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Department of Zoological Sciences**

**Assessment of the prevalence of malaria in karamara hospital and knowledge of the study population toward Malaria and its control in Jigjiga Town, Somali Regional State.**

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## LIST OF ACRONYMS AND ABBREVIATIONS

ACT	Artemisinin – Combination during Treatments
asl	Above sea level
CDC	Center for Disease Control and Prevention
CSA	Central Statistical Agency
DDT	Dichloro Diphenyl Trichloroethane
DNA	Deoxyribo Nuclie Acid
DPCD	Disease Prevention and Control Department
ELISA	Enzyme Linked Immuno-Sorbent Assay
FMoH	Federal Ministry of Health
GTS	Global Technical Strategy
HEW	Health extension Workers
IRS	Indoor Residual spray
ITNs	Insecticide Treated Bed Nets
LLINs	Long Lasting Insecticide Treated bed nets
MDTPs	Malaria detection and treatment posts
MES	Malaria eradication service
MIS	Malaria Indicator Survey
NGOs	Non-governmental organizations
NMAE	National Metrological Agency of Ethiopia
NOCMVD	National organization for the control of malaria and plasmodium other vector Born-diseases
PCR	Polymerase chain reaction
RBCs	Red Blood Cells
RDTs	Rapid Diagnostic tests
SSA	Sub- Sahara Africa
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

## ABSTRACT

*Malaria is a severe community health problem in Ethiopia, in which above 68% of the population is at risk for infection and an average of 2.5 million cases are recorded every year. The assessment of the situation of malaria disease in the study community and its knowledge, attitude and practice is necessary in order to institute appropriate malaria prevention and control activities. The objective of the study was to assess the proportion of malaria and the knowledge of study population toward malaria and its control in Jigjiga town, Somali Regional State. The study was conducted to assess the prevalence of malaria at Jigjiga General Hospital based on one year retrospective data from January, 2018 to December, 2018 and to determine the community knowledge, practice and attitude about malaria by distributing questioners. The sample size was determined using the formula  $n = Z^2 \times P (1-P)/d$ . A total of 472 participants were involved in the study. Data was collected by questioner interview technique. Data was entered and analyzed using SPSS version 20.0 statistical package. In Karamara General Hospital, from January, 2018 to December, 2018 a total of 6,393 malaria suspected patients were diagnosed microscopically, of which 230(3.6 %) of patients were malaria positive. The prevalence of Plasmodium falciparum was 74.9% and P. vivax was 19.1%. From the total of 472 respondents who were interviewed in Jigjiga town, 97.7% had ever heard of malaria, 74.4% knew that malaria could be transmitted from person to person, 56.1% believed that malaria was a preventable disease, 26% mentioned mosquito bites transmits disease. In addition, 94.7% respondents were heard about mosquito net and 57.4% bought from market, 11.7% obtained freely given from NGO's and 30.9% from government freely. The prevalence of malaria was 3.6% and it was less to compared when the total Ethiopian prevalence and the knowledge of study community is well about malaria. Further studies should be conducted to determine the status of malaria.*

**Keywords:** Knowledge, Malaria, Mosquito, Plasmodium, Prevalence, Somali Regional State.

## Introduction

### 1.1 Background of the study

Malaria is a severe community health problem in Ethiopia, above 68% of the population is at risk for infection and averages of 2.5 million cases are informed every year (WHO, 2018). Malaria symptoms that usually include fever, tiredness, vomiting, and headache. In severe cases it can cause yellow skin, seizures, coma, or death. Symptoms frequently arise 10 to 15 days later being bitten by infectious mosquito. If not appropriately treated, persons may have relapses of the disease months later. In those who have newly lived an infection, reinfection usually causes milder symptoms. This partial resistance disappears over months to years if the person has no continuing exposure to malaria (Caraballo, 2014).

Malaria is caused by single celled microorganisms of the *Plasmodium* group. The disease is most commonly spread by an infected female *Anopheles* mosquito (WHO, 2017). During the mosquito bite, the parasite inter into the person blood from the mosquito's saliva and the parasites get in to the liver where they mature and multiply (WHO, 2014).

The common five Plasmodium species can infect human biengs. This are *P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae* and *P. knowlesi*. (WHO, 2018). Most deaths are caused by *P. falciparum* because *P. vivax*, *P. ovale*, and *P. malariae* mostly cause a milder form of malaria and the species *P. knowlesi* uncommonly causes disease in humans (WHO, 2018). The additional reason for the virulence of *P. falciparum* kind of malaria is that humans and the parasite have had fewer times to become reformed to each other. It is believed that humans have been exposed to this parasite (through interaction with birds) only in comparatively latest history. Referred to as “*malignant*” malaria, untreated it eventually kills about half of those infected. The highest mortality rates occur in young children. More red blood cells (RBCs) are infected and destroyed than in other forms of malaria. The resulting anemia severely weakens the victim. The RBCs develop surface knobs that cause them to stick to the walls of the capillary vessels, which become blocked. This blockage prevents the infected RBCs from reaching the spleen, where phagocytic cells would eliminate them. The blocked capillaries and subsequent loss of blood

supply leads to death of the tissues. Kidney and liver damage is caused in this fashion. The brain is frequently affected, and *P. falciparum* is the usual cause of cerebral malaria (Tortora, 2010).

Malaria is usually identified by the microscopic examination of blood by means of blood films, or with antigen-based rapid diagnostic tests (Caraballo, 2014). Ways that use the polymerase chain reaction to detect the parasite's DNA have been developed, but are not broadly used in areas where malaria is common due to their price and complication (Nadjm and Behrens, 2012).

Malaria remains a disease of global health problem with 3.3 billion people in 97 countries at risk, around 200 million cases and lead to estimate 600,000 deaths (WHO, 2015). In tropical Asia, Africa, and Central and South America, malaria is still a severe problem. It is expected that malaria affects 300 to 500 million people world wide-reaching and reasons 2 to 4 million deaths yearly. Actually, there are probably more people dying of malaria today than 30 years ago. It is habitual to areas where it had been closely eliminated, such as Eastern Europe and central Asia. Africa, where 90% of the mortality from the disease arises, suffers the most from malaria. It is assessed that it kills an African child each 30 seconds (WHO, 2018).

Depending on World Health Organization report 2017; Ethiopia had 6% of malaria cases totally. In 2014 a total of 2, 118, 815 malaria established cases and 213 malaria deaths, in 2016 overall of 1, 962, 996 malaria established cases and 510 malaria deaths remained documented in the country (WHO, 2017). Ministry of Health yearly performance report showed that from September, 2014 to August, 2015 an overall of 2, 174, 707 malaria established cases and 662 malaria deaths were recounted in the country.

Vector control is the main approach to avoid and decrease malaria transmission. If coverage of vector control mediations within a particular area is extraordinary sufficient, then a measure of protection will be conferred through the community.

WHO recommends protection for all people at risk of malaria with effective malaria vector control. Two forms of vector control: insecticide-treated mosquito nets and indoor residual spraying are effective in a wide range of circumstances. Insecticide-treated mosquito nets sleeping under an insecticide-treated net (ITN) can reduce contact between mosquitoes and humans by providing both a physical barrier and an insecticidal effect. Population-wide

protection can result from the killing of mosquitoes on a large scale where there is high access and usage of such nets within a community.

In 2017, about half of all people at risk of malaria in Africa were threatened by an insecticide-treated net, compared to 29% in 2010. But ITN coverage improved only slightly in the period 2015 to 2017. Indoor spraying with residual insecticides indoor residual spraying (IRS) with insecticides is additional dominant way to quickly decrease malaria transmission. It involves spraying the inside of housing arrangements with an insecticide, typically once or twice per year. To confer significant community protection, IRS should be implemented at a high level of coverage (WHO, 2018).

Worldwide, IRS protection dropped from a peak of 5% in 2010 to 3% in 2017, with reductions seen across all WHO regions. The declines in IRS coverage are occurring as countries switch from parathyroid insecticides to more costly substitutes to mitigate mosquito resistance to parathyroid (WHO, 2019).

Antimalarial medicines can also be used to prevent malaria. For travellers, malaria can be prevented through chemoprophylaxis, which suppresses the blood stage of malaria infections, thereby preventing malaria disease. For pregnant women living in moderate-to-high transmission areas, WHO recommends intermittent preventive treatment with sulfadoxine-pyrimethamine, at each scheduled antenatal visit after the first trimester. Similarly, for infants living in high-transmission areas of Africa, 3 doses of intermittent preventive treatment with sulfadoxine-pyrimethamine are recommended, delivered alongside routine vaccinations (WHO, 2018).

The assessment of the situation of malaria disease in the study community of Jigjiga town and its knowledge, attitude and practice is necessary in order to institute appropriate malaria prevention and control activities.

## **1.2 Statement of the problem**

According to World Malaria Report (2015) malaria is among the most frequently occurring and distracting phenomenon that affects an average 26,400,000 (27% of total population) reside in malaria high transmission areas (>1 confirmed cases per 1000 population), 39,600,000 (41%) in low (1 case per 1000 population) and 31,000,000 (32%) malaria free (0 cases per 1000

population) in 2014. Children, particularly under-five, including newborns and infants less than 12 months of age are one of the most exposed groups affected by malaria bearing 69% of the above deaths. Point out that in high malaria transmission areas infants become vulnerable to malaria at approximately 3 months of age, when immunity acquired from the mother starts to wane and are at increased risk of rapid disease progression, severe malaria and death. Severe anemia, hypoglycemia and cerebral malaria are features of severe malaria which are particularly common in this age group (WHO, 2016).

During the major transmission season from September to December, following the main rains June to August, a large peak in malaria case occurs. A second but less pronounced peak occurs during the second transmission seasons in April and May following short rains (Tulu, 1996). Due to this unstable and seasonal transmission pattern of malaria in the country, protective immunity of not only children but the general population is low and all age groups are highly vulnerable to the disease. Thus the public health burden of malaria is huge in Ethiopia (FMoH, 2015).

There were no studies conducted on the problem so as to investigate the prevalence and knowledge of malaria in Jigjiga town and Karamara General Hospital. Therefore, this study is very important to show the prevalence and knowledge of malaria. Regardless of these, to overcome the above problem the researcher designed to investigate the prevalence and knowledge of malaria in the study area.

### **1.3. Objectives of the study**

#### **1.3.1. General objective**

- To assess the prevalence of malaria and the knowledge of the study participants toward malaria and its control in Jigjiga town, Somali Regional State.

#### **1.3.2 Specific objective**

- ✓ To assess retrospective data on malaria situation by using hospital data from Jigjiga General Hospital.
- ✓ To assess the effective of utilization of malaria control measures in Jigjiga town.
- ✓ To assess the knowledge of the study population about malaria

## **2. Literature Review**

### **2.1 Global burden of malaria**

Malaria is one of the leading causes of morbidity and mortality in the world, with an estimated 3.3 billion people at risk of malaria. Malaria disease burden and spread can be assessed using incidence or prevalence in human hosts. According to the latest world malaria report, released on November 2015, there were 216 million cases of malaria in 2014, up from 211 million cases in 2013. The estimated number of malaria deaths stood at 445 000 in 2016, a similar number to the previous year (446 000). Globally, an estimated 3.2 billion people in 97 countries are at risk of being infected with malaria and developing the disease, of which 1.2 billion are at high risk (WHO, 2016). In 2010, an estimate of 219 million cases of malaria was reported by the World Health Organization and despite endless struggles to prevent its spread 660,000 people died from the infection that year. However, the same year, a systematic review assessed the global malaria mortality rate and revealed numbers exceeding over 1.2 million deaths, so the true malaria burden might be underestimated (Murray, 2012).

Globally, an estimated 3.3 billion people are at risk of being infected with malaria and developing disease, and 1.2 billion are at high risk to acquire the disease. The burden is heaviest in the WHO African Region, where an estimated 90% of all malaria deaths occur, and in children aged less than 5 years, which account for 78% of all deaths (WHO, 2014). It estimated 660,000 deaths in 2011 directly attributed to malaria, approximately half of the world's population being at risk of infection. The disease remains one of the major challenges for people's health and livelihood around the world (WHO, 2015). Nearly half of the world's population is living under the risk of malaria. As per the WHO estimates, 91 countries and territories had an ongoing transmission of malaria in 2015 with 212 million identified cases and 429,000 deaths. Most number of cases was reported from the African Region, followed by the Southeast Asia Region (WHO, 2016). WHO recently launched the GTS for malaria, which aims to reduce the incidence and mortality rates of malaria at least by 90% by 2030. However, the malaria control strategy also faces numerous challenges to achieve WHO Global Technical Strategy (GTS) targets to reduce malaria mortality and incidence rates by at least 90% by 2030.

## 2.2 Malaria in Africa

### 2.2.1 Health burden

Malaria is one of the greatest severe public health problems worldwide with 300 to 500 million cases and about one million deaths reported to date, 90% of were reported from SSA. Malaria is a public health problem in the developing world particularly in SSA countries where malaria kills a child every two minutes (WHO, 2015). Globally, an estimated 212 million cases of malaria occurred in 2015, 90% of the cases were in the WHO African Region and 57.8% (114 million) malaria cases were reported from SSA. In 2015, 303 000 malaria deaths were estimated to have happened among below-five, accounting for 70% of the global total (WHO, 2016). Of 438,000 registered malaria deaths in 2015, approximately 80% of the deaths were concentrated in just 15 countries, mainly in Africa (FMoH, 2015; WHO, 2015).

