ADDIS ABABA UNIVERSITY
COLLEGE OF NATURAL SCIENCES

The prevalence of malaria and associated risk factors in outpatients visiting Shewarobit Health Center, North central Ethiopia

By

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A thesis submitted to the Graduate Programme of Addis Ababa University in partial fulfillment of the requirement for the Degree of Master of Science in General Biology (Zoological sciences)

Addis Ababa

Ethiopia

September, 2018

Declaration

I, the undersigned declare that this thesis is my own original work, has not been presented for a degree in any University and that all resources and materials used for this thesis have been duly acknowledged.

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3._____	(Advisor)	_____	_____
4. _____	(Chairman)	_____	_____

Dedication

· I dedicate this thesis to all my families and relatives for their continuous love, appreciation, encouragement, moral and financial support.

Acknowledgment

I would like to express my deepest appreciation to my advisor Dr. Habte Tekie for his consistence advice, comments and follow up from problem identification up to the very end of the thesis. My thanks also go to Shewarobit town Administration Health Office and Shewarobit Health Center laboratory technicians for providing me access to five years malaria retrospective data and for their technical support to collect primary data from October 2017 to April 2018. My thanks go to the Ministry of Education for financial support to carry out my research.

List of abbreviations and acronyms

ACT	Artemisinin Combined Therapy
AOR	Adjusted Odd Ratio
BFs	Blood Films
CDC	Centers for Disease Control and Prevention
CI	Confidence Interval
CSA	Central Statistical Agency
DNA	Deoxy Ribonucleic Acid
EMIS	Ethiopian National Malaria Indicator Survey
FMOH	Federal Ministry of Health
FY	Fiscal Year
IRS	Indoor Residual Spraying
ITNs	Insecticide Treated Nets
LLINs	Long-Lasting Insecticidal Nets
NCCLS	National Committee for Clinical Laboratory Standard
NMSP	National Malaria Strategic Plan
MOP	Malaria Operational Plan
mRDT	Malaria Rapid Diagnostic Test
OR	Odd Ratio
PCR	Polymerase Chain Reaction
PfHRP2	*Plasmodium falciparum* Histidine-Rich Protein 2
PH	Power of Hydrogen
PLDH	Plasmodial Lactate Dehydrogenase
RDTs	Rapid Diagnostic Tests
SPSS	Statistical Package for Social Sciences
SSA	Sub-Saharan Africa
WHO	World Health Organization

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Abstract

Malaria is one of the major public health problems in many tropical developing countries including Ethiopia. The objective of this study was to determine the prevalence of malaria parasite infections and to assess the people's knowledge and practices about malaria transmission, prevention and control measures in Shewarobit town, central Ethiopia. A total of 33,932 outpatients with malaria symptoms gave blood films for malaria diagnosis in the past five years (2013-2017) in Shewarobit Health Center. Among 33,932 cases, 4705 (13.9%) microscopically confirmed malaria cases were reported at the Health Center. Males were more affected than females by malaria infections in each year. Out of 4705 positive individuals 3074 (65.3%) were males and 1631(34.7%) were females. There were fluctuations in trends of the malaria transmission in different months in the study area, with the peak malaria transmission reported from September up to November and from June up to August.

A total of 384 outpatients with malaria symptoms were selected and gave blood films for malaria diagnosis from October 2017 up to April 2018. From this cross sectional survey, a total of 73 (19.0%) microscopically confirmed malaria cases were recorded. In multivariate analysis, the association between the prevalence of malaria and age groups of the participants were statistically significant (AOR = 4.340, 95% CI: 1.628-11.565, p=0.003). The Kebeles that the participants lived have associations with the infections of malaria (AOR = 9.300, 95% CI: 2.352-36.774, p=0.001). The association between the prevalence of malaria and income level of the participants were statistically significant (AOR = 2.285, 95% CI: 1.071-4.874, p=0.033). The relationship between the prevalence of malaria and long lasting insecticidal nets were statistically significant (AOR = 0.083, 95% CI: 0.045-0.155, p=0.000). Furthermore between the prevalence of malaria and IRS were statistically significant (AOR = 0.490, 95% CI: 0.255-0.941, p=0.032). Finally the association between mosquito breeding sites and the prevalence of malaria were highly significant in the study area (AOR = 2.573, 95% CI: 1.364-4.854, p=0.004).

Key words/phrases/: *adjusted odd ratio (AOR), significant, prevalence, long lasting insecticidal nets and indoor residual spray*

Introduction

Malaria is caused by protozoan parasites of the genus *Plasmodium*. Four *Plasmodium* species namely *P. falciparum, P. vivax, P. malariae and P. ovale* are anthroponotic while *P. knowlesi* is zoonotic (Cox-Singh *et al*., 2008). Malaria is one of the leading causes of illness and death in the world. It is a major public health problem in Ethiopia (Alemu *et al*., 2012). *P. falciparum* and *P. vivax* are the two dominant parasite species causing malaria in Ethiopia, with relative frequencies of about 60% and 40%, respectively. This proportion varies from place to place and from season to season. *P. falciparum* is the dominant parasite species in malaria epidemic situations, and this species causes severe and complicated manifestations and almost all malaria deaths. *P. falciparum* has a remarkable biological diversity including an ability to develop resistance rapidly to a number of anti-malarial drugs (FMOH, 2012).

About 30-40 species of *Anopheles* mosquitoes transmit malaria among these, *Anopheles gambiae, An. funestus* and *An. arabiensis* are the most notable vectors in Africa (Tonnage *et al*., 2010). *Anopheles arabiensis* is the most prevalent vector across malaria-endemic areas in Ethiopia (Nyanjom *et al*., 2003). *Anopheles pharoensis* is a widely distributed *Anopheles* mosquito in the country and is considered to play a secondary role in malaria transmission, along with *An.funestus* and *An.nili*. *Anopheles funestus* occurs frequently in localities along the swamps of the Baro and Awash rivers and the shores of Lake Tana in the north and the Rift Valley in the south. *Anopheles nili* is found in Gambella Regional State (FMOH, 2012).

Malaria is dependent on the geographical distribution of mosquitoes as its carriers. The existence of malaria depends on the climatic factors such as temperature, humidity and rainfalls. It is wide spread in tropical and sub-tropical areas where *Anopheles* mosquitoes can survive and multiply. The distribution of malaria is recorded in Africa, south and Central America, south and south East Asia, Indonesia, Oceania. The highest intensity of malaria transmission is recorded in Africa, South of the Sahara and parts of Oceania such as Papua New Guinea (Markoski and Melovska, 2017).

Malaria is the world‘s most deadly and life threatening parasitic disease (WHO, 2014). According to 2016 world malaria report about 119,814 people were died in the world by malaria in 2015, among these 117,886 deaths occurred in Africa (WHO, 2016). About 453,000 malaria

deaths were estimated to occur in children aged less than five years that were 78% of the global total. An estimated 437,000 of deaths occurred in children aged less than five years in the WHO Africa region (WHO, 2014).

Approximately 60 % of Ethiopia's population lives in malarious areas, and 68 % of the country's landmass are favorable for malaria transmission, with malaria primarily associated with altitude and rainfall (FMOH, 2015). The transmission of malaria in Ethiopia is seasonal and uneven (FMOH, 2012). The transmission peaks bi-annually from September to December and from April to May, with higher transmission rate in the former period. The transmission is corresponding with the major harvesting periods in rural areas. This could lead to severe economic burden for the country in different ways (Ayele *et al*., 2012).

Human infection with malaria begins when a female *Anopheles* mosquito species inoculates *Plasmodia sporozoites* into the blood system while blood meal (Chikamata, 2014). The parasite damages red blood cells using plasmepsin enzymes which are aspartic acid proteases that degrade hemoglobin (Solomon *et al*., 2014). The complex life cycle of the development of the *Plasmodium* parasite gives way to the different clinical symptoms on human like headache, abdominal discomforts, fatigue, and muscle and joint pains, commonly followed by fever, chills, sweat, loss of appetite, vomiting and disorder (Chikamata, 2014).

Current malaria prevention in Ethiopia include, Indoor Residual Spraying(IRS) that involves spraying the interior walls of a house with long-lasting insecticide (WHO, 2015), use of mosquito nets (ITNs) by households endemic and epidemic prone-areas that involves protecting people from being bitten by infected mosquitoes (FMOH,2012), environmental management and using larvicides.

Early diagnosis and rapid effective treatment have vital importance in the management of malaria. The signs and symptoms of malaria are nonspecific. Diagnosis based on clinical features alone has very low specificity and often results in over-treatment. Confirmatory diagnosis plays an important supportive role in clinical care. Diagnosis of malaria should be based on parasitological confirmation (laboratory) (Chikamata, 2014). As recommended by the World Health Organization, the management of suspected malaria cases relies on early diagnosis and effective treatment based on artemisinin-combined therapy (Mola, 2016).

1.1. Statement of the problem

Malaria control is one of the highest priorities on the international health agenda. Despite laborious effort made to control malaria for more than a century, it is still among the main public health problems in least developed regions of the world. Majority of deaths associated with malaria occur in Sub-Saharan Africa including Ethiopia. In 2016, it was estimated that 445, 000 deaths due to malaria had occurred globally, of which 407, 000 deaths approximately 91% were in the African Region (WHO, 2017). In our country Ethiopia about 9000 deaths in 2010, about 5000 deaths in 2011, about 6000 deaths in 2012, about 7000 deaths in 2013, about 5000 deaths in 2014 and about 5000 deaths in 2015 (WHO, 2017). In 2016 there were 6,367,309 malaria cases among these, 1,718,504 were microscopically confirmed, and about 5000 deaths and 48,743,923 populations at risk (WHO, 2017).

Although malaria control and prevention methods like Artemisinin Combine Therapy (ACT), insecticide treated bed nets (ITNs) and indoor residual spraying of insecticide (IRS) have been implemented in our country Ethiopia and the death rate decreases from about 9000 in 2010 to about 5000 in 2016 (WHO, 2017), the disease is still the severe public problem. The goals of NMSP in Ethiopia are, by 2020 will be achieved zero malaria deaths and will be reduced malaria cases by 75% from 2013 baseline (CDC, 2017). According to Shewarobit Health Office, the coverage of controlling malaria reaches 75.1% but the disease is still severe health problem. The disease highly harms the activity of Agriculture in the study area because the peak transmission coincides with planting and harvesting seasons. Therefore, to control the disease and to achieve the goal of 2020 National Malaria Strategic Plan (NMSP) the study was design to determine the existing situation of malaria and associated risk factors in the study area.

1.2. Objectives of the study

1.2.1. General objective

The general objective of the study was to assess the prevalence of malaria infection and associated risk factors among outpatients in Shewarobit Health Center, central Ethiopia.

1.2.2. Specific objectives

The specific objectives of the study were:

- To determine the prevalence of malaria infection in the study area.
- To determine the composition of *Plasmodium* species in the study area.
- To identify the risk factors that may contribute to malaria transmission in the study area.
- To assess the role of current control and prevention methods on malaria transmission in the study area.

2. Literature Review

2.1. *Plasmodium* parasites of human malaria

Malaria is caused by infection of red blood cells with protozoan parasites of the genus *Plasmodium*. The parasites are injected in to the human host by a feeding female *Anopheles* mosquito. The four *plasmodium* species that infect human are *plasmodium falciparum, p. vivax, p. ovale* and *p. malariae.* Human infections with the monkey malaria parasite, *P. knowlesi*, have also been reported from the forested regions of South-East Asia (WHO, 2010).These species belong to the same genus and each one has a distinctive appearance under the microscope and each one produces some what the different pattern of symptoms (CDC, 2014).

2.2. Life cycle of *Plasmodium* parasites

Malaria is a major disease of humans caused by protozoan parasites from the genus *Plasmodium*. It has a complex life cycle. The *Anopheles* mosquito bites a human and injects sporozoite forms. The sporozoites move to the liver and invade hepatocytes in which they develop to produce exoerythrocytic merozoite forms that are released into the blood stream. Merozoites invade erythrocytes and grow into trophozoites and mature schizonts. Merozoites are released that reinvade new erythrocytes. Gametocytes, formed from the asexual blood stage are taken up by a feeding mosquito into the gut where they mature to form male and female gametes. The fertilized zygote develops to an ookinete and an oocyte and finally sporozoites that migrate to the salivary glands (Cowman *et al*., 2012).

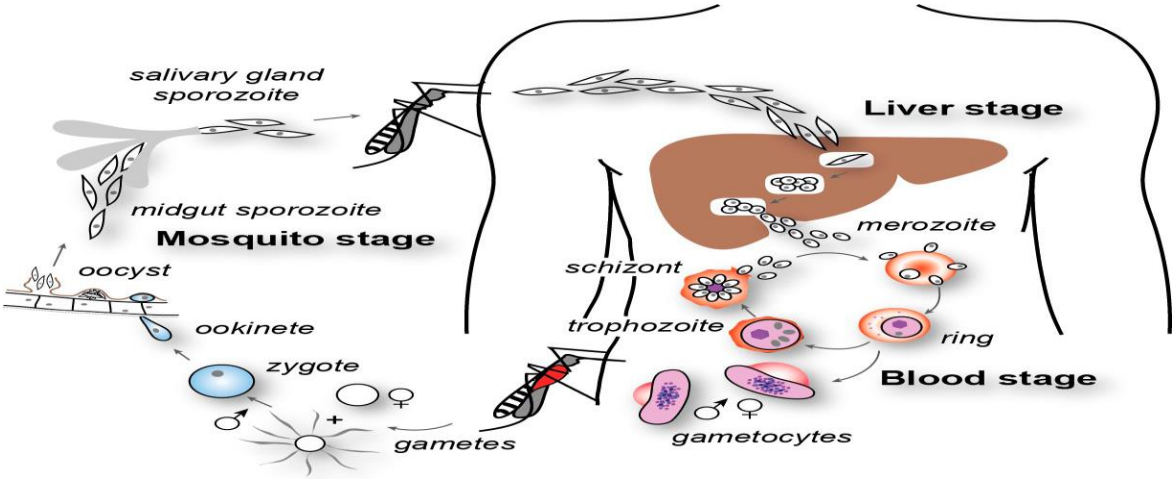

Fig. 1 Life cycle of *Plasmodium* parasites (Cowman *et al*., 2012

2.3. Malaria vectors

About 30-40 species of *Anopheles* mosquitoes carry malaria among these *Anopheles gambiae, An. funestus* and *An. arabiensis* are the most notable vectors in Africa (Tonnage *et al*.,2010). In Ethiopia *An. arabiensis* is the main vector. *An. pharoensis* is also widely distributed in the country and is considered to play a secondary role in malaria transmission (FMOH, 2012).

2.4. Geographical distribution of malaria

Due to geographical features that distinguish certain regions of the earth that is warm climate, cold climate, high humidity, dry lands, polluted water, shortage of food etc. appear certain diseases by typical geographical distribution (Markoski *et al*., 2017). Malaria is dependent on the geographical distribution of mosquitoes as its carriers. The existence of malaria depends on the climatic factors such as temperature, humidity and rainfalls. It is wide spread in tropical and sub-tropical areas where *Anopheles* mosquitoes can survive and multiply. The distribution of malaria is recorded in Africa, south and Central America, south and south East Asia, Indonesia, Oceania. The highest intensity is in Africa, South of the Sahara and parts of Oceania such as Papua New Guinea (Markoski *et al*., 2017).The four human *Plasmodium* species are found in tropical and sub-tropical regions throughout the world (CDC, 2006). *Plasmodium falciparum* is wide spread 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 death in Sub-Saharan Africa (CDC, 2006).While *P. falciparum* predominates in warmer region close to the equator, *P. vivax* predominates in more temperature 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).

2.5. Global Epidemiology of malaria

Malaria is the world most deadly and life threatening parasitic disease (WHO, 2014).The world health organization (WHO) estimated that 655,000 deaths in 2010 (WHO, 2011), 660,000 deaths in 2011(WHO, 2012), 627, 000 deaths in 2012(WHO, 2013), 584,000 deaths (WHO, 2014) and 438,000 deaths in 2015 (WHO, 2015), 445,000 death in 2016(2017). Most cases in these years are occurred in the Sub-Saharan African Region, followed by the South-East Asia Region and the Eastern Mediterranean Region. It is estimated that in 2015 most deaths (90%) were reported

in the WHO African Region, followed by the WHO South-East Asia Region (7%) and the WHO Eastern Mediterranean Region (2%). Approximately half of the world populations being at risk of getting the infection (WHO, 2012). In our country Ethiopia about 27,853,670 people were at high risk of getting malaria in 2016 (WHO, 2017). The burden and transmission of the disease are serious in most of the tropical and the WHO African Region with unevenly distributed. About 90% of all malaria deaths occur in this area (Audre *et al*., 2008). The majority of deaths are occurred due to P. falciparum (WHO, 2011).

2.6. Epidemiology of malaria in Ethiopia

Approximately 60% of Ethiopia's population lives in malarious areas, and 68 % of the country's landmass are favorable for malaria transmission, with malaria primarily associated with altitude and rainfall (FMOH, 2015). According to the report of the Federal Ministry of Health, approximately 52 million peoples of Ethiopia live in malaria endemic areas, chiefly at altitudes below 2,000 meters (FMOH, 2015). The transmission of malaria in Ethiopia is seasonal and uneven (FMOH, 2008). The infection rate is highest from September to December and from April to May, with higher transmission rate in the former period. Recent reports showed that there is a considerable decrease in malaria cases in the country, but it continues to be one of the major public health issues in different parts of the country. In 2014/2015, the total numbers of laboratory-confirmed plus clinical malaria cases were 2,174,707, of those cases, 1,867,059 (85.9 %) were confirmed by either microscopy or rapid diagnostic tests (RDTs) out of which 1,188,627 (63.7 %) were *P. falciparum* and 678,432 (36.3 %) were *P. vivax* (EMIS, 2015). The dominant *Anopheles* species transmitting the malaria are *An. arabiensis* with high variability in different transmission strata (CDC, 2015). The transmission is corresponding with the major harvesting periods in rural areas and this could lead to severe economic burden for the country in different ways. Major epidemics happen in every 5 to 8 years with focal epidemics as the predominant form (Ayele *et al*., 2012).

2.7. The pathogenesis of malaria

Human infection with malaria begins when a female *Anopheles* mosquito species inoculates *Plasmodia sporozoites* into the blood system while blood meal. Once inside the body, the parasite moves to the liver, where it enters a hepatocyte and develops. From there, it enters the

blood stream and multiplies inside the red blood cells. This complex life cycle of development of the *Plasmodium* parasite gives way to the different clinical symptoms on human (Chikamata, 2014).

2.8. The clinical symptoms and diagnosis of malaria

Clinical symptoms in malaria are extremely diverse and may range in severity from mild headache to serious complications leading to death, particularly in *P. falciparum* malaria (Bartoloni, *et al*., 2012). All the manifestations of malarial illness are caused by the infection of red cells by the asexual forms of the malaria parasite, and this makes malaria a potentially multi system disease, as every organ of the body is reached by the blood. The parasite damages red blood cells using plasmepsin enzymes which are aspartic acid proteases that degrade hemoglobin (Solomon *et al*., 2014).The first initial symptoms of malaria are not specific, varied and similar to the symptoms of some systemic viral illnesses. They comprised of headache, abdominal discomforts, fatigue, and muscle and joint pains, commonly followed by fever, chills, sweat, loss of appetite, vomiting and disorder (Chikamata, 2014).The incubation period of malaria ranges from 10 to 14 days depending on the parasite species. The first attacks are usually more severe and may continue for weeks, if untreated. The onset of malaria caused by *P. falciparum* may be challenging to diagnose (Chikamata, 2014).

