Malaria prevalence and community knowledge about its control tools in Chagni town, northwest Ethiopia

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List of Acronyms

ACT:	Artemisinin Combination Therapy
AL:	Artemether Lumefantrine
AS-MQ:	Artesunate-Mefloquine
AS-AQ:	Artesunate-Amodiaquine
CDC:	Centres for Disease Control and Prevention
DDT:	Dichlorodiphenyltrichloroethane
FY:	Fiscal Year
IBM:	International Business Machines Corporation
IRS:	Indoor Residual Spraying
ITN:	Insecticide Treated Net
LLINs:	Long Lasting Insecticidal Nets
MOH:	Ministry Of Health
NMCP:	National Malaria Control Programme
NMSP:	National Malaria Strategic Plan
PMI:	President's Malaria Initiative
RBM:	Roll Back Malaria
RDT:	Rapid Diagnostic Test
SP:	Sulphadoxine-Pyrimethamine
SPSS:	Statistical Package for Social Science
TPTp:	Intermittent Preventive Treatment in Pregnancy
WHO:	World Health Organization

Abstract

Malaria is still a major cause of morbidity and mortality in Ethiopia. Knowing its prevalence and knowledge of the population about malaria symptoms and transmission is vital to ensure effective control strategies. The aim of this study was to assess the prevalence of malaria and the knowledge of the study population towards malaria and its control in Chagni town, Awi zone northwest Ethiopia. A health centered based cross sectional study design was used. Finger prick blood samples were collected from malaria suspected patients visiting Chagni health center from September 2017 up to February 2018 and examined following standard procedures to determine the prevalence of malaria. Further, 274 samples were selected using systematic simple random sampling method for household questionnaire to assess the knowledge about malaria symptoms, transmission and control and interview for malaria focal person and head of the health center. The data was analyzed and presented using tables and figures; chi square test was used to analyze proportion of malaria prevalence. Out of 4,077 suspected patients tested, 296 (7.3%) were malaria slide positive, of this 163 (55%), 131 (44.3%) and 2 (0.7%) were P. falciparum, P. vivax and mixed infections respectively. Age was statistically significant with malaria slide positivity (P=0.001). This study also revealed that 97% of the respondents had heard about malaria and recognized it as a health problem. Taking tablet (86.3%), mosquito net (73.3%), removing stagnant water (68%) and indoor residual spraying (IRS) (66%) were the commonest malaria prevention methods mentioned by the study participants. The net coverage and net used in the previous night were 98% and 75% respectively. The IRS coverage in the study area was 99%, out of this 77.5% of the participant's house were sprayed in the last six month. Malaria prevalence was 7.3% and the knowledge of malaria symptoms was good but there is misconception on its transmission and prevention in the study area. Environmental management activities to control mosquito breeding site is poor in the study area. Concerned bodies are recommended to fill the gap.

Keywords: Malaria, Prevalence, Control, Knowledge, Chagni, Insecticide treated net, Indoor residual spraying

1. Introduction

1.1. Background

Despite malaria is a largely preventable and treatable disease, the diseases remains a worldwide major public health problem. According to 2018 World Health Organization (WHO) report about 3.2 billion people remains at risk of malaria and approximately there were 216 million new cases of malaria and 445,000 malaria death worldwide, African regions accounting for 91% of the world death, 6% of death was South East Asia region and 1.8% of death occurred in the Eastern Mediterranean Region. In Ethiopia about 75% of the population lives in malarious areas and approximately 68% of the country's land mass is suitable to malaria transmission. Malaria transmission in Ethiopia is seasonal and unstable, the peak transmission season from September to December following the main rainy season and minor transmission from April to May following small rainy season (Alelign and Dejene, 2016).

Expanding of malaria control interventions play a tremendous role in a remarkable progressive reduction of malaria burden across the world, particularly in Sub Saharan Africa were the disease is more common. The burden of malaria also declined significantly in Ethiopia in the last decade, which could be the result of improved coverage of high impact control interventions such as use of vector control methods including Long lasting insecticidal nets (LLINs) and indoor residual spraying (IRS), prevention and control of malaria among pregnant using intermittent preventive treatment (IPTp), prompt treatment of cases using artemisinin based combination therapy (ACT), environmental management and health education (Abeku *et al*., 2015).