In SSA abundant of the malarial morbidity and nearly all of the mortality affect young children (Snow *et al.*, 1999). An estimated one million people in Africa die from malaria each year and most of these are children under 5 years old (WHO, 2015). In 2010, it was estimated that over 500 million school age children were at risk of malaria infection, 200 million in SSA (Gething *et al.*, 2011). Studies in Africa have shown that 7–10% or more of newborns have malaria parasites in their placental blood and significant part of the spread of parasites from the mother to the child happens well before the time of delivery. In areas of high spread, the main burden of malaria, including nearly all malaria deaths, is in young children (Snow and Marsh, 2002; Carneiro *et al.*, 2010). Congenital malaria has been documented in malaria endemic areas for many years. It is estimated, that in 2001, there were 1.21 million deaths due to malaria, most of which were in Africa and in young children (Lopez *et al.*, 2001). Malaria is also responsible for a huge amount of illness and absence from school (Breman, 2001).

Recent estimates are that malaria kills up to 2.7 million persons yearly, and that 90 percent of these deaths occur in Africa, where most of the losses are children under the age of 5 years. It is estimated that 300 million episodes of clinical malaria happen each year in the African region, but the actual figure could be much higher than this (Samba, 2001).

Malaria affects more than 24 million pregnant women and kills more than one million children each year in SSA while more than 300 million children get sick of malaria annually (WHO,

2013). The incidence of malaria worldwide is estimated to be 216 million cases per year, with 81% of these cases happening in SSA. Malaria kills approximately 655,000 people per year; 91% of deaths occur in SSA (mostly in children under five years of age). Malaria continues to be the most significant mosquito-borne disease globally but it holds a particularly heavy burden across many countries in Africa where in 2018, 88% of global cases and 90% of global deaths due to malaria were recorded WHO.

(<http://www.who.int/mediacentre/factsheets/fs094/en>).

## **2.3 Malaria in Ethiopia**

Ethiopia is one of SSA countries attacked by malaria. Malaria is widely spread in Ethiopia; 75% of the landscape areas below 2000 m asl is malarious which is fertile low land areas and appropriate for agriculture. More than 54 million populations live in these areas and are at risk of malaria (Legesse *et al.*, 2007).

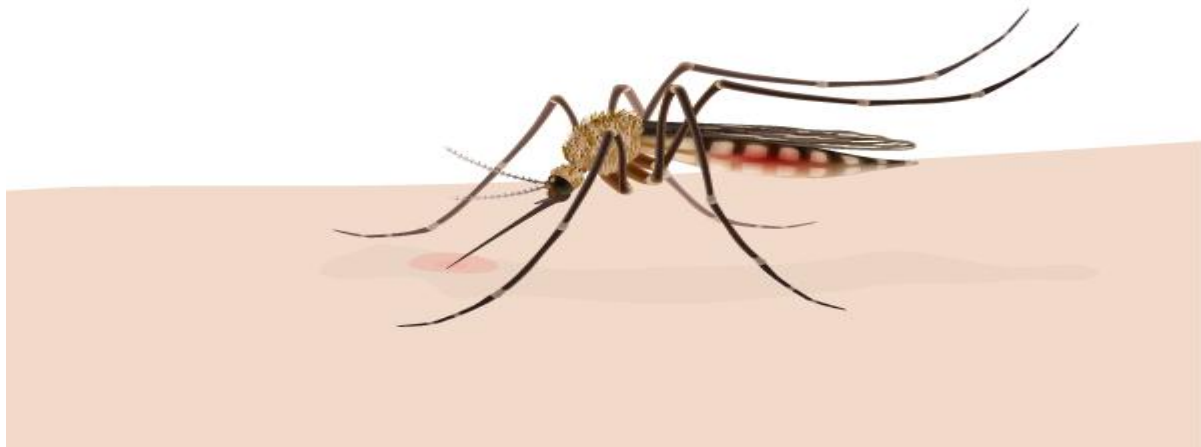
Malaria transmission in Ethiopia is perennial, seasonal and occurs as an epidemic depending on the geographical location (FmoH, 2012). The dispersal and transmission of malaria in Ethiopia differs from place to place. Ethiopia can, in regard to malaria, be divided into four epidemiological strata. The first stratum is the highland areas above 2500 meter which are considered to be free of malaria. Highland fringe areas between 1500-2500 meters constitute the second strata and are frequently affected by the disease. The third lowland areas are below 1,500 meters and with seasonal pattern of transmission and the fourth strata consist stable malaria areas that characterized by all year round transmission (WHO, 2014).

The report of FmoH in 2008 said that in Ethiopia the seasons where the peak transmissions occur are the months following the rainy season, mainly from June to September. This report showed that malaria transmission in Ethiopia is characterised by unstable and irregular occurrence of epidemics every 5-8 years. In the highlands of Ethiopia, a number of epidemics have been registered over the last 45 years. During the first epidemic in 1958, about 150, 000 people living in the highlands of Ethiopia died, where malaria historically occurred in areas up to 2, 500 metres above sea levels (Ghebreyesus *et al.*, 2012). Since then, devastating epidemics were documented in the years 1988, 1991 to 1992, 1998 and 2003 about 2 million clinical cases and 3, 000 deaths due to malaria were reported during the last epidemic in 2003. In 2010, the FMoH

2011 reported malaria to be the leading cause of morbidity in several regions of the country. The annual average number of malaria cases reported by health facilities from 2001 to 2005 was estimated to be 9.4% of all patients presenting at the health facilities (FMoH, 2008). The 2011 FMoH annual report revealed that 828, 415 cases of confirmed malaria were treated during that year (FmoH, 2011).

### 2.2.1 The Malaria Vectors

The *Anopheles* mosquito is known universally as the malaria mosquito species because it is considered the primary vector of the disease. This mosquito species seems to prefer mammals, including humans, for its blood meal. The body of the adult *Anopheles* mosquito is dark brown to black in color (CDC 2019).



**Figure 1. Anopheles Mosquito (Source CDC, 2019)**

There are about 422 species of *Anopheles* mosquitos throughout the world, but only some 70 species are vectors of malaria under natural condition. A total of 42 species Anopheline mosquitoes have been documented in Ethiopia. *An. arabiensis* and *Anopheles quadriannulatus* spp are the only two species in *An. gambiae* complex that are found in Ethiopia. *An. quadriannulatus* distribution was shown to be in the highlands of south- western and northern regions, co-existing with *An. arabiensis* (Tesfaye, 2008).

*An. arabiensis* is the most important vector of Ethiopia irrespective of the highly diversified vector of the country (White *et al.*, 1980; Tulu, 1993; Amenshewa, 1995; Abose *et al.*, 1998). This species breeds in small, temporary, sunlit water collections.

*An. funestus*, *An. pharoensis* and *An. nili* are regarded as secondary vectors of malaria in Ethiopia (Abose *et al.*, 1998). *An. funestus* was regarded as the most important secondary vectors of malaria after *An. arabiensis* (Tesfaye, 2008) but countrywide collection had shown *An. pharoensis* to be 6 fold greater than *An. funestus* (Tulu, 1993). *Anopheles nili* is the least common species, and it is more localized, to southwestern, western and northwestern part of the country. This species is an important malaria vector in Gambella (Krafsur, 1970). Both *An. funestus* and *An. pharoensis* prefer large, permanent and shaded water bodies with emergent vegetation. For instance, the swamps in Baro river in western Ethiopia provide an environment that permits *An. funestus* to exceed *An. gambiae* in number throughout most of the year (O'Connor, 1967).

The co-existence of secondary vectors with *An. arabiensis* has been reported in Gambella (Krafasur, 1970), Gergedi and Ziway (Abose *et al.*, 1998). The co-existence is much more frequent with *An. pharoensis* than with the others. *Anopheles pharoensis* might be responsible for the transmission of malaria in the absence or low number of *An. arabiensis*, particularly in dry season (Abose *et al.*, 1998).

*Anopheles arabiensis* and *An. funestus* occur in all administrative regions while *An. nili* is reported from the region Amhara, Western Oromiya, Gambella and southern Nation Nationality and Peoples administrative region. *Anopheles pharoensis* is found in all regions except the Bale zone of Oromiya (Ghebreyesus *et al.*, 2006).

*Anopheles christyi* is regarded as harmless with no epidemiological importance in malaria transmission in Ethiopia. This species was recorded in highland such as Gullele Torrent (2800 meter asl) Addis Ababa. Although the species is generally regarded as zoophilic (Gilles and De-Mellion, 1998), a blood meal analysis showed its anthropophagic behavior (Adugna and Petros, 1996).

The sporozoite rate is the proportion of *Plasmodium* infected mosquitoes in a population of local vector species. It can be determined by dissecting the salivary gland and detecting sporozoites under microscope. There is also modern technique like enzyme linked immunosorbant assay

(ELISA) and polymerase chain reaction (PCR) methods that estimate the rate more precisely. The ELISA is easy to perform, utilizes stable reagents, require less expensive equipment and it relatively sensitive and specific (Writz *et al.*, 1987). This technique sufficiently detects circumsporozoite proteins from as few as 100 sporozoites. Sporozoites infection in Ethiopia is very low and a large number of specimens need to be tested in order to be able to determine the actual infection rate (Abose *et al.*, 1998).

Krafsur (1971) recorded 1.8% sporozoite rate in which 156 positive out of 8348 dissecting *An. gambiae* mosquitoes. In that study a relatively high sporozoites rate was recorded for *An. gambiae* in October (4.97%), and in November (5.43%). Two positive out of 262 mosquitoes by using ELISA both for *P. falciparum* and *P. vivax* (Amenshewa, 1995). 1.52% infection rate by using ELISA on 3626 *An. arabiensis* specimens in Gergdi but the dissection result was 0.63% from 638 specimens (Amensewa, 1995).

Recent sporozoite detection of *An. arabiensis* in south Ethiopia sille showed 0.5 % (4/796) infection rate for *P. falciparum* and 1.76% (14/790) for *P. vivax* by ELISA method. A study conducted in Ziway, by ELISA method also gave five specimens positive for giving the sporozoite rate of 1.18% (Tesfaye, 2008).

*Anopheles pharoensis* has been naturally infected in Egypt, Nigeria, Kenya and Ethiopia detected 0.46% infection rate (2 positive out of 436 for *P. vivax*) in this specimens by ELISA method. Also other study found 0.59% infection rate for this species in Ziway area for *P. falciparum* (Tesfay, 2008). The USAID team dissected 70 *A. funestus* and found 1 positive to sporozoite (O'Connor, 1967). Dissection of 619 *Anopheles nili* in Gambella area yield 8 positive (Krafsur, 1971).

The reason for such low rates consider as due to relatively low malaria endemicity prevailing in Ethiopia compared to highly endemic regions of tropical Africa, and the possibility that non-vector species are included in the study.

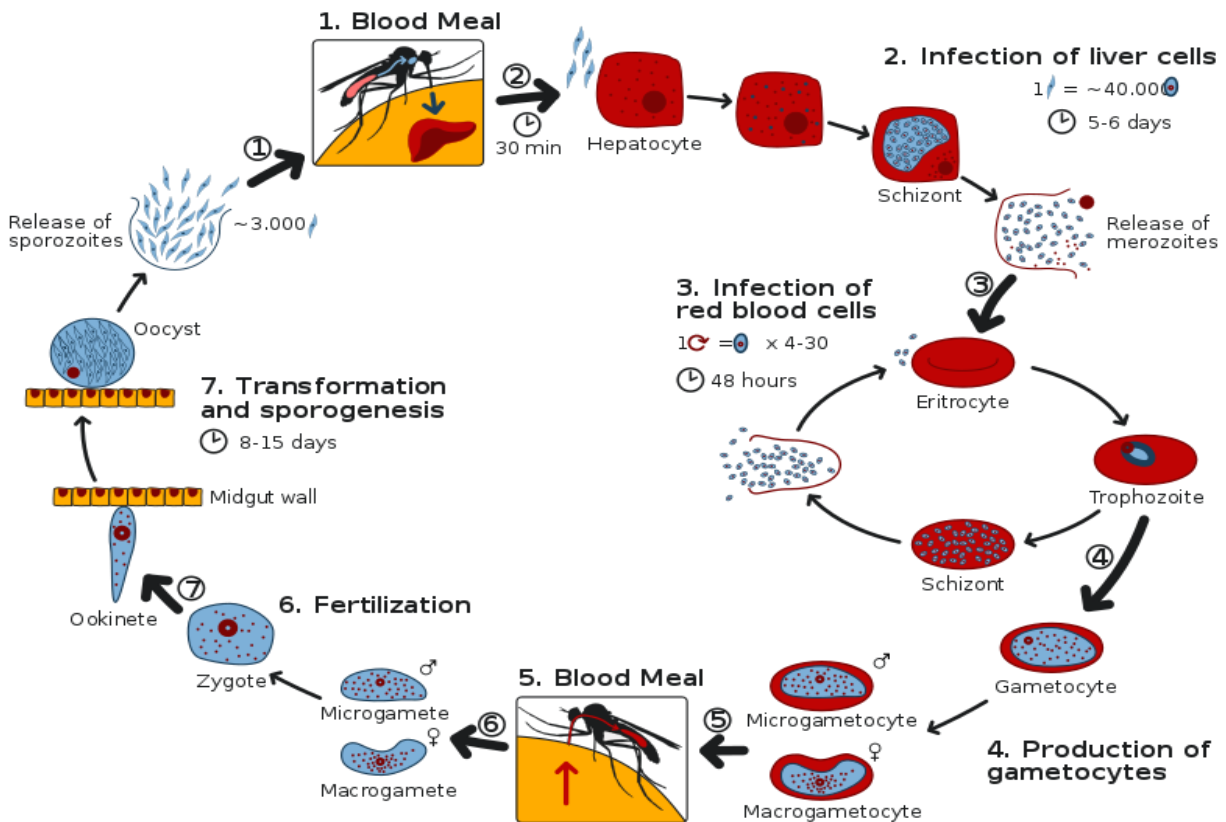
### 2.2.2 Transmission and Life cycle

The disease is spread by the bite of infected female *An. mosquitoes* (Mockenhaupt *et al.*, 2002), which inoculates the parasites with its saliva at the time of biting. The disease is due to infection with one of four species of the *Plasmodium* genus, which are obligate intracellular protozoa (WHO, 2014). The cycle starts when an infected female *An. mosquito* bites an individual, and injects sporozoites, present in mosquito's salivary glands, into the host blood stream during its blood meal. These sporozoites migrate to the liver where they mature and multiply within hepatocytes. These forms are known as schizonts. This extra-erythrocytic stage is asymptomatic (Asymptomatic infection occurs when an individual is able to tolerate the presence of parasitemia without having any symptoms of the infection. And usually lasts 6 days to 14 days, although sometimes it can last up to several months or even years in the case of *P. vivax* or *P. ovale*. These two human *Plasmodium* species can produce hypnozoites in the liver (Markus, 2011).