Accurate early diagnosis and rapid effective treatment play vital role in the management of malaria (Abrha *et al*., 2014) .The signs and symptoms of malaria are nonspecific. Diagnosis based on clinical features alone has very low specificity and often results in over-treatment. Confirmatory diagnosis plays an important supportive role in clinical care. Diagnosis of malaria should be based on parasitological confirmation (laboratory) (Chikamata, 2014).

2.8.1. Rapid Diagnostic Tests (RDTs) and Antigen Detection Tests

RDTs detect antigens derived from malaria parasites in lysed blood. (Chikamata, 2014).The three antigens are *Plasmodium falciparum* histidine-rich protein 2 (PfHRP2), plasmodial aldolase and plasmodial lactate dehydrogenase (pLDH) are currently used for RDTs (Mouatcho, 2013).

2.8.2. Confirmatory (Laboratory) Diagnosis

Microscopy of stained thick and thin blood smears remains the gold standard for confirmation of diagnosis of malaria. It is possible to distinguish different species of malaria parasites and their different stages. A parasitological confirmation of malaria improves the differential diagnosis of fever, improves fever case management, and reduces unnecessary use of antimalarial medicines. It also assists the health care provider to monitor the patient's response to treatment (Chikamata, 2014).

2.8.3. Molecular method

The other technique of malaria diagnosis is molecular technique using polymerase chain reaction (PCR). It detects parasite DNA and can identify infections below the threshold of detection for microscopy and RDTs. Although polymerase chain reaction is highly sensitive, it remains too complex for field use, requires sophisticated laboratory infrastructure and advanced training (Molla, 2016).

2.9. Prevention and control of malaria

The two major malaria prevention services implemented in Ethiopia are targeted IRS with insecticides and distribution of LLINs for universal coverage. Other vector control activities, mainly larval control through environmental management and chemical larviciding are also practiced in areas where such interventions are appropriate and expected to have significant impact (WHO, 2015).

2.9.1. Indoor residual spraying

Indoor residual spraying (IRS) is a vector control intervention that involves spraying the interior walls of a house with long-lasting insecticide (WHO, 2015). IRS is one of the primary vector control interventions for reducing and interrupting malaria transmission, and one of the most effective methods for obtaining rapid large-scale impact on vector populations and malaria morbidity as well as mortality (FMOH, 2012).

2.9.2. Use of mosquito nets by households

Universal coverage of mosquito nets is necessary to accomplish significant reductions in malaria transmission (WHO, 2015).By protecting people from being bitten by infected mosquitoes, LLINs are an effective tool to significantly reduce morbidity and mortality due to malaria. LLINs also can have an impact on vector populations. When mosquitoes are in contact with the net, it has a knock-down effect, temporarily incapacitating or even killing mosquitoes, has a repellent effect and reduces contact between the person sleeping under the net and mosquitoes by acting as a physical barrier (FMOH, 2012).

2.9.3. Environmental management

Water is essential for the breeding of malaria mosquitoes. To ensure the prevention and control of malaria, it is important that all temporary or permanent breeding sites with water are identified and eliminated through the active participation of communities. Environmental management for vector control has been implemented in urban and semi-urban areas, refugee camps, development projects, water harvesting ponds, and irrigation scheme areas. This malaria control strategy is effective only when mosquitoes are interrupted from breeding and their population is substantially decreased (FMOH, 2012).

2.9.4. Larviciding

Larvicides can be used to address collected water that cannot be managed through environmental control measures. Similar to environmental control measures, the success of larvicides depends on the identification of all mosquito breeding sites and their distribution in the entire target area, followed by sustained weekly spraying of chemicals. Larvicide control measures should be applied in conjunction with environmental control measures. The most common water-soluble chemical used to kill mosquito larvae in Ethiopia is temephos (FMOH, 2012).

2.10. Treatment of malaria

As recommended by the World Health Organization, the management of suspected malaria cases relies on early diagnosis and effective treatment based on artemisinin-combined therapy. Likewise, including Ethiopia, most Sub-Saharan African countries with Arthemeter-Lumefantrine now the first line treatment for all clinical malaria cases and for RDT confirmed

falciparum malaria cases. In areas where chloroquine is still effective, *P. vivax* malaria should be treated with this drug. Where resistance to chloroquine has been documented, *P. vivax* malaria should be treated with an appropriate artemisinin-combined therapy (Mola, 2016).

3. Materials and methodology

3.1. Description of the Study area

The study was conducted in Shewarobit town at Shewarobit Health Center. The town is located in North Shewa Zone, North central Ethiopia. It is located 225 km to the North of Adis Abeba along Dessie road. The town is located $9^0$50′16″and 10^0 01′32″ north latitude and 39^0 52’ 58” and 39^0 54′ 9″ east longitude with an area of 992.5 hectare in the rift valley. Most parts of the area are found at 1280 meters above sea level.

The town is bordered by Oromia liyu zone in the North, Tarmaber woreda in the South, Kewot woreda in the West and Afar Regional State in the East. The town has nine kebeles with the total populations of about 50,528 of which 24,638 (48.8%) were men and 25,890 (51.2) were women (**Source**, Town vital Event Registration Office 2018). Most of the dwellers of Shewarobit town are merchants, employers, daily laborers and urban farmers. Agriculture is the principal source of income for the rural populations. Cereal crops such as teff, maize, and sorghum are the most commonly cultivated crops and these are the main food crops in the district. Different fruit like mango, orange, papaya, tomato and others like sugarcane and mung bean are the dominant cash crops in the rural Kebeles. All of the Kebeles are malarious. The climax transmission of malaria is usually recorded from September up to November and from June to August.

According to the City Administration Agriculture Office document, the geography of the town is mainly plain (79%), plateau (15.5%), up and down (3%) and swamp area (2.5%).The climate is tropical and has an annual temperature ranges from 28-37 ℃ and the annual rain fall of the town is 1000mm. The main rainy seasons usually occurs from June to September.

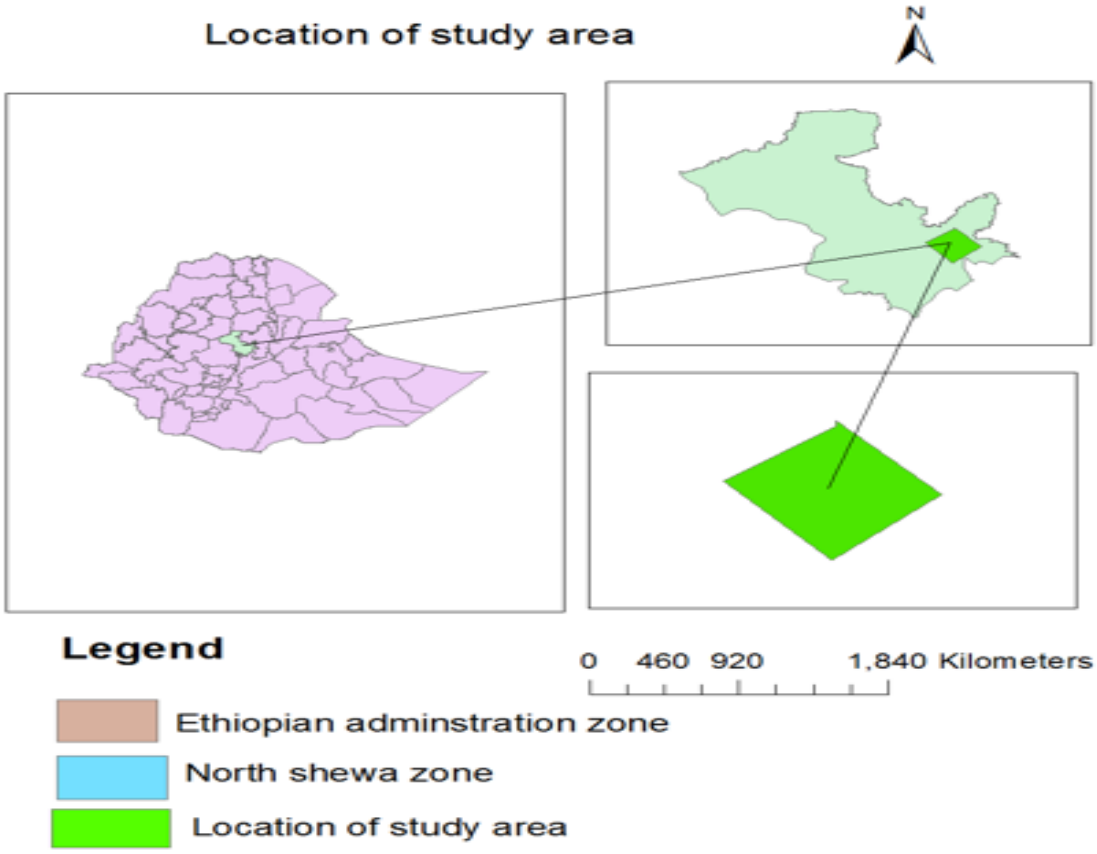

Fig. 2 Map of the study area

3.2. Study design

Retrospective (2013-2017) and Descriptive Institutional Based Cross Sectional Survey (October 2017-April 2018) were carried out for the assessment of the prevalence of malaria and associated risk factors in Shewarobit Health Center.

3.3. Study population

All malaria suspected outpatients who came to Shewarobit Health Center from the nine kebeles during study period.

3.4. Inclusions & Exclusions Criteria

The study participants included all individuals that were permanently live in Shewarobit town and willing to participate in the study but individuals who came from neighboring district for the purpose of treatment, seriously ill and did not voluntary to participate in the study were excluded.

3.5. Sample Size determination & Sampling Methods

3.5.1. Sample size determination

The required sample size for the study was estimated by taking the prevalence of malaria 50% as there was no reported in the area. The minimum numbers of the study participants were estimated using minimum sample size determination formula $n = z^2p\ (1\text{-}p)/d^2$ (Naing *et al*., 2004). Where,

n = Sample size.

Z= 1.96 at 95% confidence interval (CI).

p = Expected malaria prevalence rate in the study area =50%.

d = Margin of error which is 5%.Then n was computed to be 384. That is $n = \frac{z^2p(1-p)}{d^2} = (1.96)^2\ 0.5\ (1\text{-}\ 0.5)/(0.05)^2 = 0.9604/0.0025 = 384$.

3.5.2. Sampling methods and procedures

The sampling methods for the research were proportional sampling, stratified random sampling and simple random sampling .Proportional sampling method was used to determine the number of participants from each Kebele. Then put the number of malaria suspected outpatients in the Health Center based on their Kebeles. Finally stratified the malaria suspected outpatients based on sex and age then participants were selected from each Kebeles with random sampling method by using lottery method. Based on these methods and procedures 384 participants were selected from the outpatients who came to Shewarobit Health Center from the nine Kebeles for blood film test. The laboratory blood film results of the outpatients were recorded that were positive or negative for *plasmodium* species.

3.6. Data collection methods

3.6.1. Socio-economic and demographic data collection

Structured and pre-tested questionnaires were developed by English language and translate in to Amharic to the mother tongue language. The questionnaires were administered to gather information on the indication of sex, age, Kebele, family size, state of pregnancy, marital status, occupation, income, level of education, awareness about malaria, strategies to prevent malaria, using style of insecticide treated bed nets and numbers, house distance from nearby mosquito breeding site, main materials of room's roof, walls and floors, presence of opening on the wall from the outpatients selected randomly by lottery method in Shewarobit Health Center.

3.6.2. Blood sample collection and microscopic examination

Blood samples were taken from each Participant by laboratory technicians following safety precautions for thick and thin smears by using activated lancet. Thick and thin blood smears were made by the laboratory technicians from the outpatients who were selected randomly and labeled the slides properly for later microscopic examination. The thin films were fixed with methanol and all blood films were stained with 10% Giemsa stain of pH=7 for 10 minutes. The stained slides were dried and examined under the compound microscope with x100 objective lens or immersion oil. The results of the patients were recorded that were positive or negative for *plasmodium* species.384 blood smears were prepared from October 2017 to April 2018.

3.7. Data Quality Control

Questionnaires were reviewed and checked for errors, completeness, accuracy and consistency before record into Statistical Package for Social Science (SPSS) and corrective measures were taken. All the laboratory procedures including collection and handling of specimens were carried out in accordance with standard protocols (WHO, 1991) and to ensure general safety, disposable gloves were worn and universal bio-safety precautions (NCCLS, 2002) was followed at all times.

3.8. Data Analysis methods

The data were coded and entered in to Statistical Package for Social Science (SPSS) version 20 Software Package and Microsoft excel. Descriptive statistic was used to examine the characteristics of the data. Participants with missing values were not considered for analysis. The results of the data were presented with appropriate figures and tables. Binary logistic regression and multivariate analysis were employed to examine the association between socio-demographic variables and other risk factors with malaria infection. A p-value of less than 0.05 was considered as significant.

3.9. Ethical considerations

Data were collected after official letter and ethical clearance obtained from higher management of Shewarobit Administration Health Office. The identities of the participants were not to be mentioned. The study objectives were clearly informed and told that their participations were voluntarily. The participants got written and verbal consent to take part in the study after adequate explanation about the significant of the study. In addition potential harms and benefits of the study were explained to the participants. Those study participants who were positive for malaria infection had gotten appropriate treatment by health professional in Shewarobit Health Center.

4. Results

4.1. Retrospective Trends in Malaria Transmission

4.1.1. Annual Trends of Malaria Prevalence in Shewarobit Health Center (2013-2017)

Within the last five years (2013-2017) a total of 33,932 blood films were requested for malaria diagnosis in Shewarobit Health Center. From these requested blood films, 4705 (13.9%) outpatients were microscopically confirmed as malaria positive. There were fluctuating trends of malaria within the last five years with the minimum 622 (8.2%) microscopically confirmed malaria positive were reported in 2016 and the maximum 1949 (23.0%) microscopically confirmed malaria positive were reported in 2017 in the study area. The data showed that malaria infection was decreased from 18.0% in 2013 in to 8.2 % in 2016 but the infection was increased in 2017 that was (23.0%) (Table1).

Table 1: Annual Trends of Malaria Prevalence in Shewarobit Health Center

Years	Total cases	Total positives	(%)	p-value
2013	5944	1074	18.0	P=0.000
2014	4300	417	9.7	
2015	7678	643	8.4	
2016	7559	622	8.2	
2017	8451	1949	23.0	
Total	33932	4705	13.9	

4.1.2. Seasonal variation of malaria prevalence in Shewarobit Health Center (2013-2017)

Even though there were fluctuations in malaria infection and malaria cases were occurred in almost every months and seasons of the years in the study area. The highest peak of malaria infections were mainly recorded from September up to November months in all years followed by during the months of June up to August and the minimum numbers of malaria cases were recorded during the months of December up to May in the study area (Table 2).

Table 2: Seasonal variation of malaria prevalence in Shewarobit Health Center

Month	Year										
	2013		2014		2015		2016		2017		
	Total examined	Total confirmed & (%)	Total examined	Total confirmed & (%)	Total examined	Total confirmed & (%)	Total examined	Total confirmed & (%)	Total examined	Total confirmed & (%)	p-value
September	681	229(33.6)	571	89(15.6)	1140	123(10.8)	969	154(16.0)	464	143(30.8)	p=0.000
October	1130	236(20.9)	833	103(12.4)	1404	138(9.8)	1314	143(11.0)	571	176(30.8)	
November	1048	266(25.4)	387	43(11.1)	795	81(10.2)	619	94(15.0)	349	126(36.1)	
December	301	22(7.3)	279	16(5.7)	634	34(5.4)	700	34(4.9)	258	44(17.0)	
January	315	20(0.6)	232	12(5.2)	288	9(3.1)	715	11(1.5)	332	26(7.8)	
February	266	17(0.6)	239	8(3.3)	622	26(4.2)	504	6(1.2)	267	16(6.0)	
March	408	20(4.9)	267	5(1.9)	427	17(3.9)	310	4(1.3)	311	17(0.5)	
April	370	30(8.1)	289	14(4.8)	380	12(3.2)	355	8(2.3)	244	19(7.8)	
May	466	28(6.0)	276	11(4.0)	516	22(4.3)	287	8(2.8)	368	49(13.3)	
June	439	90(20.6)	271	27(10.0)	332	41(12.3)	440	32(7.3)	1526	403(26.4)	
July	235	57(24.5)	325	45(13.8)	280	33(11.8	491	44(9.0)	2327	592(25.4)	
August	285	59(20.7)	331	44(13.3)	860	107(12.4)	855	84(9.8)	1436	338(23.5)	
Total	5944	1074(18.0)	4300	417(9.7)	7678	643 (8.4)	7559	622(8.2)	8451	1949(23.0)	

4.1.3. Prevalence of malaria infections in relation to sex in Shewarobit Health Center (2013-2017)

According to the record review in the last five years (2013-2017) in the study area, males were more affected than females by malaria infections in each year. Out of 4705 positive outpatients 3074 were males and 1631 were females. The infection rates among males were 65.3% and females were 34.7% with a ratio of males to females was 1.9:1.The highest infections of males were occurred in 2014 (72.2%) and females were occurred in 2015 (37.9%) and the least infections of males were occurred in 2015 (62.1%) and females were in 2014 (27.8%) (Table 3).

Table 3: Prevalence of malaria infection in relation to sex in Shewarobit Health Center

	Total examined			Total confirmed			Male to female ratio	p-value
Year	Male	Female	Total	Total (%)	Male (%)	Female (%)	M :F	0.017
2013	3711	2233	5944	1074(18.0)	692(64.4)	382(35.6)	1.8:1	
2014	2153	2147	4300	417(9.7)	301(72.2)	116(27.8)	2.6:1	
2015	4063	3615	7678	643(8.4)	399(62.1)	244(37.9)	1.6:1	
2016	3956	3603	7559	622(8.2)	427(68.6)	195(31.4)	2.2:1	
2017	4580	3871	8451	1949(23.0)	1255(64.4)	694(35.6)	1.8:1	
Total	18463	15469	33932	4705(13.9)	3074(65.3)	1631(34.7)	1.9:1	

4.1.4. Prevalence of malaria infections in relation to age groups in Shewarobit Health Center (2013-2017)

The age specific prevalence rate of malaria was 492 (10.5%) for the age groups ≤4 years old, 1170 (24.9%) for the age groups between 5-14 years old and 3043 (64.6% for the age groups ≥ 15 years old. Although malaria infections were reported in all age groups, the most susceptible age groups were ≥ 15 years old with the overall prevalence 64.6%, the next susceptible age groups were from 5 to 14 years old with the total prevalence 24.9% and the least susceptible age groups were ≤4 years old with the total prevalence 10.5%.

