deaths occur in Africa with 25% of deaths in children below the age of five (WHO, 1996). However, worst effects of the disease are felt in the Sub-Saharan Africa where it undermines the health and welfare of families, endangers the survival and education of children, causes disabilities and impoverishes individuals and countries (WHO, 2004).

2.4. Malaria Transmission

The number and species of Anopheles mosquitoes determine to a large extent the level of transmission in a given area. Malaria transmission is influenced by climate and geography and often coincides with the rainy season (Craig et al., 1999), when breeding sites are available with high levels of Anopheles mosquitoes.

Anopheles arabiensis, a member of the *An. Gambiae* complex, is the primary malaria vector in Ethiopia, with *An. Funestus, An. Pharoensis* and *An. Nili are* secondary vectors. The sporozite rate for *An. Arabiensis* has been recorded to be as much as 5.4 %. The host-seeking behavior of *An. arbaiensis* varies, with the human blood index collected from different areas ranging

between 7.7 and 100 % (Craig, 1999). *An. Funestus*, a mosquito that prefers to feed on humans, can be found along the swamps of Baro and Awash rivers and shores of lakes in Tana in the North and the Rift Valley area. *An. pharoensisis* widely distributed in Ethiopia and has shown high levels of insecticide resistance, but its role in malaria transmission is unclear. An. Nili can be an important vector for malaria, Particularly in Gambella Regional State (Aynalem, 2008). Detailed information on the basic ecology and distribution of these vectors in Ethiopia is provided in the FY year 2008 MOP (Aynalem, 2008). However, insecticide resistance among these vectors has become an important issue, with implications for vector control strategies.

Changes in the environment of the mosquito habitat, such as those taking place in Ethiopia, whether natural or man-made, rearranges the ecological landscape in which these vectors breed. Every Anopheles spp. occupies a specific ecological niche that is genetically determined. Changes in temperature, humidity, altitude, population density of humans, and deforestation are just a few ecological factors that play essential roles in the transmission of malaria. (Aynalem, 2008).

In tropical regions temperature and humidity are often mediated by altitude. The mosquito density (number of female mosquitoes per human inhabitants) is a critical determinant of the intensity of infection. Transmission is directly proportional to density. Mosquito longevity is also a critical factor.

The malaria vector requires water to complete its life cycle: egg, larva, pupa, and the adult. 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 continuous until dawn (Aynalem , 2008).

Population movements also contribute to the spread of malaria and movement of infected people from areas where malaria is endemic to areas where the disease has been eradicated has led to the resurgence of disease (John, 2009). Deforestation for resettlement and creation of irrigation schemes also increase the risk of transmission (John et al., 2004). Ecological disturbances due to human actions such as deforestation and establishment of new settlements in previously unsettled areas allow for the proliferation of mosquitoes that prefer human habitation to natural settings as does the construction of dams.

A study in Tigray investigated the possible impacts of small dams on malaria transmission. Malaria incidence was 14.0 episodes/ 1000 child months in communities within 3 km radius from dams as compared to 1.9 in villages 8-10 km from the dams (Yohannes et al, 2005) The rate of infection among children near dams was seven times greater than in communities with no dams. The study, thus, concluded that micro dams close to villages have the potential to increase the incidence of malaria substantially among children living nearby (Yohannes et al, 2005).

2.5. Climatic Factors and Malaria Transmission

Meteorological factors are important drivers of malaria transmission by affecting both malaria parasites and vectors directly or indirectly. Temperature, rainfall and humidity have been associated with the dynamics of malaria vector populations and, therefore, with spread of the disease. Especially, ambient temperature plays a major role in the life cycle of the malaria vector.

The development of the parasite within the mosquito is also dependent on temperature. It takes about 9 to 10 days at temperatures of 28 ^{0}c, but stops at temperatures below 16 ^{0}c. The minimum temperature for parasite development of *P. falciparum* and *P. vivax* approximates 18 ^{0}c and 15 ^{0}c respectively (Crag et al, 1999). Also the daily survival of the vector is dependent on temperature. At temperatures between 16^{0}c and 36 ^{0}c, the daily survival is about 90%. The highest proportion of vectors surviving the incubation period is observed at temperatures between 28 ^{0}c -32 ^{0}c (Craig et al, 1999 and Jonathan et al, 2006). Rainfall provides breeding sites for mosquitoes to lay their eggs, and ensures a suitable relative humidity of at least 50 to 60% to prolong mosquito survival (Reiter, 2001).

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. Climate change is also expected to affect malaria indirectly by changing ecological relationships that are important to the organisms involved in malaria transmission (the vector, parasite and host). Previous studies showed that changes in temperature and precipitation have already changed the distribution and behavior of the vector (Gebere-Mariam, 1984). A study in Ethiopia had reported that although an epidemic was associated with higher rainfall (Woube, 1997), an epidemic in another year was preceded by very little rain. A reduction in malaria infection occurred in the Usambara

Mountains of Tanzania following 2.4 times more rainfall than normal (Lindsay et al, 2000), while excessive rainfall during the same period was associated with increased malaria in South-western highlands of Uganda (Kilian et al, 1999). Moreover, another study found that variation in the relationship between the mosquito population and rainfall in different districts of Kenya and attributed the variation to environmental heterogeneity (Mbogo et al, 2003).

Similarly, other studies in the East African highlands showed there was high spatial variation in the sensitivity of malaria outpatient numbers to climate fluctuations (Zhou et al, 2004). In line with these, different studies in different parts of Africa and other continents' concluded that at one month lagged effect meteorological variables are more likely correlated and predicts malaria cases occurrence than at zero month effect. They also reported that one meteorological variable might be more likely correlated than other meteorological variables (Anthony et al, 2000).

In Ethiopia, epidemiological pattern of malaria transmission is generally unstable and seasonal, the level of transmission varying from place to place because of differences in altitude and rainfall patterns. Changes have been observed in the epidemiology of malaria through time. Previously, malaria was known to occur in areas below 2000 m but currently it has been documented to occur indigenously even in areas above 2400 m, such as Addis Ababa, Akaki (MOP, 2013).

So, unstable malaria occurs in most parts of the country particularly in the highland fringes where climatic conditions are conducive for its transmission. The major transmission of malaria follows the June to September rains and occurs between Septembers to December while the minor transmission season occurs between Aprils to May following February to March rains. Some localities also experience perennial malaria, because the environmental and climatological situations permit the continual breeding of vectors in permanent breeding sites (MOP, 2013).

Many time-series studies and studies of epidemics have been done to find explanatory variables for changes in malaria transmission, but many of them fail to take climatic factors into account. Those studies mainly reported the relationships between factors other than climate that affect malaria rates such as urbanization, migration, irrigation, agricultural practices, deforestation, and malaria control efforts (MOP, 2013). This makes difficult to assess the true determinants of malaria in given area.

2.6. **Symptoms and Signs of Malaria Disease**

The first symptoms of malaria are nonspecific and similar to the symptoms of a minor systemic viral illness. They comprise; headache, fatigue, abdominal discomfort, muscle and joint aches, followed by fever, chills, perspiration, anorexia, vomiting and worsening malaise. This is the typical picture of uncomplicated malaria. Residents of endemic areas are often familiar with this combination of symptoms, and frequently self-diagnose. Malaria is therefore frequently over diagnosed on the basis of symptoms alone. Infection with P. vivax and P. ovale, more than other species, can be associated with well defined malarial paroxysms, in which fever spikes, chills and rigors occur at regular intervals (Eyob, 2015)..

If infective drugs are given or treatment is delayed in *falciparum* malaria, the parasite burden continues to increase and severe malaria may ensue. A patient may progress from having severe disease within a few hours. This usually manifests with one or more of the following: coma (cerebral malaria), metabolic acidosis, severe anemia, and hypoglycemia in adults, acute renal failure or acute pulmonary edema. Usually at this stage, mortality in people receiving treatment has risen to 15 to 20%. If untreated, severe malaria is almost always fatal (Umeh, Mmaduka, 2009).

2.7. Malaria Diagnosis

Malaria is diagnosed by seeing the parasite under the microscope. Blood taken from the patient is smeared on a slide for examination. Special stains are used to help highlight the parasite. Sometimes, it is possible to identify the species of Plasmodium by the shape of the parasite, especially if gametophytes are seen. Whenever possible, smears should be reviewed by someone with expertise in the diagnosis of malaria. If the smears are negative, they can be repeated every 12 hours. Smears that are repeatedly negative suggest another diagnosis should be considered.

Other types of tests are available for diagnosis of malaria. One rapid test is the detection of proteins called antigens that are present in Plasmodium. This test takes less than 30 minutes to perform. However, the reliability of rapid tests varies significantly from product to product. Thus it is recommended that rapid tests can be used in conjunction with microscopy. A second type of test is the polymerase chain reaction (PCR), which detects malaria DNA. Because this test is not widely available, it is important not to delay while waiting for results (CDC, 2013).

2.8. Treatment of Malaria

Malaria is an entirely preventable and treatable disease. The primary objective of treatment is to ensure a rapid and complete elimination of the Plasmodium parasite from the patients' blood in order to prevent progression of uncomplicated malaria to severe disease or death, to chronic infection that leads to malaria-related anemia. From a public health perspective, treatment is meant to reduce transmission of the infection to others, by reducing the infectious reservoir and to prevent the emergence and spread of resistance to anti-malarial medicines (WHO, 2014).

Most countries with *P falciparum* malaria have adopted artemisinin-based combination therapy (ACTs) as a first-line treatment. WHO recommended that uncomplicated P. falciparum malaria should be treated with an ACT. In areas where chloroquine is still effective, P. vivax malaria should be treated with the drug. Where resistance to chloroquine has been documented, P.vivax malaria should be treated with an appropriate ACT (WHO, 2014).

2.9. Malaria Situation in Ethiopia

2.9.1. Epidemiology of Malaria in Ethiopia

In Ethiopia, malaria transmission is largely determined by altitude and climate as affected by Indian Ocean global weather patterns. Most of the malaria transmission occurs between September and December, after the main rainy season from June to August. Certain areas, largely in the western and eastern parts of the country, experience a second minor malaria transmission period from April to May, following a short rainy season from February to March (FMOH, 2006).

There are four major eco-epidemiological strata of malaria in the country:

1. Malaria free highland areas above 2,500 meter altitude.
2. Highland fringe areas between 1,500-2,500 meters (which are affected by frequent epidemics).
3. Lowland areas below 1,500 meters (with seasonal pattern of transmission) and
4. Stable malaria areas (characterized by all year round transmission) limited to the western lowlands and river basins (FMOH, 2006).

P. falciparum and *P. vivax* are the most dominant malaria parasites in Ethiopia. They are prevalent in the malarious areas in the country and their relative composition generally is 60% and 40% of the malaria cases respectively. *P.malariae* accounts for less than 1% and *P. ovale* has never been reported from health facilities. The major malaria vector known in Ethiopia is *An. arbiensis*. In some areas *An. pharoensis, An. funestus* and *An. nilli* also transmit the malaria (FMOH, 2006).

2.9.2. The Role of Human Factors in the Spread of Malaria in Ethiopia

Human factors in Ethiopia contributing to the spread of malaria include population growth and movements, urbanization, water development schemes, agricultural development, conflicts, and improper use of drugs and the attendant consequences of the emerging drug-resistant malaria parasites (Aynalem , 2008).

Among the obvious strategies embarked on by the country's government is a shift way from rain-fed agriculture to small-scale irrigation through run-off harvesting in micro-dams and ponds (Tedros, 2006). Large-scale irrigation agriculture has also been in existence for decades as is the practice of damming rivers for the production of hydro electric power. None of these have been without health consequences, however, and the toll in malaria illness and death has been documented in one of the few studies focusing on the subject (Ghebreyesus, 1999).Successive governments have sought to harness the power of Ethiopian rivers.

The low education level of malaria sufferers most of whom live in the country side and have never been to school or received adequate guidelines regarding dosage, fail to adhere to prescription requirements, or stop medication all together up on feeling well (Ghebryesus, 1999).