The life-cycle of vector-borne diseases like malaria is complex relative to that of many directly-transmitted human diseases (including bacterial or viral diseases like bacterial meningitis or HIV). The malaria parasite life cycle involves two hosts. On the whole, directly transmitted diseases require a threshold level and complexity of population agglomeration, and are therefore relatively recent phenomena perhaps evolving within the last 10 millennia (May and Anderson, 1990). Hypnozoites are a dormant form of the parasite, also called cryptic form, which can stay in the liver for long periods of time and are the cause of the disease relapse. After the liver stage, tens of thousands of merozoites will be released into the blood; where they will invade and develop within erythrocytes. The blood stage of infection includes asexual forms of the parasite that undergo repeated cycles of multiplication in erythrocytes, causing parasite numbers to rise rapidly. This phase is responsible for the symptoms of malaria. Within the erythrocyte, the asexual forms of the parasite permits through different sequential maturation stages: ring, trophozoite and schizont forms. In the end, the erythrocyte ruptures and new merozoites are released and ready to infect new erythrocytes. Some parasites will grow into the sexual forms, responsible for transmission, known as gametocytes. The female and male gametocytes (macro-gametocyte and micro-gametocyte, respectively) will be ingested by the mosquito vector during

its feeding, and sexual reproduction occurs inside the mosquito midgut before the parasite is transmitted to another human host and the whole cycle starts again (Greenwood *et al.*,2005).

The intensity of transmission depends on factors related to the parasite, the vector, the human host, and the environment (WHO, 2014). The transmission intensity is highly sensitive to environmental variations that affect the densities of these vectors and their ability to transmit the infection. Temperature influences the length of larval development, mosquito survival, and parasite development. Elevated temperatures accelerate the development rate of both the mosquito larvae and of the *Plasmodium* parasites (Paaijmans *et al.* 2009). Variations in transmission intensity have been observed within very small localities due to geographical (the geographical distribution of these species varies; *P. vivax* infection is rare in Africa but common in Asia, biological or socioeconomic factors (Gebremariam,1988;Tulu,1993;Negash *et al.*,2005 and Ghebreyesus *et al.*,2006). Mosquitoes breed in water with different preference, for example some prefer shallow collection of fresh water (rice fields, hoof prints). Transmission is more intense in places where the mosquito's lifespan is longer (giving the parasite the time to complete its development inside the mosquito) and where the vector prefers to bite humans rather than other animals. These characteristics are seen in African vector species which explains the high rate (90%) of malaria deaths in Africa (WHO 2014).



**Figure 2: Life cycle of Malaria Parasite**

([https://commons.wikimedia.org/wiki/File:Life\\_Cycle\\_of\\_the\\_Malaria\\_Parasite.svg](https://commons.wikimedia.org/wiki/File:Life_Cycle_of_the_Malaria_Parasite.svg))

### 2.2.3 Factors of Malaria Transmission

Malaria transmission intensity, along with its temporal and spatial distribution in Ethiopia, is mainly determined by the diverse eco-climatic conditions. Climatic factors such as temperature, rainfall and humidity show high variability mainly as a function of altitude and are the most important variables that influence malaria transmission (Tamiru *et al.*, 2014). Malaria transmission varies among communities largely due to environmental factors, such as proximity to breeding sites. Many water resources development and management projects result in local outbreaks of malaria and other vector-borne diseases such as Schistosomiasis, lymphatic filariasis and Japanese encephalitis. These outbreaks can be attributed to an increase in the number of breeding sites for mosquitoes, an extended breeding season and longevity of mosquitoes, relocation of local populations to high-risk reservoir shorelines and the arrival of

migrant populations seeking a livelihood around the newly created reservoirs (Delenasaw *et al.*, 2009).

Due to the unstable and seasonal pattern of malaria transmission, the protective immunity of the population is generally low and all age groups are at risk of infection and disease. Some small-scale studies have documented on malaria parasite prevalence between 10.4–13.5% in Gambella; 7.6–14.1% in Tigray; 4.6% in Amhara, 0.9% in Oromiya and 5.4% in Southern Nations, Nationalities and People's Region in all age groups (Ghebreyesus *et al.*, 2006). Malaria case a lot of costs on the population not only lives lost, but also in medical costs, lost income and reduced economic output (Betemariam and Yayeh, 2002). More than 600,000 confirmed and more than 9 million clinical cases each year and cause about 70,000 deaths in all age stages each year in Ethiopia (Zerihun *et al.*, 2007).

#### **2.2.4 Control and prevention on malaria in Ethiopia**

The control of malaria in Ethiopia has a history of more than 40 years (WHO, 2009). Initially malaria control had begun as pilot control project in the 1950's and then it was transformed to a national malaria eradication campaign in the 1960's then to a control strategy in the 1970's (Deressa *et al.*, 2003). In 1976, the national organization for the control of malaria and other vector-borne diseases (NOCMVD), emerged from the malaria eradication service (MES). Until the early 1996's malaria control was organized by sectors, (PMI, 2008). Sector malaria control office were responsible for malaria detection and treatment posts (MDTPs) which collected data on microscopically confirmed cases in each sector. Despite reduced prevalence and level of transmission in many areas, the eradication of malaria by that time was not successfully partly because of some technician and financial constraints in both the country and the institutional organization supporting the project (MOH, 2000; Deressa *et al.*, 2006).

Following the global malaria control strategy by WHO in 1992, Ethiopia had made a major reorganization and decentralization in health administration starting from 1993. Region took over responsibility for many aspect of the program and malaria control was integrated with other parts of the health system. In a subsequent reorganization of the Federal Ministry of health (MOH) malaria control become a 'team' under the disease prevention and control department (DPCD) rather than a separate department at the central level, cores of professionals and responsible for

formulation of policies, provision of technical guidelines to regions, assistance in training, conducting operational research and support in anti-malaria drugs, insecticides and equipment (Roberts *et al.*, 1997; FMOH, 2002).

The malaria control and prevention in Ethiopia has been governed by a five-year strategic plan for 2006-2010 based on ITNs, IRS (IRS in selected villages) distribution and prompt treatment of malaria patient using ACT based on diagnosis of patient (WHO African region, 2007). The main objectives of the malaria strategic is to reduce the overall burden of malaria by 50% for 2010 as compared to the baseline level (determined in 2006, 80%) and maintain malaria free area through strong surveillance and preventive measures. The operation is targeted on only for altitudes below 2000m a.s.l and based on the criteria such as altitude morbidity data and history of epidemic (MOH, 2008).

Indoor residual Spray (IRS) is the application of long-lasting insecticides (up to six months) on the walls of dwellings. Insecticides repel mosquitoes from entering houses and /or kill it, thereby preventing subsequent transmission (Jima, 2007). In Ethiopia IRS operation are currently implemented in kebele selected within each district based on local knowledge using information. The number of annual spray round required is determined by the history of malaria case; altitude and the presence of nearby anophele breeding site with rain fall patterns. It is believed that *An. pharoensis* and *An. arabiensis* breeding in lakes may be focal point for initiating epidemics when the rainy season begins, thereby allowing anopheline population to spread (PMI, 2008).

As with IRS, the vector control effects of ITNs become more apparent when household coverage increases (Binka *et al.*, 1998; WHO, 2006). The distribution of ITNs in Ethiopia was started since 1998 using ordinary nets with low coverage and re-impregnation (Jima, 2007). Later on, the long lasting insecticide treated nets (ITNs) was introduced in 2005 followed by rapid scale-up in the LLINs distribution to provide 2 nets per household in 2007. Therefore, national ITNs coverage rates have been increased from 3.4% in 2005 to 53.3% in 2007 (MOH, 2007). The national malaria indicator survey (MIS), 2007 showed that an average of 60% of children under five years and 65.7% of pregnant women had slept under an ITN in households that owned at least one ITN, in malarious areas and also nationwide (FMOH, 2008).

In addition to the vector control measures described above, distribution of anti-malaria drugs; environmental management; larvicides; health education and counseling are also essential to combat the disease (MOH, 2003). Therefore, in Ethiopia, sulfa–doxin-pyriethamine (fansider) at 36% clinical failure rate was successfully replaced by new, highly effective artemisinin-combination drug treatment (ACT) as the first line treatment drug. This has been done with the help of rapid diagnostic tests (RDTs) kit that can detect malaria case quickly in their home (FMoH, 2004).

In addition, environmental management as vector control intervention in Oromia Regional Health bureau, Ethiopia, showed implementation of vector mosquito's identification and filling-in breeding sites with low community participation (PMI, 2008). In north Ethiopia, Tigray Regional State, filling, draining and shading of potential mosquito- breeding habitats was carried out by the community of Deba (study village) as pilot study and relatively few malaria case, were recorded after control intervention (Yohannes *et al.*, 2005). Along with environmental management, the application of chemical insecticides, called larvicides, may be applied to all mosquitoes breeding sites or targeted to the breeding sites of specific vectors in conjunction with environmental control measure. The most common water soluble chemical used in Ethiopia is Temephos (Abate). It is safe for human and therefore it can be applied to drinking water (FMoH, 2003).

Moreover, the health extension workers (HEWs) have been giving health services to the community such as case management of childhood illness (e.g., pneumonia and malaria) and delivery of preventive intervention such as LLINs, immunization, promotion of healthy behavioral and mobilization of communities (Haines *et al.*, 2007; Neguss *et al.*, 2007).

According to MOH (2008), Ethiopia has seen a significant reduction in malaria morbidity, mortality and in the number of life threatening epidemics, which is the result of integrated malaria prevention and control intervention methods.

#### ***2.2.4.1 Environmental Management***

Environmental management was the most popular malaria prevention method in Ethiopia. Communities are destroying mosquito breeding sites; clearing stagnant water, covering spring water, eradicating dirt from the compound (Mohammed *et al.*, 2010). If accumulated water could

not be removed, spraying “used motor oil” has preventive effect. Some mentioned they disposed of waste, by burning or burying it, in holes dug far from their house. They also prepared toilet properly, as a toilet which was not dug properly could accumulate water and thus be a good breeding site for mosquito (Alelign and Dejene, 2016). In addition, they separated their house from their cattle’s/livestock since fecal matter from animals results in favorable environment for mosquito breeding. In addition to environmental management, some considered keeping personal hygiene as a good malaria preventive mechanism (Tsige *et al.*, 2009).

#### ***2.2.4.2 Treatment***

Early diagnosis and treatment of malaria can prevent it developing into a severe condition which could be fatal. In view of widespread drug resistance, treatment should follow national recommended protocols (UNICEF, 2000). If chloroquine fails to clear the malaria infection; an alternative drug needs to be used. If resistance to chloroquine is known to exist, other treatment is recommended. For example, pyrimethamine/sulfadoxine (Fansidar) or mefloquine may be used as first line drugs in areas of chloroquine resistance. Mefloquine is effective in the treatment of many cases of drug-resistant malaria, though resistance to mefloquine is growing in South East Asia. In addition, adverse reactions have been reported.

Artemisinin is a natural product developed by Chinese scientists from the wormwood plant, *Artemisia annua*. Artemisinin clears the parasite from the body more quickly than chloroquine or quinine. It is also considered to be less toxic than quinine. Combination drug therapies are being advocated for treatment of malaria, such as mefloquine plus artemisinin (WHO, 2012).

The recommended treatment of severe complicated malaria is intravenous quinine or artemisinin derivatives. Intravenous infusion of quinine should be given slowly over 8 hours to avoid cardiac complications. This should be followed by oral quinine tablets for a total of 7 days once the patient is conscious and can drink. Although treatment may start at the health center, the patient should then be immediately referred to a hospital (UNICEF, 2000).

Chloroquine is the recommended treatment for uncomplicated cases in areas where resistance is low or non-existent. Fansidar is the recommended treatment in areas of high chloroquine resistance where Fansidar is still effective. To mask the bitter taste of chloroquine, crushed

tablets can be given to the child with banana or other local food. Quinine is the standard treatment for children with severe malaria (WHO, 2012).

Pregnant women in malaria endemic areas are more susceptible to malaria infections because of their reduced natural immunity and may therefore develop complications such as fever and severe anaemia. In some countries, national policies recommend routine use of anti-malarial drugs during pregnancy. Difficulties arise in providing pregnant women with prophylaxis in areas where there is resistance to chloroquine. Pyrimethamine/sulfadoxine (Fansidar) has been used as prophylaxis/intermittent treatment in Malawi and in Kenya with good preliminary results. In addition, all pregnant women should attend routine pre-natal clinic and should be protected from malaria by sleeping under treated mosquito nets. They should also receive ferrous sulphate and folic acid daily, to treat and prevent anaemia. When pregnant women become ill with malaria, treatment depends on national guidelines. Chloroquine, amodiaquine and quinine can all be safely given during pregnancy (UNICEF, 2000).