In the age groups ≤4 years old the highest infections were occurred in 2013 (15.4%) and the least infections were occurred in 2016 (6.8%). For the age groups between 5 to 14 years old the highest infections were occurred in 2013 (30.3%) and the least infections were occurred in 2016 that (18.8%) and for the age groups ≥15 the highest infections were occurred in 2016 (74.4%) and the least infections were occurred in 2013 (54.3%) in the study area (Table 4).

Table 4: Prevalence of malaria infections in relation to age groups in Shewarobit Health Center

year	Total examined	Total confirmed	Age groups			P-value
			≤ 4 in № &%	5 to 14 in № &%	≥ 15 in № &%	
2013	5944	1074(18.0)	165(15.4)	325(30.3)	584(54.3)	
2014	4300	417(9.7)	54(12.9)	115(27.6)	248(59.5)	p=0.000
2015	7678	643(8.4)	57(8.9)	166(25.8)	420(65.3)	
2016	7559	622(8.2)	42(6.8)	117(18.8)	463(74.4)	
2017	8451	1949(23.0)	174(8.9)	447(22.9)	1328(68.2)	
Total	33932	4705(13.9)	492 (10.5)	1170(24.9)	3043(64.6)	

4.1.5. Distribution of *plasmodium* species in the study area (2013-2017)

The patterns of malaria infections by different species of Plasmodium parasites in the study area were indicated. 2296 (48.8%) of the outpatients were infected by *P. vivax*, followed by 2077 (41.1%) of the outpatients were infected by *P. falciparum* and 332 (7.1%) were infected by mixed infection. The dominant *plasmodium* species in the study area was *P. vivax* (Fig.3).

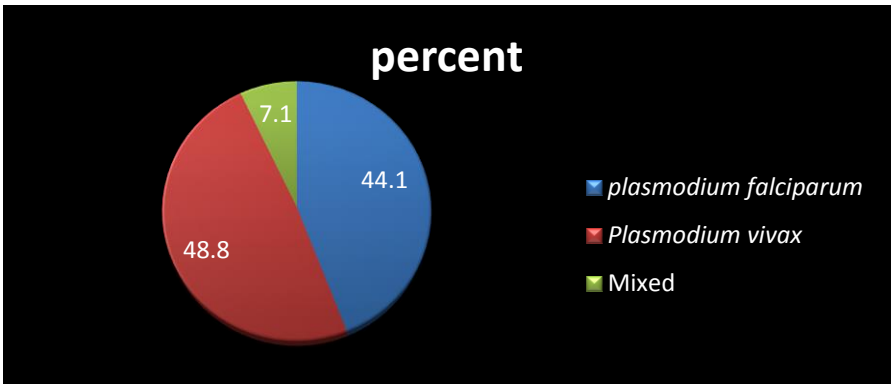

Fig. 3. Distribution of *Plasmodium* species in the study area

4.1.6. Patterns of *Plasmodium* infections in relation to sex and age groups in Shewarobit Health Center (2013-2017)

The data showed that in all years males were more affected by *P. falciparum*, *P. vivax* and mixed infections than females. The outpatients highly infected by *P. falciparum* in 2015 (63.6%),

among these 272 (66.5%) were males and 137 (33.5%) were females. The outpatients highly infected by *P.vivax* in 2013 (78.5%), among these 548 (65%) were males and 295 (36%) were females and the outpatients highly infected by mixed infection in 2017 (10.1%) from these 141 (71.9%) were males and 55 (28.1) were females.

In relation to the age groups, the age groups ≤4 years old were highly infected by *P. falciparum* in 2014 (12.1%), by *P.vivax* in 2013 (17.3%) and by mixed infection in 2015 (16.2%). The age groups between 5 to14 years old were highly infected by *P. falciparum* in 2014 (27.6%), by *P. vivax* in 2013 (32.2%) and by mixed infection in 2016 (27.2%). Finally, the age groups ≥ 15years old were highly infected by *P. falciparum*, P. *vivax* and mixed infection in 2016 with the infection of 269 (76%), 178 (72.3%) and 16 (72.8%) respectively (Table 5).

Table 5: Pattern of *Plasmodium* infections in relation to sex and age groups in Shewarobit Health Center

		Age groups								
	Total	≤4 years old			5 to 14 years old			≥15 years old		
Year and *p.*species	confirmed	M (%)	F (%)	T (%)	M (%)	F (%)	T (%)	M (%)	F (%)	T
2013 (n= 1074)										
P .falciparum	179(16.7)	10(5.6)	5(2.8)	15(8.4)	21(11.8)	18(10.0)	39(21.9)	78(43.6)	47(26.3)	125(69.8)
P. vivax	843(78.5)	86(10.2)	60(7.1)	146(17.3)	169(20.0)	103(12.2)	272(32.2)	293(34.8)	132(15.7)	425(50.4)
Mixed	52(4.8)	2(3.8)	2(3.8)	4(7.6)	9(17.3)	5 (9.6)	14(26.9)	24(46.1)	10(19.2)	34(65.3)
2014 (n=417)										
P .falciparum	156(37.4)	11(7.0)	8(5.1)	19(12.1)	25(16.0)	18(11.5)	43(27.6)	64(41.0)	30(19.2)	94(60.2)
P.vivax	230(55.2)	26(11.3)	7(3.0)	33(14.3)	51(22.1)	14(6.1)	65(28.2)	98(42.6)	34(14.8)	132(57.3)
Mixed	31(7.4)	2(6.5)	0(0)	2(6.5)	6(19.4)	1(3.2)	7(22.6)	18(58.1)	4(12.9)	22(71.0)
2015 (n=643)										
P .falciparum	409(63.6)	17(4.2)	6(1.5)	23(5.7)	68(16.6)	40(9.8)	108(26.4)	187(45.7)	91(22.2)	278(67.9)
P.vivax	203(31.6)	13(6.4)	16(7.9)	29(14.3)	18(8.9)	32(15.8)	50(24.7)	76(37.4)	48(23.6)	124(61.0)
Mixed	31(4.8)	3(9.7)	2(6.5)	5(16.2)	5(16.1)	3(9.7)	8(25.8)	12(38.7)	6(19.4)	18(58.1)
2016 (n=622)										
P .falciparum	354(56.9)	15(4.2)	4(1.1)	19(5.3)	40(11.3)	26(7.3)	66(18.6)	187(52.8)	82(23.2)	269(76)
P.vivax	246(39.5)	16(6.5)	7(2.8)	23(9.3)	27(11.0)	18(7.3)	45(18.3)	127(51.6)	51(20.7)	178(72.3)
Mixed	22(3.6)	0(0)	0(0)	0(0)	5(22.7)	1(4.5)	6(27.2)	10(45.5)	6(27.3)	16(72.8)
2017 (n=1949)										
P .falciparum	979(50.2)	42(4.3)	51(5.2)	93(9.5)	108(11,0)	88(9.0)	196(20.0)	450(46)	240(24.5)	690(70.5)
P.vivax	774(39.7)	28(3.6)	30(3.9)	58(7.5)	117(15.1)	69(8.9)	186(24.0)	369(47.7)	161(20.8)	530(68.5)
Mixed	196(10.1)	13(6.6)	10(5.1)	23(11.7)	50(25.5)	15(7.7)	65(33.2)	78(39.8)	30(15.3)	108(55.1)

Key: 'n' refers to infected outpatients

4. 2. Results of the current survey

4.2.1. Socio- Economic and Demographic Characteristics of the Respondents

A total of 384 outpatients provided blood samples for malaria diagnosis and all were interviewed to collect evidences about the risk factors of malaria (Table 6).

Table 6: Socio-Demographic Characteristics of the Respondents in Shewarobit Health Center

Variables	Frequency	Percent(%)
1.Sex of the respondents		
Male	192	50.0
Female	192	50.0
2.Age of the respondents		
≤4	68	17.7
5 to 14	67	17.4
≥ 15	249	64.8
3.kebeles of the respondents		
kebele 01	49	12.8
kebele 02	45	11.7
kebele 03	52	13.5
kebele 04	61	15.9
kebele 05	27	7.0
kebele 06	38	9.9
kebele 07	24	6.3
kebele 08	51	13.3
kebele 09	37	9.6
4. Households of the respondents		
1	24	6.3
2	62	16.1
3	66	17.2
4	91	23.7
≥5	138	35.9
Missing	3	0.8
5.State of pregnancy in respondents		
Pregnant	44	22.9
Non-pregnant	145	75.5
Missing	3	1.6
6.Marital status of the respondents		
Married	238	62.0
Single	91	23.7
Divorced	32	8.3
Widowed	22	5.7
Missing	1	0.3
7.Occupations of the respondents		

Farmer	94	24.5
NGO worker	37	9.6
House wife	84	21.9
Merchant	45	11.7
Government employee	56	14.6
Daily laborer	35	9.1
Others	31	8.1
Missing	2	0.5
8.Income in month		
<700birr	174	45.3
800-3000birr	95	24.7
>3000	91	23.7
Missing	24	6.3
9.Educational status of the respondents		
Illiterate.	149	38.8
Primary school	105	27.3
Secondary school	51	13.3
Certificate	3	0.8
Diploma holder	46	12.0
Degree holder	24	6.3
Master and above.	3	0.8
Missing	3	0.8
10.Educational concern about malaria		
Yes	332	86.5
No	51	13.3
Missing	1	0.3
11.The Cause of malaria		
Plasmodium	125	32.6
Cold climatic condition	30	7.8
Contaminated water	128	33.3
Sleep outside	7	1.8
Do not know	37	9.6
Malnutrition	51	13.3
Missing	6	1.6
12.Important strategy to prevent malaria		
Use insecticide sprays	40	10.4
Use a bed net	245	63.8
Taking tablet	13	3.4
Keeping the house and surrounding clean	38	9.9
Destroying mosquito breeding sites	28	7.3
Others specify	17	4.4
Missing	3	0.8
13.Are there Insecticide treated bed nets		
Yes	289	75.3

No	95	24.7
14.Are currently used		
Yes	233	80.6
No	56	19.4
15. Who uses long lasting insecticidal nets?		
Children	12	5.2
Mother	3	1.3
Father	4	1.7
Father and mother	15	6.4
Children and mother	14	6.0
Children and father	2	0.9
The whole family	183	78.5
16. How often you or your families sleep under bed nets?		
Daily	127	54.5
Irregularly	21	9.0
During Malaria season	54	23.2
Almost weekly	31	13.3
Others		
17.Types of bed nets		
Untreated net	51	21.9
Locally treated net	38	16.3
Long lasting insecticide treated net	114	48.9
Do not know	30	12.9
18.Was the house sprayed with insecticides		
Yes	183	47.7
No	200	52.0
Missing	1	0.3
19.Infected by malaria before this time		
Yes	284	74.0
No	98	25.5
Missing	2	0.5
20. Main materials of the room's roofs		
Thatches	54	14.1
Grooved iron sheet	323	84.1
Others specify	6	1.6
Missing	1	0.3
21. Main materials of the room's floor		
Soil	92	24.0
Plastic carpet	40	10.4
Ceramics	38	9.9
Local dung	25	6.5
Cement	188	49.0
Other specify		
Missing	1	0.3
22.Main materials of your room's wall		

Mud blocks	192	50.0
Sticks	132	34.4
Gypsum	46	12.0
others specify	14	3.6
23.Holes on the walls		
Yes	123	32.0
No	261	68.0
24.Holes between the walls and roofs		
Yes	113	29.4
No	269	70.1
Missing	2	0.5
25.Mosquito breeding sites		
Yes	188	49.0
No	195	50.8
Missing	1	0.2
<1000m	94	50.0
1000m-2000m	41	21.8
>2000m	21	11.2
Others	13	6.9
Missing	19	10.0

Key: N=Number of participants

4.2.2. Seasonal pattern of malaria infections in Shewarobit Health Center (October 2017 – April 2018)

A total of 384 outpatients were examined from October 2017 up to April 2018 in Shewarobit Health Center. From these outpatients only 73(19.0%) were microscopically confirmed as malaria positive. Even if there were malaria infections in each month, the highest infections were occurred in October (41.3%) and November (40.4%) (Table7).

Table 7: Seasonal pattern of malaria infections in Shewarobit Health Center (October 2017 – April 2018)

Month	Total examined	Total Confirmed	X^2	P-value
October	63	26(41.3)	55.7	P=0.000
November	52	21(40.4)		
December	30	6(20)		
January	42	2(4.8)		
February	71	8(11.3)		
March	65	8(12.3)		
April	61	2(3.3)		
Total	384	73(19)		

4.2.3. Prevalence of malaria infections in relation to sex (October 2017 - April 2018)

Among 384 outpatients 192 were males and 192 were females. The data showed that 37 (50.7%) of the infected outpatients were males and 36 (49.3%) were females. The highest infections of males were occurred in January 2 (100%) and females were occurred in February 6 (75.0%).The least infections of males were occurred in March 1 (12.5%) and females were occurred in January 0 (0%) (Table 8).

Table 8: Prevalence of malaria infections in relation to sex (October 2017 to April 2018)

	Total examined			Total	Sex		X^2	P-value
Month	Male	Female	Total	Confirmed	Male (%)	Female (%)		
October	28	35	63	26(41.3)	15(57.7)	11(42.3)	0.017	0.897
November	25	27	52	21(40.4)	12(57.1)	9(42.9)		
December	14	16	30	6(20.0)	4(66.7)	2(33.3)		
January	22	20	42	2(4.8)	2(100.0)	0(0.0)		
February	38	33	71	8(11.3)	2(25.0)	6(75.0)		
March	33	32	65	8(12.3)	1(12.5)	7(87.5)		
April	32	29	61	2(3.3)	1(50.0)	1(50.0)		
Total	192	192	384	73(19.0)	37(50.7)	36(49.3)		

4.2.4. Prevalence of malaria infections in relation to age groups (October 2017 -April 2018)

Among 73 infected outpatients, 3 (4.1%) were the age groups ≤4 years old, 14 (19.2%) were the age groups between 5 to 14 years old and 56 (76.7%) were the age groups ≥15 years old. The data showed that the most infected age groups were ≥15 years old. The highest infections in the age groups ≤4 years old were occurred in October 2 (7.7%), in the age groups between 5 to 14

years old were occurred in January 2 (100%) and in the age groups ≥15 years old were occurred in April 2 (100%).The least infections in the age groups ≤4 years old were occurred from December up to April 0(0%), in the age groups between 5 to 14 years old were occurred in April 0(0%) and in the age groups ≥15 years old were occurred in January 0(0%)(Table 9).

Table 9: Prevalence of malaria infections in relation to age groups (October 2017 to April 2018)

			Age groups				
Month	Total examined	Total Confirmed	≤4	5 to 14	≥15	X2	P-value
October	63	26(41.3)	2(7.7)	3(11.5)	21(80.8)	11.5	0.003
November	52	21(40.4)	1(4.8)	2(9.5)	18(85.7)		
December	30	6(20.0)	0(0.0)	3(50.0)	3(50.0)		
January	42	2(4.8)	0(0.0)	2(100.0)	0(0.0)		
February	71	8(11.3)	0(0.0)	2(25.0)	6(75.0)		
March	65	8(12.3)	0(0.0)	2(25.0)	6(75.0)		
April	61	2(3.3)	0(0.0)	0(0.0)	2(100.0)		
Total	384	73(19.0)	3(4.1)	14(19.2)	56(76.7)		

4.2.5. Prevalence of malaria infections in relation to kebeles in Shewarobit Health Center (October 2013 -April 2017)

Even if there were malaria infections in all kebeles in Shewarobit town, the highest infections were occurred in kebele 03 (28.8%) (Table 10).

Table 10: Distribution of malaria infections in relation kebeles in Shewarobit Health Center (October 2017 -April 2018)

Kebele	Total examined	Total confirmed	X2	p-value
Keble 01	49	14(19.2)	32.6	p=0.000
Keble 02	45	8(11.0)		
Keble 03	52	21(28.8)		
Keble 04	61	14(19.2)		
Keble 05	27	1(1.4)		
Keble 06	38	6(8.2)		
Keble 07	24	3(4.1)		
Keble 08	51	3(4.1)		
Keble 09	37	3(4.1)		
Total	384	73(100)		

4.2.6. Distribution of plasmodium species in the study area (October 2017 -April 2018)

The predominant species was *P. vivax* 58 (79.4%) followed by *P. falciparum* 11 (15.1%) and mixed infection 4(5.5%). The highest infections of *P.falciparum* were occurred in October 7(26.9%), *P.vivax* were occurred from December to April (100%) and mixed infections were occurred in October 3(11.6%) (Table 11).

Table 11: Distribution of plasmodium species in the study area (October 2017 - April 2018)

Month	Total examined	Total Confirmed	*Plasmodium* species			X^2	p-value
			P. falciparum	*P.vivax*	mixed		
October	63	26(41.3)	7(26.9)	16(61.5)	3(11.6)		
November	52	21(40.4)	4(19.0)	16(76.2)	1(4.8)	72.1	p=0.000
December	30	6(20.0)	0(0.0)	6(100.0)	0(0.0)		
January	42	2(4.8)	0(0.0)	2(100.0)	0(0.0)		
February	71	8(11.3)	0(0.0)	8(100.0)	0(0.0)		
March	65	8(12.3)	0(0.0)	8(100.0)	0(0.0)		
April	61	2(3.3)	0(0.0)	2(100.0)	0(0.0)		
Total	384	73(19.0)	11(15.1)	58(79.5)	4(5.5)		

4.2.7. Distribution of plasmodium species in relation to sex and age groups in Shewarobit Health Center (October 2017-April 2018)

The data showed that there were not *P.falciparum* infections in the age groups ≤4 years old but the highest infections of *P.falciparum* were occurred in October in the age groups ≥15 years old 6 (85.7%), among these 5(71.4%) were males and 1(14.3%) was female. In case of *P.vivax* the infections were occurred in all age groups but the highest infections were occurred in January in the age groups between 5 to 14 years old 2 (100%) and all are males. Finally in case of mixed infections there were not infections in the age groups ≤4 years old but the highest infections were occurred in the age groups ≥15 years old in November 1(100%) and the outpatient was female (Table 12).