2.9.3. The Socio-Economic Impacts of Malaria in Ethiopia

Up to 2 million people die of malaria around the world annually, mostly in Africa and half of them children. Some have called malaria… "the number one health problem in Ethiopia"(Aynalem , 2008).The disease is ranked as the leading communicable disease in Ethiopia, accounting for approximately 30% of the overall Disability Adjusted Life Years (DALYs) lost and causes about 70,000 deaths each year (PMI, 2008).

Quantification of the social economic burden of malaria in Ethiopia is problematic since the victims live mostly in rural areas out of sight and out of mind of social scientists and other researchers (Tedros, 2006).

The Ministry of Health (as quoted by Gabriel Senay and James Virdin, 2005) summarizes malaria's socio-economic impacts in Ethiopia as follows:

1. The high morbidity and mortality rate in the adult population significantly reduces production activities;
2. The prevalence of malaria in many productive parts of the country prevents the movement and settlement of people in resource-rich low-lying river valleys; on the flip side, the concentration of population in non-malaria risk highland areas has resulted in a massive environmental and ecological degradation and loss of productivity, exposing a large population of the country to repeated droughts, famine and overall abject poverty;
3. The increased school absenteeism during malaria epidemics significantly reduces the learning capacity of students;
4. Coping with malaria epidemics overwhelms the capacity of the health services in Ethiopia to focus on other diseases, and thus substantially increases public health expenditures.

This makes malaria in Ethiopia not just a health issue but a food-security and environmental issue as well. The malaria season coincides with peak economic activity in rural Ethiopia when both rainfall levels and temperature are high and conductive for the growth of subsistence crops. Vector activity peaks in the months often set aside for cultivation, weeding harvesting and winnowing. Weddings and other culturally important activities also peak at this time. In other words, optimal climate regimes for socio-economic activities in rural Ethiopia also favor the reproduction, propagation and thereby the preying up human blood of vector mosquitoes. Gabriel Senay and James Verdin's recently published graphs show the link between temperature/rainfall on the one hand and infection rates on the other. They also show that infection rates have been increasing sharply in recent years. This could be attributed partly to better reporting of cases enabled by increases in accessibility to health centers and larger institutions catering to the needs of malaria patients (Aynalem, 2008).

2.9.4. Malaria Disease Burden in Ethiopia

Despite the low malaria parasite prevalence compared to many African countries, malaria remains the leading communicable disease seen at health facilities in Ethiopia (kassahun, 2004). Historically, malaria has forced people to inhabit the less agriculturally productive highlands. Given that the country's economy is based on agriculture and peak malaria transmission coincides with the planting and harvesting season, this has placed a heavy economic burden on the country.

As stated previously, malaria is the leading cause of outpatient consultations and of health facility admissions. About 75% of the geographic area of the country has significant malaria transmission risk (defined as areas less than 2000 meters), with about 68% (57.3 million) of the country's total population living in these areas (WHO,2009).

The FMOH estimates that there are about 12 million suspected malaria cases each year. The FMOH reported a total of 3,384,589 malaria cases from July 2011-June 2012, with 1,793,832 (53.0 %) of laboratory confirmed, with 1,061,242 (59.2 %) *P. falciparum* and 732,590 (40.8%) *P.vivax*. Ethiopia reported 936 malaria deaths in 2011, according to the 2012 World Malaria Report.

Malaria morbidity reporting from the official FMOH surveillance sources and systems is improving, but is still substantially incomplete. PMI a micro planning survey in late 2012 to help estimate malaria morbidity and malaria commodity requirements based upon July 2011 –June 2012 district level reports from all districts in Ethiopia, with essentially 100% completeness. This micro planning survey documented 11,127,705 suspected malaria cases, of which 9,255,139 (83%)were tested with microscopy or RDT; 5,522,462 malaria cases were diagnosed as malaria, including 3,649,896 laboratory confirmed and 1,872, 566 probable malaria cases 9which were treated without diagnostic testing). There were 2,475,337 laboratory confirmed *P. falciparum* cases, and 1,174,559 *P. vivax* cases reported.

Regardless of decades of sustained control efforts, malaria still remains as the major cause of morbidity, mortality and socio-economic problems in Ethiopia because malaria control is a big challenge due to many factors. The complexity of the disease control process, experiences of the

control program, resistance of the parasite to anti-malarial drugs and vectors to insecticides are some of the challenges (Deressa et al., 2006).

2.9.5. Ethiopia's Malaria Control Strategy

Ethiopia developed a five-year National Strategic Plan for Malaria Prevention, Control and Elimination (2011- 2015). This strategic plan was developed following the 2007 MIS, as well as the discussions and recommendations following a consultative meeting held in Adama, Ethiopia, in March 2009 with key in-country and international malaria stakeholders. The HSDP and the national strategic plan are in line with RBM partnership objectives.

Goals: by 2015, achieve malaria elimination within specific geographical areas with historically low malaria transmission; and by 2015, achieve zero deaths due to malaria in the remaining areas with malaria transmission.

Overall Objective: The objective of the National Strategic Plan for Malaria Prevention and Control 2011-2015 is to consolidate the achievements of the 2006-2010 Strategic-plan and sustain its impacts (Ethiopia MOP FY, 2014).

3. Methodology

3.1. Study Area

The study was conducted at Motta Hospital, Hulet Eju Enesse district, which is located in Eastern Gojjam, Amhara region, about 370 km North West of Addis Ababa. Hulet Eju Enesse is one of the districts of East Gojjam Administrative Zone. The district administrative center, Motta is located 120 km South East of Bahirdar(the city of the Amhara Regional State). The topography of this district is 65% flat land, 15% mountainous and 20% valley. The altitude ranges from 1266-3300 m above sea level. The district is divided into three climatic zones: Dega, Woinadega and Kola. They cover 18%, 52%, and 30% of the district respectively. The mean annual rainfall is 1100-1189 mm (District Rural Development Agricultural Office, 2014). There are 46 rural kebeles and 4 town kebeles in this district. Malaria occurs in the 42 kebeles seasonally. 11 kebeles are considered as malaria risk areas. The total population is 321,325, out of this, 57,000 people live in malaria risk kebeles. Malaria is the most prevalent seasonal disease in the area (District Health Office, 2015).

3.2. Study Design

The data sources for this study were essentially secondary and retrospective blood film malaria reports in Motta Hospital from September 2006 to August 2015 slide positive.

3.3. Study Population and Data collection

The study participants were all malaria suspected individuals who had complains of febrile illness at Motta Hospital during the study period. Socio-demographic and laboratory data were collected from patients' registration book. In this hospital, the staining technique and blood film examination for malaria parasite detection were conducted according to a standard operating procedure (SOP) adopted from WHO protocol (WHO, 2010).

To assess the climatic factors such as rainfall, humidity and temperature, meteorological data were collected from the nearby meteorological agency (National Meteorology Agency Bahirdar Branch Directorate).

3.4. **Data Analysis**

Descriptive statistics was used to describe the frequency distribution of both prevalence of plasmodium species and meteorological and socio-demographic factors. Average yearly mean temperature, total rainfall and relative humidity (January through December for each year) were calculated. All data from meteorological and hospital records were checked for completeness and cleaned for any inconsistencies.

The data were entered and analyzed by SPSS 16 software package. To observe the correlation between meteorological variables and malaria cases, the monthly malaria cases were regarded as the dependent variables, while meteorological variables such as monthly mean temperature, total monthly rainfall, and monthly relative humidity were independent variables. Pearson's correlation analysis was conducted to examine the type and strength of relationship between meteorological variables and malaria cases.The frequency distribution of both dependent and independent variables was worked out by using crosstab. Finally, the data was described and presented using tables and figures.

Results and Discussion

4.1 Annual Trends of Malaria Prevalence at Motta Hospital

Within the last decade (2006-2015) a total of 37180 blood films were requested for malaria diagnosis in Motta Hospital and 4289 (11.53%) blood samples were microscopically confirmed as malaria cases. There was a fluctuating trend of malaria within the last decade with the minimum 111(2.59.5%) microscopically confirmed malaria cases being reported in 2015 and the maximum 934 (21.78%) microscopically confirmed cases of malaria being reported in 2006 (Table 1).

Table 1: The Distribution of Plasmodium Species in the two sexes in each Year (2006-2015)

Year	P. falciparum			P. vivax			Mixed infection		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
2006	349	291	640	140	118	258	24	12	36
2007	128	79	207	60	39	99	1	-	1
2008	178	144	322	33	31	64	13	4	17
2009	180	160	340	68	59	127	11	5	16
2010	296	282	578	128	107	235	38	14	52
2011	68	43	111	97	84	181	17	5	22
2012	54	38	92	75	53	128	14	6	20
2013	127	77	204	120	76	196	25	8	33
2014	51	20	71	70	46	116	11	1	12
2015	40	8	48	45	14	59	4	-	4
Total	1471	1142	2613	836	627	1463	158	55	213

The data also showed that *P. falciparum* and *P. vivax* are the major causative agents for malaria infection in the area. Accordingly, regarding the identified Plasmodium species, both species of Plasmodium were reported in each year with *P. falciparum* being the dominant species in the study area. *P. falciparum* and *P. vivax* accounted for 60.9% and34.1% of malaria morbidity respectively in the study area and mixed infection of *P. falciparum* and *P. vivax* was 5%.

The relative distribution of the two parasites showed that *P. falciparum* infection was more prevalent in 2006 up to 2010, than the *P. vivax* infection with a ratio of 2.5:1 (**Table 1**).Although the total malaria infection in the years 2008 and 2009 was lower than the years 2006 and 2010, yet the domination of *falciparum* infection was in the ratio of 5:1 and 2.7:1, respectively. Recently, in the year 2011 to 2015 *P. falciparium* was decreasing whereas *P. vivax* infection was

stable. Consequently, the data showed the ratio of *P. vivax* to *P.falciparum* infection was 1.6:1 and 1.4:1 in the years 2011 and 2012, respectively indicating a shift from *P.falciparum* to *P. vivax* in the study area (**Table 1**). Interestingly, there was a substantial decrease in malarial infection in 2014 and 2015 years by 54% and 74% compared with the prevalence of malaria by the year 2013, respectively. With regard to mixed infection the data showed a single infection 1(0.3%) by 2007 to that of 52 (6%) by the year 2010.