#### **2.4. Community Knowledge, Attitude and Practices about Malaria**

The achievement of vector control programs is more effective with the involvement of the community. Some studies have documented an advanced knowledge of the community beliefs and practices with respect to the malaria disease that required obtaining and maintaining its participation in control activities. Incorrect understanding and beliefs can interfere with the effectiveness of control measures (Rodriguez *et al.*, 2003). And the control programmes is more successful when the communities are informed of what they can do to prevent and treat malaria. Lack of understanding on malaria and its control can interfere the effectiveness of control measures (CDC, 2017).

A study conducted in Nigeria on the knowledge, attitude and practice on malaria prevention and control indicated that from 261 participants 97. 7% of the respondents heard about malaria and majority (93. 1%) of them use radio as a source of information about malaria. With regard to respondents knowledge on signs and symptoms of malaria, most respondents (98. 8%) associated malaria with high temperature or fever, 84. 29% head ache, 53. 64% loss of appetite and 5. 75% vomiting. In their study sleeping under bed nets was the most prevalent method of malaria

prevention and control were 97.7% sleeping under bed nets, 58.6% mosquito coil and 11.8% spraying insecticide (Amusan *et al.*, 2017).

A community based cross sectional study conducted on the knowledge, attitude and practice in south western Ethiopia, revealed that all respondents heard about malaria and they were able to recognize the commonest symptoms of malaria that they mentioned 88.8% fever, 75.5% head ache and 73.5% chills. The communities awareness on means of transmission and way of prevention of malaria seems to be good in the study area, however, the bed net ownership and utilization was not as high as their knowledge, where bed net (83.1%) and draining stagnant water (77.5%) were mentioned as a protective method of malaria only 69.9% respondents use bed net and 62% drain stagnant water in their surroundings (Henok *et al.*, 2017).

A study conducted in Areka town, southern Ethiopia indicated that among the total of 405 respondents participated in the study 204 (50.4%) had good knowledge while 201 (49.6%) had poor knowledge on malaria. Majority 363 (89.6%) of respondents correctly mentioned the use of insecticide treated mosquito nets and stagnant water as a means of malaria prevention. In addition, 356 (87.9%) said that sleeping under a mosquito net during the night prevent oneself from getting malaria. However, 24.9% of the study participants did not correctly identify the mode of transmission and treatment (Kebede *et al.*, 2017).

### 3. MATERIALS AND METHODS

#### 3.1. Description of the study area

The study was carried out in Somali regional state eastern Ethiopia, Fafan zone in Jigjiga town. It is located eastern Ethiopia, 632 km far from Addis Ababa. approximately at about 80km east of Harar and 60km west of the border of Somalia. The study area lies between 9°35'N latitude and 42° 8' E longitude and has an elevation of 1,609m above sea level (The GPS Coordinates .net). Jigjiga Woreda is climatically characterized by semi-arid and arid climate with 402.9 mm mean annual rainfall. The annual daily minimum and maximum temperature ranges from 12.8 - 28.3° c (NMAE, 2017).

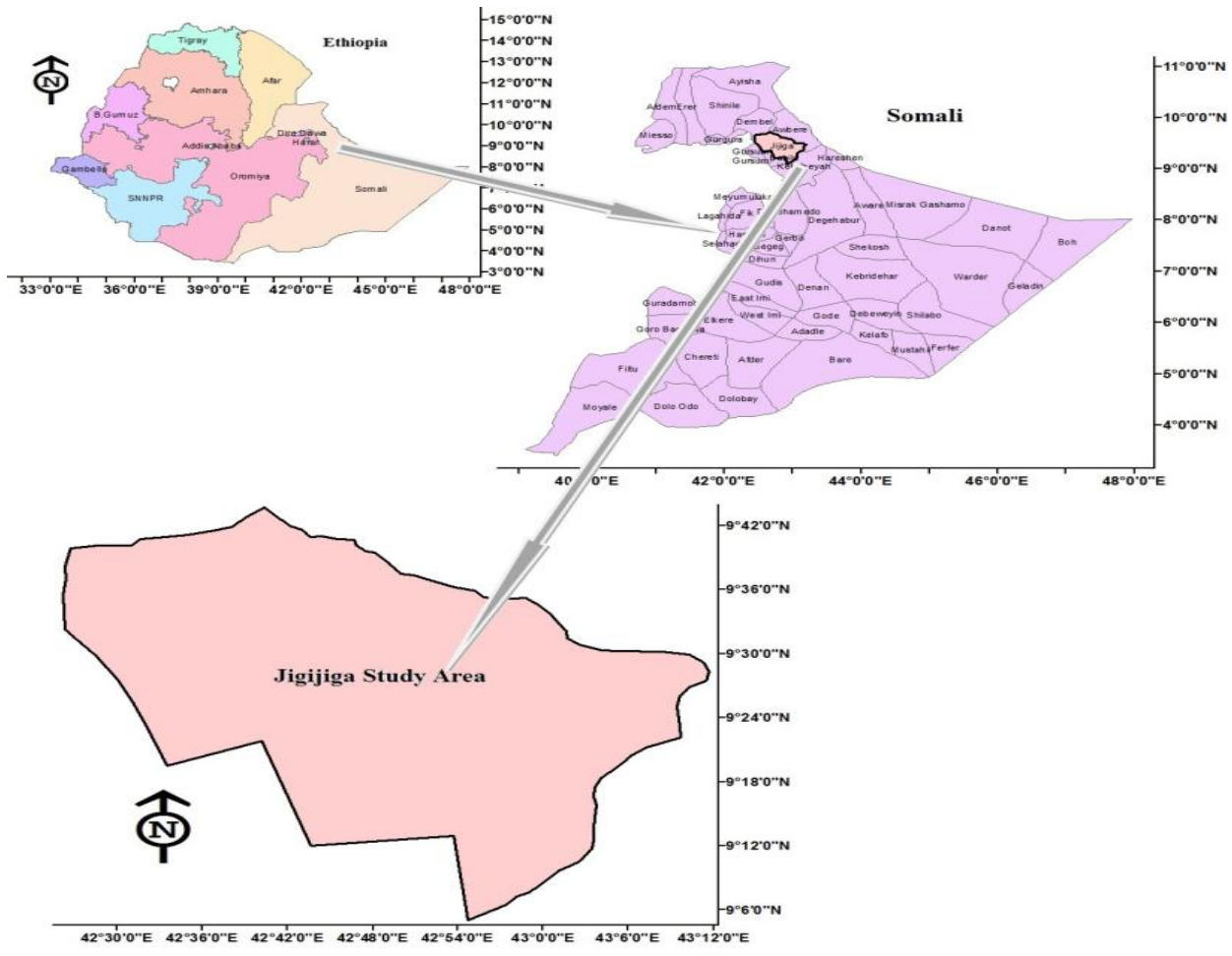


Figure 3: Map of the Study Area (Source: Jigjiga town Administrative office, 2018).

Based on the 2007 census conducted by the central statistical agency of Ethiopia (CSA), Jigjiga wereda has a total population of 277,560 from this 149,292 are men and 128,268 women. While 125,876 or 45.35% are urban inhabitants, 2.51% are pastoralists (CSA, 2007).

### 3.2. Study design and population

The study was conducted at Jigjiga General Hospital. A General Hospital based on cross sectional survey study was carried out to assess the prevalence of malaria and the knowledge of the study population towards malaria and its control in Jigjiga town. One year retrospective data from January, 2018 to December, 2018 was taken, therefore the study participants were patients of malaria suspected individuals microscopically tested in the hospital those registered on patient registration book were taken to determine the current prevalence of malaria. Second, household questionnaire was used to assess the knowledge of the study participants about malaria and its control.

All kebeles of individual household members, who came to hospital for any kind of healthcare, formed the sampling population. Adults above or equal to 20 years of age were selected randomly from all three kebeles considering probability proportional to size allocation for survey of household questioner.

### 3.3 Sample size determination

A total of 6,393 malaria suspected patients registered in the Jigjiga General Hospital from January, 2018 to December, 2018 was the sample size to determine the current prevalence of malaria and also to determine the community knowledge, practice and attitude about malaria questioners was distributed to determine participants sample size using a single proportional formula was used at the level of 95% CI [ $Z_{\alpha/2} = 1.96$ ]. The prevalence malaria in the region is unknown using  $P = 50\%$ . Using the formula,  $n = Z^2 \times P \times (1-P) / d$  (Henok *et al.*, 2015); 600 samples (n) was estimated taking the marginal error (d) 4% as shown below:

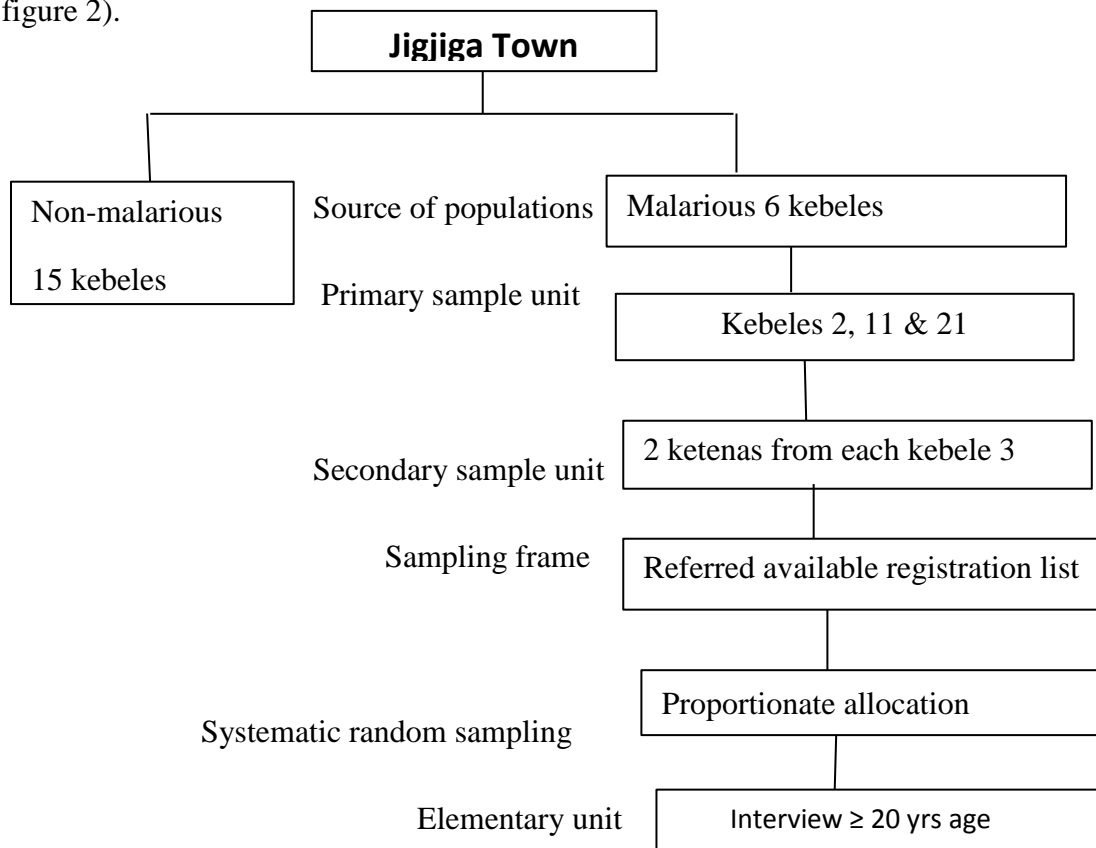
$n = Z^2 P (1-P) / d$	where n is sample size
$n = (1.96)^2 \times 0.5(1-0.5) / (0.04)^2$	P- average prevalence
$n = 0.96 / 0.0016$	$Z^2$ - value at 95% CI
$n = 600$	d – worst accepted value (marginal error).

From 600 study participants only 472 (78.8%) respond properly and 128 (21.2%) were not good (the document was not correctly found).

### 3.4 Sampling Technique to assess the knowledge of the study participants

Among 21 kebeles in Jigjiga town, 6 were identified as malarious kebeles by Jigjiga Town Health office. Accordingly, kebele 2, 5, 6, 11, 19 and 21 were identified and located. Then, by using cluster sampling method three kebeles and two ketenas from each selected kebeles with four ketenas were randomly selected. By having these selected kebeles and ketenas, the recent registration lists on households were used to determine the number of households to be selected from each study ketena in the respective kebeles.

The share of households for each ketena was divided by the total number of households in a given ketenas to determine a sampling interval and then households were selected by systematic random sampling. Based on the interval made for each ketena data collection was carried out (See figure 2).



**Figure 4: Schematic Presentation of Sampling Procedure**

### **3.5 Blood Sample Collection and Analysis**

In Jigjiga General Hospital there are two senior laboratory technicians, one senior nurse supervisor and one guide man who has been identified the malaria blood sample suspected.

Sampling was involved in the blood sample collection for smear test. Before blood sample collection, slides for both thin and thick films were prepared. The blood samples were collected from finger pricks of all the individuals who were suspected of malaria then labeled the slides and all blood slides fix of thin films with methanol and stained with Giemsa solution for 30 minutes. Materials used were cotton, 70% alcohol, and sterile disposable lancet. The staining technique and blood film examination is conducted according to WHO manual (WHO, 2018). Giemsa's staining procedure was used for both thick smears and thin smears. Thick smear was deepened in Giemsa's staining solution and allowed to act for 30 minutes, then washed with tap water and examined after dried. In the case of thin smear, the smear was fixed with methyl alcohol for 30 seconds. Then, the slides were stained for 30 minutes. Finally, the slides were flashed with tap water and examined under microscope after dried.