Table 12: Distribution of *plasmodium* species in relation to sex and age groups in Shewarobit Health Center (October 2017 -April 2018)

		Age groups								
		≤4			5 to 14			≥15		
Month	Total confirmed	M (%)	F (%)	T (%)	M (%)	F (%)	T (%)	M (%)	F (%)	T
October(n=26)										
P .falciparum	7(26.9)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(14.3)	1(14.3)	5(71.4)	1(14.3)	6(85.7)
P.vivax	16(61.5)	0(0.0)	2(12.5)	2(12.5)	0(0.0)	0(0.0)	0(0.0)	9(56.3)	5(31.3)	14(87.5)
Mixed	3(11.6)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(66.7)	2(66.7)	1(33.3)	0(0)	1(33.3)
November(n=21)										
P .falciparum	4(19.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(25.0)	1(25.0)	3(75.0)	0(0.0)	3(75.0)
P.vivax	16(76.2)	1(6.3)	0(0.0)	1(6.3)	0(0)	1(6.3)	1(6.3)	7(43.8)	7(43.8)	14(87.5)
Mixed	1(4.8)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(100.0)	0(0.0)	1(100.0)
December(n=6)										
P .falciparum	0(0.0)	0(0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
P.vivax	6(100.0)	0(0.0)	0(0.0)	0(0.0)	2(33.3)	1(16.7)	3(50.0)	2(33.3)	1(16.7)	3(50.0)
Mixed	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
January(n=2)										
P .falciparum	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
P.vivax	2(100.0	0(0.0)	0(0.0)	0(0.0)	2(100.0)	0(0.0)	2(100.0)	0(0.0)	0(0.0)	0(0.0)
Mixed	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
February(n=8)										
P .falciparum	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
P.vivax	8(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(25.0)	2(25.0)	2(25.0)	4(50.0)	6(75.0)
Mixed	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
March(n=8)										
P .falciparum	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
P.vivax	8(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(25.0)	2(25.0)	1(12.5)	5(62.5)	6(75.0)
Mixed	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
April(n=2)										
P .falciparum	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
P.vivax	2(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(50.0)	1(50.0)	2(100.0)
Mixed	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)

4.2.8. Long lasting insecticide nets and Indoor residual spray coverage

4.2.8.1. Long lasting insecticide nets

Long-lasting insecticidal net ownership (LLINs) was investigated among the outpatients in the study area. One of the most important strategies to prevent malaria in the study area was long-lasting insecticidal nets. According to the Town Administration Health Office Report, about 27,034 long-lasting insecticidal nets were distributed in 2018. 289 (75.3%) of the participants had long-lasting insecticidal nets, only 95 (24.7%) of the participants were lacked the nets. 73 (25.3%) self-reported that their households owned one long-lasting insecticidal net, 107 (37.0%)

two, 56 (19.4%) three and 53 (18.3%) owned four and above. Among 289 participants, 233 (80.6%) participants were reported that they were slept under long-lasting insecticidal nets the remaining 56 (19.4%) of the participant had long-lasting insecticidal nets but did not sleep under long-lasting insecticidal Nets.

183(78.5%) Participants were reported that the whole families were used long-lasting insecticidal nets,15 (6.4%) of the participants were reported that only fathers and mothers were used long-lasting insecticidal nets ,14 (6.0%) of the participants were reported that only children and mothers were used long-lasting insecticidal nets ,4 (1.7%) of the participants were reported that only fathers were used long-lasting insecticidal nets, 3 (1.3%) of the participants were reported that only mothers were used long-lasting insecticidal nets, 2 (0.9%) of the participants were reported that only children and fathers were used long-lasting insecticidal nets and 12 (5.2%) of the participants reported that only Children were used long lasting insecticidal nets. 127 (54.5%) of the participants were slept under long-lasting insecticidal net daily, 54 (23.2%) of the participants were slept under long-lasting insecticidal net during malaria seasons, 21 (9.8%) of the participants were slept under long-lasting insecticidal nets irregularly and 31 (13.3%) of the participants were slept under long-lasting insecticidal nets almost weekly.

Even if 289 (75.3%) of the participants had long lasting insecticidal nets only 233 (60.7%) of the participants were used and the remaining 56 (14.6%) of the participants had took the nets but they did not use. A total of 151(39.3) participants did not use long lasting insecticide nets. The reasons for not using the long-lasting insecticidal nets were investigated in the study area and the replies were 95 (62.9. %) of the participants had not long lasting insecticide, 12 (8.0%) of the participants were believed that the nets did not prevent malaria, 44 (29.1%) of the participants were afraid the toxicity of the chemicals.

Table 13: Distribution of LLINs and prevalence of malaria in Shewarobit town (2013 – 2018)

Year	Prevalence of malaria	Distributed LLINs
2013	18.0%	8
2014	9.7%	22
2015	8.4%	300
2016	8.2%	1188
2017	23.0%	Not distributed
2018	19.0%	27034

A B

Fig. 4 Improper utilization of long lasting insecticide nets in Kebele 03 for fencing (A) and straw cover (B)

4.2.8.2. Indoor residual spray coverage

Indoor residual spray coverage and frequency were assessed during data collection in the study area. From 384 participants in the study area only 183(47.7%) were used indoor residual spray, 200 (52.1%) of the participants were not use this method to prevent malaria in this year (2017/2018) and one participant (0.2%) did not answer the question.

4.2.9. Mosquito breeding sites

The relationship between malaria vectors' density and the distance of settlement from a water body like stagnant water is an important indicator of malaria transmission. In the study area among 384 participants, 188 (49%) participants were lived in the areas which have mosquito breeding sites, among these 94 (50%) of the participants were lived in areas of the distance of mosquito breeding sites less than 1000 meter, 41(21.8%) of the participants were lived in areas where the distance of mosquito breeding sites between 1000m-2000m, 21(11.2%) of the participants were lived in the areas where the distance of mosquito breeding sites are greater than 2000m, 13 (6.9%) of the participants were lived in areas out of these distances in areas and 19 (10.11%) did not explain the distance of mosquito breeding sites from their living areas.

A

B

Fig. 5 Stagnant water as mosquito breeding sites in Kebele 03.

4.3. Univariate and multivariate analysis of malaria-risk-factors

4.3.1. Univariate analysis of malaria-risk-factors

Potential association of malaria prevalence with varieties of environmental factors was assessed in the study area. Table 14 showed binary logistic regression analysis results for a list of variables that were tested for their possible association with risk of malaria. Even if the chances for males to get malaria was increased by 1.034 times that of females [odds ratio (OR) = 1.034, 95% CI: 0.621-1.722] but the association was statistically not significant (p=0.897).The relationship between malaria prevalence and age groups was statistically significant. With reference to the age groups ≤4, participants with age groups ≥15 years old were more infected by malaria [odds ratio (OR) = 0.159, 95% CI: 0.048- 0.525, p=0.003] than the age groups between 5 to14 years old [odds ratio (OR) = 0.175, 95% CI: 0.048- 0.640, p=0.008].The participants who were lived in Kebele 03 were more infected by malaria [odds ratio (OR) = 7.677, 95% CI: 2.084-28.283, p=0.002] than the participants who were lived in Kebele 01 [odds ratio (OR) = 4.533, 95% CI: 1.195-17.19,p=0.026]. The participants who had large family sizes were infected by malaria [odds ratio (OR) =0.024, 95% CI: 0.002-0.342, p=0.006] than the participants who had smaller family sizes [odds ratio (OR) =0.045, 95% CI: 0.003-0.750, p=0.031].

With reference to non-pregnant, the state of pregnancy was not statistically significant (p=0.145). Even if the association between the prevalence of malaria and respondents' marital

status was not statistically significant (p=0.604), Participants they were married were more affected by malaria 43 (11.2%).Concerning to occupation farmers and daily laborer were more affected by malaria [odds ratio (OR) =5.544, 95% CI: 1.234-24.909, p=0.025] and [odds ratio (OR) =8.568, 95% CI: 1.750-41.953, p=0.008] respectively. Participant with low-income level significantly higher risk of getting malaria [odds ratio (OR) =2.031, 95% CI: 1.029-4.006, p=0.041] than participants with higher-income .The relationship between the prevalence of malaria and education was not statistically significant. The use of mosquito nets was statistically significant, the risk of malaria was low for participants who were used mosquito nets [odds ratio (OR) = 0.085, 95% CI: 0.048-0.152, p=000]. It was observed that the likelihood of getting malaria and IRS practice was statistically significance [odds ratio (OR) =0.288, 95% CI: 0.161-0.512, *p*=0.000].

The table below (Table 14) further showed the likelihood of having malaria in association with physical/ housing environmental factors/. It was observed that the association between malaria positivity and houses having holes on the walls (OR= 3.847, 95% CI: 2.267-6.527, *p*=0.000) and holes between walls and roofs (OR= 4.542, 95% CI: 2.2661 7.750, *p*=0.000), was statistically significant. It was also observed that the association between the prevalence of malaria and house roof was statistically significant. The participants who lived in the thatches roofs were more infected by malaria (OR= 19.545, 95% CI: 2.067-184.858, *p*=0.010) than the roofs of grooved iron sheets. It was further noted that house floors and rooms walls types were not significantly correlated with getting malaria (*p*=0.473&p=0.220). Finally, as far as nearness to mosquito breeding site(s) was concerned, participants who lived at a distance located in <1000 m were at significantly higher risk of having malaria in comparison with those that were lived at a greater distance (OR = 0.171, 95% CI: 0.049-0.594, *p*=0.005) (Table 14).

Table 14: Binary logistic regression analysis of malaria prevalence and associated risk factors

Variables	N	Malaria negative	Malaria positive	p-value	OR	95 % CI	
1 Sex						Lowe	Upper
Male	192	155(80.7)	37(19.3)	0.897	1.034	.621	1.722
Female	192	156(81.2)	36(18.8)		1.00		
2.Age							
≤ 4	68	65(95.6)	3(4.4)		1.00		
5 to 14	67	53(79.1)	14(20.9)	0.008	0.175	0.048	0.640
≥15	249	193(78.5)	56(22.5)	0.003	0.156	0.048	0.0525
2.Kebeles							
01	49	35(71.4)	14(28.6)	0.026	4.533	1.195	17.197
02	45	37(82.2)	8(17.8)	0.212	2.450	0.601	9.999
03	52	31(59.6)	21(40.4)	0.002	7.677	2.084	28.283
04	61	47(77.0)	14(23.0)	0.071	3.376	0.899	12.672
05	27	26(96.3)	1(3.7)	0.483	0.436	0.043	4.436
06	38	32(84.2)	6(15.8)	0.314	2.125	0.490	9.220
07	24	21(87.5)	3(12.5)	0.576	1.619	0.299	8.776
08	51	48(94.1)	3(5.9)	0.684	0.708	0.135	3.724
09	37	34(91.9)	3(8.1)	1.00	1.00		
4.House holds							
1	24	22(91.7)	2(8.3)	0.031	0.045	0.003	0.750
2	62	55(88.7)	7(11.3)	0.033	0.064	0.005	0.796
3	66	63(95.5)	3(4.5)	0.006	0.024	0.002	0.342
4	91	72(79.1)	19(20.9)	0.106	0.132	0.011	1.534
≥5	138	98(71.0)	40(30.0)	0.200	0.204	0.018	2.315
Missing value	3	1(33.3)	2(66.7)				
6.State of pregnancy							
Pregnant	44	39(88.6)	5(11.4)	0.145	0.471	0.171	1.297
Non-pregnant	145	114(78.6)	31(21.4)		1.00		
Missing value	3	3(100.0)					
7.Marital status							
Married	238	195(81.9)	43(18.1)	0.604	1.397	0.396	4.932
Single	91	72(79.1)	19(20.9)	0.445	1.671	0.447	6.246
Divorced	32	24(75.0)	8(25.0)	0.315	2.111	0.492	9.063
Widowed	22	19(86.4)	3(13.6)		1.00		
Missing value	1	1(100.0)					
8.Ocupation							
Farmer	94	68(72.3)	26(27.7)	0.025	5.544	1.234	24.909
NGO worker	37	32(86.5)	5(13.5)	0.350	2.266	0.408	12.590
House wife	84	72(85.7)	12(14.3)	0.267	2.417	0.509	11.475
Merchant	45	38(84.4)	7(15.6)	0.242	2.671	0.516	13.826
Government employee	56	49(87.5)	7(12.5)	0.383	2.071	0.403	10.649

Daily laborer	35	22(62.9)	13(37.1)	0.008	8.568	1.750	41.953
Others	31	29(93.5)	2(6.5)		1.00		
Missing value	2	1(50)	1(50)				
9.Income in month							
<700birr	174	130(74.7)	44(25.3)	0.041	2.031	1.029	4.006
800-3000birr	95	84(88.4)	11(11.6)	0.583	0.786	0.332	1.857
>3000	91	78(85.7)	13(14.3)		1.00		
Missing value	24	19(79.2)	5(20.8)				
10.Education							
Illiterate.	149	108(72.5)	41(27.5)	0.824	0.759	0.067	8.600
Primary school	105	92(87.6)	13(12.4)	0.316	0.283	0.024	3.340
Secondary school	51	42(82.3)	9(17.7)	0.508	0.429	0.035	5.253
Certificate	3	2(66.7)	1(33.7)	1.000	1.000	0.034	29.807
Diploma holder	46	40(87.0)	6(13.0)	0.355	0.300	0.023	3.839
Degree holder	24	22(91.7)	2(8.3)	0.233	0.182	0.011	2.999
Master and above.	3	2(66.7)	1(33.3)		1.00		
Missing value	3	3(100.)					
11.Education concern about malaria							
Yes	332	267(80.4)	65(19.6)	0.511	1.309	0.587	2.918
No	51	43(84.3)	8(15.7)		1.00		
Missing value	1	1(100.0)					
12.Important strategy							
Use insecticide sprays	40	35(87.5)	5(12.5)	0.610	0.667	0.140	3.172
Use a bed net.	245	196(80.0)	49(20.0)	0.814	1.167	0.323	4.220
Taking tablet	13	12(92.3)	1(7.7)	0.439	0.389	0.036	4.248
Keeping surrounding clean	38	27(71.1)	11(28.9)	0.379	1.901	0.455	7.949
Destroying mosquito breeding	28	25(89.3)	3(10.7)	0.511	0.560	0.099	3.155
Others	17	14(82.4)	3(17.6)		1.00		
Missing value	3	2(66.7)	1(33.3)				
13.LLINs use							
Yes	289	265(91.7)	24(8.3)	0.000	0.085	0.048	0.152
No	95	46(48.4)	49(51.6)		1.00		
14.Sleep under bed nets							
Daily.	127	122(96.1)	5(3.9)		1.00		
Irregularly	21	17(81.0)	4(19.0)	0.961	0.941	0.081	10.875
During Malaria season	54	46(85.2)	8(14.8)	0.759	0.696	0.069	7.053
Almost weekly.	31	3(9.7)	28(90.3)	0.004	37.333	3.083	452.044
Others							
Missing value							
15.IRS							
Yes	183	165(90.2)	18(9.2)	0.000	0.288	0.161	0.512
No	200	145(72.5)	55(27.5)		1.00		
Missing value	1	1(100)					
16.House roof							

Thatches	54	11(20.4)	43(79.6)	0.010	19.545	2.067	184.858
Grooved iron sheet.	323	294(91.1)	29(8.9)	0.525	0.493	0.056	4.366
Others	6	5(83.3)	1(16.7)				
Missing value	1	1(100.0)					
17.Rooms floor							
Soil	92	71(77.2)	21(22.8)	0.473	1.249	0.680	2.293
Plastic carpet	40	37(92.5)	3(7.5)	0.088	0.342	0.100	1.173
Ceramics	38	33(86.8)	5(13.2)	0.385	0.640	0.233	1.753
Local dung	25	17(68.0)	8(32.0)	0.142	1.987	0.795	4.963
Cement	188	152(80.8)	36(19.2)		1.00		
Others							
Missing value	1	1(100.0)					
18.Rooms wall							
Mud blocks	192	150(78.1)	42(21.9)	0.220	3.640	0.463	28.632
Sticks	132	109(82.6)	23(17.4)	0.342	2.743	0.342	22.025
Gypsum	46	39(84.8)	7(15.2)	0.448	2.333	0.262	20.792
Others	14	13(92.9)	1(7.1)		1.00		
19.Holes on the wall							
Yes	123	81(65.9)	42(34.1)	0.000	3.847	2.267	6.527
No	261	230(88.1)	31(11.9)		1.00		
20.Holes b/n wall and roof							
Yes	113	71(62.8)	42(37.2)	0.000	4.542	2.661	7.750
No	269	238(88.5)	31(11.5)		1.00		
Missing value	2	2(100.0)					
21.Mosquito breeding site							
Yes	188	141(75.0)	47(25.0)	0.004	2.167	1.277	3.676
No	195	169(86.7)	26(13.3)		1.00		
Missing value	1	1(100.0)					
22.Distance from Mosquito breeding							
1. <1000 m	94	82(87.2)	12(12.8)	0.005	0.171	0.049	0.594
1000m-2000m	41	32(78.0)	9(22.0)	0.097	0.328	0.088	1.225
>2000 m	21	17(81.0)	4(19.0)	0.100	0.275	0.059	1.282
Others	13	7(53.8)	6(46.2)		1.00		
Missing value	19	3(15.8)	16(84.2)				

Key=Missing value refers to the value which was not answered by the participants
OR=Odd ratio
P-value ≤ 5 is significant
N=Number of participants

4.3.2. Multivariate analysis of malaria-risk-factors

Potential malaria risk factors that showed significant associations in univariate analysis were selected and entered in to SPSS version 20 for multivariate logistic regression modeling to identify the most important predictors or independent variables for the infection of malaria. Table 15 below showed adjusted odd ratios (AOR), independent effect of Socio demographic, environmental factors, LLINs and IRS. The association between the prevalence of malaria and age groups of the participants was statistically significant .The age groups ≥ 15 years old were highly infected by malaria (AOR = 0.134, 95% CI: 0.040-0.450, *p*=0.001) than the age groups between 5-14 years old (AOR = 0.163, 95% CI: 0.043-0.613, *p*=0.007). The Kebeles that the participants were lived have associations with the infection of malaria (AOR = 9.300, 95% CI: 2.352-36.774, *p*=0.001).The highest infection was found in Kebele 03. The association between the prevalence of malaria and income level of the participants was statistically significant (AOR = 2.285, 95% CI: 1.071-4.874, *p*=0.033).The participants who had low level of incomes were highly infected by malaria. The association between the prevalence of malaria and long lasting insecticidal nets was statistically significant. The infection of malaria was low on the participants who were used long lasting insecticidal nets (AOR = 0.083, 95% CI: 0.045-0.155, *p*=0.000). Furthermore, the relationship between prevalence of malaria and IRS was statistically significant (AOR = 0.490, 95% CI: 0.255-0.941, *p*=0.032). The association between mosquito breeding sites and the prevalence of malaria was highly significant (AOR = 2.573, 95% CI: 1.364-4.854, *p*=0.004). In general, age groups, Kebeles, mosquito breeding sites, income level of the participants, number of LLIN and IRS were the different risk factors that were significantly associated with prevalence of malaria in the study area (Table 15).