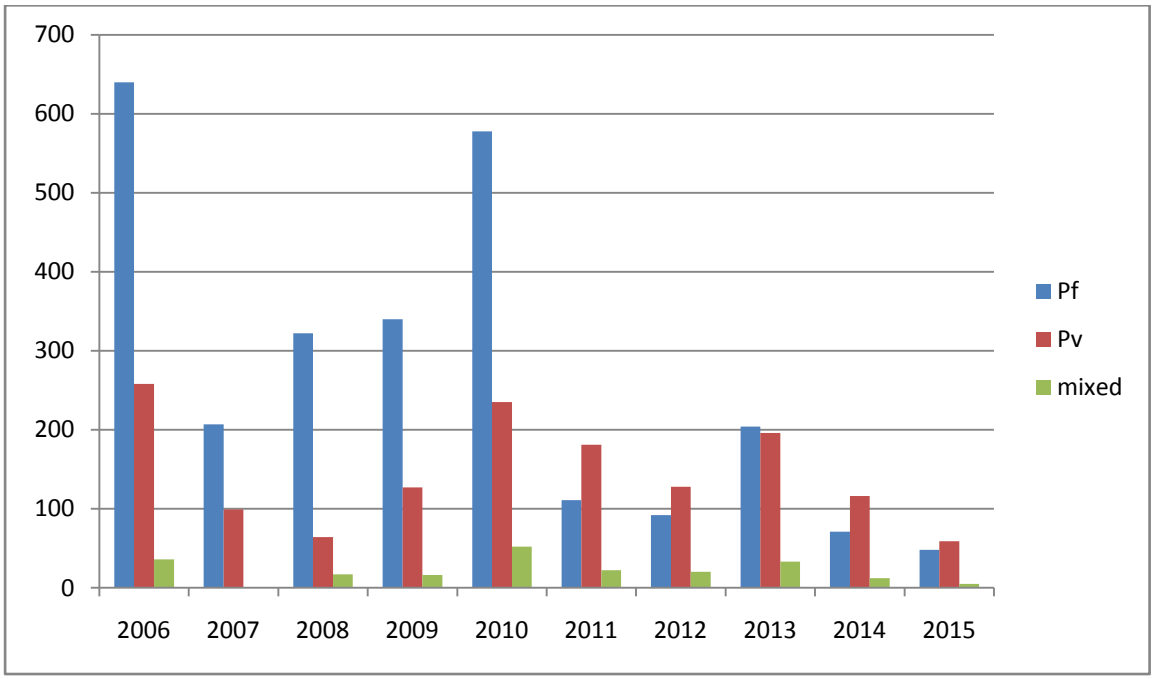

Figure 1: Distribution of Confirmed Malaria Cases by Species Composition and Year from 2006-2015

4.2 Prevalence of malaria parasites in relation to sex and age

According to the record review in the last decade (2006-2015) in the study area, males were more affected than females by malaria parasites. Out of the 4289 malaria positive individuals 2465 were males and 1824 were females. The infection rates among males were 57.47% and females were 42.53% with a ratio of male to female infection of 1.4:1 (**Table 1).**

In relation to Plasmodium species, in the study area, Plasmodium falciparum was the predominant parasite in all age groups. The age specific prevalence rate was also found as follows: 18.3% for age (≤5) years, 7.59% for (6-14) years, 16.87% for (15-59) years, 12.04 for

(30-45) years, 7.36% for (>45) years (**Table 2**). Although malaria was reported in all age groups in the area, it was higher in the 15-29 age group (**Table 2**). The prevalence of malaria with regard to age groups was found to be statistically significant (P<0.05).

Table 2: Slide positive rate of malaria by Age Groups in Motta Hospital from 2006-2015

Age groups	Number Screened	Malaria Positive	Rate of Infection
≤5	1918	351	18.30%
6-14	3329	253	7.59%
15-29	9561	1613	16.87%
30-45	10432	1193	12.04%
>45	11940	879	7.36%
Total	37180	4289	11.53

The data also showed there was not any significant difference in malaria infection between males and females within the age groups (Table 3). In all cases, malaria infection is slightly higher in males than females, and in a ratio 1:1.1-1.4 with *falciparum* infection and 1:1.1-1.8, with vivax infection respectively. The prevalence of malaria infection by both Plasmodium species is significantly higher, 53.6-95.2 amongst age groups higher than >15 years than the other age groups with prevalence of 16.2-24.4. In both cases, the highest infection was recorded from age groups of 15-29 (Table 3).

Table 3. Prevalence of Plasmodium species with respect to Sex and Age

Parasite	Sex	≤5	6-14	15-29	30-45	>45
P. falciparum	Male	15.50	10.3	52.9	39.2	29.2
	Female	11.13	8.4	42.3	32.5	27.3
	Total	26.63^{b}	18.7^{b}	95.2^{a}	71.7^{a}	56.5^{a}
P. vivax	Male	8.3	6.2	30.5	22.5	17.5
	Female	4.6	4.3	24.1	18.2	13.8
	Total	12.9^{c}	10.5^{c}	54.6^{a}	40.7^{ab}	31.3^{b}
Mixed	Male	0.0	0.0	8.4	5.9	2.9
	Female	0.0	1.0	3.9	2.3	2.0
	Total	0.0	1.0	12.3	8.2	4.9

Note: Means within a row with different superscript were significantly different (P<0.05)

There was a significant variation (P<0.05) in the infection of *P. falciparum* between the age groups <15 and the age groups >15. With regard to *P.vivax* infection, there was also a significant variation (P<0.05) between the age groups 15-45 and the age groups >45.

4.3 Seasonal variation of Plasmodium species in Motta Hospital from 2006-2015

Despite fluctuations in malaria infection, malaria cases occur in almost every month and season of the year. The highest peak of almost 40% of malaria was recorded between September and November months in all years followed by 26% of infection during the months of June to August (Table 4) and the minimum number of malaria cases was observed during the months of March to May (15.5%).

Although the maximum number of cases of *P. falciparum* and *P. vivax* was observed from September to November and from June to August, *P. falciparum* was the dominant infectious agent in all cases which was more than twice the infection caused by P. vivax except the months from June to August and December to February, where the *vivax: falciparum* infections were slightly higher to 30%:22% and 21%:18%, respectively.

Table 4: The Distribution of Malaria Parasites in Different Seasons from 2006-2015

Plasmodium species	Sep-Nov	Dec-Feb	Mar-May	Jun-Aug	Total	SEM	P-value
P.falciparum	109 (42%)	46 (18%)	48 (18%)	58 (22%)	261 (61%)	12.067	0.316
P. vivax	49 (33%)	31 (21%)	24 (16%)	43 (30%)	147 (34%)	4.559	0.283
Mixed infection	9 (36%)	4 (16%)	3 (12%)	9 (36%)	25 (5%)	1.175	0.148
Total	167 (38.6%)	81 (18.7%)	75 (17.3%)	110 (25.4%)	433	5.933	0.249

Note: SEM= Standard Error of Mean

The co-infection with both species was much lower than the infection with individual species and the infection during the months of September to November and June to August was three times higher than the other seasons (Table 4). The co-infection with both species during the months of September to November and June to August was 1.7 times higher than the other seasons (Table 4).

4.4 Correlation between prevalence of plasmodium species and meteorological factors

A slight fluctuation trend of meteorological factors (temperature, rainfall and relative humidity) through the years 2006-2015 was observed. Unlike malaria cases from 2006 to 2015, there was no statistically significant inter-annual variation of all measured meteorological factors in the study area. However, there was a slight relationship between annual relative humidity and annual total malaria cases than other meteorological variables in the study area (Table 5).

Table 5: The Prevalence of Malaria Infection with Respect to Meteorological Variables between 2006 and 2015.

Year	Male	Female	Total	Mean T(^{0}C)	Mean RF (mm)	Mean RH (%)
2006	513	421	934	16.9	117.2	57.0
2007	189	118	307	16.8	89.0	54.3
2008	224	179	403	17.9	102.3	48.7
2009	259	224	483	16.7	63.4	42.4
2010	462	403	865	17.3	108.9	56.4
2011	182	132	314	17.1	109.3	56.1
2012	143	97	240	17.1	94.7	51.5
2013	272	161	433	17.4	123.8	52.4
2014	132	67	199	17.0	120.8	56.0
2015	89	22	111	17.2	108.4	54.8

Note: Mean T= Mean Temperature; Mean RF= Mean rainfall; Mean RH= Mean Relative Humidity

Although there was the highest malaria infection in the year 2006 (934), the correlation between malaria infection and temperature was negative (r= Pearson's Correlation Co-efficient <0) since the highest annual mean temperature was in 2008 and the infection of malaria was lower than that of 2006 (Table 5).But there was a positive correlation between mean relative humidity and malaria infection in 2006 and 2010 (r> 0).

Table 6: Prevalence of Malaria Parasites in Motta Hospital in Relation to other Studies in Ethiopia

Sample Site	P. falciparum	P. vivax	Mixed	Reference
Motta Hospital	60.9%	34.1%	5%	This Study
Metema Hospital	90.7%	9%	0.3%	Getachew et al(2013)
Kola Diba, North Gondar	25%	75%	-	Alemu et al(2012)
Assendabo Health Center	45.7%	54.3%	-	Ghbreyesus et al(2000)
Dilla Town	26.8%	62.5	10.7	Molla et al(2015)
Arsi Negelle Health Center	19.8%	74	6.2	Mengistu et al (2014)
Butajira area	12.4%	86.5%	6.2%	A Woyessa (2012)

4.5 Discussion

This study was aimed at evaluating the prevalence of Plasmodium species among patients attending treatment in Motta Hospital. The study showed that the overall malaria prevalence among the patients was 4289 (11.53%). This was lower than the study conducted in Metema Hospital in which the overall prevalence of malaria was 17% (Getachew et al, 2013).The prevalence of malaria in my study was also considerably low compared to the study conducted in Kenya in which the prevalence was 32.4% (Oluoch J, 2002).The research conducted in Maputo city, Mozambique also showed the prevalence of malaria to be 15.7% (Macedo de O, 2011) which was higher than my finding. This difference might be due to variation in sample size, altitude and climate.

The predominant plasmodium species detected was *P.falciparum* (60.9%) followed by P. vivax (34.1%) and the remaining 5% was mixed infection. This result is different from the result obtained from Metema Hospital in which *Plasmodium falciparum* accounted 90.7% and *Plasmodium vivax* 9% and mixed infection 0.3%. (Getachew et al., 2013). But other studies reported that the most prevalent species was *P. vivax*. The study conducted in Kola Diba Health Centre showed that *Plasmodium vivax* accounted for 75% and *Plasmodium falciparum* accounted for 25% of malaria morbidity (Alemu et al, 2012).

However, this study contradicts with the study conducted in Jimma zone at Assendabo Health Centre, with reported prevalence of *Plasmodium vivax* 45.7% and *Plasmodium falciparum* 54.3% (Ghebreyesus et al., 2000). The other was the one which was conducted in five zones of Eritrea in 12,935 individuals in which *Plasmodium falciparum* accounted 90.4% and

Plasmodium vivax 9.6% of 285 positive cases (Sintasath et al, 2005). This might be due to the difference in the study area, study period, sample size as well as study population in which those studies focused on.

Similarly, a research conducted in Dilla Town showed that the prevalence of P. vivax was 62.5% followed by 26.8% and 10.7% infections with *P. falciparum* and mixed infections, respectively (Molla et al, 2015). Another finding was from Arsi Negelle in which the prevalence of *P.* falciparum and p. vivax was 19.8 and 74% respectively and mixed infection was 6.2% (Mengistu et al, 2014). This shows that the prevalence of *P.vivax* was higher than that of *P. falciparum* in Arsi Negelle.. A study was also conducted in Butajira area in 2012 and the study showed that the prevalence of *P. falciparum* and *P. vivax* was 12.4% and 86.5% respectively and mixed infection was 1.1% (A. Woyessa, 2012) **(Table 6).**

Although many of the above mentioned reports suggested that *P. vivax* is also dominant in some parts of the country. This finding is concurrent with malaria parasite distribution in Ethiopia which indicates that *Plasmodium falciparum* and *Plasmodium vivax* are the two predominant malaria parasites distributed all over the country and accounting for 60% and 40% of malaria cases respectively (FMOH,2006).

This study also shows that since 2011 *Plasmodium falciparum* is decreasing but *Plasmodium vivax* is slightly, but not significantly increasing which indicates a trend shift. The possible reason for this trend shift from Plasmodium falciparum to Plasmodium vivax might be due to the public health importance of *P. vivax* that is frequently overlooked and left in the shadow of the enormous problem caused by *Plasmodium falciparum* (Hay et al. 2006; Baired, 2007). increasing, which indicates a trend shift. The possible reason for this trend shift from *Plasmodium falciparum* to *Plasmodium vivax* might be due to the public health importance of *P. vivax* that is frequently overlooked and left in the shadow of the enormous problem caused by *Plasmodium falciparum* (Hay et al. 2006; Baired, 2007).

In addition, the prevention and control activities are guided by the National Strategic Plan (2006-2010) mainly focus on *Plasmodium falciparum* because it is assumed more prevalent and fatal malaria in the country. Other possible reasons might be climate variability and *Plasmodium vivax* might have developed resistance for the currently used drug chloroquine (Alemu, 2012).