Based on World Health Organization report 2017, Ethiopia accounts 6% of malaria cases globally. In 2014 a total of 2,118,815 malaria confirmed cases and 213 malaria deaths, in 2016 a total of 1,962,996 malaria confirmed cases and 510 malaria deaths were documented in the country (WHO, 2017). Ministry of Health annual performance report indicated that from September 2014 to August 2015 a total of 2,174,707 malaria confirmed cases and 662 malaria deaths were reported in the country (www.moh,gov.et). The highest number of total malaria cases was reported from Amhara region 610,486 followed by

Oromia 430,969 and Southern Nations, Nationalities and People region 375,746, after the scale up of control interventions. However, in Ethiopia malaria remains a major health problem. *P. falciparum* and *P. vivax* are distributed throughout the endemic regions of the country (WHO, 2017). The main malaria control strategies in Ethiopia are implemented based on World Health Organization (WHO) recommendations which include Vector control using long lasting insecticidal nets (LLINs) and indoor residual spraying (IRS), prompt treatment and early diagnosis, intermittent prevention therapy of prevention and control of malaria among pregnant (IPTp), environmental management and health education.

Amhara region also implemented malaria control interventions based on the National strategic plan. However, malaria continued to be a major cause of mortality and morbidity in the country and particularly in Amhara region. This could be many problems on the communities and control interventions. Some studies indicated that there is misconceptions exist among the communities concerning malaria transmission; prevention and malaria treatment seeking behaviour and their participation to practical activities to mosquito vector control have been unsatisfactory (Tilaye, 2005 and Henok *et al*., 2015).

Among the malarious regions in Ethiopia Amhara region is one of them, in which the prevalence of malaria in 2017 was 18.3% and *P. falciparum* and *P. vivax* are the two dominant species in the region (Amhara Region Health Bureau, 2018). Malaria is one of the major public health problems in Amhara region. Awi zone is one of malarious zones in the Amhara region. Chagni town is among the malaria affected areas in Awi zone of Amhara region. This study tries to assess malaria prevalence and community knowledge about its control tools in Chagni town.

1.2. Statement of the problem

In Ethiopia malaria remains one of the major public health problems despite considerable effort made to control it. The malaria control and prevention activities are implemented based on the national strategic plan for malaria control and prevention that operates in line with the recommendation of World Health Organization (WHO), those targets to minimizing and interrupt the burden of the disease. Long lasting insecticidal nets (LLINs), indoor residual spraying (IRS), prompt treatment of case using artemisinin based combination therapy (ACT), environmental control through community participation and health education are the malaria control measures that have been implemented in Chagni town. 100% IRS coverage and 49,278 LLINs were distributed in the town between 2012 up to 2016 however; from September 2012 up to August 2016 out of 22,090 malaria suspected patients examined, 4,961 (22.45%) were microscopically confirmed malaria cases (Chagni Health centre Record). Despite all these practiced control activities; malaria is one of the major public health problems of Chagni town. This indicates that there may be several reasons.

Universal coverage of malaria control interventions and its assessment on the implementation and effectiveness needed to be done in order to reduce the prevalence of malaria; particularly for those all people living in areas where the risk of malaria is high. Having the most recent information on malaria prevalence and community knowledge about malaria and the possible control tools they are using plays a great contribution to the reduction of malaria burden. There was no study that has been conducted in Chagni town regarding the issue of malaria prevalence and community knowledge about its control tools. Therefore, this study was conducted to assess malaria prevalence and community knowledge about its control tools in Chagni town. The study was likely to make significant starting point information for future study and control intervention and also put forward information on the implemented malaria control strategies which are successfully achieved or not in the study area.

1.3. Objectives

1.3.1. General objective

The main objective of this study was to assess malaria prevalence and community knowledge about its control tools in Chagni town, Awi Zone, Northwest, Ethiopia.