Table 15: Multivariate logistic regression analysis of malaria incidence and risk factors

Variables	N	Malaria negative in № & (%)	Malaria positive in № & (%)	p-value	AOR	95% CI	
1. Age						Lower	Upper
≤ 4	68	65(95.6)	3(4.4)		1.00		
5-4	67	53(79.1)	14(20.9)	0.007	0.163	0.043	0.613
≥ 15	249	193(78.5)	56(22.5)	0.001	0.134	0.040	0.450
2. Kebeles							
01	49	35(71.4)	14(28.6)	0.026	4.879	1.212	19.637
02	45	37(82.2)	8(17.8)	0.282	2.236	0.516	9.699
03	52	31(59.6)	21(40.4)	0.001	9.300	2.352	36.774
04	61	47(77.0)	14(23.0)	0.055	3.972	0.973	16.208
05	27	26(96.3)	1(3.7)	0.622	.551	0.052	5.890
06	38	32(84.2)	6(15.8)	0.553	1.593	0.341	7.439
07	24	21(87.5)	3(12.5)	0.508	1.818	0.310	10.675
08	51	48(94.1)	3(5.9)	0.870	0.867	0.159	4.736
09	37	34(91.9)	3(8.1)		1.00		
3. Income in month							
<700birr	174	130(74.7)	44(25.3)	0.033	2.285	1.071	4.874
800-3000birr	95	84(88.4)	11(11.6)	0.259	0.581	0.226	1.491
>3000	91	78(85.7)	13(14.3)		1.00		
Missing value	24	19(79.2)	5(20.8)				
4. LLINs use							
Yes	289	265(91.7)	24(8.3)	0.000	0.083	0.045	0.155
No	95	46(48.4)	49(51.6)		1.00		
5. IRS							
Yes	183	165(90.2)	18(9.8)	0.032	0.490	0.255	0.941
No	200	145(72.5)	55(27.5)		1.00		
Missing value	1	1(100.0)					
6. Mosquito breeding site							
Yes	188	141(75.0)	47(25.0)	0.004	2.573	1.364	4.854
No	195	169(86.7)	26(13.3)		1.00		
Missing	1	1(100.0)					

Key=Missing value refers to the value which was not answered by the participants

5. Discussions

This study investigated prevalence, risk factors and awareness about malaria among malaria outpatients in Shewarobit Health Center. The document based health care service study was assessed the prevalence of malaria over a period of five years in person, time and composition of *plasmodium* species. The result of the study revealed that during the last five years, a fluctuating fashion of malaria rate was observed in each year. A total of 33,932 blood film samples were collected and tested for malaria diagnosis in Shewarobit Health Center (2013 – 2017) of which 4705 (13.9%) of the samples were microscopically confirmed as malaria positives. The data showed that a down ward trend in malaria infection except 2017. Accordingly, the highest prevalence (23.0%) was recorded in 2017 which was higher by (14.8%) than the prevalence recorded in 2016 (8.2%). Even though the numbers of malaria cases were decreased from 2013 to 2016, the highest malaria cases were recorded in 2017.The reduction of malaria cases from 2013 to 2016 might be due to the increased attention to malaria control and preventive activities by different responsible bodies in the study area, increased the awareness of the community on use of long lasting insecticide nets, indoor residual spray and the hygiene of community. The highest infection in 2017 might be due to the creation of mosquito breeding sites due to the construction of new houses and lack of consistent use of long lasting insecticidal nets and indoor residual sprays.

The prevalence of malaria in retrospective data in Shewarobit Health Center was 13.9%. It is higher than the results of other studies conducted in Woreta Health Center 5.4% (Derbie *et al*., 2017), by Hailemariam *et al*. (2015) in Arsi Negelle Health Centers 11.45%, but it is less than the results of other studies done in Kola Diba Health Center 39.6%(Alemu *et al*., 2012), by Tefera (2014) in Hallaba Health Center 82.84% and by (Legese *et al*. (2015) in Wolaita Zone 33.27%. This difference may be due to the type of study design used, climatic condition differences, altitude variation, malaria diagnosis technique variation, skill of the laboratory technicians and difference on the record of the data and other factors.

In the current survey a total of 384 blood film samples were collected and diagnosed for malaria in Shewarobit Health Center (October 2017- April, 2018) of which 73 (19.0%) of the samples were microscopically confirmed as malaria positive. The prevalence is lower than the results of other studies done in Kola Diba Health Center (Alemu *et al.*, 2012) 39.6%, by Legese *et al.*

(2015) 33.27% in Wolaita Zone, by Tefera (2014) 82.84% in in Hallaba Health Center but the prevalence was higher than the results of other studies done in Aresi Negelle Health Cente 11.45% (Hailemariam *et al.*, 2015), by Awoke *et al.* (2017) 5.4% in Woreta Health Center, by Gebretsadik *et al.* (2018) 7.52% in Kombolcha, by Ayalew *et al.* (2016) 2.8% in Jiga Area, by Alemu *et al.* (2011) 5.2% in Jimma town and in Ethiopia 7% (Regasa, 2014). These differences might be due to the geographical setup, variations in the study period, sample size as well as study population in which those studies focused on.

Seasonality and year play a role in the transmission of malaria in the study area, even though there were fluctuations in malaria infections, malaria cases were occurred in almost every month and season of the year. The highest peak of malaria infections were recorded in September, October and November months in the years followed by during the months of June, July and August and the minimum numbers of malaria cases were recorder during the months of December to May in the study area. In the current survey the highest infections were occurred in October and November. This might be due to the environmental and climatological situations that permit the continual breeding of vectors in permanent breeding sites on these months.

The result of this study is in line with the study findings in Aresi Negelle Health Center (Hailemariam *et al.*, 2015), by Derbie *et al.* (2017) in Woreta Health Center, by Gebretsadik *et al.* (2018) in Kombolcha, by (Alemu *et al.* (2012) in Kola Diba, by Tesfaye *et al.* (2012) in the high land fringe of Butagira, by Alemu *et al.* (2011) in Jimma town and by Legese *et al.* (2015) in Wolaita Zone. .

According to the record review in the last five years (2013-2017) in the study area, males were more affected than females by malaria infection in each year. Out of 4705 positive outpatients 3074 were males and 1631 were females. The infections rate among males were 65.3% and females were 34.7% with a ratio of males to females was 1.9:1.The current survey also showed that males were slightly more affected than females. The data showed that 37(50.7%) of the infected outpatients were males and 36(49.3%) were females. The reason why malaria affects males than females in the study area might be due to the life style and occupation of males. Males are usually involved in agricultural activities which are highly matched to the infection seasons of malaria, they sleep outside due to hot climatic condition, they did not use long lasting

insecticidal nets properly like females and engaged in activities outside their residence area (migration) which made them more susceptible to mosquito bites as compared to females which were limited to their residence area at home and may not be exposed to malarial areas.

The result of the this study contradicts with the results of other studies conducted in Ethiopia (Ayele *et al.*, 2012), the highest prevalence occurring in females, by Derbie et *al*. (2017) in Woreta Health Center, females were 1.3 times more likely to be infected than males and by (Legese *et al.* (2015) in Wolaita Zone, the disease affected both males and females almost equally. The result is also line up with the study findings reported in Aresi Negelle Health Center (Hailemariam *et al.*, 2015), the prevalence of malaria parasites among males (55.4%) was somewhat higher than females (44.6%), by Gebretsadik *et al. (*2018) in Kombolcha, male patients were more affected (68.1%) than female ones (31.89%) and by Alemu *et al.* (2012) in Kola Diba, the infection rates among males were (52.6%) and females were (47.3%).

Regarding to the age groups the infection rate was 10.6% in the age groups ≤4 years old, 25.3% in the age groups between 5-14 years old, and 65.5% in the age groups ≥ 15 years old in retrospective data. In the current survey, 4.1% in the age groups ≤4 years old, 19.2% in the age groups between 5 to 14 years old and 76.7% in the age groups ≥15 years old. Although malaria infection was reported in all age groups, the most vulnerable age groups were ≥ 15 years old with the overall prevalence of 65.5% in retrospective data and 76.7% in the current survey. This might be related with their frequent outdoor activities like agriculture associated with irrigation, the area is hot so staying outside the home and sleeping under trees was common during the night time. This can increase the exposure of these age groups of the population to *Anopheles* mosquito bites, which can transmit *Plasmodium* parasites. Due to peak malaria transmission often coincides with the planting and harvesting season in the study area as the result the majority of malaria burden was occurred among working adults in rural agricultural areas.

The result of the study contradicts with the study findings reported in Wolaita Zone (legese *et al.*,2015), the highest slide positivity rate was observed among the age groups between 5–14 years old, by Hailemariam *et al.*(2015) in Aresi Negelle Health Center, children in the age range 0 to 5 years old were the most affected groups by the disease, by Woyessa *et al.* (2012) in Butajira area, the incidence in the highlands was similar for all age groups, by Alemu *et*

*al.(*2011) in Jimma town, higher malaria prevalence rate was observed among under-five children (11%) , by Lelisa *et al.* (2014) in south west Ethiopia, children in the age groups between 10 to 14 years were the most affected by the disease, by Ayele *et al. (*2012) in Ethiopia, positive malaria diagnosis rate decreased with age , by Tefera (2014) in Hallaba Health Center, the highest prevalence of malaria was seen in the age groups of 0-19 years old. The result of the study also in agreement with the study findings reported in Woreta Health Center (Derbie *et al.*,2017), patients in the age group of above 15 years old were 1.9 times more likely to be positive for malaria than individuals under the age of 5 years old, by Gebretsadik *et al.* (2018) in Kombolcha, the highest malaria prevalence (69.69%) was seen in the 15–45 years age group , by Alemu *et al.* (2012) in Kola Diba, malaria was reported in all age groups in the area but the age groups of 15–44 years old were more affected with a prevalence rate of (50.1%).

In the retrospective data from the total confirmed malaria cases 4705, the predominantly reported species were *P. vivax,* accounted for 2296 (48.8%) of the overall prevalence followed by *P. falciparum,* accounted for 2077 (44.1%) and mixed infection accounted for 332(7.1%). In the current survey, the predominant species were *P. vivax* that was 58 (79.5%) followed by *P. falciparum* 11 (15.1%) and the mixed infections were 4(5.5%). In both cases the predominant *Plasmodium* species was *P. vivax*. The reasons why *P. vivax* dominates *P. falciparum* might be due to the relapsing characteristics of *P. vivax* at the time of relatively malaria free seasons, the prevention and control activities that was guided by the National Strategic Plan (2006- 2010) mainly focus on *P. falciparum* because it was assumed more prevalent and fatal malaria in the country, other possible reasons might be climate variability and *P. vivax* might have developed resistance for the currently used drug chloroquine (Alemu, 2012).

The result of the study contradicts with the results of other studies conducted in Woreta health center (Derbie *et al.*,2017), which reported that prevalence of *P. falciparum* 53.7%, *P. vivax* 42.4% and 3.9% mixed infection , by Gebretsadik *et al.*(2018) in Kombolcha which reported prevalence of *P. falciparum* 60.2% , *P, vivax* 35.5% , by Ayalew *et al.*(2016) in Jiga area in North West Ethiopia which reported nearly similar existence of *P. falciparum* and *P. vivax,* by Lelisa *et al.*(2014) in South West Ethiopia which reported the prevalence of *P. falciparum* 54.6% , *P. vivax* 41.6%) and 3.8% mixed infection. 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. The result of the study coincides with the study findings reported from Aresi Negelle Health Center (Hailemariam *et al.*, 2015), *P. vivax* (74%), *P. falciparum* (19.8%) and (6.2%) mixed infection, by Tefera (2014) in Hallaba Health Center, *P. vivax* (70.41%), *P. falciparum* (23.08%) and (6.51%) mixed infection, by Tesfaye *et al.*(2012) in butajira, *P. vivax* was dominant, by Alemu *et al.*(2011) in Jimma town, *P. vivax* (71.4%), *P. falciparum* (26.2%) and (2.4%) mixed infection and South Central Ethiopia, Butajira area (Woyessa *et al.*, 2012), *P. vivax* (86.5%), *P. falciparum* (12.4%) and (1.1%) mixed infection.

There was relationship between prevalence of malaria and localities or Kebeles, participants who were lived in Kebele 03 were more infected by malaria (AOR = 9.300, 95% CI: 2.352-36.774, *p*=0.001) than the participants who were lived in Kebele 01 (AOR = 4.879, 95% CI: 1.212-19.637, *p*=0.001). This might be due to the living standard of the participants, most of the participants live in the Kebele houses and the houses are very old and they are not suitable to apply malaria control strategies and the Kebele is found near to the mosquito breeding sites. The result coincides with the result reported by Yeshiwondim *et al. (*2009) in Ethiopia; there were the wide variations of malaria infection between Kebeles.

The association between the prevalence of malaria and income level of the participants were statistically significant .The participants who had low level of incomes were highly infected by malaria (AOR = 2.285, 95% CI: 1.07-4.87, *p*=0.033).This might be due to lack of money to live in better houses. The result coincides with the result reported by Alemu *et al.* (2011) in Jimma town, more cases of malaria were observed in those having monthly income <31.25 USD (OR = 3.7; 95% CI 1.1-12.8, p = 0.042) compared to having >62.5 USD.

The association between the prevalence of malaria and long lasting insecticidal nets were statistically significant. The infection of malaria was low on the participants who were used long lasting insecticidal nets (AOR = 0.083, 95% CI: 0.045-0.155, *p*=0.000).The result is in agreement with the result of other studies done in Jimma town has also shown that long lasting insecticides were positively associated with protection against malaria (Alemu *et al.*, 2011), Southern Ethiopia (Derese *et al.*, 2014), in Ethiopia (Ayele *et al.*, 2012), South west Ethiopia (Lelisa *et al.*, 2014), in Ethiopia from 1990 to 2015 (Amare *et al.*, 2017), Benishangul-Gumuz (Melaku *et al.*, 2016) and in Jiga area (Ayalew *et al.*, 2016).

The overall IRS coverage in the study area was 47.7% the remaining 52.1% of the participants were not use the method to prevent malaria in this year (2018). Globally, IRS protection declined from a peak of 5.8% in 2010 to 2.9% in 2016, with decreases seen across all WHO regions (WHO, 2017). Furthermore between the prevalence of malaria and IRS were statistically significant (AOR = 0.490, 95% CI: 0.255-0.941, *p*=0.032).The participants who used IRS were less infected by malaria in the study area. The result coincides with the result of the other study done on the prevalence and risk factors of malaria in Ethiopia (Ayele *et al.*, 2012).

The association between mosquito breeding sites and the prevalence of malaria was highly significant in the study area (AOR = 2.573, 95% CI: 1.364-4.854, *p*=0.004). As far as nearness to mosquito breeding site was concerned, participants who were lived in <1000 m distance were at significantly higher risk of having malaria in comparison with those that were at a greater distance.

The result coincides with the result of the research done in Jimma town (Alemu *et al.*,2011), living in areas where stagnant water existed (OR = 2.1; 95% CI 1.00-4.2, p = 0.047) and its distance of existence <1 km from the house (OR = 2.1; 95% CI 2.0-15.8, p = 0.001) were more likely to be infected with malaria parasite compared with those who live away from stagnant at a distance greater than 1 km and in North west Ethiopia (Ayalew *et al.*,2016), proximity to mosquito breeding site was significant predictor of mRDT positivity with OR, 95% CI and p-values of 0.11, 0.12–0.64, 0.014 respectively.

6. Conclusions and recommendations

6.1. Conclusions

The five years retrospective data showed that there was a consequence reduction in the prevalence of malaria from 2013 to 2016 but there was increasing in 2017. Even though there were fluctuations in malaria infections, malaria cases occurred in almost every months and seasons of the year. The highest peak of malaria infection was recorded in September, October and December months in all years followed by during the months of June, July and August, and the minimum number of malaria cases was observed during the months of December to April in study area.

However, malaria infection was reported in all age groups, the most vulnerable age groups were ≥15 years old in case of both males and females. The predominantly species in the study area were *P. vivax* followed by, *P. falciparum* and mixed infection.

Based on the cross sectional survey, the prevalence of malaria in the study area was high (19.0%).The infection of *P. vivax* was pre-dominant, followed by *P. falciparum* and mixed infection. The association between the prevalence of malaria and age groups of the participants were statistically significant .The age groups ≥15 years old were highly infected by malaria. The Kebeles that the participants were lived have association with the infection of malaria .The highest infection was found in Kebele 03. The association between the prevalence of malaria and income level of the participants were also statistically significant .The participants who had low level of incomes were highly infected with malaria. The prevalence of malaria and long lasting insecticidal nets were statistically significant. The infection of malaria was low on the participants who were used long lasting insecticidal nets. Furthermore between the prevalence of malaria and IRS were statistically significant. Malaria infection was low on the participants who were used indoor residual spray. Finally the association between mosquito breeding sites and the prevalence of malaria was highly significant. Participants who lived in <1000 meter distance were at significantly higher risk of having malaria in comparison with those that were at a greater distance.

Even if the current malaria control strategies were effective in decreasing patients' morbidity and mortality, but malaria is still among the public health problems in the study area.

6.2. Recommendations

Based on the study findings, strongly forward the following recommendations;

- As it was revealed by the result of the study use of long lasting insecticidal nets can reduce both malaria transmission and its mortality therefore, great emphasis should be given to long lasting insecticidal nets distribution and ensure its utilization at every households in the study area.
- Special attentions should be given to the implementation of indoor residual spray, the activities must be carried out after aware the community to prepare their houses for spray.
- Special attentions should be given for some Kebeles such as Kebele 03, where malaria prevalence was observed highly throughout the majority of the study periods.
- The community should be destroyed the breeding site of mosquitoes especially in areas where new houses construction takes place.
- Health workers should be mobilized the communities to improve the health situation through health education.
- Further studies should be conducted to determine or forecast potential epidemic patterns in the study area.

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7. References

Abreha, T., Alemayehu, B., Tadesse, Y., Gebresillassie, S. and Tadesse, A. (2014). Malaria diagnostic capacity in health facilities in Ethiopia. *Malaria Journal* **13** (292).

Alemu, A., Tsegaye, W., Golassa, L., and Abebe , G.(2011). Urban malaria and associated risk factors in Jimma town, south-west Ethiopia. *Malaria Journal* **10** (173):1-10.

Alemu, A., Muluye, D., Mhret, M., Adugna, M. and Gebeyaw, M. (2012).Ten year trend analysis of malaria prevalence in Kola Diba, North Gondar, Northwest Ethiopia. *Parasites & Vectors* ***5***(173): 1-6.

Amare, D., Tariku, D., Biruck, K., Gizachew, A., Tessema, Y., Adama, M., Awoke, M., Teshome, G., Asrat, H., Sibhatu, B., Alemayehu, A.,Biruck D., Y., Amanuel, A., A., Oumer, S., Semaw, F. A., Nebiyu, N.,Belete, M., Azmeraw, T. A., Abate, M., Birhan, M., Zerihun, T., Mesfn, S., Elizabeth, C., Scott D. G., Kebede, D., and Jefrey, D., S.(2017). Incidence, prevalence and mortality rates of malaria in Ethiopia from 1990 to 2015: analysis of the global burden of diseases 2015.*Malaria Journal* **16** (195): 1-7.

Ayalew, S., Mamo, H., Animut, A. and Erko, B. (2016).Assessment of Current Malaria Status in Light of the Ongoing Control Interventions, Socio Demographic and Environmental Variables in Jiga Area, Northwest Ethiopia. PLoS ONE **11**(1): e0146214. doi:10.1371/journal.pone.0146214.

Audrey, P., Eboni, T., Duvall, D., Martine, T. and Steve, M. (2008). Perceptions among women seeking antenatal care in Kinshasa, Democratic Republic of the Congo (DRC): Opportunities for improved maternal and child health. *Biomedical Center Public Health* **8** (331).

Ayele, D. G., Zewotir, T.T., and Mwambi, H. G. (2012). Prevalence of malaria and risk factors of malaria in Ethiopia. *Malaria Journal* **11**(195):2-9.

Bartoloni, A. and Zammarchi, L. (2012).Clinical aspects of uncomplicated and sever malaria. *Mediterranean Journal of Hematology and Infectious Diseases* **4**(1).

CDC (2006). Malaria Surveillance - United State: Morbidity and Mortality Weekly Report 24(SS-5):24.