The data showed that males (57.47%) were more infected than females (42.53%) but without any significant statistical difference. This is in line with other studies in Ethiopia. According to the study conducted at Kola Diba Health Centre males were more affected than females. The infection rate among males was 52.6% and females were 47.3% (Getachew et al., 2013). The higher prevalence rate might be due to the fact that males engage in activities outside their residence area (migration) which make them more prone to infective mosquito bites as compared to female counterparts which are mostly at home and are not exposed to malaria areas and protected from such infective bites. Malaria infection was recorded from all age groups in the study area. However, the rate of infection was high in the age groups ≤5 years old followed by 15-29 years old. This might be associated with their lack of immunity and daily activities respectively.

In the study area, malaria was observed in almost every month of the year. Although there was significant fluctuation in the number of malaria cases, the highest prevalence of malaria cases was observed between September and November followed by summer (June, July, and August), while low slide positive rate occurred between March and May. This is in agreement with other studies done in Metema Hospital and Kola Diba Health Centre in which malaria transmission peaks from September to November (Getachew et al., 2013; Alemu et al, 2012).

An association between annual malaria cases and meteorological variables (rainfall, and relative humidity) was observed. However, there was no significant correlation between these meteorological variables and malaria cases in the study area. There was no any correlation between temperature and prevalence of malaria in the study area within the last decade (2006-2015).

Generally, this study showed that during the last ten years, there was trend in the decrease of malaria cases observed at Motta town. The highest peak was in 2006, there after there was drastic decrease in 2015 by 88% compared with the malaria infection recorded in 2006.

Conclusion and Recommendation

Conclusion

This study shows that the prevalence of malaria in the area was 11.53%, and the infection by *P falciparum* was higher than *P. vivax* .There might be misdiagnosis of parasite (Plasmodium) species as single and mixed infection. Clinical diagnosis of malaria species and detection of mixed species needs special attention in the study area.

This finding shows that the meteorological variables, rainfall and relative humidity have a slight correlation with prevalence of plasmodium species, but temperature does not have any relationship with prevalence of malaria parasites.

There was significant correlation between malaria infection and age of patients in the study area ($P<0.05$).The patients aged 15-29 years were more infected with malaria than other age groups. This study also revealed that males were more affected than females by malaria parasites, but with no significant statistical difference.

This finding shows that the meteorological variables, rainfall and relative humidity have a slight positive correlation with prevalence of plasmodium species, but temperature does not have any positive relationship with prevalence of malaria parasites.

The study also shows that there was a consequent reduction shift in the prevalence of malaria from 2014 to 2015. The reason behind this trend shift might be due to malaria intervention methods such as the use of insecticide treated nets (ITNs) and indoor residual spray (IRS) in the study area.

Recommendations

This study is limited to the data obtained from the patients' records, being a secondary data; it is liable to disadvantages associated with any secondary data. The information and data might not be accurate due to errors made during malaria parasite diagnosis. This study was not able to gather information on the number of patients examined in other health institutes (Health Centers and Health Posts) in the study area (woreda). So further study could consider the whole of Hulet Eju Enesse Woreda since the woreda is noted for high incidence of malaria cases. Further,

integrated investigation is needed to understand the magnitude and prevalence of malaria parasites in the study area.

In order to get a clear picture of the prevalence of malaria in general, and that of the distribution of the parasites in particular, proper diagnosis methods should be established. Consequently, the method is highly advantageous to control and manage prevalence of mixed infection, right representation of single species infection and detection of emergency of drug resistance strains. Clinical diagnosis quality control strategy is important in the study area for prompt treatment and control of the disease.

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Appendices

Appendix. 1. Statistical Data for Prevalence of Malaria with Regard to Sex, Age and Climatic Factors.

Table 1: Prevalence of Malaria with Regard to Sex and Age at Motta Town from 20006-2015.

Variables			Screened	F Present	V Present	Mixed P
			Mean(SEM)	Mean(SEM)	Mean(SEM)	Mean(SEM)
Sex		Female	1732.1(177.814)[a]	113.1(32.819)[a]	62.7(10.528)[a]	6.9(1.517)[b]
		Male	1985.9(179.820)[a]	147.1(33.561)[a]	83.6(11.434)[a]	15.8(3.434)[a]
Age	≤5	Female	91.9(12.721)[a]	11.13(3.472)[a]	4.6(0.841)[b]	No case
		Male	99.9(12.265)[a]	15.50(3.407)[a]	8.3(1.155)[a]	No case
	6-14	Female	158.4(23.391)[a]	8.4(2.277)[a]	4.3(0.959)[a]	1
		Male	174.5(23.063)[a]	10.3(2.241)[a]	6.2(0.878)[a]	No case
	15-29	Female	438.4(42.959)[a]	42.3(12.122)[a]	24.1(4.143)[a]	3.9(0.743)[b]
		Male	517.7(46.152)[a]	52.9(12.330)[a]	30.5(4.377)[a]	8.4(1.714)[a]
	30-45	Female	481.8(47.427)[a]	32.5(9.061)[a]	18.2(3.040)[a]	2.3(0.522)[a]
		Male	561.4(47.846)[a]	39.2(9.327)[a]	22.5(3.110)[a]	5.9(0.964)[a]
	>45	Female	561.6(53.487)[a]	27.3(7.091)[a]	13.8(2.065)a	2.0(0.557)[a]
		Male	632.4(53.378)[a]	29.2(6.713)[a]	17.5(2.056)a	2.9(0.800)[a]

Note: *Means within a column with different superscript were significantly different (P<0.05). SEM- Standard error of mean*

Table 2: The prevalence of plasmodium species with Respect to age groups in ten years infestation level

	Age Groups						
Variables	**≤5**	**6-14**	**15-29**	**30-45**	**>45**	**SEM**	**P- value**
Screened	191.8[b]	332.9[b]	956.1[a]	1043.4[a]	1194.0[a]	66.711	<0.001
F Present	24.4[b]	16.2[b]	95.2[a]	71.7[a]	53.6[ab]	7.7947	0.003
V Present	11.9[c]	10.0[c]	54.6[a]	40.7[ab]	31.3[b]	3.358	<0.001
Mixed	0	1.0	11.5	7.7	4.0	1.206	0.054

Note: Means with a different superscript in a row are significantly different (p< 0.05); F=Falciparum; V=Vivax, SEM- standard error of mean

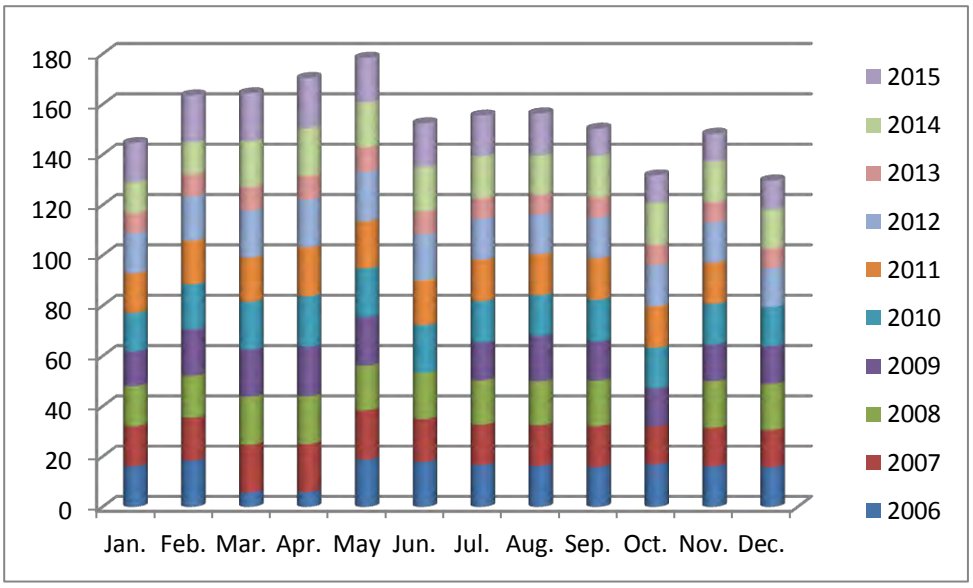

Figure 1: Mean temperature from 2006-2015 at Motta town

Table 3: Correlation between prevalence of plasmodium species and Temperature (2006-2015 years)

Variables	Mean	r	P-value
FP	261.3(66.063)	0.066	0.857
VP	146.3(21.673)	-0.267	0.457
MP	21.3(4.879)	-0.202	0.575
Mean Temperature	15.4(0.800)		

Note: FP= falcparum present; VP= vivax present; MP= mixed present

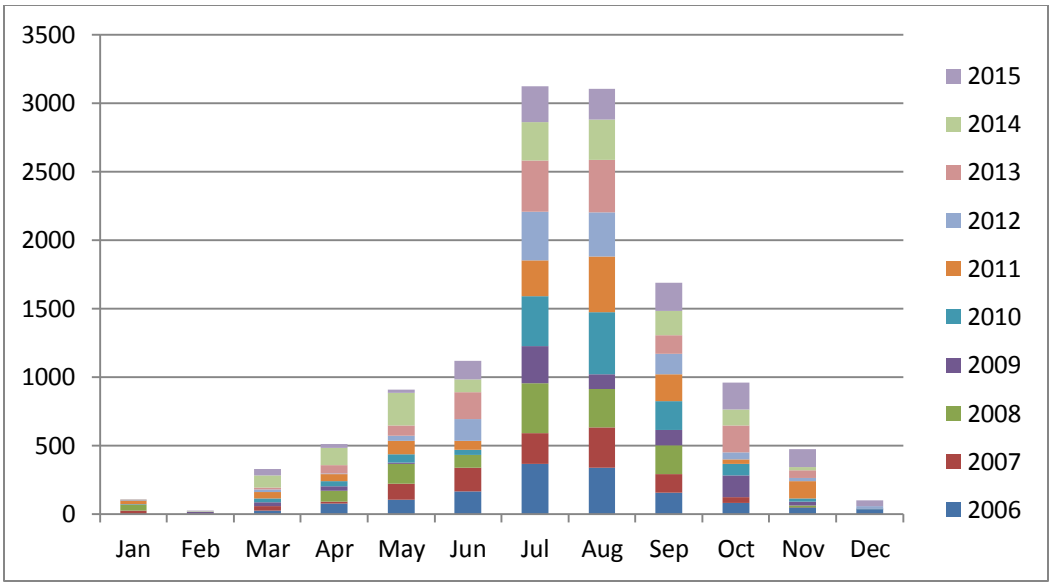

Figure 2: Mean Rainfall from 2006-2015 at Motta Town

Table 4: Correlation between prevalence of plasmodium species and rainfall (2006-2015 years)

Variables	Mean	r	P-value
FP	261.3(66.063)	-0.012	0.974
VP	146.3(21.673)	0.362	0.304
MP	21.3(4.879)	0.357	0.311
Mean Rainfall	103.8(5.654)		

Note: FP= falciparum present; VP= vivax present; MP= mixed present

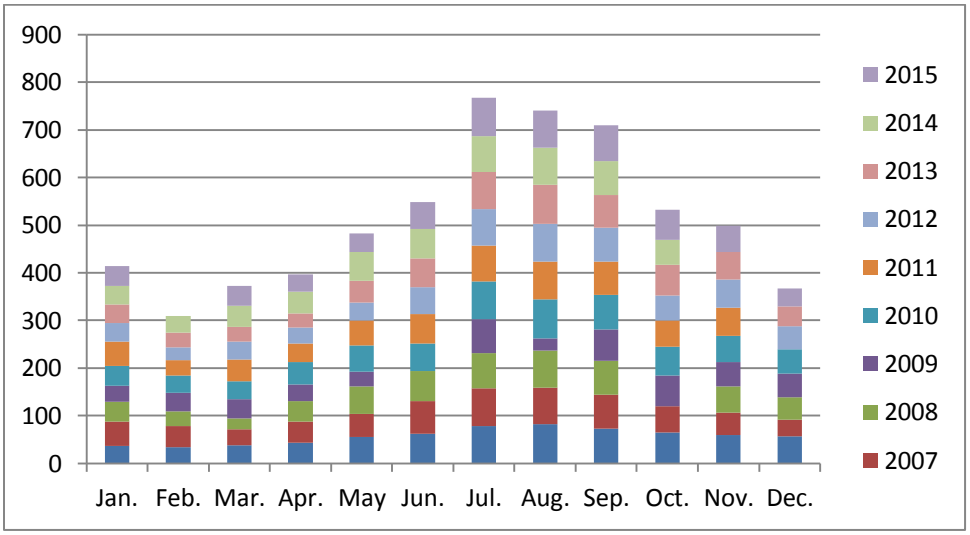

Figure 3: Mean relative humidity from 2006-2015 at Motta town

Table 5: Correlation between prevalence of plasmodium species and relative humidity (2006-2015 years)