### **3.6 Data quality control**

The recorded data were taken from patient registration book of the Hospital. Data was collected, checked and confirmed. The questionnaire was first translated in to local language Somali and edited by a nurse and health extension to avoid ambiguity questions to assure the quality of the data before analysis. The Somali version was later translated back into English by professionals. Data was collected and the collected information was checked every day for completeness and consistency.

### **3.7 Data entry and analysis**

Data was checked for completeness and consistency and entered in to excel and exported in to Statistical Package for Social Science (SPSS) version 20 software (IBM Corporation, Chicago) for statistical data analysis. Data was analysed using descriptive statistics in percentage and presented by using figures and tables. The chi-squared test was used for prospective malaria prevalence data to determine differences between age, sex and seasons and malaria parasite distribution. Statistical significance was defined at P-values less than 0.05 ( $P < 0.05$ ).

### **3.8 Supportive letter**

The Addis Ababa University, College of Natural and Computational science, Department of Zoological Science ethical committee had issued supportive letter before the study was conducted through an official letter To Whom It May Concern. Thus, in agreement with the letter received the Town health office in collaboration with the General Hospital and collaborated in many aspects of the study.

## 4. Results

### 4.1. The prevalence of malaria in Jigjiga General Hospital from January, 2018 to December, 2018.

Monthly outpatients' morbidity report of malaria case treated based hospital laboratory diagnosis in Karamara General Hospital from January, 2018 to December, 2018 is compiled in Table 1. In Karamara General Hospital, A total of 6,393 malaria suspected patients were diagnosed microscopically, of which 230 (3.6 %) of patients were microscopically confirmed as malaria positive. Among the patients, there were 3,552 males and 2,841 females, of which 137 (59.7%) and 93(40.3%) were slide positive for males and females, respectively. Malaria confirmed cases were greater in males than females (Table 1).

**Table 1: Prevalence of malaria among outpatients in Karamara General Hospital between January - December, 2018 year**

Months	No of blood sample			No of positive sample		Total	%	M : F	P=0.0001
	No	M	F	M (%)	F (%)				
January	516	290	216	6 (1.1)	4 (0.8)	10	1.9	1.2:1	
February	601	306	295	9(1.5)	3 (0.5)	12	2	3:1	
March	530	236	294	2(0.2)	4(0.4)	6	1.1	1:2	
April	488	200	288	3(0.6)	1(0.2)	4	0.8	3:1	
May	385	305	154	25(6.5)	13(3.4)	38	9.9	1.9:1	
June	479	297	231	25(5.2)	18(3.8)	43	9	1.7:1	
July	494	429	155	36(7.3)	17(3.4)	53	10.7	2.1:1	
August	547	306	294	10(1.8)	9(1.6)	19	3.4	1.1:1	
September	475	278	139	8(1.7)	11(2.3)	19	4	1:1.4	
October	510	281	216	7(1.4)	2(0.4)	9	1.8	3.5:1	
November	630	276	209	4(0.6)	8(1.3)	12	1.9	1:2.2	
December	738	348	350	2(0.3)	3(0.4)	5	0.7	1:1.3	
<b>Total</b>	<b>6,393</b>	<b>3,552</b>	<b>2,841</b>	<b>137</b>	<b>93</b>	<b>230</b>	<b>3.6</b>	<b>1.5:1</b>	

Note: No = Number, M = male, F = female

The prevalence of male and female difference might be due to males stay outside their home during night time, travelers than females that mostly do their activities at home and the region communities are pastoralist and move from place to place and this activity is done by males.

The prevalence of malaria in the Town showed variations from month to month ranging from the highest record of 10.7% in June to that of 0.7% in December. The data showed a steady decrease from July to December (from 10.7% to 0.7%). However, there was a significant increase from April to June (Table 1), thereafter; the prevalence of the disease progressively declined at April as shown the table fluctuation rate. However, it showed a fluctuating pattern with in the category of the high prevalence in the month July, May and June, medium prevalence in the month of February, August and September and lower prevalence in the months of January, March, April, October, November and December (Table1).

#### **4.2 Plasmodium Species detected in outpatients**

The data also showed that the prevalence of *P. falciparum* and *P. vivax* as causative agents of a disease of which *P. falciparum* being the predominant parasite 172 (74.8%), followed by *P. vivax* 44 (19.1%) malaria morbidity respectively, whereas the mixed infection was 14(6.1%) in study area (Table 2).

**Table 2. The distribution of *Plasmodium species* in Karamara General Hospital from January - December, 2018.**

Month	Plasmodium species			Total	%
	Pf (%)	Pv (%)	Mi (%)		
January	9(90%)	1(10%)	0	10	4.3%
February	8(66.7%)	3(25%)	1(8.3%)	12	5.2%
March	5(83.3%)	1(16.7%)	0	6	2.6%
April	2(50%)	1(25%)	1(25%)	4	1.7%
May	26(68.4%)	9(23.7%)	3(7.9%)	38	16.5%
June	31(72.1%)	7(16.3%)	5(11.6%)	43	18.7%
July	48(90.6%)	4(7.5%)	1(1.9%)	53	23%
August	13(68.4%)	6(31.6%)	0	19	8.3%
September	10(52.6%)	7(36.8%)	2(10.5%)	19	8.3%
November	8(88.9%)	1(11.1%)	0	9	3.9%
October	7(58.3%)	4(33.3%)	1(8.3%)	12	5.2%
December	5(100%)	0	0	5	2.2%
<b>Total</b>	172(74.8%)	44(19.1%)	14(6.1%)	230	

Note: Pf = Plasmodium falciparum, Pv = Plasmodium vivax, Mi= Mixed infection.

*Plasmodium falciparum* was the predominant parasite in the study area and accounted for 74.8% of malaria prevalence. This finding coincides with the malaria parasite distribution in Ethiopia which indicates *P. falciparum* and *P. vivax* are the two predominant malaria parasites, distributed all over the nation accounting for 60% and 40% of malaria cases respectively ( MOH, 2010). The

occurrence of malaria also showed significant difference amongst months within seasons. Accordingly, the highest peak of 16.5%, 18.7% & 23% was recorded in May, June and July respectively (Table 2).

### 4.3 Proportion of malaria case by age of patients

In relation to age, malaria was detected in all age groups. The total number of patients examined with the age of <5 years 1808. Among these, 61 (26.5%) were found to be slide-positive (46 *P. falciparum*, 12 *P. vivax* and 3 mixed). From the total examined patients, 1311 were between the ages of 5 to 14 years and 38 (16.5%) of them were malaria positive (28 *P. falciparum*, 9 *P. vivax* and 1 mixed). For those age from  $\geq 15$  years, the number of examined was 3274 of whom 131(60% of total number of malaria positive) were malaria positive (98 *P. falciparum*, 23 *P. vivax* and 10 mixed). The age groups  $\geq 15$  showed the highest prevalence rate which is 56.9% from total examined malaria positives (Table 3).

**Table 3: Proportion of malaria case by age of patients in Karamara General Hospital from January - December 2018.**

Age	Examined number	Confirmed No (%)	<i>P. falciparum</i> No (%)	<i>P. vivax</i> No (%)	Mixed No (%)	Total
< 5	1808	61 (26.5)	46	12	3	61 (26.5%)
5-14	1311	38 (16.5)	28	9	1	38(16.5%)
$\geq 15$	3274	131(60)	98	23	10	131(60%)
<b>Total</b>	6,393	230	172	44	14	230(100%)

Note: No = Number, P = Plasmodium

#### **4.4 Socio-demographic characteristics**

Out of 472 respondents interviewed, 271 (57.4%) were males and 201(42.6%) females. The highest proportion (32%) was within the age group of 31 – 40 years considered as youngsters, with the least proportion (6.2%) being 60+ years and above. The respondents' age ranged from 20 to 90 years. Regarding their occupation of the interviewee merchants were predominant 171(76.6%), followed by government employees 157(32.6%) and others 139(29.04%). Assessment of their level of education revealed that 309 (63.1%) of them had been to school: the least number (27, 5.7%) of the respondents were illiterates, more than halve (290, 46.4%) have attended diploma and above, secondary school (98, 20.4%) and elementary school (58, 12.3%) completed, while the rest were write and read (69, 14.4%). Majority of the respondents were followers of Muslim religion 423(87.9%) followed by Christian (Orthodox, Catholic, Protestant) 48(9.9%) and the rests were others 1(0.2%) (Table 4).

**Table 4: Socio-demographic characteristics of the study population, Jigjiga town, 2019**

<b>Characteristics</b>	<b>Frequency</b>	<b>Percent (%)</b>
<b>Sex</b>		
Male	271	57.4
Female	201	42.6
<b>Age</b>		
20-30	117	24.8
31-40	154	32.6
41-50	105	22.2
51-60	66	13.7
61+	30	6.2
<b>Occupation</b>		
Government employee	157	33.3
Merchant	176	37.3
Others	139	29.04
<b>Education</b>		
literate	27	5.7
Read and write only	69	14.6
Elementary school completed	58	12.3
Secondary school completed	98	20.8
College diploma and above	290	46.4
<b>Religion</b>		
Muslim	423	87.9
Christian	48	9.9
Others	1	2.2

## 4.5 Knowledge, Attitude and Practice about malaria

Almost all respondents (461, 97.7%) had ever heard of malaria and recognized that malaria was one of the health problems of the community. From a total of 472 respondents, 351(74.4%) knew that malaria could be transmitted from person to person and 121(25.6%) did not believe the transmissibility of the disease (Table 5).

More than half of the respondents (56.1%) believed that malaria was a preventable disease, 23.5% didn't believe that malaria is preventable and the rest 20.1% did not have the idea of malaria preventability. One-fourth of the respondents (26.5%) mentioned mosquito bites transmits disease. Others by eating and drinking unhygienic food and water 8.7%, by using the same utensils with patients 11.7%, by the curse of god 23.7% and other like replied mother to child (placental), by flies, by physical contact, by breathing and malaria infected blood donation are 29.4% (Table 5).

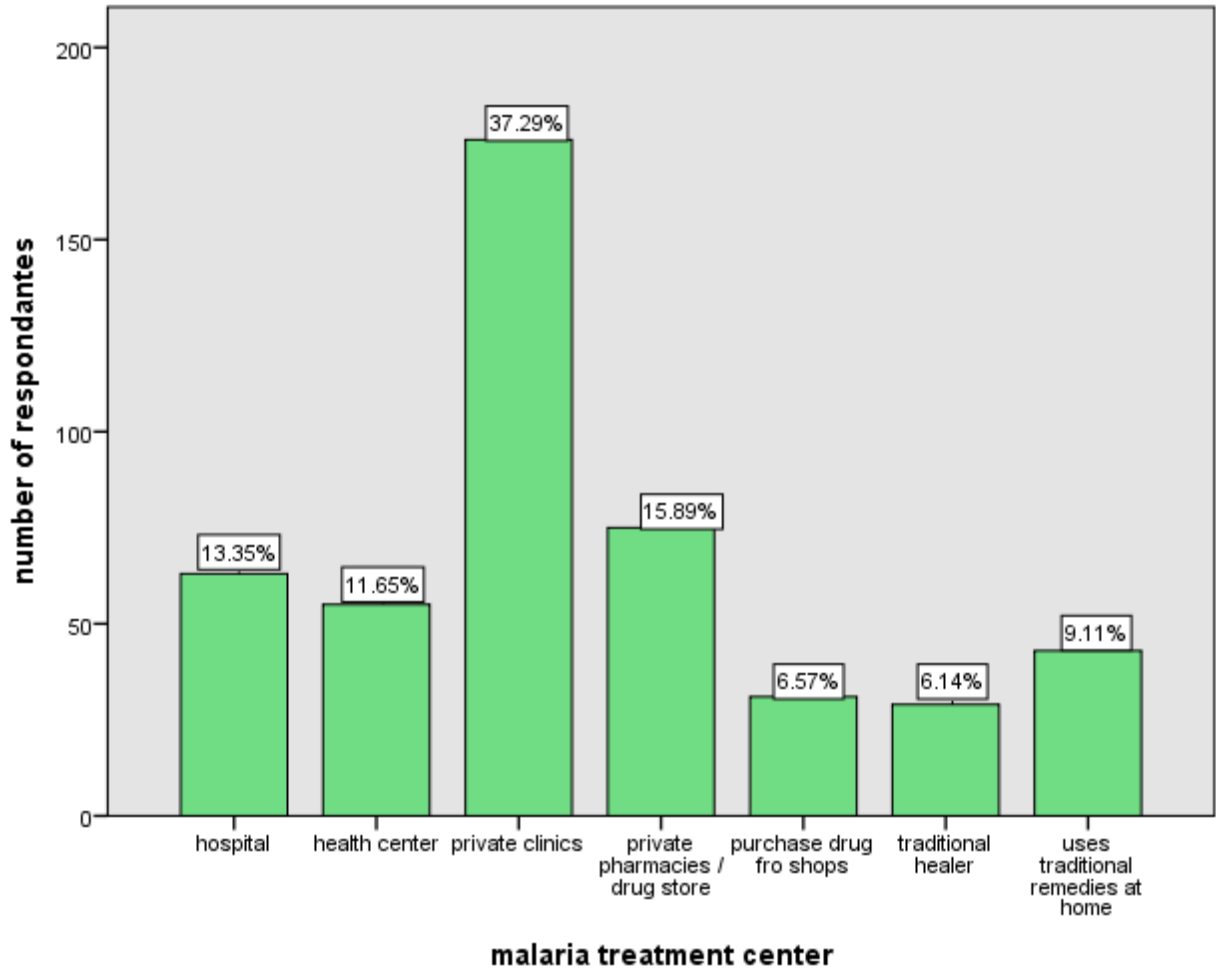
**Table 5: Knowledge of respondents related to malaria preventability, transmissions and symptoms Jigjiga town, 2019.**