CDC (2014).Malaria Surveillance - United States: Morbidity and Mortality Weekly Report. **66** (12).

CDC (2015).Malaria operational plan: President's malaria initiative Ethiopia pp.9-18

CDC (2017). Malaria operational plan: President's malaria initiative Ethiopia p.17

Chikamata, D. (2014). Guidelines for the Diagnosis and Treatment of Malaria in Zambia (4thedn) Ministry of Health, Zambia.

Cowman, A.F., Berry, D. and Baum, J. (2012).The cellular and molecular basis for malaria parasite invasion of the human red blood cell. *Journal of Cell Biology* **98**(6): 961-971.

Cox-Singh, J., David, T.M., Lee, K., S., Shamsul, S.S., Matusop, A. and Ratnam, S. (2008). *Plasmodium knowlesi* malaria in humans in widely distributed and potentially life threatening. *Clinical Infectious Disease **46***(2):165–171.

Derbie, A. and Megbaru, A. (2017). Five Years Malaria Trend Analysis in Woreta Health Center, Northwest Ethiopia. *Ethiopian Journal of Health Science* **27***(5):465-472*

Deressa,W.,Yihdego,Y.Y.,Kebede,Z.,Batisso,E.,Tekalegn,A. and Dagne, G.(2014).Effect of combining mosquito repellent and insecticide treated net on malaria prevalence in Southern Ethiopia: a cluster-randomized trial. *Parasites & Vectors* **7**(132):1-10.

EMIS (2015). Ethiopian Malaria Indicator Survey, Ethiopian public Health Institute Addis Ababa, Ethiopia: Malaria Epidemiology p.13.

FMOH (2015). Ethiopian National Malaria Indicator survey, Federal Ministry of Health Addis Ababa, Ethiopia pp.1-112.

FMOH (2012). National Malaria Guidelines, Federal Ministry of Health, Federal Democratic Republic of Ethiopia: 14-46.

Gebretsadik, D., Getacher, D., F. and Fisha, M. (2018). Eight-year trend analysis of malaria prevalence in Kombolcha, South Wollo, north-central Ethiopia: a retrospective study. *Parasites & Vectors* **11**(55):1-6.

Getachew, G. and Tsige, K. (2016). Severe Malaria Associated with *Plasmodium falciparum* and *P. vivax* among Children in Pawe Hospital, Northwest Ethiopia. *Mala Research & Treatment*, 2016 Article ID 1240962: 1-7.

Getachew, S., Kamala, T., Sarah A., Abera, A., Gadisa, E., Aseffa, A., Ric, N.P. and Petros, B. (2015).Chloroquine efficacy for *Plasmodium vivax* malaria treatment in southern Ethiopia. *Malaria Journal* **14**(525):1-8.

Hailemariam, M. and Gebre, S., (2015).Trend analysis of malaria prevalence in Arsi Negele health center, southern Ethiopia. *Journal of Infectious Diseases and Community* **7** (1):1-6.

Legesse, D. Haji, Y. and Abreha, S. (2015). Trend Analysis of Malaria Occurrence in Wolaita Zone, Southern Ethiopia: Retrospective Cross-Sectional Study. *Malaria Research and Treatment*, Article ID 123682, **2015**:1-8.

Lelisa, D.S., Wakgari, A.D., and Ahmed, A.A. (2014).Analysis of the trend of malaria prevalence in South Ethiopia: a retrospective comparative study, *Malaria Journal* **13**(188).

Markoski, B. and Melovska, T. (2017). Geographical distribution of diseases in the world: Prevalence of diseases transmitted by insects. *Research gate*, ISBN-13978-9989-648-37-3:146-156.

Melaku, W. and Ayele, M. (2016). Impact of insecticide-treated bed net use on malaria prevalence in Benishangul-Gumuz regional state, Ethiopia, *Journal of Vector Borne Disease* **53**: 215–224.

Molla, E. (2016). Malaria: What are the Needs for Diagnosis, Treatment and Control? *Biology and Medicine (Aligarh*) **8**(7):2-10.

Mouatcho, J.C., and Goldring, J.P.D. (2013). Malaria rapid diagnostic test: Challenges and prospects. *Journal of Medical Micro-biology* **62**:1491-1505.

Naing, L. T., Winn and B.N. Rusil. (2007). Practical issues in calculating sample size for prevalence studies. *Journal of Archives Orofacial Sciences* **1**:9-14.

NCCLS (2002). Protection of Laboratory workers from Occupationally Acquired Infections. Approved guideline M29-A3, **25** (10):1-111.

Nyanjom,S.R.G.,Chen,H.,GebreMichael,T.,Bekele,E.,Shililu,J.,Guthere,J.,Beier,J.C.and Yan, G.(2003).Population Genetic Structure of *Anopheles arabiensis* mosquitoes in Ethiopia and Eritrea. *Journal of Heredity* 94(6): 457–463.

Regasa, B. (2014). Magnitude of malaria infection in Ethiopia. *Global Journal of Medical Research* **14** (7).

Solomon, L., Okere, H. and Daminabo, V. (2014). Understanding Human Malaria: Further Review on the Literature, Pathogenesis and Disease Control. Repeport and Opinion **6**(6) : 55-63.

Tefera, G. (2014). Prevalence of Malaria and Associated Factors among Patients attending at Hallaba Health Center, Southern Ethiopia. *Immunology and Infectious Diseases* **2**(3): 25-29.

Tesfaye, S., Belyhun,Y., Teklu, T., Medhin, G., Mengesha, T., and Petros, B.(2012). Malaria pattern observed in the highland fringe of Butajira, Southern Ethiopia: a ten-year retrospective analysis from parasitological and metrological data. *Malaria World Journal* **3** (5):1-8.

Tonnang, H. E.**,** Kangalawe, R.Y. and Yanda, P.Z. (2010). Predicting and mapping malaria under climate change scenarios: The potential redistribution of malaria vectors in Africa. *Malar Journal **9***(111):2-10.

Woyessa, A., Deresa, W., Ali, A. and Berent, L. (2012). Prevalence of malaria infection in Butajira area, south-central Ethiopia. *Malaria Journal* 11(84):1-8.

WHO (1991). Basic Laboratory Method in Medical Parastology. World Health Organization, Geneva.

WHO (2010). Guidelines for the treatment of malaria (2ndedn), World Health Organization Press, Geneva, Switzerland.

WHO (2011). World Malaria Report, World Health Organization Press, Geneva.

WHO (2012). World Malaria Report, World Health Organization Press, Geneva, Switzerland.

WHO (2013). World Malaria Report, World Health Organization Press, Geneva, Switzerland.

WHO (2014).World malaria report, World Health Organization.

WHO (2015). World Malaria Report, World Health Organization Press, Geneva, Switzerland.

WHO (2017). World Malaria Report,World Health Organization.

Yeshiwondim, A.K., Sucharita, G., Hailemariam, A.T., Dengela, D.O and Hrishikash, p. p. (2009). Spatial analysis of malaria incidence at the village level in areas with unstable transmission in Ethiopia. *International Journal of Health Geographic* **8**(5):1-11.

8. Annexes

8. 1. Consent form in English version

I am TadegewTeshome MSc student in Addis Ababa University College of Natural Sciences Department of zoological science. I am here to study about malaria prevalence and associated risk factors in Shewarobit town for my MSc thesis. In order to design and implement cost-effective malaria control interventions, up-to-date information on the prevalence, distribution and influencing local factors of the disease are the very important elements. The primary objective of this study is, therefore, to assess the current status of malaria in area in relation to the current control activities thereby to contribute towards informed decision making in malaria control. The study will involve any of the patients that are randomly selected by the data collector in Shewarobit Health Center. I will gather relevant data using structured questionnaires and will be asked about malaria test using a finger-prick blood sample which will be done by health professionals. Therefore, your kind and genuine response will play key role to make this study successful. In addition, no personal identification will be written and I assure you that whatever information you are providing will only be used for the research purpose and the data will be handled only by the researcher. Are you willing to participate in the study?

Agreed ☐ Not agreed ☐ .If you are agreed to participate in the study, put **(√)** in the box in front of number that contains the answer you expected.

Thank you

8. 2. Questionnaires in English version

Part one: personal information.

1. Sex of respondents: 1. Male ☐ 2. Female ☐

2. Age of respondents: 1.≤ 4 years old ☐ 2.5-14 years old ☐ 3.≥ 15 years old ☐

3. Kebeles of the respondents: 1. kebele01☐ 2. kebele 02☐ 3. kebele 03☐ 4. kebele 04☐

5. kebele 05 ☐ 6. kebele 06 ☐ 7. kebele 07 ☐ 8. kebele 08 ☐ 9. kebele09 ☐

4. Numbers of households: 1.one ☐ two ☐ three ☐ four ☐ Five ☐

5. State of pregnancy: 1. Pregnant ☐ 2.Non-pregnant ☐

6. Marital status: 1. Married ☐ 2.Single ☐ Divorced ☐ Widowed ☐

7. House number of the respondent---------.

8. Occupation

1. Farmer ☐ 5. Government employee ☐

2. NGO worker ☐ 6. Daily laborer ☐

3. House wife ☐ 7. Others specify ____.

4. Merchant ☐

9. Income in a month: 1. <700 Birr ☐ 2.800-3000Birr ☐ 3. >3000Birr ☐

10. Educational status:

1. Illiterate ☐ 4. Certificate ☐ 7. Master and above ☐

2. Primary school ☐ 5. Diploma holder ☐

3. Secondary school ☐ 6. Degree holder ☐

Section two: Questionnaires that are prepared to know the distribution and risk factors of malaria

11. Have you seen or heard any educational messages concerning to malaria from any sources?

1. Yes ☐ 2.No ☐

12. If your answer on question number 11 is yes, explain the source.

1. Health workers ☐ 3. Religious institutions ☐

2. Mass media ☐ 4. Others specify _____.

13. What is the cause of malaria?

1. *Plasmodium* ☐ 4. Malnutrition ☐

2. Cold climatic condition ☐ 5. Sleep outside ☐

3. Contaminated water ☐ 6. Do not know ☐

14. What is the most important strategy in your house to prevent malaria infection?

1. Use insecticide sprays ☐ 4. Keeping the house and surrounding clean ☐

2. Use a bed net ☐ 5. Destroying mosquito breeding sites ☐

3. Taking tablet ☐ 6. Others specify _____.

15. Are there insecticide treated bed nets in your house?

1. Yes ☐ 2.No ☐

16. If your answer on question number 15 is yes, how many ITNs do you have in your house?

1. One ☐ 2. Two ☐ 3. Three ☐ 4. > Four ☐

17. Are they currently being used?

1. Yes ☐ 2. No ☐

18. If your answer on question number 17 is no, reason for not using the available ITNs;

1. Nets do not prevent malaria ☐ 2. Afraid of its toxicity ☐ Do not have (LLINs) ☐

19. Who uses the ITNs in your house?

1. Children ☐ 4. Father and mother ☐

2. Mother ☐ 5. Children and mother ☐

3. Father ☐ 7. Children and father ☐

6. The whole family ☐

20. How often do you or your family sleep under bed nets?

1. Daily ☐ 3. During Malaria season ☐

2. Irregularly ☐ 4. Almost weekly ☐ Others specify ____.

21. Types of bed nets?

1. Untreated nets ☐ 3. Long-lasting insecticide treated nets ☐

2. Locally treated nets ☐ 4. Don't know ☐

22. Was the house sprayed with insecticide?

1. Yes ☐ 2. No ☐

23. Have you or your family members infected with malaria before this time?

1. Yes ☐ 2. No ☐

24. If your answer on question number 23 is yes, where did you go for treatment?

1. Health center ☐ 4. Nowhere (managed at home) ☐

2. Hospital ☐ 5. Others specify _____.

3. Traditional healers ☐

25. What are the main materials of the room's roof?

1. Thatches ☐ 2. Grooved iron sheet ☐ 3. Others specify _____.

26. What are the main materials of the room's floor?

1. Soil ☐ 2.Plastic carpet ☐ 3.Ceramics ☐ 4.Local dung ☐ 5. Cement ☐ 6. Other specify____

27. What are main materials of the room's wall?

1. Mud blocks ☐ 2. Sticks ☐ Gypsum ☐ Others specify _____.

28. Are there holes on the wall of your house?

1. Yes ☐ 2. No ☐

29. Are there holes b/n the wall and the roof of your house?

1. Yes ☐ 2. No ☐

30. Are there any mosquito breeding habitats around your village?

1. Yes ☐ 2. No ☐

31. If the answer of question number 30 is yes, distance of the house from mosquito breeding habitats is: 1. <1000m ☐ 2.1000m-2000m ☐ 3. >2000m ☐ Others specify-----

32. How many times you are infected by malaria in this year?

1. One times ☐ 2.Two times 3.Three times ☐ 4.Not infected ☐ Other specifies____

33. Is malaria affecting the economy of the country?

1. Yes ☐ 2.No ☐ 3.I do not know ☐

8. 3. Written consent form in Amharic.

የስምምነት ቅፅ

እኔ ታደገው ተሾመ በአዲስ አበባ ዩኒቨርስቲ የተፈጥሮ ሳይንስ ኮሌጅ በዚኦሎጂ ትምህርት ክፍል የሁለተኛ ዲግሪ ተማሪ ነኝ።በሸዋሮቢት ከተማ አስተዳደር የተገኘሁት በዚሁ ከተማ ውስጥ የወባ በሽታ ስርጭት እና ለስርጭቱ መባባስ ተያያዥነት ያላቸው ነገሮች ላይ የሁለተኛ ዲግሪ ጥናት ለመስራት ነው ።በመሆኑም አስተማማኝ የወባ በሽታ መከላከያ ዘዴዎችን ተግባራዊ ለማድረግ ስለበሽታው ጉዳትና ስርጭት ወቅታዊ መረጃ ያስፈልጋል ።የጥናቱ ዋና ዓላማ በሸዋሮቢት ከተማ አስተዳደር የወባ በሽታ ስርጭት እና ቁጥጥር ያለበትን ሁኔታ ለማወቅ ነው ።ጥናቱ በሸዋሮቢት ጤና ጣቢያ ካሉት ታካሚዎች ውስጥ በእጣ ናሙና የተመረጡትን የወባ በሽታ በሽተኞችን የካትታል ።የጥናቱ መረጃዎች በተደራጁ መጠይቆዎች የሚሰበሰቡ ሲሆን በባለሙያዎች የሚወሰዱ የደም ናሙና ውጤቶች የጥናቱ መረጃ አንድ አካል ናቸው ።በመሆኑም የእናተ ልባዊ ትብብር ይህ ጥናት እንዲሳካ ከፍተኛ አስተዋፅዎ ያድርጋል ።በጥናቱ የተገኙ መረጃዎች ለጥናቱ ብቻ የሚያገለግሉ እና በአጠኒው የሚያዙ ናቸው።በጥናቱ ላይ መረጃ ለመስጠት ፍቃደኛ ነዎት? እስማማለሁ ☐ አልስማማም☐ ።ከተስማሙ ከታች ለተሰጡት መጠይቆች ተገቢ ነው የሚሉት መልስ ላይ √ በባዶ ቦታው ላይ ያስቀምጡ።

አመሰግናለሁ!

8. 4. Questionnaire in Amharic version

መጠይቅ ክፍል አንድ፡የመላሹ/ሿ/ አጠቃላይሁኔታ፡፡

_1.የመላሾች ፆታ 1.ወንድ ☐ 2.ሴት ☐

2. የመላሾች እድሜ 1 .≤4 ☐2.5-14 ☐3. ≥ 15 ☐

3. መላሾች የሚኖሩበት ቀበሌ 1.ቀበሌ01 ☐2. ቀበሌ02 ☐ ቀበሌ03 ☐በሌ04 ☐

5. ቀበሌ05 ☐6 ቀበሌ06 ☐. ቀበሌ07 ☐ ቀበሌ08 ☐9. ቀበሌ09 ☐

4.የቤተሰብ አባላት ብዛት 1.አንድ ☐ 2.ሁለት ☐ 3 .ሦስት ☐4.አራት ☐.አምሰት እና በላይ ☐

5. የእርግዝና ሁኔታ 1.ነፍሰጡር ☐2. ነፍሰጡር ያልሆኑ ☐

6. የጋብቻ ሁኔታ 1.ያገባ/ች/ ☐.ያለገባ/ች/ ☐የፈታ/ች/ ☐ባለቤቱ/ቷ/ በህይወት የሌለ ☐

7. የመላሹ /ሿ/ የቤት ቁጥር----------

8. የመላሹ/ሿ/ የስራ ሁኔታ

1.አርሶ አደር ☐2.መንግስታዊ ያልሆነ ድርጅት ሰራተኛ ☐የቤት እመቤት ☐ጋዴ ☐

5 የመንግሰት ሰራተኛ ☐6.የቀን ሰራተኛ ☐7.ሌላ ካለ ይግለጹ---------

9.የወር ገቢ ሁኔታ 1.ከ700 ብር ያነሰ ☐2.ከ800-3000 ብር ☐ከ3000 ብር የበለጠ ☐

10.የትምህርት ሁኔታ 1.ያልተማረ/ች/ ☐2.1ኛደረጃ ያጠናቀቀ/ች/ ☐ 3.የሁለተኛ ደረጃ ትምህርት ያጠናቀቀ/ች/ ☐4.ሰርተፊኬት ☐.ድፕሎማ ☐.ድግሪ ☐ 7.ሁለተኛ ድግሪ ☐

መጠይቅ ክፍል ሁለት: **ስለ ወባ በሽታ ስርጭት እና የስርጭቱ መንስኤን ለማወቅ የተዘጋጀ መጠይቅ፡፡**

11. ከዚህ በፊት ስለ ወባ በሽታና ስለሚያስከትለዉ ችግር ትምህርታዊ መልዕክት ሰምተው ያዉቃሉ?

1.አዎ ☐ 2.የለም ☐

12. የጥያቄ ቁጥር **11** መልስዎ አዎ ከሆነ ትምህርቱን ከየት አገኙት?

1. ከጤና ባለሙያ ☐ 2 ከመገናኛ ብዙሀን ☐ 3.ከሀይማኖት መሪዎች ☐ 4 . ሌላ ካለ ይግለጹ

13. የወባ በሽታ መንስኤዉ ምንድን ነዉ?

1.ፕላዝሞድየም ☐2.ቀዝቃዛ የአየር ሁኔታ ☐ የተበከለ ውሐ ☐. የምግብ እጥረት ☐

5. ዉጭ መተኛት ☐ 6. አላውቅም ☐

14. በቤተሰባችሁ ውስጥ የወባ በሽታን የምትከላከሉበት ዋነኛ ዘዴ ምንድን ነው?

1. ፀረ-ወባ መድሀኒት ርጭት ☐ 2. በኬሚካል የተነከረ አጎበር መጠቀም ☐ 3. ክኒን መዋጥ ☐

4.ቤትንና አካባቢን በንፅህና መያዝ ☐ 5.የወባትነኝ የሚራቡበትን ቦታዎች ማጥፋት ☐

6. ሌላ ካለ ይግለጹ ----------

15. በቤተዎ ውስጥ በኬሚካል የተነከረ አጎበር አለ? 1.አለ ☐.የለም ☐

16. የ**15** ጥያቄ መልስዎ አለ ከሆነ በቁጥር ምን ያህል ነው?