Variable	Mean	r	P-value
FP	261.3(66.063)	0.444	0.199
VP	146.3(21.673)	0.590	0.072
MP	21.3(4.879)	0.501	0.140
Mean relative humidity	51.1(1.410)		

Note: FP=Falciparum present; VP= Vivax present; MP= mixed present

Appendix.2. Meteorological data at Motta town from 2006 to 2015

Motta Monthly Rainfall (2006-2015)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Jan.	0.0	26.2	41.7	0.0	7.2	21.8	2.7	3.1	0.2	3.8
Feb.	2.2	0.0	0.7	13.2	0.0	0.0	0.0	0.0	4.0	4.5
Mar.	27.9	32.4	0.0	28.5	27.0	48.0	16.3	14.5	86.5	50.7
Apr.	76.9	16.5	78.9	30.2	37.5	53.0	3.5	61.3	127.1	27.9
May	106.3	116.6	143.9	9.0	63.5	94.4	37.2	77.4	239.5	20.3
Jun.	164.1	175.5	94.2	0.0	34.1	69.4	157.7	193.0	93.9	138.5
Jul.	366.2	225.8	363.1	273.1	364.4	260.9	355.3	370.1	283.7	261.3
Aug.	339.0	295.7	279.8	108.4	450.4	408.9	322.5	381.6	292.1	226.2
Sep.	158.0	136.4	209.7	109.4	212.7	197.0	147.9	135.6	176.8	204.5
Oct.	80.3	42.5	0.0	160.9	84.5	32.1	50.0	195.0	118.3	195.6
Nov.	49.1	0.2	15.4	28.4	22.1	126.1	23.6	54.0	26.9	127.4
Dec.	36.8	0.0	0.0	0.3	3.0	0.0	19.8	0.0	0.0	39.8

Motta Monthly Relative Humidity (2006-2015)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Jan.	37	51	41	34	42	50	39	40	38	42
Feb.	34	44	31	39	37	31	28	30	35	*
Mar.	38	34	23	39	38	46	37	32	44	41
Apr.	43	44	43	36	47	39	33	30	46	35
May	56	48	57	32	55	52	38	45	60	39
Jun.	62	68	64	0	58	61	57	60	62	56
Jul.	78	79	74	72	79	75	77	78	75	80
Aug.	82	77	78	25	82	79	80	81	78	79
Sep.	73	71	71	66	73	69	71	69	72	75
Oct.	65	55	0	65	60	55	52	65	52	63
Nov.	60	47	55	50	55	60	59	58	*	55
Dec.	57	35	47	50	51	*	48	41	*	38

*= No data obtained

Motta Monthly Minimum Temperature (2006-2015)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Jan.	8.6	7.5	7.5	6.4	6.1	7.7	7.1	7.5	*	7.2
Feb.	10.6	8.6	7.8	11.0	9.8	8.7	9.2	9.6	*	10.4
Mar.	11.3	10.8	10.4	10.6	11.5	10.1	10.9	11.8	10.5	11.6
Apr.	11.7	11.7	11.9	12.2	13.3	12.3	11.0	11.6	11.9	13.0
May	11.8	12.6	10.7	10.9	12.9	11.8	12.1	12.0	11.8	8.9
Jun.	11.3	11.1	13.0	*	12.1	11.4	11.6	11.8	11.1	8.9
Jul.	12.0	11.5	13.9	10.1	11.8	11.5	11.4	10.6	11.4	11.8
Aug.	11.7	11.3	13.6	17.9	11.9	11.7	10.8	*	10.5	12.5
Sep.	10.7	10.5	14.1	8.5	11.3	10.9	10.3	*	11.0	*
Oct.	10.5	7.7	*	8.0	9.7	9.2	9.1	*	10.4	*
Nov.	9.1	7.0	14.3	5.8	9.0	9.3	8.5	*	8.6	*
Dec.	8.0	5.8	13.2	6.4	8.0	*	7.5	*	7.4	*

*= No data obtained

Motta Monthly Maximum Temperature (2006-2015)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Jan.	23.7	24.2	24.6	21.2	24.5	23.8	24.7	24.6	24.4	24.1
Feb	26.1	25.5	25.6	25.8	26.1	26.0	25.9	26.8	25.4	27.0
Mar.	*	27.3	27.8	26.8	26.5	25.0	26.6	27.3	25.9	26.4
Apr.	*	26.6	26.0	27.3	26.7	26.7	26.8	28.0	25.9	26.9
May	25.6	26.7	24.9	27.6	25.9	25.6	27.1	26.1	24.0	26.4
Jun.	24.3	23.1	23.7	*	25.8	24.4	24.8	23.8	24.4	25.7
Jul.	21.3	20.6	21.4	19.9	21.1	21.6	20.9	20.8	22.1	20.6
Aug.	20.7	21.2	21.2	18.4	20.4	20.9	20.7	20.1	20.6	21.0
Sep.	20.9	22.0	22.1	22.8	21.8	22.0	22.0	22.2	22.0	21.5
Oct.	23.1	22.6	*	22.3	22.8	23.7	23.4	22.4	22.8	21.9
Nov.	23.0	23.7	22.7	23.5	23.3	23.7	23.4	23.1	23.5	22.2
Dec.	23.4	23.8	23.5	23.7	23.0	*	23.7	23.4	23.4	23.0

*=No data obtained

Appendix .3. Prevalence of Plasmodium Species with Respect to age and Sex at Motta Hospital from 2006-2015

Year: 2006

		≤5				6-14				15-29				30-45				>45			
Month	Sex	Ns	pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx
Sep	M	22	8	3	-	34	5	2	-	84	29	8	3	78	16	6	2	70	12	4	1
	F	21	6	1	-	32	3	1	-	75	25	5	1	73	17	4	1	68	11	3	1
	T	43	14	4	-	66	8	3	-	159	54	13	4	151	33	10	3	138	23	7	2
Oct	M	21	9	1	-	42	4	1	-	122	34	3	3	124	31	2	2	139	16	1	2
	F	19	7	1	-	43	3	1	-	108	30	4	2	112	26	3	1	131	18	2	1
	T	40	16	2	-	85	7	2	-	230	64	7	5	236	57	5	3	270	34	3	3
Nov	M	18	6	2	-	39	4	1	-	119	26	8	2	123	22	6	2	142	14	5	1
	F	17	5	1	-	36	3	1	-	82	24	6	2	112	18	4	1	98	10	2	1
	T	35	11	3	-	75	7	2	-	201	50	14	4	235	40	10	3	240	24	7	2
Dec	M	14	3	2	-	32	2	1	-	91	9	10	1	102	7	8	1	110	5	4	1
	F	13	2	2	-	27	1	2	-	83	9	8	1	91	6	7	-	92	3	5	-
	T	27	5	4	-	59	3	3	-	174	18	18	2	193	13	15	1	202	8	9	1
Jan	M	12	2	1	-	29	1	1	-	71	8	6	1	87	6	4	1	64	4	2	-
	F	11	2	1	-	27	1	1	-	65	6	7	-	71	4	5	-	76	3	3	-
	T	23	4	2	-	56	2	2	-	136	14	13	1	158	10	9	1	140	7	5	-
Feb	M	10	1	2	-	18	1	1	-	59	4	6	-	65	3	5	-	68	2	2	-
	F	9	1	1	-	16	-	1	-	42	3	3	-	51	2	2	-	59	1	1	-
	T	19	2	3	-	34	1	2	-	101	7	9	-	116	5	7	-	127	3	3	-
Mar	M	8	1	1	-	15	-	-	-	52	3	2	-	50	2	2	-	61	2	1	-
	F	8	1	-	-	14	1	1	-	49	4	2	-	52	3	2	-	62	2	1	-
	T	16	2	1	-	29	1	1	-	101	7	4	-	102	5	4	-	123	4	2	-
Apr	M	11	1	1	-	19	1	-	-	54	4	2	-	52	3	2	-	56	2	1	-
	F	12	-	-	-	22	-	1	-	59	3	2	-	57	2	2	-	67	1	1	-
	T	23	1	1	-	41	1	1	-	113	7	4	-	109	5	4	-	123	3	2	-
May	M	22	1	-	-	34	1	-	-	74	7	2	1	77	5	1	-	81	3	1	-
	F	21	-	-	-	31	-	-	-	62	4	3	-	68	3	1	-	67	2	1	-
	T	43	1	-	-	65	1	-	-	136	11	5	1	145	8	2	-	148	5	2	-
Jun	M	14	1	-	-	29	-	1	-	61	2	2	-	66	2	2	-	69	1	1	-
	F	13	-	-	-	27	-	-	-	47	2	2	-	52	2	2	-	59	1	1	-
	T	27	1	-	-	56	-	1	-	108	4	4	-	118	4	4	-	128	2	2	-
Jul	M	11	1	-	-	18	-	1	-	39	4	2	-	42	2	1	-	47	1	1	-
	F	10	-	-	-	16	-	-	-	31	3	2	-	34	2	2	-	37	1	1	-
	T	21	1	-	-	34	-	1	-	70	7	4	-	76	4	3	-	84	2	2	-
Aug	M	10	1	-	-	16	-	1	-	41	2	2	-	47	1	1	-	51	1	1	-
	F	9	-	-	-	14	-	-	-	32	2	2	-	34	1	1	-	36	1	-	-
	T	19	1	-	-	30	-	1	-	73	4	4	-	81	2	2	-	87	2	1	-