Characteristics	Frequency	Percent (%)
<b>Ever heard of malaria</b>		
Yes	461	97.7
No	11	2.3
<b>Malaria transmissible</b>		
Yes	351	74.4
No	121	25.6
<b>Mode of malaria transmission</b>		
Bite of infective mosquitoes	125	26.5
Eating and drinking unhygienic food and water	41	8.7
Using the same utensils with patients	55	11.7
The curse of God	112	23.7
Others (placental, flies, contact, blood donation)	139	29.4

<b>Symptoms of malaria</b>		
Loss of consciousness	11	2.2
Vomiting	400	84.7
Thirst	412	87.1
Back pain	415	87.9
Joint pain	426	90.2
Loss appetite	436	92.2
Headache	454	96.1
Chilling and shivering	455	96.3
Fever	455	96.3
<b>Heard about mosquito net</b>		
Yes	447	94.7
No	25	5.3
<b>Family had mosquito net</b>		
Yes	195	41.3
No	277	58.1
<b>Mosquito breeding sites</b>		
Stagnant water and swampy areas	203	43
Running water	39	8.3
Other	230	48.7
<b>Mosquito biting time</b>		
Day	84	17.8
Night	277	58.7
Didn't know	111	23.5
<b>Mosquito resting sites</b>		
Unclean vegetation	258	54.7
In the House	78	16.5
Didn't know	136	28.8

As depicted in Table 5, majority of the respondents (94.7%) were heard about mosquito net. However, only 41.3% of those who had mosquito net and used it. Regarding the number of mosquito net possession, from those who have mosquito net 163 (83.7%) had only one, 21 (11%) two and 5(2.3%) had three and more. They were used by children under five years of age 220(46.6%), Children age above five to ten 1(0.2%), husbands and wives 19(4%), all family members 136(28.8) and no one used 96(20.3%). The purpose of mosquito net was mainly believed to protect from mosquito bite 298(63.1%) and few 63(14.6%) believed from other insects and for sleeping better were 22.2%. With regard to the knowledge of mosquito breeding sites, most respondents 203(43%) recognized that mosquito bred in stagnant water and swampy areas and running water 39 (8.3%). However, the remained 230(48.7%) respondents said waste material and other breeding site. Among those who said mosquito is a biter, 277% said mosquito's bite human beings at night, 17.8% during daytime and 23.5% didn't know. On the other hand, the study subjects have replied that mosquitoes rest in unclean vegetation 258 (54.7%), in the house 78(16.5%), others account (28.8%) did not know.

As attitude on treatment during seek indicated in figure 4, 176 (37.3%) preferred to go to private clinic followed by hospital 63(13.3%), health center 55(11.4%), private pharmacies/drug shops 75 (15.6), purchase 31(6.4%), traditional healer 29(6%), and traditional treatment at home 43 (8.9%). This study showed that private clinic was mostly selectable health treatment center than other. This might be due to good hospitality habit of private clinics. The lowest treatment method was traditional healer (figure 4). The reason may be awareness of community about the disadvantages of traditional medicine.



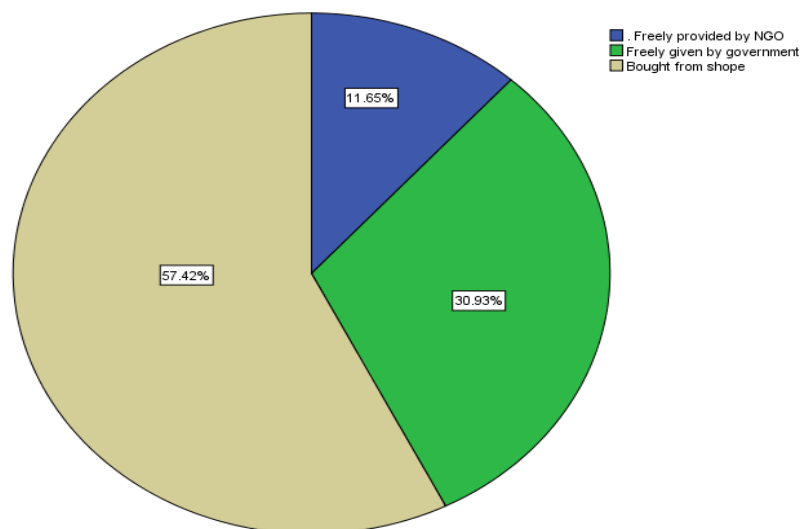
**Figure 5. Malaria treatment center of respondents at study area**

As to understand by the study subjects on the other causes of malaria, 411(87.1%) said cold, dirty stagnant and waste material 221(46.8%), rain 192 (39.3%), cloudy weather 165 (35%) and maize 148(31.4%). The rest related it to hunger 28(6%) and sun- stroke (1.3%), whereas only 19 (3.9%) didn't know (Table 6).

**Table 6: Knowledge towards other causes of malaria disease, Jigjiga town, 2019.**

<b>Characteristics</b>	<b>Frequency</b>	<b>Percent (%)</b>
<b>Cold</b>		
Yes	411	87.1
No	61	12.9
<b>Waste materials</b>		
Yes	221	46.8
No	251	53.2
<b>Rain</b>		
Yes	192	39.3
No	280	59.3
<b>Cloudy weather</b>		
Yes	165	35
No	307	65
<b>Eating maize stalk</b>		
Yes	148	31.4
No	324	68.6

As to the source of mosquito net, most of the house holds 271(57.4%) bought from market and private shops and the rest 55(11.7%) were freely given from NGO's, and 146(30.9%) from government freely (figure 5). This study showed that more than half of the participants' bed net obtains from market. The reason might be enough availability of bed net in the shop. This study participant said that the supply of bed net from government and NGOs were not enough.



**Figure 6: Response of participants for the Sources of their bed nets. Jigjiga town, from January - December, 2018.**

Regarding knowledge and practice on malaria prevention (Table 7), the most of study participant thought that the use of mosquito net (98.5%). In addition to the mosquito net the response were 36.4% taking tablets could prevent malaria, 82.4% by drainage of stagnant water, 63.8% by house spray with insecticide, 71.2% by clearing vegetation, 11.2% smoking, 35% use of aerosols and 79% closing windows and doors were mentioned as preventive methods. These studies indicate that the awareness of respondents is good about the advantages of bed net.

**Table 7: Knowledge of participants toward malaria prevention, Jigjiga town, 2019.**

Knowledge		
Characteristics	Frequency	Percent (%)
Take tablets	172	36.4
House spray with insecticide	301	63.8
Drain stagnant water	389	82.4
Clear the vegetation	336	71.2
Use of mosquito net	465	98.5
Fumigation	53	11.2
Use mobile (aerosol)	165	35
Closing windows & doors early	373	79

Note: Total percent may exceed 100 due to multiple responses.

Whereas with regard to practice for malaria prevention, 31.7% respondents took antimalarial drugs when they were sick, 32.3% sprayed their living house with insecticide usually in April before the emergence of malaria diseases, 46.3% drained stagnant water and 43.3% cleared vegetation from June to August, 37.8% used mosquito net throughout the year, 23% smoked their living rooms, 21.8% used mobile and 30.4% closed windows and doors to be protected from having malaria during the time of mosquito biting.

**Table 8: Practices of participants toward malaria prevention, Jigjiga town, 2019**

<b>Practice</b>		
<b>Characteristics</b>	<b>Frequency</b>	<b>Percent (%)</b>
Take tablets	167	31.7
House spray with insecticide	170	32.3
Drain stagnant water	244	46.3
Clear the vegetation	228	43.3
Use of mosquito net	199	37.8
Fumigation	121	23
Use mobile (aerosol)	115	21.8
Closing windows & doors early	160	30.4

Note: Total percent may exceed 100 due to multiple responses.

As concern to knowledge of respondents on antimalarial drugs (Table7), Fansidar (6.6%) and chloroquine (8.5%) were the two commonly known antimalarial drugs followed by Quinine (6.4%) and 16.4% named Primaquine.

**Table 9: Knowledge of respondents on the name of the current antimalarial drugs, Jigjiga town, 2019.**

Name of antimalarial drugs	Frequency	Percent (%)
<b>Chloroquine (CQ)</b>		
Yes	40	8.5
No	432	91.5
<b>Fansidar (SP)</b>		
Yes	31	6.6
No	441	93.4
<b>Primaquine (PQ)</b>		
Yes	76	16.2
No	396	83.8
<b>Quinine (QN)</b>		
Yes	31	6.4
No	441	93.6

Out of the 472 respondents, only 104 (21.3%) had DDT spray in their living house. Regarding the purpose of DDT spraying, about 93(89.4%) responded that it killed mosquitoes followed by 49(47.1%) protected malaria and 33(31.7%) killed other insects. Among these, 52 (50%) said DDT has no long lasting preventive effect, 49(47.1%) claimed that DDT could cause eye irritation, 35(33.7%) head ache, 12(11.5%) could kill domestic animals and 26(25%) believed that it had no any side effect. There were about nine respondents replastered at different times after DDT was sprayed. Of these, 9(55.5%) maintained after six months, the rest 3(33.3%) after three months and 1(11.1%) after two months. The main reason noted for replastering was to keep their homes clean.

For housing condition, a total of 432(88.3%) had windows and only 116(26.9%) houses had screened windows. There were about 188(38.4%) houses had open space on their walls and about fifty-four respondents shared their living rooms with animals.

As shown in table 8, 215 (45.6%) of the study participants practiced environmental management (Filling and drainage of mosquito breeding sites, in health education campaigns, reporting problems to local health worker or authority) to be protected from mosquito bite. The measures taken were filling and drainage of mosquito breeding sites 16.4%, in health education campaigns 8.3%, reporting problems to local health worker or authority 20%.

**Table 10: Practices of respondents towards environmental management to prevent malaria, Jigjiga town, 2019.**

Characteristics	Frequency	Percent (%)
<b>Environmental management for Mosquito control</b>		
Yes	215	45.6
No	257	54.4
Type of measures taken		
Filling/leveling		
Yes	79	16.4
No	393	83.6
Health education campaigns		
Yes	40	8.3
No	432	91.7
Reporting problems		
Yes	96	20
No	376	80
Reason not participate in Malaria controls activities		
No responsible bodies	98	20.4
No interest to participate	75	15.6
No access to get information when the program launched	84	17.5
Other	215	46.5

## 4.6 Health officers interview

Two male individuals were interviewed. The respondents were the head of Jigjiga town health office and the other focal person of malaria control and prevention. They had 2 and 5 years of experience respectively. Regarding to their education status both of them are degree holders. The discussion points were situation of malaria, malaria control and prevention strategies, the coverage of LLIN and IRS and the problem of the community to the success of malaria control interventions. For the discussion point on the situation of malaria in the study area, the respondents mentioned that, based on the patients flow and number of patients seen in the health center and hospital malaria situation shows a remarkable decrease than in the past decades. However, malaria is not a health problem in the study area.

The implemented malaria control and prevention interventions strategy also asked and they respond that, in this health center malaria suspected patients are diagnosed through blood smear microscopy rather than using RDT. Most of the time the surrounding area is dominated by *P. falciparum* than *P. vivax*. Those infected patients with *P. falciparum* treated by Coretem and *P. vivax* by Chloroquine as a part of case detection and management.

Vector control method is the main strategy in the area that LLINs are distributed and houses of the community are sprayed with DDT per year. Besides these control measures as malaria is a seasonal transmission the concerned health workers mobilize community participation to remove mosquito breeding sites in the surrounding and there is also health education programme for the community given by the health workers. The health education is about prevention which is an important component of malaria control that achieved through vector control such as spraying houses and mosquito breeding sites with chemicals, dispose water holding materials, and drainage stagnant water. Personal protection from mosquito bite through sleeping under bed net and screening windows.

When they are asked on the coverage of LLIN and IRS, they respond that the coverage of IRS shows improvement as compared to the last two years but the distribution amount was not calculated as percentage. With regard to the problems of the community to the success of malaria control interventions, they mentioned that lack willingness to participate environmental control activities and ready their home for spraying.

## 5. Discussion

In the Karamara General Hospital, from January - December 2018 the overall prevalence of malaria was 3.6%. This is in agreement with a study conducted in Kombolch Health Center where the prevalence of malaria was 7.52% (Gebretsadik *et al.*, 2018). However, in contrast to this finding, the study conducted in Afar region showed higher malaria prevalence (19.4%) from September 2016 to January 2017 (Kahsu, 2017). The reason behind to this lower prevalence rate in the study area might be due to the climate and altitude variation and communities' better understanding about knowledge of malaria and control strategies.

The prevalence of malaria confirmed cases was greater in males (59.7%) than in females (40.3%). This result is similar with a study conducted in Arsi Negele in which the prevalence of malaria was greater in males than females (Mengistu and Solomon, 2015). This might be due to males stay outside their home during night time, sleep without close and travellers than females that mostly do their activities at home. Therefore the exposure chances of males to mosquito bite action are greater than females. This was not similar with a study conducted in Amhara Region where the prevalence of malaria was relatively higher among females (60%) than males (40%) (Derbie and Mekonnen, 2017). The possible reason for this difference might be the number of male participants in this study area was greater than females.