1.አንድ ☐ 2.ሁለት ☐3.ሶስት ☐. አራት እና ከዚያ በላይ ☐

17. በአሁኑ ስአት አጎበሩን ትጠቀሙበታላችሁ?

1.አዎ ☐2.አንጠቀምም ☐

18. የ**17** ጥያቄ መልስዎ አንጠቀምም ከሆነ ምክንያቱ ምንድን ነው?

1.አጎበር የወባን በሽታ ስለማይከላከል ነው ☐ 2.ኬሚካሉን ስለምንፈራው ☐3. ስለሌለን ☐

19. በቤት ውስጥ አጎበርን የሚጠቀመው ማን ነው?

1. ልጆች ☐ 2.እናት ☐3.አባት ☐4.እናት እና አባት ☐. ልጆችና እናት ☐

6. ልጆችና አባት ☐7.አጠቃላይ ቤተሰቡ ☐

20. አርስዎ (ቤተሰብዎ) በአጎበር ውስጥ መቼ ነው የምትተኙት? 1. በየቀኑ ☐. አንዳንድግዜ ☐

3. በወባ ወቅት ☐4. ቢበዛ በሳምንት ☐. ሌላ ካለ ይግለጹ ----------

21.የትንኝ መከላከያ አጎበር ዓይነት:

1.በኬሚካል ያልተነከረ ☐ 2.በመኖሪያ አካባቢ በኬሚካል የተነከረ ☐ 3.በፋብሪካ ውስጥ በኬሚካል የተነከረ ☐ 4.አላውቅም ☐

22. መኖሪያ ቤትዎ በፀረ-ወባ ኬሚካል ተረጭቷል? 1.አዎ ☐ 2.አልተረጨም ☐

23. እርስዎ ወይም የእርስዎ የቤተሰብ አባላት ከዚህ በፊት በወባ በሽታ ተይዘው ያውቃሉ?

1.አዎ ☐ 2.አያውቅም ☐

24. የጥያቄ ቁጥር **23** መልስዎ አዎ ከሆነ ለህክምና ወዴት ሄዱ?

1.ጤና ጣቢያ ☐2.ሆስፒታል ☐3.የባህል አዋቂዎች ☐4.የትም አልሄድኩም ☐

5. ሌላ ካለ ይግለጹ----------

25. የቤትዎ ጣሪያ በዋናነት ከምንድን ነው የተሰራው?

1.ከሳር ☐ 2.ከቆርቆሮ ☐ 3.ሌላ ካለ ይግለጹ----------

26. የቤትዎ ወለል በዋናነት ከምንድን ነው የተሰራው?

1.ከአፈር ☐ 2.ከፕላስቲክ ምንጣፍ ☐ 3.ከሰራሚክስ ☐ 4.ከእንሰሳት እበት ☐

5. ከሲሚንቶ ሊሾ ☐ 6. ሌላ ካለይ ግለጹ----------

27. የቤትዎ ግድግዳ በዋናነት ከምንድን ነው የተሰራው?

1.ከጭቃ ☐ 2.ከእንጨት ☐ 3.ከጅፕሰም ☐ 4. ሌላ ካለ ይግለጹ----------

28. በቤትዎ ግድግዳ ላይ ቀዳዳዎች አሉ?

1.አዎ ☐ 2.የለም ☐

29. በቤትዎ ግድግዳና በጣራው መካከል ክፍተች አሉ?

1.አዎ ☐ 2.የለም ☐

30. በአካባቢያችሁ ለወባ ትንኝ መራቢያ አመች የሚሆን ቦታ አለ?

1. አዎ ☐ 2.የለም ☐

31. የጥያቄ ቁጥር ‘**30**’ መልስዎ አዎ ከሆነ ቦታው ከመኖሪያ ቤትዎ ምን ያህል ይርቃል?

1.ከ1000ሜ ያነሰ ☐ 2.ከ1000-2000ሜ ☐ 3.ከ2000ሜ የበለጠ ☐

4. ሌላ ካለ ይግለጹ----------

32. በዚህ ዓመት በወባ በሽታ ስንት ጊዜ ተይዘዋል?

1.አንድ ጊዜ ☐ 2.ሁለትጊዜ ☐ 3.ሶስት ጊዜ ☐ 4.አልተያዝኩም ☐

5. ሌላ ካለ ይግለጹ---

33.የወባ በሽታ የሀገርን ኢኮኖሚ ይጎዳል?

1.አዎ ☐ 2.አይጎዳም ☐ 3.አላውቅም ☐

8. 6. Five years retrospective Data

Prevalence of malaria in Shewarobit Health Center in 2013 E.C

Plasmodium	Months	Total cases			Age and sex							Percent
		M	F	T	male≤ 4	Male 5 to 14	Male≥ 15	Female≤ 4	Female 5 to 14	Female≥ 15	Total	
P.falciparum	September	451	230	681	3	2	7	1	1	4	18	2.6
	October	752	378	1130	2	2	17	1	4	11	37	3.3
	November	719	329	1048	2	5	18	3	3	10	41	3.9
	December	227	74	301	0	0	1	0	1	0	2	0.6
	January	224	91	315	0	0	2	0	0	1	3	0.9
	February	170	96	266	0	1	2	0	0	0	3	1.1
	March	258	150	408	0	0	1	0	0	1	2	0.5
	April	180	190	370	1	1	3	0	1	2	8	2.2
	May	287	179	466	0	1	4	0	2	1	8	1.71
	June	212	227	439	0	5	7	0	3	4	19	4.3
	July	118	117	235	1	2	6	0	2	4	15	6.38
	August	113	172	285	1	2	10	0	1	9	23	8.03
	Total	3711	2233	5944	10	21	78	5	18	47	179	3.01

Plasmodium	Months	Total cases			Age and sex							Percent
		M	F	T	male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female≥ 15	Total	
P.vivax	September	451	230	681	16	39	78	15	19	32	199	25.48
	October	752	378	1330	26	43	63	9	16	22	179	13.45
	November	719	329	1448	25	47	78	16	27	23	216	14.9
	December	227	74	441	2	4	7	1	3	3	20	4.5
	January	224	91	445	1	3	5	2	3	3	17	3.82
	February	170	96	396	0	1	7	1	0	5	14	3.53
	March	258	150	518	1	3	7	0	2	5	18	3.47
	April	180	190	470	0	2	5	1	9	5	22	4.68
	May	287	179	466	1	3	8	0	2	6	20	4.29
	June	212	227	539	5	12	18	9	12	13	69	12.8
	July	118	117	235	7	8	7	3	5	8	38	16.17
	August	113	172	285	2	4	10	3	5	7	31	10.87
	Total	3711	2233	5944	86	169	293	60	103	132	843	14.18

Plasmodium		Total cases			Age and sex							
Mixed	Months	M	F	T	male≤4	Male 5 to 14	Male≥ 15	Female≤ 4	Female 5 to 14	Female≥ 15	Total	Percent
	September	451	230	681	0	2	6	1	1	2	12	1.53
	October	752	378	1330	1	3	10	0	2	4	20	1.5
	November	719	329	1448	1	2	3	0	1	2	9	0.62
	December	227	74	441	0	0	0	0	0	0	0	0
	January	224	91	445	0	0	0	0	0	0	0	0
	February	170	96	396	0	0	0	0	0	0	0	0
	March	258	150	518	0	0	0	0	0	0	0	0
	April	180	190	470	0	0	0	0	0	0	0	0
	May	287	179	466	0	0	0	0	0	0	0	0
	June	212	227	539	0	1	1	0	0	0	2	0.37
	July	118	117	235	0	o	2	0	1	1	4	1.7
	August	113	172	285	0	1	2	1	0	1	5	1.75
	Total	3711	2233	5944	2	9	24	2	5	10	52	0.87

The data is collected by_____

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The data is given by_____

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Prevalence of malaria in Shewarobit Health Center in 2014

Plasmodium	Months	Total cases			Age and sex							
		M	F	T	male≤ 4	Male 5 to 14	Male≥ 15	Female≤ 4	Female 5 to 14	Female≥ 15	Total	percent
P.falciparum	September	274	297	571	2	6	17	2	2	3	32	5.6
	October	399	434	833	4	5	11	3	6	9	38	4.56
	November	146	241	387	1	1	7	1	1	5	16	4.13
	December	173	106	279	0	1	3	0	2	0	6	2.15
	January	103	129	232	0	2	1	0	0	1	4	1.72
	February	121	118	239	0	1	3	0	0	0	3	1.03
	March	144	123	267	0	1	0	0	0	0	1	0.37
	April	110	179	289	0	0	1	0	0	2	3	1.03
	May	194	82	276	0	0	3	0	0	1	4	1.44
	June	160	111	271	1	2	5	0	0	2	11	4.05
	July	139	186	325	1	3	6	1	4	5	20	6.15
	August	190	141	331	2	3	7	1	3	2	18	5.43
	Total	2153	2147	4300	11	25	64	8	18	30	156	3.62

Plasmodium	Months	Total cases			Age and sex							
		M	F	T	male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female≥ 15	Total	percent
P.vivax	September	274	297	571	2	10	23	1	3	8	47	8.23
	October	399	434	833	9	13	20	3	5	7	57	6.84
	November	146	241	387	2	3	8	1	2	5	21	5.42
	December	173	106	279	1	2	5	0	1	1	10	3.58
	January	103	129	232	1	2	5	0	0	0	8	3.44
	February	121	118	239	0	1	3	1	0	0	5	2.09
	March	144	123	267	0	1	3	0	0	0	4	1.49
	April	110	179	289	1	3	5	0	0	2	11	3.8
	May	194	82	276	0	1	3	1	1	1	7	2.53
	June	160	111	271	3	5	4	0	1	2	15	5.53
	July	139	186	325	4	3	11	0	1	3	22	6.76
	August	190	141	331	3	7	8	0	0	5	23	6.94
	Total	2153	2147	4300	26	51	98	7	14	34	230	5.34

Plasmodium	Months	Total cases			Age and sex							
		M	F	T	male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female≥ 15	Total	percent
Mixed	September	274	297	571	1	1	5	0	1	2	10	1.75
	October	399	434	833	1	1	5	0	0	1	8	0.96
	November	146	241	387	0	2	3	0	0	1	6	1.55
	December	173	106	279	0	0	0	0	0	0	0	0
	January	103	129	232	0	0	0	0	0	0	0	0
	February	121	118	239	0	0	0	0	0	0	0	0
	March	144	123	267	0	0	0	0	0	0	0	0
	April	110	179	289	0	0	0	0	0	0	0	0
	May	194	82	276	0	0	0	0	0	0	0	0
	June	160	111	271	0	0	1	0	0	0	1	0.36
	July	139	186	325	0	1	2	0	0	0	3	0.92
	August	190	141	331	0	1	2	0	0	0	3	0.9
	Total	2153	2147	4300	2	6	18	0	1	4	31	0.72

The data is collected by_____

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Prevalence of malaria in Shewarobit Health Center in 2015

Plasmodium	Months	Total cases			Age and sex							
		M	F	T	male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female≥ 15	Total	PERCENT
P.falciparum	September	640	500	1140	1	8	39	0	8	19	75	6.57
	October	744	660	1404	4	15	38	1	18	15	91	6.48
	November	443	352	795	4	6	25	2	2	19	58	7.29
	Deember	392	242	634	1	5	13	0	2	4	25	3.94
	January	161	127	288	0	1	4	0	1	2	8	2.77
	February	358	264	622	1	1	9	0	0	5	16	2.57
	March	227	200	427	0	1	3	1	2	3	10	2.34
	April	204	176	380	0	2	2	0	2	0	6	1.57
	May	270	246	516	0	2	4	0	0	2	8	1.55
	June	180	152	332	2	4	8	2	0	0	16	4.81
	July	178	102	280	0	5	12	0	0	0	17	6.07
	August	266	594	860	4	18	30	0	5	22	79	9.18
	Total	4063	3615	7678	17	68	187	6	40	91	409	5.32

Plasmodium	Months	Total cases			Age and sex							
		M	F	T	male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female≥ 15	Total	PERCENT
P.vivax	September	640	500	1140	2	4	24	1	3	6	40	3.5
	October	744	660	1404	3	2	16	3	6	4	34	2.42
	November	443	352	795	2	1	6	2	3	5	19	2.38
	December	392	242	634	0	0	5	0	1	3	9	1.41
	January	161	127	288	0	0	1	0	0	0	1	0.34
	February	358	264	622	1	2	3	0	2	2	10	1.6
	March	227	200	427	1	0	2	1	1	2	7	1.63
	April	204	176	380	0	1	3	0	0	2	6	1.57
	May	270	246	516	1	3	2	0	1	7	14	2.71
	June	180	152	332	1	1	5	4	7	5	23	6.92
	July	178	102	280	1	1	2	1	4	5	14	5
	August	266	594	860	1	3	7	4	4	7	26	3.02
	Total	4063	3615	7678	13	18	76	16	32	48	203	2.64

Plasmodium	Months	Total cases			Age and sex							
		M	F	T	male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female≥ 15	Total	PERCENT
Mixed	September	640	500	1140	1	1	2	1	1	2	8	0.7
	October	744	660	1404	1	2	4	1	2	3	13	0.92
	November	443	352	795	0	1	2	0	0	1	4	0.5
	December	392	22	634	0	0	0	0	0	0	0	0
	January	161	127	288	0	0	0	0	0	0	0	0
	February	358	264	622	0	0	0	0	0	0	0	0
	March	227	200	427	0	0	0	0	0	0	0	0
	April	204	176	380	0	0	0	0	0	0	0	0
	May	270	246	516	0	0	0	0	0	0	0	0
	June	180	152	332	1	0	1	0	0	0	2	0.6
	July	178	102	280	0	1	1	0	0	0	2	0.38
	August	266	594	860	0	0	2	0	0	0	2	0.31
	Total	4063	3615	7678	3	5	12	2	3	6	31	0.4

The data is collected by_____ The data is given by_____

Date_____ Date_____

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Prevalence of malaria in Shewarobit Health Center in 2016

Plasmodium	Months	Total cases			Age and sex							PERCENT
		M	F	T	male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female≥ 15	Total	
P,falciparum	September	618	351	969	4	6	53	1	4	15	83	8.56
	October	548	766	1314	4	12	43	1	6	27	93	7.07
	November	298	321	619	1	4	33	1	7	12	58	9.36
	December	388	312	700	1	3	8	0	1	2	15	2.14
	January	469	246	715	0	0	3	0	0	1	4	0.55
	February	273	231	504	0	0	2	0	0	0	2	0.39
	March	195	115	310	0	0	1	0	0	0	1	0.32
	April	174	181	355	o	0	2	0	0	1	3	0.84
	May	140	147	287	0	0	3	0	0	1	4	1.39
	June	166	274	440	1	0	10	0	2	3	16	3.63
	July	282	209	491	1	6	12	0	3	8	30	6.1
	August	405	450	855	3	9	17	1	3	12	45	5.26
	Total	3956	3603	7559	15	40	187	4	26	82	354	4.68

Plasmodium	Months	Total cases			Age and sex							PERCENT
		M	F	T	male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female≥ 15	Total	
P.vivax	September	618	351	969	5	8	34	1	2	16	66	6.81
	October	548	766	1314	3	4	24	1	3	8	43	3.27
	November	298	321	619	1	2	22	1	3	5	34	5.49
	December	388	312	700	1	1	10	1	1	5	19	2.71
	January	469	246	715	0	0	3	1	2	1	7	0.97
	February	273	231	504	0	0	3	0	0	1	4	0.79
	March	195	115	310	0	1	2	0	0	0	3	0.96
	April	174	181	355	0	0	3	0	0	2	5	1.4
	May	140	147	287	0	0	3	0	0	1	4	1.39
	June	166	274	440	1	3	4	1	3	3	15	3.4
	July	282	209	491	1	2	4	0	2	2	11	2.24
	August	405	450	855	4	6	15	1	2	7	35	4.09
	Total	3956	3603	7559	16	27	127	7	18	51	246	3.25

Plasmodium	Months	Total cases			Age and sex							PERCENT
		M	F	T	male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female e≥ 15	Total	
Mixed	September	618	351	969	0	2	2	0	0	1	5	0.51
	October	548	766	1314	0	1	3	0	1	2	7	0.53
	November	298	321	619	0	0	1	0	0	1	2	0.32
	December	388	312	700	0	0	0	0	0	0	0	0
	January	469	246	715	0	0	0	0	0	0	0	0
	February	273	231	504	0	0	0	0	0	0	0	0
	March	195	115	310	0	0	0	0	0	0	0	0
	April	174	181	355	0	0	0	0	0	0	0	0
	May	140	147	287	0	0	0	0	0	0	0	0
	June	166	274	440	0	0	1	0	0	0	1	0.22
	July	282	209	491	0	1	2	0	0	0	3	0.61
	August	405	450	855	0	1	1	0	0	2	4	0.46
	Total	3956	3603	7559	0	5	10	0	1	6	22	0.29

The data is collected by_____
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Prevalence of malaria in Shewarobit Health Center in 2017

Plasmodium	Months	Total cases		Total	Age and sex							
		M	F		male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female≥ 15	Total	Percent
P.falciparum	September	221	241	462	2	6	20	3	7	16	54	11.68%
	October	330	241	571	6	12	31	4	8	24	85	14.89%
	November	167	182	349	4	9	23	6	8	21	71	20.34%
	December	147	111	258	1	3	7	1	2	4	18	6.98%
	January	171	161	332	0	2	5	1	1	3	12	3.61
	February	128	139	267	0	1	3	0	0	1	5	1.87%
	March	170	141	311	0	1	3	0	0	2	6	1.92
	April	135	109	244	0	1	4	1	1	3	10	4.09%
	May	192	176	368	0	3	14	2	1	6	26	7.07%
	June	965	561	1526	4	17	89	2	6	35	153	10.03
	July	1216	1111	2327	18	37	173	21	35	88	372	15.99%
	August	738	698	1436	7	16	78	10	19	37	167	11.62
	Total	4580	3871	8451	42	108	450	51	88	240	979	11.58%

Plasmodium	Months	Total cases		Total	Age and sex							
		M	F		male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female≥ 15	Total	Percent
P.vivax	September	221	241	462	4	8	21	2	5	9	49	10.6
	October	330	241	571	1	10	37	2	5	11	66	11.56
	November	167	182	349	2	7	15	2	5	10	41	11.74
	December	147	111	258	1	3	5	0	2	5	16	6.2
	January	171	161	332	0	2	5	0	1	3	11	3.31
	February	128	139	267	0	1	3	1	2	2	9	3.37
	March	170	141	311	0	1	5	0	1	2	9	2.89
	April	135	109	244	0	1	3	0	1	2	7	2.86
	May	192	176	368	0	2	10	0	1	7	20	5.43
	June	965	561	1526	9	45	100	6	17	36	213	13.95
	July	1216	1111	2327	4	21	100	7	14	45	191	8.2
	August	738	698	1436	7	16	65	10	15	29	142	9.88
	Total	4580	3871	8451	28	117	369	30	69	161	774	9.15