Key: Ns= Number screened, Pf= p. falciparum, Pv= P. vivax, mx= mixed

Prevalence of Malaria with Respect to Age Groups

Year: 2007

		0-5				6-14				15-29				30-45				>45			
Yaar	Sex	Ns	pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx
Sep	M	7	1	-	-	13	1	-	-	37	2	1	-	39	2	1	-	47	1	1	-
	F	6	-	-	-	11	-	-	-	31	1	-	-	33	-	-	-	38	-	-	-
	T	13	1	-	-	24	1	-	-	68	3	1	-	72	2	1	-	85	1	1	-
Oct	M	9	1	1	-	16	1	1	-	49	4	2	-	51	3	2	-	74	2	1	-
	F	6	-	-	-	11	-	-	-	29	1	1	-	31	1	1	-	35	1	-	-
	T	15	1	1	-	27	1	1	-	78	5	3	-	82	4	3	-	109	3	1	-
Nov	M	11	1	1	-	19	1	-	-	53	4	2	-	61	3	2	-	72	2	2	
	F	10	-	-	-	17	-	-	-	44	2	1	-	49	1	1	-	51	1	1	-
	T	21	1	1	-	36	1	-	-	97	6	3	-	110	4	3	-	123	3	3	-
Dec	M	6	1	1	-	11	1	-	-	22	3	2	-	33	2	2	-	37	2	2	-
	F	5	-	-	-	10	-	-	-	19	3	2	-	24	2	1	-	28	1	1	-
	T	11	1	1	-	21	1	-	-	41	6	4	-	57	4	3	-	65	3	3	-
Jan	M	4	1	-	-	9	1	-	-	28	3	2	-	31	2	2	-	39	2	1	-
	F	4	-	-	-	10	-	-	-	26	3	2	-	38	2	1	-	39	1	1	-
	T	8	1	-	-	19	1	-	-	54	6	4	-	69	4	3	-	78	3	2	-
Feb	M	7	2	-	-	11	1	-	-	34	5	1	-	46	4	1	-	52	3	1	-
	F	7	1	-	-	10	1	-	-	36	3	1	-	42	3	1	-	53	2	1	-
	T	14	3	-	-	21	2	-	-	70	8	2	-	88	7	2	-	105	5	2	-
Mar	M	9	2	-	-	14	1	1	-	46	5	2	-	51	4	2	-	65	3	2	-
	F	8	-	-	-	12	-	-	-	39	4	1	-	44	2	1	-	52	2	1	-
	T	17	2	-	-	26	1	1	-	85	9	3	-	95	6	3	-	117	5	3	-
Apr	M	8	1	1	-	13	1	-	-	38	6	2	-	40	3	1	-	44	3	1	-
	F	7	-	-	-	11	-	-	-	33	3	2	-	36	3	2	-	38	2	1	-
	T	15	1	1	-	24	1	-	-	71	9	4	-	76	6	3	-	82	5	2	-
May	M	12	2	1	-	16	1	-	-	43	6	2	1	46	4	2	-	51	3	2	-
	F	11	1	-	-	14	1	1	-	39	3	2	-	41	4	2	-	41	3	1	-
	T	23	3	1	-	30	2	1	-	82	9	4	1	87	8	4	-	92	6	3	-
Jun	M	4	1	-	-	11	-	-	-	25	2	1	-	34	2	1	-	39	1	-	-
	F	4	1	-	-	9	1	-	-	22	2	1	-	25	2	1	-	28	2	-	-
	T	8	2	-	-	20	1	-	-	47	4	2	-	59	4	2	-	67	3	-	-
Jul	M	5	1	-	-	9	1	-	-	22	3	1	-	27	2	-	-	33	1	-	-
	F	6	-	-	-	9	-	-	-	27	2	1	-	31	2	-	-	38	2	-	-
	T	11	1	-	-	18	1	-	-	49	5	2	-	58	4	-	-	71	3	-	-
Aug	M	6	1	1	-	12	1	-	-	41	2	2	-	45	2	2	-	34	1	1	-
	F	6	-	-	-	11	-	1	-	38	3	2	-	42	2	2	-	35	2	1	-
	T	12	1	1	-	23	1	1	-	79	5	4	-	87	4	4	-	69	3	2	-

Key: Ns= Number screened, Pf= p. falciparum, Pv= P. vivax, mx= mixed

Prevalence of Malaria with Respect to Age Groups

Year: 2008

		0-5				6-14				15-29				30-45				>45			
Yaar	Sex	Ns	pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx
Sep	M	7	1	-	-	9	1	-	-	39	5	3	1	42	4	2	1	53	2	1	-
	F	7	1	-	-	10	-	-	-	37	5	2	-	40	3	3	-	54	2	2	-
	T	14	2	-	-	19	1	-	-	76	10	5	-	82	7	5	1	107	4	3	-
Oct	M	5	2	-	-	13	2	-	-	41	6	2	1	43	5	1	-	57	3	1	-
	F	8	2	-	-	16	1	-	-	39	7	3	-	47	6	2	1	69	3	1	-
	T	13	4	-	-	29	3	-	-	80	13	5	1	90	11	3	1	126	6	2	-
Nov	M	8	3	-	-	19	2	-	-	47	17	2	2	45	13	1	2	66	9	1	1
	F	8	2	-	-	18	1	-	-	45	11	2	1	44	8	1	1	63	5	1	-
	T	16	5	-	-	37	3	-	-	92	28	4	3	89	21	2	3	129	14	2	1
Dec	M	12	2	-	-	19	3	-	-	48	6	1	1	58	4	-	1	70	5	-	-
	F	11	1	-	-	17	2	-	-	46	4	-	-	60	4	-	-	68	3	-	-
	T	23	3	-	-	36	5	-	-	94	10	1	1	118	8	-	1	138	8	-	-
Jan	M	10	1	-	-	16	1	-	-	47	2	1	-	62	2	-	-	67	2	-	-
	F	11	1	-	-	13	-	-	-	41	3	-	-	47	2	-	-	66	3	-	-
	T	21	2	-	-	29	1	-	-	88	5	1	-	109	4	-	-	133	5	-	-
Feb	M	12	-	-	-	15	1	-	-	52	3	-	-	63	2	-	-	66	2	-	-
	F	13	1	-	-	18	1	-	-	46	3	1	-	54	3	1	-	51	2	-	-
	T	25	1	-	-	33	2	-	-	98	6	1	-	117	5	1	-	117	4	-	-
Mar	M	10	1	-	-	16	-	-	-	49	2	-	-	57	1	-	-	67	2	-	-
	F	13	-	-	-	19	1	-	-	52	3	1	-	59	3	-	-	77	4	-	-
	T	23	1	-	-	35	1	-	-	101	5	1	-	116	4	-	-	144	6	-	-
Apr	M	16	1	-	-	21	1	-	-	64	4	1	-	70	2	1	-	77	3	1	-
	F	15	-	-	-	20	-	-	-	46	3	-	-	47	2	-	-	66	3	-	-
	T	31	1	-	-	41	1	-	-	110	7	1	-	117	4	1	-	143	6	1	-
May	M	19	2	-	-	30	1	-	-	59	4	2	1	62	3	1	-	84	4	1	-
	F	19	1	-	-	27	1	-	-	48	3	1	-	51	2	1	-	67	2	1	-
	T	38	3	-	-	57	2	-	-	107	7	3	1	113	5	2	-	151	6	2	-
Jun	M	17	2	-	-	28	1	-	-	57	5	1	1	64	4	1	-	76	6	1	-
	F	18	1	-	-	27	1	-	-	51	3	1	1	61	4	1	-	77	4	1	-
	T	35	3	-	-	55	2	-	-	108	8	2	2	125	8	2	-	153	10	2	-
Jul	M	12	1	-	-	19	2	-	-	53	3	1	-	51	2	1	-	59	3	1	-
	F	11	1	-	-	17	-	-	-	41	2	1	-	38	2	-	-	45	2	1	-
	T	23	2	-	-	36	2	-	-	94	5	2	-	89	4	1	-	104	5	2	-
Aug	M	11	1	-	-	19	1	-	-	41	1	2	1	47	2	1	-	51	2	1	-
	F	10	1	-	-	17	-	-	-	39	1	1	-	41	2	1	-	39	2	1	-
	T	21	2	-	-	36	1	-	-	80	2	3	1	88	4	2	-	90	4	2	-

Key: Ns= Number screened, Pf= p. falciparum, Pv= P. vivax, mx= mixed

Prevalence of Malaria with Respect to Age Groups

Year: 2009

		0-5				6-14				15-29				30-45				>45			
Yaar	Sex	Ns	pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx
Sep	M	18	3	1	-	29	2	2	-	66	8	3	-	61	6	2	-	72	5	2	-
	F	16	2	-	-	29	2	-	-	47	5	2	-	45	5	1	-	84	4	2	-
	T	34	5	1	-	58	4	2	-	113	13	5	-	106	11	3	-	156	9	4	-
Oct	M	14	2	1	-	26	2	1	-	44	7	2	1	47	4	2	1	56	4	2	-
	F	13	1	-	-	24	2	1	-	35	4	2	-	40	3	1	-	47	4	1	-
	T	27	3	1	-	50	4	2	-	79	11	4	1	87	7	3	1	103	8	3	-
Nov	M	9	1	1	-	14	1	1	-	42	4	4	-	49	5	4	-	53	5	4	-
	F	8	1	1	-	12	1	1	-	39	3	4	-	46	4	3	-	44	4	5	-
	T	17	2	2	-	26	2	2	-	81	7	8	-	95	9	7	-	97	9	9	-
Dec	M	7	1	-	-	12	1	-	-	39	2	1	-	42	1	-	1	62	1	-	-
	F	8	1	-	-	11	1	-	-	43	3	1	-	47	2	-	-	66	3	-	-
	T	15	2	-	-	23	2	-	-	82	5	2	-	89	3	-	1	128	4	-	-
Jan	M	11	3	-	-	18	2	-	-	59	9	1	-	61	6	-	-	66	6	-	-
	F	10	1	-	-	16	2	-	-	47	7	-	-	52	5	-	-	49	5	-	-
	T	21	4	-	-	34	4	-	-	106	16	1	-	113	11	-	-	115	11	-	-
Feb	M	8	1	-	-	17	1	-	-	41	2	1	-	39	1	1	-	61	2	2	-
	F	7	-	-	-	16	-	-	-	43	2	1	-	36	2	1	-	56	1	-	-
	T	15	1	-	-	33	1	-	-	84	4	2	-	75	3	2	-	117	3	2	-
Mar	M	10	1	-	-	19	1	-	-	47	2	1	-	49	1	1	-	56	1	1	-
	F	9	1	-	-	17	1	-	-	42	3	1	-	38	2	1	-	57	2	1	-
	T	19	2	-	-	36	2	-	-	89	5	2	-	87	3	2	-	113	3	2	-
Apr	M	16	1	-	-	27	1	-	-	58	5	1	1	67	3	-	1	70	4	-	1
	F	14	1	-	-	24	1	-	-	47	3	1	-	55	2	-	1	52	3	-	1
	T	30	2	-	-	51	2	-	-	105	8	2	1	122	5	-	2	122	7	-	2
May	M	6	1	-	-	11	1	-	-	32	2	2	-	35	1	2	-	43	3	2	-
	F	5	-	-	-	11	-	-	-	24	1	2	-	32	2	1	-	46	2	2	-
	T	11	1	-	-	22	1	-	-	56	3	4	-	67	3	3	-	89	5	4	-
Jun	M	4	2	1	-	9	1	1	-	36	3	3	1	39	4	2	1	51	4	3	-
	F	4	1	1	-	10	1	1	-	39	4	3	1	41	5	2	-	56	7	6	-
	T	8	3	2	-	19	2	2	-	75	7	6	2	80	9	4	1	107	11	9	-
Jul	M	7	2	1	-	15	2	1	-	34	8	1	1	39	5	2	1	56	6	1	-
	F	6	3	1	-	14	2	1	-	32	7	2	1	44	6	1	1	61	8	2	-
	T	13	5	2	-	29	4	2	-	66	15	3	2	83	11	3	2	117	14	3	-
Aug	M	12	2	-	-	19	1	-	-	49	6	2	1	57	4	1	-	59	4	1	-
	F	11	1	-	-	21	1	-	-	44	4	1	-	59	3	1	-	39	3	1	-
	T	23	3	-	-	40	2	-	-	93	10	3	1	116	7	2	-	98	7	2	-