1.3.2. Specific objectives

- ✓ To determine the current prevalence of malaria based on age, sex, species and seasonal distribution.
- ✓ To assess knowledge about malaria and its control measures.
- ✓ To assess the coverage and use of LLINs and IRS.

2. Literature review

2.1. Malaria

Malaria is a life threatening disease caused by parasites that are transmitted to people through the bites of infected female anopheles mosquitoes. Malaria is a preventable and curable disease caused by protozoan parasite and transmitted through the bites of female anopheles mosquitoes. There are five plasmodium species that able to cause malaria these are *P. falciparum, P. vivax, P. malariae, P. ovale and P. knowlesi* (Cox-Singh and Singh, 2008). According to WHO World Malaria day 2018, *P. falciparum* is responsible for majority of malaria deaths globally and it is the most prevalent malaria on the African continent and *P. vivax* is the dominant malaria parasite in most countries outside of sub Saharan Africa (WHO, 2018).

P. vivax and P. ovale cause periodic fevers recurring every 48 hours but *P. malariae* fevers recur every 72 hours. Current findings indicate that *P. knowlesi* is zoonotic being transmitted from macaque monkey to humans by the vector belongs to leucosphyrus group of Anopheles mosquitoes (Vythilingam *et al*., 2018). This strain cause cyclic periodic fevers every 24 hours (Cox-Singh and Singh, 2008).

The life cycle of Malaria parasite (Figure 1) include both vector mosquitoes and human host. Female Anopheles mosquitoes require blood meals to undergo production of egg and these blood meals are the connection link between the human and the mosquitoes host in the malaria parasite life cycle. In the mosquitoes life cycle, when the mosquitoes bites the infected humans suck the blood and gametocytes go in to along the blood. Red blood cells burst and gametocytes are released forming more mature gametes, male and female gametes fuse to form diploid zygotes. Zygotes develop into actively moving ookinetes that burrow into the mosquitoes midgut wall and form oocysts. Each oocysts undergo growth and division produce more active haploid sporozoites. After 8-15 days, the oocyst bursts and releasing sporozoites into the mosquito body cavity, from which they travel to the mosquito salivary glands. The life cycle in the humans (Figure 1), when the female anopheles mosquito bites human release its saliva that contain sporozoite into the bloodstream, the sporozoites move to the liver and invade hepatocytes. Initially elongated sporozoite has transformed into a rounded form that matures within the hepatocyte to a

schizont containing many merozoites which is completed within 5 to 16 days. Then the merozoites leave the liver and inter into the blood, the merozoite in the red blood cell undergo asexual cycle produce more merozoites. This cycle repeats 1 to 3 days that result in thousands of parasite infected cells in the host blood stream and the patient may develop sign and symptoms of illness and complication of malaria. Some of the merozoites transform into a sexual form called as male and female gametocytes that circulate in the blood circulation. Some malaria parasite species remain dormant for extended periods in the liver (CDC, 2014). *P. vivax* has a dormant liver stage hypnozoite that can activate months after an initial infection, causing a relapse of symptoms.