Plasmodium	Months	Total cases		Age								
		M	F	Total	male≤4	Male 5 to 14	Male≥ 15	Female≤4	Female 5 to 14	Female≥ 15	Total	Percent
Mixed	September	221	241	462	2	12	15	2	3	6	40	8.65
	October	330	241	571	1	7	10	1	2	4	25	4.37
	November	167	182	349	1	3	5	1	2	2	14	4.01
	December	147	111	258	0	2	3	1	2	2	10	3.87
	January	171	161	332	0	1	2	0	0	0	3	0.9
	February	128	139	267	0	0	2	0	0	0	2	0.74
	March	170	141	311	0	0	1	0	o	1	2	0.64
	April	135	109	244	0	0	2	0	0	0	2	0.54
	May	192	176	368	0	0	2	0	0	1	3	0.81
	June	965	561	1526	3	12	15	1	2	4	37	2.41
	July	1216	1111	2327	2	7	12	2	2	4	29	1.24
	August	738	698	1436	4	6	9	2	2	6	29	2.02
	Total	4580	3871	8451	13	50	78	10	15	30	196	2.31

The data is collected by_____
Date_____
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The data is given by_____
Date_____
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8. 7. Current data

Laboratory Results Reporting Format

Name of Health Center Shewarobit

№	Code	Sex	age	kebele	*Plasmodium* species	Slide number
1	T1	F	30	01	*P.vivax*	3743
2	T 2	F	20	01	*P.vivax*	3908
3	T 3	F	24	01	Mixed	3755
4	T 4	F	55	01	*P. falciparum*	4030
5	T 5	F	15	01	*P.vivax*	5114
6	T 6	F	29	01	*P. falciparum*	5120
7	T 7	F	27	01	Negative	5158
8	T 8	F	20	01	*P.vivax*	5224
9	T 9	F	3	01	Negative	4838
10	T 10	F	2	01	Negative	5665
11	T 11	F	19	01	Negative	5669
12	T 12	F	22	01	Negative	5276
13	T 13	F	35	01	Negative	6241
14	T 14	F	4	01	Negative	6239
15	T 15	F	25	01	Negative	6245
16	T 16	F	27	01	Negative	6025
17	T 17	F	27	01	Negative	6037
18	T 1 8	F	18	01	Negative	8778
19	T 19	F	5	01	Negative	6792
20	T 20	F	20	01	*P.vivax*	7081
21	T 21	F	50	01	Negative	7084
22	T 22	F	9	01	Negative	6367
23	T 23	F	24	01	Negative	7334

24	T 24	F	28	01	Negative	7478
25	T 25	F	45	01	Negative	7147
26	T 26	F	2	01	*P.vivax*	7149
27	T 27	F	40	01	Negative	7969
28	T 28	F	6	01	Negative	8351
29	T 29	F	34	01	Negative	8358
30	T 30	F	35	02	Negative	3887
31	T 31	F	28	02	*P.vivax*	3698
32	T 32	F	30	02	*P.vivax*	3703
33	T 33	F	35	02	Negative	4245
34	T 34	F	32	02	Negative	4427
35	T 35	F	5	02	Negative	4774
36	T 36	F	11m	02	Negative	5234
37	T 37	F	33	02	*P.vivax*	4925
38	T 38	F	27	02	*P.vivax*	4828
39	T 39	F	35	02	Negative	5664
40	T 40	F	22	02	Negative	5360
41	T 41	F	16	02	Negative	6243
42	T 42	F	19	02	Negative	6198
43	T 43	F	17	02	Negative	6204
44	T 44	F	22	02	Negative	6026
45	T 45	F	55	02	Negative	6601
46	T 46	F	30	02	Negative	6696
47	T47	F	20	02	Negative	6710
48	T48	F	30	02	Negative	7546
49	T49	F	60	02	Negative	7138
50	T50	F	14	02	Negative	7283

51	T51	F	6	02	Negative	7286
52	T52	F	3	02	Negative	7835
53	T53	F	9m	02	Negative	7941
54	T54	F	1	02	Negative	8082
55	T55	F	7m	02	Negative	8165
56	T56	F	2	03	*P.falciparum*	8477
57	T57	F	16	03	*P.vivax*	4009
58	T58	F	34	03	*P.vivax*	4928
59	T59	F	31	03	*P.vivax*	5154
60	T60	F	11	03	*P.vivax*	4809
61	T61	F	45	03	Negative	5136
62	T62	F	3m	03	Negative	5653
63	T63	F	35	03	*P.vivax*	5268
64	T64	F	40	03	Negative	5270
65	T65	F	11	03	Negative	6076
66	T66	F	60	03	Negative	6028
67	T67	F	7	03	Negative	6030
68	T68	F	10	03	*P.vivax*	6766
69	T69	F	11	03	Negative	6560
70	T70	F	31	03	*P.vivax*	6517
71	T71	F	19	03	*P.vivax*	7604
72	T72	F	21	03	*P.vivax*	7606
73	T73	F	13	03	*P.vivax*	7612
74	T74	F	9	03	*P.vivax*	6905
75	T75	F	26	03	Negative	7852
76	T76	F	30	03	Negative	7945
77	T77	F	2	03	Negative	8079
78	T78	F	3	03	Negative	8363

79	T79	F	5	04	Mixed	3892
80	T80	F	53	04	Negative	3888
81	T81	F	55	04	Negative	3836
82	T82	F	4	04	Negative	4515
83	T83	F	30	04	Negative	4247
84	T84	F	6	04	Negative	4634
85	T85	F	60	04	Negative	4947
86	T86	F	5m	04	Negative	6246
87	T87	F	4	04	*P.vivax*	5375
88	T88	F	45	04	Negative	5653
89	T89	F	35	04	Negative	5658
90	T90	F	39	04	Negative	5660
91	T91	F	30	04	Negative	6229
92	T92	F	26	04	Negative	6248
93	T93	F	5	04	Negative	6237
94	T94	F	40	04	*P.vivax*	6554
95	T95	F	40	04	*P.vivax*	6684
96	T96	F	13	04	*P.vivax*	6391
97	T97	F	20	04	Negative	6504
98	T98	F	55	04	*P.vivax*	7553
99	T99	F	38	04	Negative	7353
100	T100	F	29	04	Negative	7616
101	T101	F	6m	04	Negative	7665
102	T102	F	20	04	Negative	7156
103	T103	F	4	04	Negative	7969
104	T104	F	27	04	Negative	8163
105	T105	F	25	04	Negative	8355

106	T106	F	28	04	Negative	8364
107	T107	F	20	04	Negative	8148
108	T108	F	24	05	Negative	3654
109	T109	F	23	05	Negative	4179
110	T110	F	25	05	Negative	4485
111	T111	F	23	05	Negative	4425
112	T112	F	25	05	Negative	6333
113	T113	F	24	05	Negative	4789
114	T114	F	35	05	Negative	4929
115	T115	F	20	05	Negative	6575
116	T116	F	8	05	Negative	6385
117	T117	F	8	05	Negative	6509
118	T118	F	8	05	Negative	6693
119	T119	F	32	05	Negative	6784
120	T120	F	6	05	Negative	7600
121	T121	F	8	05	Negative	7302
122	T122	F	32	05	Negative	8072
123	T123	F	18	05	Negative	8167
124	T124	F	19	06	Negative	3744
125	T125	F	25	06	Negative	4000
126	T126	F	25	06	Negative	4248
127	T127	F	40	06	Negative	4779
128	T128	F	23	06	Negative	4794
129	T129	F	13	06	Negative	5145
130	T130	F	22	06	*P.vivax*	4852
131	T131	F	22	06	Negative	4951
132	T132	F	1	06	Negative	5355

133	T133	F	55	06	Negative	6180
134	T134	F	35	06	Negative	6192
135	T135	F	7	06	Negative	6077
136	T136	F	27	06	Negative	7534
137	T137	F	6	06	Negative	7540
138	T138	F	30	06	Negative	7954
139	T139	F	45	06	*P.vivax*	8149
140	T140	F	36	07	Negative	3941
141	T141	F	30	07	Negative	4176
142	T142	F	4m	07	Negative	4426
143	T143	F	26	07	*P.vivax*	5113
144	T144	F	7m	07	Negative	5361
145	T145	F	54	07	Negative	6568
146	T146	F	50	07	Negative	6377
147	T47	F	29	07	Negative	6503
148	T148	F	28	07	Negative	7683
149	T149	F	25	07	Negative	7340
150	T150	F	48	07	Negative	7148
151	T151	F	34	07	Negative	7295
152	T152	F	30	07	Negative	8362
153	T153	F	26	08	Negative	3890
154	T154	F	9	08	Negative	3894
155	T155	F	15	08	Negative	3898
156	T156	F	18	08	Negative	4182
157	T157	F	1m	08	Negative	4776
158	T158	F	20	08	Negative	4787
159	T159	F	25	08	Negative	5101

160	T160	F	11	08	Negative	5351
161	T161	F	6	08	Negative	5566
T162	T162	F	27	08	Negative	6247
163	T163	F	18	08	Negative	7668
164	T164	F	36	08	Negative	6783
165	T165	F	35	08	Negative	6777
166	T166	F	70	08	Negative	6714
T167	T167	F	14	08	Negative	6706
168	T168	F	25	08	Negative	6374
169	T169	F	30	08	*P.vivax*	7676
170	T170	F	1o	08	Negative	7486
171	T171	F	35	08	Negative	7496
172	T172	F	25	08	Negative	7847
173	T173	F	25	08	Negative	8085
174	T174	F	35	08	Negative	8162
175	T175	F	23	08	Negative	8303
176	T176	F	6m	08	Negative	8523
177	T177	F	60	09	Negative	8734
178	T178	F	32	09	Negative	9044
179	T179	F	60	09	*P.vivax*	3697
180	T180	F	35	09	Negative	4495
181	T181	F	40	09	Negative	6079
182	T182	F	18	09	Negative	6564
183	T183	F	10	09	Negative	6501
184	T184	F	2m	09	Negative	6943
185	T185	F	40	09	Negative	6952
186	T186	F	35	09	Negative	7672

187	T187	F	13	09	Negative	7473
188	T188	F	32	09	Negative	7480
189	T189	F	23	09	Negative	7484
190	T190	F	40	09	Negative	7832
191	T191	F	2	9	Negative	7854
192	T192	F	16	09	Negative	7965
193	T193	M	18	01	*P.vivax*	5155
194	T194	M	36	01	*P.falciparum*	4919
195	T195	M	19	01	*P.falciparum*	4927
196	T196	M	22	01	*P.falciparum*	5422
197	T197	M	15	01	Negative	5659
198	T198	M	29	01	*P.vivax*	5663
199	T199	M	3	01	Negative	5272
200	T200	M	7	01	Negative	6233
201	T201	M	2	01	Negative	6090
202	T202	M	43	01	Negative	6232
203	T203	M	17	01	Negative	6772
204	T204	M	7	01	Negative	6368
205	T205	M	6	01	Negative	6702
206	T206	M	12	01	Negative	7483
207	T207	M	6	01	Negative	6967
208	T208	M	1	01	Negative	7289
209	T209	M	43	01	Negative	8062
210	T210	M	4	01	Negative	8080
211	T211	M	7m	01	Negative	8158
212	T212	M	1	01	Negative	8296
213	T213	M	3	02	Negative	7609

214	T214	M	32	02	Negative	7552
215	T215	M	60	02	Negative	7345
216	T216	M	45	02	*P.vivax*	3897
217	T217	M	30	02	*P,vivax*	3904
218	T218	M	21	02	Negative	4418
219	T219	M	28	02	*P.vivax*	4935
220	T220	M	28	02	*P.vivax*	4830
221	T221	M	20	02	Negative	5353
222	T222	M	7	02	Negative	6199
223	T223	M	32	02	Negative	6085
224	T224	M	28	02	Negative	6944
225	T225	M	14	02	Negative	7679
226	T226	M	5	02	Negative	6366
227	T227	M	1	02	Negative	6519
228	T228	M	2	02	Negative	7838
229	T229	M	30	02	Negative	7943
230	T230	M	3	02	Negative	8094
231	T231	M	4	02	Negative	8504
232	T232	M	60	03	*P.falciparum*	8510
233	T233	M	28	03	*P.falciparum*	3900
234	T234	M	28	03	Mixed	3678
235	T235	M	25	03	*P.vivax*	6325
236	T236	M	18	03	*P.falciparu*	4775
237	T237	M	20	03	*P.vivax*	5148
238	T238	M	20	03	Mixed	4940
239	T239	M	64	03	Negative	5661
240	T240	M	17	03	Negative	5265
241	T241	M	21	03	Negative	5265

242	T242	M	8	03	*P.vivax*	5281
243	T243	M	30	03	Negative	6230
244	T244	M	3	03	*P.vivax*	6250
245	T245	M	19	03	Negative	6188
246	T246	M	1	03	Negative	6072
247	T247	M	24	03	Negative	6087
248	T248	M	5	03	Negative	6024
249	T249	M	18	03	Negative	6780
250	T250	M	20	03	Negative	7090
251	T251	M	6m	03	Negative	6569
252	T252	M	19	03	Negative	6588
253	T253	M	7	03	Negative	7679
254	T254	M	25	03	Negative	7037
255	T255	M	4	03	Negative	7154
256	T256	M	4	03	Negative	7301
257	T257	M	21	03	Negative	7684
258	T258	M	35	03	Negative	8060
259	T259	M	30	03	Negative	8077
260	T260	M	45	03	Negative	8292
261	T261	M	30	04	Negative	7656
262	T262	M	25	04	*P.vivax*	4236
263	T263	M	22	04	*P.vivax*	4184
264	T264	M	58	04	Negative	4165
265	T265	M	35	04	Negative	4484
266	T266	M	28	04	*P.falciparum*	5144
267	T267	M	42	04	Negative	4632
268	T268	M	26	04	Negative	5148

269	T269	M	6m	04	Negative	4841
270	T270	M	7	04	*P.vivax*	5668
271	T271	M	1	04	Negative	5357
272	T272	M	25	04	Negative	5667
273	T273	M	34	04	Negative	5352
274	T274	M	24	04	*P.vivax*	6033
275	T275	M	20	04	Negative	6025
276	T276	M	48	04	Negative	6193
277	T277	M	7	04	Negative	6181
278	T278	M	7	04	Negative	6182
279	T279	M	50	04	*P.vivax*	6935
280	T280	M	16	04	Negative	6711
281	T281	M	2	04	Negative	6395
282	T282	M	16	04	Negative	6563
283	T283	M	35	04	Negative	6958
284	T284	M	26	04	*P.vivax*	7169
285	T285	M	6	04	Negative	7153
286	T286	M	20	04	Negative	7463
287	T287	M	30	04	Negative	7656
288	T288	M	23	04	*P.vivax*	7851
289	T289	M	6m	04	Negative	7837
290	T290	M	3	04	Negative	8064
291	T291	M	42	04	Negative	8287
292	T292	M	32	04	Negative	8338
293	T293	M	41	05	Negative	3981
294	T294	M	37	05	Negative	3993
295	T295	M	23	05	Negative	6628

296	T296	M	31	05	Negative	4792
297	T297	M	25	05	Negative	4267
298	T298	M	30	05	*P.vivax*	5280
299	T299	M	2	05	Negative	6381
300	T300	M	30	05	Negative	6514
301	T301	M	4	05	Negative	6954
302	T302	M	25	05	Negative	7682
303	T303	M	15	05	Negative	8348
304	T304	M	2	06	Negative	3977
305	T305	M	45	06	*P.vivax*	3990
306	T306	M	2	06	*P.vivax*	4169
307	T307	M	4	06	*P.vivax*	4724
308	T308	M	9	06	Negative	6314
309	T309	M	4	06	*P.vivax*	6319
310	T310	M	60	06	Negative	4932
311	T311	M	4	06	Negative	6185
312	T312	M	5	06	Negative	6202
313	T313	M	9m	06	Negative	6506
314	T314	M	50	06	Negative	6962
315	T315	M	18	06	Negative	7083
316	T316	M	16	06	Negative	7100
317	T317	M	8m	06	Negative	7680
318	T318	M	37	06	Negative	7617
319	T319	M	2	06	Negative	7535
320	T320	M	20	06	Negative	7162
321	T321	M	10	06	Negative	7164
322	T322	M	4	06	Negative	8061

323	T323	M	23	06		8063
324	T324	M	24	06	Negative	8293
325	T325	M	60	07	Negative	8210
326	T326	M	29	07	*P.vivax*	4519
327	T327	M	65	07	Negative	4930
328	T328	M	24	07	*P.vivax*	4949
329	T329	M	35	07	Negative	5264
330	T330	M	3	07	Negative	6383
331	T331	M	20	07	Negative	6955
332	T332	M	4	07	Negative	6959
333	T333	M	9	07	Negative	6660
334	T334	M	3	07	Negative	6964
335	T335	M	54	07	Negative	7674
336	T336	M	1	07	Negative	8159
337	T337	M	4	07	Negative	8346
338	T338	M	21	08	Negative	8950
339	T339	M	28	08	Negative	9040
340	T340	M	35	08	*P.vivax*	3752
341	T341	M	20	08	Negative	3648
342	T342	M	4	08	Negative	4778
343	T343	M	7	08	Negative	4651
344	T344	M	9	08	Negative	5140
345	T345	M	14	08	Negative	4825
346	T346	M	16	08	Negative	4786
347	T347	M	30	08	Negative	6249
348	T348	M	15	08	Negative	6246
349	T349	M	20	08	Negative	6687

350	T350	M	60	08	Negative	6095
351	T351	M	35	08	*P.vivax*	6701
352	T352	M	55	08	Negative	6789
353	T353	M	2	08	Negative	6937
354	T354	M	2	08	Negative	6953
355	T355	M	16	08	Negative	7674
356	T356	M	5	08	Negative	7331
357	T357	M	6	08	Negative	7355
358	T358	M	18	08	Negative	7353
359	T359	M	6	08	Negative	7344
360	T360	M	4	08	Negative	7472
361	T361	M	25	08	Negative	7840
362	T362	M	3	08	Negative	7957
363	T363	M	19	08	Negative	7961
364	T364	M	17	08	Negative	8086
365	T365	M	70	09	*P.falciparum*	8041
366	T366	M	18	09	Negative	3740
367	T367	M	28	09	*P.vivax*	3912
368	T368	M	12	09	Negative	5235
369	T369	M	35	09	Negative	6237
370	T370	M	6	09	Negative	6036
371	T371	M	15	09	Negative	6951
372	T372	M	20	09	Negative	6516
373	T373	M	3m	09	Negative	6500
374	T374	M	7	09	Negative	8330
375	T375	M	1	09	Negative	7348
376	T376	M	17	09	Negative	7353

377	T377	M	53	09	Negative	7354
378	T378	M	35	09	Negative	7151
379	T379	M	15	09	Negative	7300
380	T380	M	16	09	Negative	7967
381	T381	M	21	09	Negative	8084
382	T382	M	4	09	Negative	8087
383	T383	M	5	09	Negative	8526
384	T384	M	6m	09	Negative	8523

Key: Pv =*Plasmodium vivax* Pf=*Plasmodium falciparum*
m=month F=Female
M=Male