The study revealed that the predominant plasmodium species was *P. falciparum* (74.8%) followed by *P. vivax* (19.1%) and mixed infection (6.1%). The study contradicts from the study conducted in Kola Diba Health Centre in which the prevalence of *P. falciparum* 25% and *P. vivax* 75% (Alemu *et al.*, 2012). Similar other studies indicated that *P. falciparum* was the most prevalence species. The study conducted in Metema Hospital revealed that the predominant species was 90.7% *P. falciparum* and 9% *P. vivax* and 0.3% mixed infection (Getachew *et al.*, 2013). This study in line with the general nationwide plasmodium species distribution in Ethiopia where *P. falciparum* (60%) and *P. vivax* (40%) are the two predominant species in the country (FMOH, 2012).

Results from the questionnaire survey showed that 97% of the respondents had heard about malaria and recognized as health problem. This is similar with the study conducted in Nigeria where 97.7% of the respondents have heard about malaria (Amusan *et al.*, 2017) and not similar

with previous study conducted in Tepe town, south western Ethiopia where all respondents 100% recognized malaria as a disease (Henok *et al.*, 2015).

Most of the respondents were able to recognize at least one of the symptoms of malaria. Fever, head ache, chills and shivering, loss of appetite and vomiting were mentioned by the respondents as sign and symptoms of malaria. This is comparable with the study conducted in Abeshge, south central Ethiopia (Yimer *et al.*, 2015).

In this finding it was observed that 74.4% of the respondents understand malaria was a transmissible disease and 25.6% not transmissible. This finding is smaller than the study reported in south Ethiopia, Arbaminch which is 98.2% of the participants knew that malaria is a transmissible disease (Astatkie, 2010). It was observed that 26.5% of the respondents had correctly recognized mosquito bite as means of malaria transmission, which is similar with the study conducted in Amhara region, Berehet district which was 96.6% (Aleme *et al.*, 2014). Ethiopia currently has national strategic plan that targeted to achieve national malaria control programme, which states by 2020, all households living in malaria endemic areas will have the knowledge, attitude and practice towards malaria prevention and control. Health education through health workers and communication intervention through mass media are parts of the methods.

More than half of the respondents (56.1%) believed that malaria was a preventable disease, 23.5% didn't believe that malaria is preventable and the rest 20.1% did not have the idea of malaria preventability. One-fourth of the respondents (26.5%) mentioned mosquito bites transmits disease. Others by eating and drinking unhygienic food and water 8.7%, by using the same utensils with patients 11.7%, by the curse of god 23.7% and other like replied mother to child (placental), by flies, by physical contact, by breathing and malaria infected blood donation are 29.4%. Majority of the respondents 94.7% were heard about mosquito net. But it varied and high that compared from 60.1% total in Ethiopia had knowledge about nets, varied from 22.1% in Afar to 79.9% in Dire Dawa that showed similar studies of the assessment of distribution, knowledge and utilization of insecticide treated nets in selected malaria prone areas of Ethiopia (Animut *et al.*, 2008). This is because the communities were urban and the health extension worker and NGO play a great role who's said the participants. The most important source of their information was health workers 59.1%. However, only 41.3% of those who had mosquito

net and used it. Regarding the number of mosquito net possession, from those who have mosquito net 83.7% had only one, 11% two and 2.3% had three and more. They were used by children under five years of age 46.6%, Children age above five to ten 0.2%, husbands and wives 4%, all family members 28.8 and no one used 20.3%. The purpose of mosquito net was mainly believed to protect from mosquito bite 63.1% and few 14.6% believed from other insects and for sleeping better were 22.2%. With regard to the knowledge of mosquito breeding sites, most respondents 43% recognized that mosquito bred in stagnant water and swampy areas and running water 8.3%. However, the remained 48.7% respondents said waste material and other breeding site. Among those who said mosquito is a biter, 277% said mosquitoes bite human beings at night, 17.8% during daytime and 23.5% didn't know. On the other hand, the study subjects have replied that mosquitoes rest in unclean vegetation 54.7%, in the house 16.5%, others account 28.8% did not know.

Concerning the knowledge of malaria symptoms, the most frequently mentioned were fever 96.3%, chills and shivering 96.3%, and headache 96.1%, loss of appetite 92.2%, joint pain 90.2%, back pain 87.9%, thirst 87.1%, vomiting 84.7% and least mentioned of loss of consciousness 2.2%. In Maji District, Bench Maji Zone, Southwest Ethiopia the similar finding was observed that malaria symptoms were known by 86.1% of respondent, fever, shivering, headache, loss of appetite, thirsty was mentioned by almost all of in depth interview participant (Abraham *et al.*, 2016). The average percentage indicates for this study is the same as Maji district study.

From the study 89% of the participants mentioned mosquito breeds in stagnant water and 93% respond mosquito bite humans at night. This result is higher than in Central Ethiopia, where 72.6% of the study participants revealed that mosquito breed in stagnant water (Zewdie and Molla, 2013) and in Gondar 82.8% knew mosquito bite during night time (Tilaye, 2005). This study shows that the study participants use mosquito net during the night time is appropriate method of malaria control, that in line with the World Health Organization recommendation in which nets are used properly at the time of sleeping.

## **6. Conclusion and Recommendation**

### **6.1 Conclusion**

The study showed that the prevalence of malaria was 3.6% and it showed less prevalence. The data also showed seasonal peaks in malaria infection with the highest infection rate to be 29.6 % during the months of May – July. The study shows that males were more affected (59.7%) than females (40.3%) and the age groups  $\geq 15$  were infected (60%) compared to the other age groups indicating that men and the active age groups were more vulnerable to malaria infection because of their mobility to malarious regions and their activity outside and during the night compared to other groups.

The two *Plasmodium* species namely *P. falciparum* and *P. vivax* were the species that were predominant parasite among outpatients in Karamara General Hospital. In this study the community knowledge, attitude and practice towards malaria cause, treatment and prevention found to be encouraging.

### **6.2 Recommendations**

The following recommendations are forwarded future plan and implementation aiming at the Regional Health Bureau, Jigjiga Town Health Office, the community of Jigjiga Town and other institutions.

- The use of personal protection methods such as impregnated bed nets must be introduced and encouraged through health education, availability of bed nets, cost subsidy, free in charge for poor if possible and there should be availability of chemicals for re-impregnation to avert the possible increase in malaria prevalence in the town.
- Both professionals and the people at large should consider environmental management and the community should be mobilized for practice for sustainable and integrated vector control measures including drainage of breeding sites to play a crucial role in preventing the occurrence of further malaria epidemics.
- Proper awareness creation for appropriate utilization of ITNs
- Further studies should be conducted to determine the status of malaria based on year round primary data to circumvent the problem of documenting and collecting data from secondary sources.

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## 8. APPENDIXES

### APPENDIX I: English questionnaire

**INSTRUCTIONS:** Please read each question to the respondent clearly and slowly. Then, circle the number of choice(s) the interviewee selects carefully. For open-ended questions, write the exact answers of the respondent in the spaces provided.

**Questionnaire on prevalence of malaria and knowledge of the study population toward malaria and its control in jijiga town.**

#### I. Socio-demographic Characteristics

Adress: zone ----- woreda-----kebele-----house no. -----

##### Household profile

1. Name of kebele -----
2. Age -----years
  - 1 . 20-30 years
  2. 31-40
  3. 41-50 years
  4. 51-60 years
  5. 61+
3. What is your Sex?
  - 1 = male
  - 2 = female
4. What is your Religion?
  1. Muslim
  2. Christian
  3. Other (specify)
5. Occupation of the household
  1. Government employee
  2. Merchant
  3. Farmer
  4. Pastorialist
  5. Other (specify)
6. Educational level of the household
  - 0 = illiterate
  - 1 = read and write only
  - 2 = elementary school education ( 1-8) completed
  - 3 = secondary school education ( 9 – 12) completed
  - 4 = college diploma
  - 5 = first degree
  - 6 = above first degree

7. What is the average monthly family income?  
 1. <1000 Birr      2. 1000-2000 Birr      3. >2000 Birr
8. Type of housing  
 1 = corrugated tin top  
 2 = cloth top

**II. Knowledge, Attitude and Practice**

9. Have you ever heard of malaria?  
 1. Yes                      2. No
10. Is malaria a health problem in your area?  
 1. Yes                      2. No
11. Do you know how malaria transmitted from person to person?  
 1 = yes                      2 = no                      3= I don't know
12. If yes Q no. 11, how does malaria transmitted from one person to other person ?  
 1= by the bite of mosquito  
 2 = by eating and drinking unhygienic food and water  
 3= by using the same utensils with patients  
 4= by the curse of God  
 5= I don't know
13. Which family members has the highest malaria incidence?  
 1 = young children less than 5 years  
 2 = older children greater than 5 years  
 3 = older family members  
 5 = all of the family members
14. What are the symptoms of malaria (possible to give more than one response)?
- |                      | Yes | No |
|----------------------|-----|----|
| 1. Fever             | 1   | 2  |
| 2.Chills & Shivering | 1   | 2  |
| 3.Headache           | 1   | 2  |
| 4.Backache           | 1   | 2  |
| 5.Joint pain         | 1   | 2  |

6.Vomiting	1	2
7.Thirsty	1	2
8.Loss of appetite	1	2

15. What do you do when you or your family member are getting sick from malaria?

	Yes	No
1.Hospital	1	2
2.Health center	1	2
3.Health clinic/post	1	2
4.Private clinics	1	2
5.Private pharmacies/drug store	1	2
6.Purchase drugs from shops	1	2
7.Traditional healer	1	2
8.Use the left over drugs	1	2
9.Use traditional remedies at home	1	2
Others -----		

16. What are the other conditions that associated with malaria infection?

	Yes	No
1. Cold	1	2
2. Cloudy weather	1	2
3. Rain	1	2
4. Eating maize stalk	1	2
5. Dirt	1	2
6. I don't know	1	2

17. Where do mosquitoes mostly breed?

	Yes	No
1. Stagnant water& swampy areas	1	2
2. Running water	1	2
3. Waste material	1	2
4. Others -----		

18. When do mosquitoes mostly bite?

1. Day      2. Night      3. I don't know

19. What is the mosquito resting site during day time?

1. Unclean vegetation
2. In the house
3. Others -----
4. I don't know

20. Is malaria a preventable disease?

1. Yes
2. No
3. I don't know

21. If yes to Q 20, what methods do you know to prevent malaria?

	Yes	No
1. Take tablets	1	2
2. House spray with insecticides	1	2
3. Drain stagnant water	1	2
4. Clear the vegetation	1	2
5. Use of mosquito net	1	2
6. Fumigation	1	2
7. Aerosol (mobile)	1	2
8. Closing windows & doors early in time	1	2
9. Others -----		

22. What prevention method(s) do you currently use to protect your family member from malaria?

	Yes	No
1. Take tablets	1	2
2. DDT spraying	1	2
3. Drain stagnant water	1	2
4. Clear the vegetation	1	2
5. Use of mosquito net	1	2
6. Fumigation	1	2
7. Aerosol (mobile)	1	2
8. Closing windows and doors early in time	1	2
9. Others -----		

23. What is (are) the reason (s) of preferring these method (s)?

1. Easily available
2. More effective
3. Low cost
4. Others-----

24. Do you know the name of the current antimalarial drugs?

	Yes	No
1. CQ	1	2
2. SP	1	2
3. PQ	1	2
4. QN	1	2

26. Reasons for not using any protective methods, if any

1. Not affordable
2. Not available
3. Not aware about its use
4. Others -----

27. Have you ever heard about mosquito net?

1. Yes
2. No

28. If yes Q no.27, what is the purpose of it?

1. Protect from mosquito bite
2. Protect from other insects
3. Sleep well
4. Warmer
5. Others -----

29. What Type of your bed net?

1. Untreated Net
2. Locally Treated Net (ITN)
3. Long-Lasting Insecticide Treated Net (LLIN)
4. I don't Know

30. Does your family have it?

1. Yes
2. No

31. If yes, how many? -----

32. Have you used mosquito net (ITN/LLIN)?

1. Yes      2. No

33. How did you obtain it?

1. Freely provided by NGO
2. Freely given by government
3. Bought from shope
4. Bought from government
5. Others

34. Did you ever impregnate the net with insecticide?

1. Yes      2. No

35. If no, why -----

36. Does your kebele have regular DDT spraying in your house?

1. Yes      2. No

37. What are the purposes of residual DDT spraying in your house?

	Yes	No
1. To kill mosquitoes	1	2
2. To kill other insects	1	2
3. To prevent malaria	1	2
5. I don't know	1	2

38. What are the disadvantages of DDT spraying?

	Yes	No
1. Irritate the eyes	1	2
2. Cause headache	1	2
3. Kills household animals	1	2
4. Has no last long effect	1	2
5. Others -----		

39. Have ever refused DDT spraying in your house?

1. Yes      2. No

40. If yes Q no.39, what are the reasons?

1. Bad smell
2. Don't believe that it is effective
3. Don't like it
4. Others -----

41. Do you replaster your house after being sprayed with residual DDT?

1. Yes
2. No

42. If yes Q no.41, when do you mostly replaster it?

1. Just after spraying
2. After two months
3. After three months
4. After six months
5. I don't remember

43. Why do you replaster your house?

	Yes	No
1. To clean and make it nice	1	2
2. To against cold	1	2
3. To prevent insects	1	2
4. For holidays	1	2
5. To prevent disease	1	2
6. To prevent mosquito	1	2
7. Others		

44. Does your main living house have window?

1. Yes
2. No

45. If yes Q no.44, does it have screen?

1. Yes
2. No

46. Is there any opening on the wall to allow mosquito entrance?

1. Yes
2. No

47. Are mosquitos breeding sites available nearby your home?

1. Yes
2. No
3. I don't know

48. If yes Qno.47, how far is it?

49. Are there any type activities of environmental management for mosquito control?

1. Yes      2. No

50. If yes Q no.49, what type of activities being carried out?

	Yes	No
1. Filling	1	2
2. Drainage	1	2
3. Clearing of vegetation in shaded areas	1	2
4. Lining of earth drains	1	2
5. Others -----		

51. Have you ever participated in malaria epidemic control activities?

1. Yes      2. No

52. If yes Q no.51, in which activities?

	Yes	No
1. Filling and drainage of mosquito breeding sites	1	2
2. In health education campaigns	1	2
3. Reporting problems to local health worker or authority	1	2
4. Others -----		

53. If no Q no.52, what are the reasons?

1. No responsible local community health worker to organize the activities
2. No interest to participate
3. No access to get information when the program launched
4. Others (specify) -----

## APPENDIX II: Af-Somali questionnaire

**BARISTA:** Fadlan ugu akhri ka jawaabaha si degan su'aal walba. Kadibna ka dooro ka mid ah doorashooyinka si taxader leh. sualaha furan qor jawlaabta saxda ah ee ka jawaabaha.