Key: Ns= Number screened, Pf= p. falciparum, Pv= P. vivax, mx= mixed

Prevalence of Malaria with Respect to Age Groups

Year: 2010

		0-5				6-14				15-29				30-45				>45			
Year	Sex	Ns	pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx
Sep	M	9	1	-	-	17	2	-	-	41	4	2	-	38	3	-	-	48	4	1	-
	F	8	1	-	-	15	1	-	-	38	3	-	-	35	2	1	-	51	3	-	-
	T	17	2	-	-	32	3	-	-	79	7	2	-	73	5	1	-	99	7	1	-
Oct	M	14	6	1	-	26	4	1	-	77	22	3	2	81	19	2	1	97	14	2	1
	F	13	5	1	-	22	3	1	-	71	20	2	1	72	17	2	1	89	15	2	-
	T	27	11	2	-	48	7	2	-	148	42	5	3	153	36	4	2	186	29	4	1
Nov	M	7	3	-	-	13	2	-	-	31	10	2	1	39	7	1	1	42	5	1	-
	F	7	4	-	-	12	3	-	-	28	11	1	-	41	6	1	-	40	6	1	1
	T	14	7	-	-	25	5	-	-	59	21	3	1	80	13	2	1	82	11	2	1
Dec	M	6	4	-	-	13	3	-	-	33	7	2	2	36	4	1	-	41	3	-	-
	F	6	3	-	-	15	1	-	-	39	6	1	-	41	5	1	-	49	3	-	-
	T	12	7	-	-	28	4	-	-	72	13	3	2	77	9	2	-	90	6	-	-
Jan	M	12	2	1	-	19	1	-	-	41	6	2	1	47	3	1	1	58	2	1	-
	F	11	1	-	-	17	1	-	-	30	5	1	1	36	2	1	-	43	2	-	-
	T	23	3	1	-	36	2	-	-	71	11	3	2	83	5	2	1	101	4	1	-
Feb	M	13	1	-	-	21	-	-	-	44	2	1	1	49	2	1	1	54	2	-	-
	F	13	1	-	-	19	1	-	-	43	4	2	-	47	3	2	-	58	3	1	-
	T	26	2	-	-	40	1	-	-	87	6	3	1	96	5	3	1	112	5	1	-
Mar	M	10	2	-	-	18	1	-	-	52	7	2	-	59	5	1	-	72	3	1	-
	F	9	1	-	-	16	1	-	-	21	5	1	-	28	3	1	-	37	2	-	-
	T	19	3	-	-	34	2	-	-	73	12	3	-	87	8	2	-	109	5	1	-
Apr	M	8	2	-	-	19	1	-	-	45	6	2	1	51	5	1	-	39	3	1	-
	F	7	1	-	-	17	1	-	-	41	5	1	-	48	4	1	-	37	3	1	-
	T	15	3	-	-	36	2	-	-	86	11	3	1	99	9	2	-	76	6	2	-
May	M	7	4	2	-	18	2	1	-	54	18	6	2	58	11	4	1	74	7	4	1
	F	8	5	1	-	21	3	1	-	59	24	7	1	63	18	4	1	82	9	4	1
	T	15	9	3	-	39	5	2	-	113	42	13	3	121	29	8	2	156	16	8	2
Jun	M	11	3	2	-	21	2	1	1	52	18	14	5	57	14	12	3	74	10	8	3
	F	10	2	1	-	20	1	1	-	45	20	7	2	49	9	4	2	58	6	4	1
	T	21	5	3	-	41	3	2	1	97	30	21	7	106	23	16	5	132	16	12	4
Jul	M	9	2	2	-	17	1	2	-	30	6	10	4	42	5	6	3	51	3	5	1
	F	8	2	3	-	15	1	1	-	41	7	16	1	47	4	7	1	65	4	5	-
	T	17	4	5	-	32	2	3	-	71	13	26	5	89	9	13	4	116	7	10	1
Aug	M	12	1	2	-	14	1	1	-	29	2	5	1	36	2	4	-	42	1	3	-
	F	8	1	-	-	12	-	1	-	35	3	6	-	42	2	5	-	54	2	3	-
	T	20	2	2	-	26	1	2	-	64	5	11	1	78	4	9	-	96	3	6	-

Key: Ns= Number screened, Pf= p. falciparum, Pv= P. vivax, mx= mixed

Prevalence of Malaria with Respect to Age Groups

Year: 2011

		0-5				6-14				15-29				30-45				>45			
Yaar	Sex	Ns	pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx
Sep	M	13	1	2	-	18	1	1	-	47	2	7	1	43	2	5	1	54	1	4	-
	F	11	-	-	-	15	-	1	-	36	1	3	1	33	1	2	-	38	-	2	-
	T	24	1	2	-	33	1	2	-	83	3	10	2	76	3	7	1	92	1	6	-
Oct	M	8	1	-	-	11	1	1	-	49	4	5	2	56	2	3	1	72	2	4	1
	F	8	1	-	-	10	-	1	-	43	3	3	1	51	2	3	-	66	1	2	-
	T	16	2	-	-	21	1	2	-	92	7	8	3	107	4	6	1	138	3	6	1
Nov	M	10	2	1	-	19	1	1	-	48	7	6	1	52	5	6	1	58	3	5	1
	F	9	1	2	-	17	-	1	-	42	5	7	1	41	4	6	1	57	2	4	-
	T	19	3	3	-	36	1	2	-	90	12	13	2	93	9	12	2	115	5	9	1
Dec	M	9	-	2	-	17	-	1	-	55	3	3	1	58	2	2	1	61	1	2	-
	F	8	-	1	-	11	-	1	-	28	3	5	-	33	2	3	-	35	2	3	-
	T	17	-	3	-	28	-	2	-	83	6	8	1	91	4	5	1	96	3	5	-
Jan	M	8	1	1	-	16	-	1	-	51	2	2	1	54	1	2	1	61	1	1	-
	F	7	-	1	-	14	-	1	-	45	1	1	-	48	1	2	-	58	-	2	-
	T	15	1	2	-	30	-	2	-	96	3	3	1	102	2	4	1	119	1	3	-
Feb	M	4	-	-	-	9	-	-	-	56	2	2	-	64	2	1	-	64	1	1	-
	F	4	-	-	-	8	-	-	-	47	1	1	-	51	1	1	-	50	1	-	-
	T	8	-	-	-	17	-	-	-	103	3	3	-	115	3	2	-	114	2	1	-
Mar	M	6	-	-	-	11	-	-	-	27	1	1	-	36	1	-	-	39	-	-	-
	F	5	-	-	-	11	-	-	-	24	1	1	-	32	-	1	-	41	-	-	-
	T	11	-	-	-	22	-	-	-	51	2	2	-	68	1	1	-	80	-	-	-
Apr	M	3	-	-	-	7	-	-	-	32	1	-	-	36	-	-	-	43	-	1	-
	F	2	-	-	-	5	-	-	-	25	-	1	-	29	-	1	-	48	-	1	-
	T	5	-	-	-	12	-	-	-	57	1	1	-	65	-	1	-	91	-	2	-
May	M	5	-	1	-	11	-	1	-	43	1	2	1	46	1	1	-	57	-	1	-
	F	4	-	-	-	10	-	-	-	39	-	1	-	42	-	2	1	59	-	1	-
	T	9	-	1	-	21	-	1	-	82	1	3	1	88	1	3	1	116	-	2	-
Jun	M	6	-	1	-	9	-	1	-	42	1	2	1	48	1	1	-	55	-	1	-
	F	4	-	1	-	8	-	1	-	39	1	1	-	43	-	2	-	52	-	1	-
	T	10	-	2	-	17	-	2	-	81	2	3	1	91	1	3	-	107	-	2	-
Jul	M	5	-	-	-	9	-	-	-	41	2	1	1	49	1	2	1	48	1	1	-
	F	5	-	1	-	7	-	1	-	33	1	2	-	41	1	1	-	42	-	1	-
	T	10	-	1	-	16	-	1	-	74	3	3	1	90	2	3	1	90	1	2	-
Aug	M	7	1	1	-	12	1	1	-	44	2	2	-	48	2	1	-	53	1	1	-
	F	6	-	-	-	12	-	-	-	39	2	1	-	41	1	1	-	42	2	1	-
	T	13	1	1	-	24	1	1	-	83	4	3	-	89	3	2	-	95	3	2	-

Key: Ns= Number screened, Pf= p. falciparum, Pv= P. vivax, mx= mixed

Prevalence of Malaria with Respect to Age Groups

Year: 2012

		0-5				6-14				15-29				30-45				>45			
Yaar	Sex	Ns	pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx
Sep	M	8	-	1	-	14	-	1	-	39	1	2	-	46	1	1	-	48	1	1	-
	F	7	-	1	-	12	-	-	-	34	1	2	-	42	-	2	-	46	-	1	-
	T	15	-	2	-	26	-	1	-	73	2	4	-	88	1	3	-	94	1	2	-
Oct	M	6	-	1	-	9	-	1	-	35	1	2	1	45	1	2	-	54	-	2	-
	F	5	-	-	-	7	-	-	-	32	1	2	-	41	-	2	-	51	-	1	-
	T	11	-	1	-	16	-	1	-	67	2	4	1	86	1	4	-	105	-	3	-
Nov	M	9	-	1	-	13	-	1	-	38	2	3	1	44	1	2	1	52	1	2	-
	F	8	-	1	-	13	-	1	-	31	1	2	-	39	1	2	-	48	-	1	-
	T	17	-	2	-	26	-	2	-	69	3	5	1	83	2	4	1	100	1	3	-
Dec	M	6	-	1	-	10	-	-	-	46	1	1	1	50	1	1	1	60	1	-	-
	F	6	-	-	-	11	-	1	-	39	1	1	1	41	1	-	1	40	-	1	-
	T	12	-	1	-	21	-	1	-	85	2	2	2	91	2	1	2	100	1	1	-
Jan	M	8	1	-	-	12	-	-	-	51	1	1	1	53	1	1	1	64	1	-	-
	F	7	-	-	-	9	-	-	-	34	1	1	1	45	1	-	1	45	1	-	-
	T	15	1	-	-	21	-	-	-	85	2	2	2	98	2	1	2	109	2	-	-
Feb	M	2	-	-	-	6	-	1	-	23	1	1	-	26	1	1	-	32	-	1	-
	F	2	-	-	-	4	-	-	-	21	-	1	-	24	-	-	-	29	-	-	-
	T	4	-	-	-	10	-	1	-	44	1	2	-	50	1	1	-	61	-	1	-
Mar	M	2	-	-	-	4	-	-	-	24	1	1	-	29	-	1	-	31	-	-	-
	F	1	-	-	-	2	-	-	-	13	-	-	-	15	-	-	-	22	-	-	-
	T	3	-	-	-	6	-	-	-	37	1	1	-	44	-	1	-	53	-	-	-
Apr	M	1	-	-	-	3	-	-	-	19	-	2	-	17	-	1	-	22	-	1	-
	F	1	-	-	-	2	-	-	-	8	-	-	-	10	-	-		12	-	-	-
	T	2	-	-	-	5	-	-	-	27	-	2	-	27	-	1	-	34	-	1	-
May	M	2	-	-	-	2	-	-	-	13	1	2	1	14	1	2	-	17	-	1	-
	F	-	-	-	-	1	-	-	-	9	-	1	-	11	-	1	-	15	-	1	-
	T	2	-	-	-	3	-	-	-	22	1	3	1	25	1	3	-	32	-	2	-
Jun	M	9	1	1	-	17	1	1	-	29	3	3	1	31	2	3	1	35	1	2	-
	F	8	1	1	-	14	1	1	-	22	4	2	1	24	3	3	-	32	3	3	-
	T	17	2	2	-	31	2	2	-	51	7	5	2	55	5	6	1	67	4	5	-
Jul	M	6	1	1	-	9	1	1	-	14	3	2	1	17	3	2	1	22	2	2	-
	F	6	1	-	-	8	-	1	-	15	3	2	1	16	3	2	-	24	2	1	-
	T	12	2	1	-	17	1	2	-	29	6	4	2	33	6	4	1	46	4	3	-
Aug	M	11	2	1	-	17	1	1	-	39	5	5	1	45	4	4	1	54	3	3	-
	F	10	1	1	-	15	1	-	-	27	2	4	1	31	2	3	-	40	2	2	-
	T	21	3	2	-	32	2	1	-	66	7	9	2	76	6	7	1	94	5	5	-

Key: Ns= Number screened, Pf= p. falciparum, Pv= P. vivax, mx= mixed

Prevalence of Malaria with Respect to Age Groups

Year: 2013

		0-5				6-14				15-29				30-45				>45			
Yaar	Sex	Ns	pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx
Sep	M	7	2	1	-	12	1	1	-	39	6	4	1	37	5	3	-	56	3	2	-
	F	6	-	-	-	10	-	-	-	32	2	2	-	29	2	1	-	35	1	1	-
	T	13	2	1	-	22	1	1	-	71	8	6	1	66	7	4	-	91	4	3	-
Oct	M	5	1	2	-	11	-	1	-	34	2	6	1	38	2	4	1	51	1	3	1
	F	4	-	-	-	8	-	-	-	20	1	1	1	21	1	1	-	35	-	1	-
	T	9	1	2	-	19	-	1	-	54	3	7	2	59	3	5	1	86	1	4	1
Nov	M	4	1	1	-	9	1	1	-	28	3	5	1	34	2	4	1	43	2	3	-
	F	3	-	1	-	7	-	-	-	22	2	3	-	25	2	3	-	32	1	2	-
	T	7	1	2	-	16	1	1	-	50	5	8	1	59	4	7	1	75	3	5	-
Dec	M	6	1	2	-	10	-	2	-	39	3	5	1	37	2	4	-	46	1	3	-
	F	5	-	-	-	8	-	-	-	24	1	2	-	18	1	1	-	36	-	1	-
	T	11	1	2	-	18	-	2	-	63	4	7	1	55	3	5	-	82	1	4	-
Jan	M	7	1	1	-	12	1	-	-	41	3	2	1	42	2	1	-	47	1	1	-
	F	7	-	-	-	10	-	-	-	32	1	1	-	37	1	-	-	40	-	-	-
	T	14	1	1	-	22	1	-	-	73	4	3	1	79	3	1	-	87	1	1	-
Feb	M	4	-	1	-	9	-	1	-	36	1	2	1	39	1	2	-	46	1	1	-
	F	4	-	1	-	8	-	-	-	34	1	2	1	37	1	1	-	45	-	1	-
	T	8	-	2	-	17	-	1	-	70	2	4	2	76	2	3	-	91	1	2	-
Mar	M	9	-	1	-	14	-	1	-	44	2	2	1	49	1	1	1	47	1	1	-
	F	8	-	1	-	12	-	-	-	36	1	2	1	41	1	2	-	46	-	2	-
	T	17	-	2	-	26	-	1	-	80	3	4	2	90	2	3	1	93	1	3	-
Apr	M	10	1	1	-	15	1	-	-	46	2	2	1	42	2	2	-	51	1	2	-
	F	9	-	-	-	13	-	-	-	41	1	2	-	37	1	2	-	34	1	1	-
	T	19	1	1	-	28	1	-	-	87	3	4	1	79	3	4	-	85	2	3	-
May	M	12	2	-	-	19	2	-	-	49	7	1	1	52	6	1	1	56	4	1	1
	F	10	2	-	-	18	1	-	-	43	6	2	1	47	5	2	-	57	5	2	-
	T	22	4	-	-	37	3	-	-	92	13	3	2	99	11	3	1	113	9	3	1
Jun	M	12	2	1	-	16	1	1	-	42	8	7	1	41	5	5	1	46	4	4	-
	F	12	1	-	-	17	1	-	-	45	4	5	1	41	3	3	-	49	3	2	-
	T	24	3	1	-	33	2	1	-	87	12	12	2	82	8	8	1	95	7	6	-
Jul	M	14	3	1	-	21	2	1	-	48	6	4	2	51	4	2	2	52	4	2	2
	F	13	2	1	-	19	1	-	-	42	7	5	1	45	5	4	1	52	3	3	1
	T	27	5	2	-	40	3	1	-	90	13	9	3	96	9	6	3	104	7	5	3
Aug	M	9	1	1	-	16	-	-	-	37	2	3	1	34	2	2	1	36	1	1	-
	F	9	-	-	-	14	-	1	-	34	2	4	-	32	2	2	-	33	1	2	-
	T	18	1	1	-	30	-	1	-	71	4	7	1	66	4	4	1	69	2	3	-

Key: Ns= Number screened, Pf= p. falciparum, Pv= P. vivax, mx= mixed

Prevalence of Malaria with Respect to Age Groups

Year: 2014

		0-5				6-14				15-29				30-45				>45			
Year	Sex	Ns	pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx
Sep	M	9	1	1	-	14	1	1	-	41	3	2	1	42	3	2	1	46	2	1	1
	F	8	-	-	-	12	-	-	-	34	2	2	1	37	1	2	-	42	1	1	-
	T	17	1	1	-	26	1	1	-	75	5	4	2	79	4	4	1	88	3	2	1
Oct	M	7	1	1	-	12	-	1	-	44	3	3	1	47	2	2	1	49	1	2	-
	F	7	-	-	-	11	-	-	-	33	1	3	-	35	1	2	-	38	1	2	-
	T	14	1	1	-	23	-	1	-	77	4	6	1	82	3	4	1	87	2	4	-
Nov	M	4	1	2	-	9	-	1	-	39	2	5	1	36	1	4	1	45	1	3	-
	F	3	-	-	-	9	-	1	-	31	1	2	-	28	1	2	-	42	-	2	-
	T	7	1	2	-	18	-	2	-	70	3	7	1	64	2	6	1	87	1	5	-
Dec	M	6	-	1	-	9	-	1	-	37	1	2	1	33	1	2	-	38	1	1	-
	F	6	-	-	-	10	-	-	-	40	1	1	-	38	-	1	-	42	-	1	-
	T	12	-	1	-	19	-	1	-	77	2	3	1	71	1	3	-	80	1	2	-
Jan	M	3	-	-	-	10	-	-	-	51	1	2	-	52	1	1	-	48	-	1	-
	F	3	-	-	-	8	-	-	-	40	-	1	-	41	-	1	-	32	-	1	-
	T	6	-	-	-	18	-	-	-	91	1	3	-	93	1	2	-	80	-	2	-
Feb	M	8	1	-	-	11	-	1	-	42	-	2	-	47	-	2	-	40	-	1	-
	F	7	1	-	-	9	-	-	-	34	-	3	-	38	-	2	-	49	-	1	-
	T	15	2	-	-	20	-	1	-	76	-	5	-	85	-	4	-	89	-	2	-
Mar	M	4	-	-	-	8	-	-	-	33	1	2	-	36	-	1	-	42	-	1	-
	F	3	-	-	-	6	-	-	-	29	-	1	-	33	1	1	-	38	-	-	-
	T	7	-	-	-	14	-	-	-	62	1	3	-	69	1	2	-	80	-	1	-
Apr	M	2	-	-	-	4	-	-	-	32	-	1	-	28	-	1	-	35	-	-	-
	F	2	-	-	-	3	-	-	-	26	-	1	-	22	-	1	-	35	-	-	-
	T	4	-	-	-	7	-	-	-	58	-	2	-	50	-	2	-	70	-	-	-
May	M	3	-	1	-	5	-	-	-	39	1	1	-	44	1	1	-	47	-	1	-
	F	3	-	-	-	4	-	1	-	28	1	1	-	33	1	1	-	38	-	1	-
	T	6	-	1	-	9	-	1	-	67	2	2	-	77	2	2	-	85	-	2	-
Jun	M	6	1	1	-	9	1	-	-	39	3	2	-	42	2	2	-	35	1	1	-
	F	5	-	-	-	7	-	-	-	26	1	1	-	33	-	-	-	30	-	-	-
	T	11	1	1	-	16	1	-	-	65	4	3	-	75	2	2	-	65	1	1	-
Jul	M	4	1	-	-	8	-	-	-	32	1	1	1	26	1	-	-	20	1	-	-
	F	3	-	-	-	6	-	-	-	26	1	1	-	19	1	1	-	18	-	1	-
	T	7	1	-	-	14	-	-	-	58	2	2	1	45	2	1	-	38	1	1	-
Aug	M	6	1	-	-	9	1	-	-	38	3	2	1	40	2	1	1	38	2	1	-
	F	5	-	-	-	8	-	-	-	29	2	1	-	34	1	1	-	38	1	-	-
	T	11	1	-	-	17	1	-	-	67	5	3	1	74	3	2	1	76	3	1	-

Key: Ns= Number screened, Pf= p. falciparum, Pv= P. vivax, mx= mixed

Prevalence of Malaria with Respect to Age Groups

Year: 2015

		0-5				6-14				15-29				30-45				>45			
Yaar	Sex	Ns	pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx	Ns	Pf	Pv	mx
Sep	M	4	1	1	-	7	-	1	-	42	2	2	-	39	1	1	-	50	1	1	-
	F	3	-	-	-	5	-	-	-	34	1	1	-	32	-	1	-	41	-	-	-
	T	7	1	1	-	12	-	1	-	76	3	3	-	71	1	2	-	91	1	1	-
Oct	M	6	1	-	-	9	1	-	-	48	2	3	1	44	2	2	-	56	1	2	-
	F	5	-	-	-	8	-	-	-	39	1	1	-	36	-	-	-	35	-	-	-
	T	11	1	-	-	17	1	-	-	87	3	4	1	80	2	2	-	91	1	2	-
Nov	M	7	1	-	-	11	1	-	-	59	3	1	1	69	2	1	1	63	2	-	-
	F	6	-	-	-	10	-	-	-	38	1	-	-	41	-	-	-	50	-	-	-
	T	13	1	-	-	21	1	-	-	97	4	1	1	110	2	1	1	113	2	-	-
Dec	M	6	1	-	-	9	-	1	-	32	2	2	-	39	2	2	-	32	1	2	-
	F	4	-	-	-	7	-	-	-	19	1	1	-	21	-	-	-	24	-	-	-
	T	10	1	-	-	16	-	1	-	51	3	3	-	60	2	2	-	56	1	2	-
Jan	M	4	-	1	-	8	-	1	-	21	1	2	-	32	-	2	-	28	-	2	-
	F	3	-	-	-	6	-	-	-	19	-	1	-	29	-	-	-	25	-	-	-
	T	7	-	1	-	14	-	1	-	40	1	3	-	61	-	2	-	53	-	2	-
Feb	M	2	-	1	-	4	-	-	-	22	1	2	-	29	-	1	-	24	-	1	-
	F	2	-	-	-	3	-	-	-	17	-	-	-	22	-	-	-	17	-	-	-
	T	4	-	1	-	7	-	-	-	39	1	2	-	51	-	1	-	41	-	1	-
Mar	M	3	-	-	-	5	-	-	-	22	1	1	-	19	1	1	-	27	-	-	-
	F	2	-	-	-	3	-	-	-	16	1	1	-	14	-	-	-	22	-	1	-
	T	5	-	-	-	8	-	-	-	38	2	2	-	33	1	1	-	49	-	1	-
Apr	M	2	-	-	-	3	-	-	-	18	-	1	-	22	-	1	-	19	-	1	-
	F	1	-	-	-	2	-	-	-	7	-	1	-	10	-	1	-	8	-	-	-
	T	3	-	-	-	5	-	-	-	25	-	2	-	32	-	2	-	27	-	1	-
May	M	2	-	-	-	4	-	-	-	17	1	1	-	20	-	-	-	21	-	-	-
	F	2	-	-	-	3	-	-	-	16	-	-	-	18	-	1	-	22	-	-	-
	T	4	-	-	-	7	-	-	-	33	1	1	-	38	-	1	-	43	-	-	-
Jun	M	2	-	-	-	4	-	-	-	21	1	-	1	20	1	1	-	16	-	1	-
	F	2	-	-	-	2	-	-	-	15	-	1	-	16	-	-	-	12	-	1	-
	T	4	-	-	-	6	-	-	-	36	1	1	1	36	1	1	-	28	-	2	-
Jul	M	2	-	-	-	3	-	-	-	18	1	1	-	19	1	-	-	20	1	-	-
	F	1	-	-	-	2	-	-	-	14	1	-	-	15	-	-	-	19	-	-	-
	T	3	-	-	-	5	-	-	-	32	2	1	-	34	1	-	-	39	1	-	-
Aug	M	4	1	-	-	6	-	-	-	24	1	1	-	27	1	-	-	17	-	-	-
	F	3	-	-	-	5	-	-	-	22	1	-	-	23	1	1	-	23	-	1	-
	T	7	1	-	-	11	-	-	-	46	2	1	-	50	2	1	-	40	-	1	-

Key: Ns= Number screened, Pf= p. falciparum, Pv= P. vivax, mx= mixed