**Sualo diyaarsan oo kusaabsan waxyeela da duumada iyo qoonta ku aadan shacabka la daraasayno iyo kontalolka damada ee magaalada jigjiga.**

ciwan:gobal\_\_\_\_\_ dagmo\_\_\_\_\_ qabale\_\_\_\_\_ no.guriga

### **Axwasha qoyska**

1. Magaca masulka qoyska\_\_\_\_\_
2. Masulka qoyska da'adisa\_\_\_\_\_
3. Masulka qoyska ma lab ba mise wa dhidig
  1. Lab
  2. Dhidig
4. Masulka qoyska dintisa/dinteda
  1. Islam
  2. Ortodhox
  3. Protestant
  4. Katolik
  5. Kuwa kale
5. Shaqada masulka qoyska
  1. Shaqale dawladed
  2. Beralay
  3. Ganacsade
  4. Xolo dhaqato
6. Darajada aqonta masulka qoyska
  1. Qof an wax baran
  2. Akhritan iyo qoralka kaliya
  3. Dugsiga hose (1-8) dhameyey
  - 4 Dugsiga dhexe (9-12) dhameyey
  5. Heer jamiced
  6. Degreeega kobad
  7. Degreeega kobad iyo wixi ka sareya
7. Bishi lacagta qoyska so gasha
  1. greater than 1000 birr
  2. 1000-2000 birr
  3. less than 2000 birr
8. Wa maxay nuca gurigu?
  1. jingad
  2. maro
  3. Dhagax

### **Aqonta, araga iyo wax qabadka**

9. Wali ma maqashay xanunka dumada?
  1. haa
  2. maya

10. Xanunka dumada dhibato ma ku haya dagmadina/meshad dagantihin?  
 1. haa                      2. maya
11. Magaranaysa sida u xanunka dumada qofba qofka kale ugu gudbo?  
 1. haa                      2. maya                      3. magaranaayo
12. Hadi suasha 11 jawabtadu tahay haa, side bu xanunka dumada qofba qofka kale uga qada?  
 1. kanic o ku qaninta                      2. ado cuna cuno nadif an ahyn  
 3. ado isticmala macuunta bukanka    4. cadhada ilahay    5. kuwa kale
13. Qoyskina dhexdisa kebu xanunka dumadu si fudud ugu dhaca?  
 1. caruurta kayar 5 jir                      2. caruurta ka wayn 5 jir  
 3. dadka wawayn e ka tirsan qoyska    4. dhaman dadka ka tirsan qoyska
15. Wa maxay calamadaha xanunka dumada (1 sual in ka badan wad ka jawabi kartaan).

	Haa	Maya
1. xumad	1	2
2. qadhqadhyo iyo garir	1	2
3. madax xanun	1	2
4. dhabar xanun	1	2
5. muruq xanun	1	2
6. matag	1	2
7. haraad	1	2
8. cuno jodin	1	2

16. Maxaad samayn lahayd hadi u xanunka dumada u ku dhaco qoyskaga qof kamid ah?

	Haa	Maya
1. dhakhtarka dawlada	1	2
2. xarunta cafimaadka	1	2
3. xarunta bukanka	1	2
4. dhakhtarka garka lo leyahay	1	2
5. farmasiga garka lo leyahay	1	2
6. daawoyinka tukanka	1	2
7. daawo dhaqameedka	1	2
8. daawoda isticmalin sidi logu talagalay	1	2
9.isticmalida daawo dhaqmwadka lagu diyariyey guriga	1	2

17. Wa maxaay xaladaha kale la xidhidha xanunka dumada?

	Haa	Maya
1. qabowga	1	2
2. daruro	1	2
3. rob	1	2
4. nadafad daro	1	2
5. magaranaayo	1	2

18. Wa halke mesha u badan ay kanicdu ku taranto?

	Haa	Maya
1. biyaha fadhiya iyo melaha qoyanka	1	2
2. biyaha socda/ darera	1	2
3. qushashka	1	2
4. kuwa kale	1	2

19. Gorma ayay kanicadu qaninta dadka?

1. malinka      2. habenka      3. magaranaayo

20. Halkebay kanicadu ku dhumata malinkii?

1. dhirta an nadifta ahayn      2. guriga dhexdisa      3. kuwa kale      4. magaranaayo

21. Malaga hortagi kara xanunka dumada?

1. haa      2. maya      3. magaranaayo

22. Hadi suasha 21 jawabtau tahay haa, side/habke uga hortagi lahayd xanunka dumada?

	Haa	Maya
1. Qadashada kaninka	1	2
2. Bufinta daawada	1	2
3. Dadinta biyaha fadhiya	1	2
4. Nadifinta dhirta	1	2
5. Isticmalida shandarwaga/maro kanic	1	2
6. Qijin	1	2
7. Buufis	1	2
8. Xidhida daqada iyo albabka	1	2
9. kuwa kale	1	2

23. Wa maxaay habka ad hada kaga hortagaysaan xanunka dumada e qoysakaga?

	Haa	Maya
1. Qadashada kininka	1	2
2. Buufitanka DDT	1	2
3. Daadinta biyaha fadhiya	1	2
4. Nadifinta dhirta	1	2
5. Isticmalida shandarwaga/maro kanic	1	2
6. Qijin	1	2
7. Buufis	1	2
8. Xidhida daqada iyo albabka	1	2
9. kuwa kale	1	2

24. Wa maxay sababta ad u u doratay habkan ka hortagista xanunka dumada?

1. Si fudud aya lo heli kara    2. In badan wax ku ol leh    3. Qimo yari

25. Mad garanaysa magaca dawada lagaga hortago xanunka dumada?

	Haa	Maya
1. CQ	1	2
2. SP	1	2
3. PQ	1	2
4. QN	1	2
5. Magaranaayo	1	2

26. Wa maxay sababta aad u istimalayn wax yalaha lagaga hortago xanunka dumada?

1. Ima nasibaayi    2. Lama heli karo    3. Wacdi galin la'an    4. kuwa kale

27. Wali ma maqashay maro kanic/shandarwa?

- 1, Haa                      2. Maya

28. Hadi suasha 27 ay jawabtadu tahay haa, waa maxay ujedadedu/fa'idadedu?

1. In ad kaga hortagtid qaninyada kanicada  
2. In ad kaga hortagto cayayanka kale

29. Marakanic nooce ah?

1. Mid aan daawaysnayn
2. Mid dagaanka daawo lagu mariyay/ buufiyay
3. Mid leh daawo / sunkaniiceed raagaya
4. Ma garanaayo

30. Qoyskiinu maleeyiniin marakaniic?

1. Haa
2. Maya

31. Hadi ay haa tahay , imisa xabo?\_\_\_\_\_

32. Sided kuhesheen marakaniicada?

1. Waxa nasiiyay ururda kamadaxbaan dawladda/ ururada aan dawliga ahayn
2. Dawlada na siisay
3. Dukaamadan kasogadanay
4. Dawladan ka iibsaday
5. Kuwo kale\_\_\_\_\_

33. Habeen hore, ayaa isticmaalay?

1. Caruurta kayar 5 sano
2. Caruurta udhaxaysa 5-10 sano
3. Odayga iyo xaaska
4. Dadka waawayn ee kale qoyska

34. Wali mara kanic sun kaniiceed maku buufiseen?

1. Haa
2. Maya

35. Hadi ay maya tahay, sabab?\_\_\_\_\_

36. Qabalihiinu si joogto ah DDT ma uga buufiyaan gurigiina?

1. Haa
2. Maya

37. Maxay tahay sababta DDTda looga buufiyo gurigiina?

- |                                  | Haa | maya |
|----------------------------------|-----|------|
| 1. Si looga dilo kaniicada.      | 1   | 2    |
| 2. Si looga dilo cayayaanka kale | 1   | 2    |
| 3. Si looga difaaco dumada       | 1   | 2    |
| 4. Kuwo kale_____                |     |      |
| 5. Magara naayo                  |     |      |

38. Wamaxay saamaynta buufinta DDTda?

- |                               | Haa | maya |
|-------------------------------|-----|------|
| 1. Waxaa ku cuucuni indhaha   | 1   | 2    |
| 2. Waxay sababta madax xanuun | 1   | 2    |
| 3. Waxay disha xoolaha guriga | 1   | 2    |

4. Malahan saamayn raagta 1 2
5. Kuwo kale \_\_\_\_\_
39. Waligiin maad diideen in suriga DDT lagu buufiyo?
1. Haa 2. Maya
40. Hadi ay haa tahay suaasha 39, wamaxay sababtu?
1. Way urta
2. Ma aminsani inay fiicantahay.
3. Ma jecli
4. Kuwo kale. \_\_\_\_\_
41. Ma cusboonaysiisay guriga kadib marki labuufiyay?
1. Haa 2. maya
42. Hadi ay haa tahay suaasha 41, goormaad kudhawaad cusboonay siisaan.
1. Isla marki labuufiyayba
2. Labo bilood kedib
3. Saddex bil kedib
4. Lix bil kedib
5. Kuulo kale
43. Maxad ucusboonaysiisaan guriga?
- |                                      | Haa | maya |
|--------------------------------------|-----|------|
| 1. Si'aan unadiifino una qurxino     | 1   | 2    |
| 2. Si'aan iskaga difaacno qabawga    | 1   | 2    |
| 3. Si'aan iskaga difaacno cayayaanka | 1   | 2    |
| 4. Cidaha dartood                    | 1   | 2    |
| 5. Si'aan cudurka iskaga difaacno    | 1   | 2    |
| 6. Kuwo kale                         |     |      |
44. Gurigiina wayni daaqado maleeyahay?
1. Haa 2. Maya
45. Hadi ay haa tahay suaasha 44<sup>aad</sup>, daaqadu muraayad maledahay?
1. Haa 2. Maya
46. Majiraan dal daloolo gidaarka usuurta galinaaya soo galidda kaniicadda?

1. Haa                      2. Maya

47. Majiraan ilo tarreed kaniico agagaarka guriga?

1. Haa                      2. Maya

48. Haddi ay haa tahay suaasha 47<sup>aad</sup>, fooyaan inteeleeg ayey ujiran?

49. Majiraan dhaqdhaqaaqo deegaan oo lagu maraynayo taranka / kahortaga kaniicada?

1. Haa                      2. Maya

50. Hadi ay haa tahay suaasha 47<sup>aad</sup>, dhaqdhaqaaqyo / waxqabadyo caynkee ah aya lafuliyay?

	Haa	maya
1. Buu xinta	1	2
2. Engejin / dhurinta	1	2
3. Dabargoynta dhirta iskucufan / ishadhaysay	1	2
4. Safidda biyo daadinta / shaydhinta dhulka	1	2
5. Kuwo kale_____		

51. Waligaa ma kaqaybqaadeen dhaqdhaqaaq lagu dhimayo safmrka duumada?

1. Haa                      2. Maya

52. Haddi ay haa tahay suaasha 51<sup>aad</sup>, dhaqdhaqaaqyadee?

	Haa	maya
1. Buuxinta iyo biyo saaridda ilaha ay kaniicadu kutaranto	1	2
2. Olelaha aqooneed ee caafimadka	1	2
3. Ugudbinta dhibaatooyinka caafimaadeed shaaqaalaha deegaank	1	2
4. Kuwo kale _____		

53. Hadi ay maya tahay suaasha 52<sup>aad</sup>, waamaxay nababuhu?

1. Majiraan shaqaale cafimaad oo heer deegaan ah oo u xil saran dhaqdhaqaaqyada
2. Xiiso uma hayno aan kaga qaybqaadano
3. Xogo nagu filan maan helo marko dhaqdhaqaaqa labilaabo
4. Kuwo kale (sifee)\_\_\_\_\_

### APPENDIX III: PHOTOS



Figure 7: Picture of mosquitos breeding site at the study area



Figure 8: Blood sample collection and analysis in the lab of karamara General Hospital

## **Declaration**

I, the undersigned, declare that this Thesis is my original work and all sources materials used are duly acknowledged.

Name: Hussen Ebrahim Bedru

Signature \_\_\_\_\_

Date \_\_\_\_\_

## **Statement of supervisor**

This Thesis has been approved for submission to the Department of Zoological Science for public defense.

Name: Tegenu Gelana (PhD)

Signature \_\_\_\_\_

Date \_\_\_\_\_