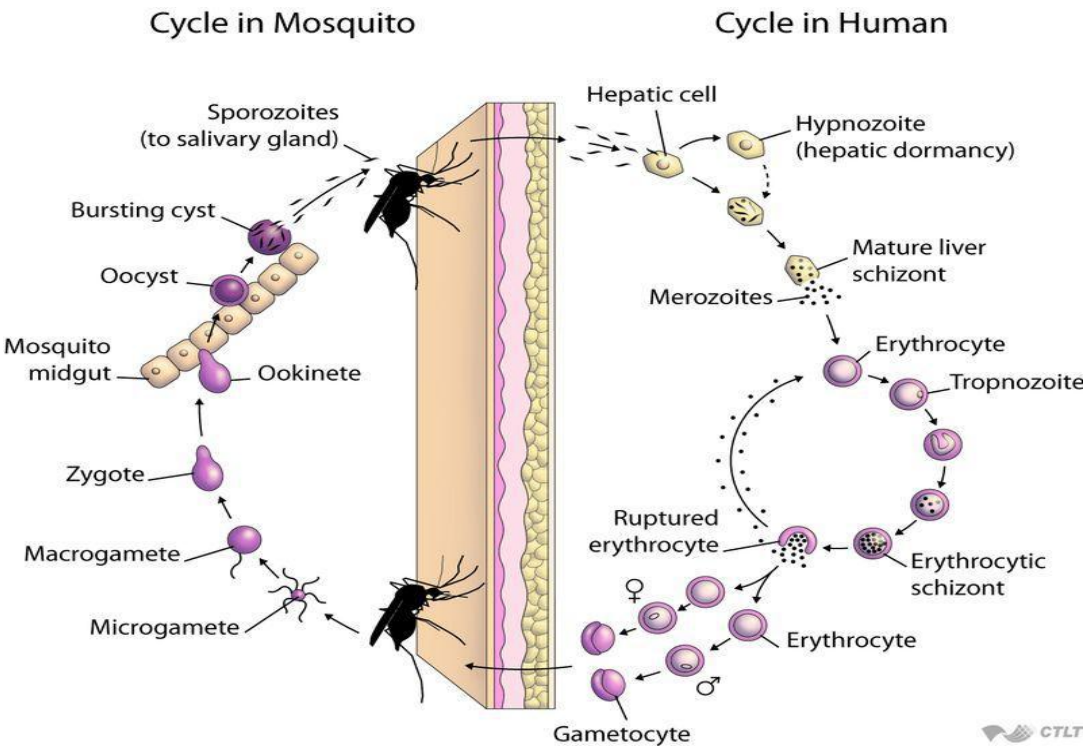

Figure 1. The life cycle of malaria parasite in human and mosquito (https://www.malariasite.com/life-cycle/).

The symptoms of malaria typically develop within 10 to 30 days following the infection. The first symptoms of malaria are similar to a minor systematic viral disease, typically this symptoms are the characteristics of uncomplicated malaria include fever, chills, shivering, joint pain, vomiting, haemolytic anaemia, sweating, headaches, and abdominal discomfort. The symptoms may be mild and difficult to recognize as malaria. If not treated within 24 hours, *P. falciparum* malaria can progress to severe illness, often leading to death (WHO,

2017). Symptoms of sever complicated malaria include brain tissue damage, pulmonary edema, kidney failure, severe anaemia and low blood sugar. Many patients, found in malaria endemic areas recognize the symptoms as malaria and treat themselves.

2.2. Global Malaria disease burden

An estimated 3.2 billion people in the world across 91 countries are still at risk of malaria. Malaria is a leading cause of morbidity and mortality worldwide. According to the latest data from world health organization 2017, shows that approximately there were 216 million new cases of malaria and 445,000 malaria deaths worldwide. The Africa region continues to bear 90% of malaria cases and 91% of malaria deaths worldwide.

In areas with high transmission of malaria, children under five are particularly susceptible to infection, illness and death, more than 70% of all malaria deaths occur in this age group. The number of under-five malaria deaths has declined from 440, 000 in 2010 to 285,000 in 2016. However, malaria remains a major killer of children under five years old, taking the life of a child every two minutes (WHO, 2018).

2.3. Malaria in Ethiopia

Ethiopia, the second most populous country in Africa, about 75% of the country's landmass is malarious approximately 68% of the total population at risk of malaria. Areas which are less than 2,000 meters of altitude above sea level are considered to be malarious. In Ethiopia malaria transmission varying with altitude and rainfall that exhibits a seasonal and unstable pattern. In most parts of the country the major transmission season is from September to November, following the main rainy season from June/July to September and in some parts of the country following the smaller rainy season there is a short transmission season from April to May, coinciding with major harvesting seasons (Alelign and Dejene, 2016).

P. falciparum and P. vivax are the two most dominant malaria parasite species and are prevalent in all malaria endemic areas in the country and *P. falciparum* is a leading cause of outpatient visits, hospitalizations and deaths across the country (MOH, 2014). Malaria transmission in Ethiopia tends to be highly heterogeneous geo-spatially within each year as well as between years; long transmission season occurs relatively in the western low land

areas, basin, river, valley and irrigation schemes. Due to the unstable and seasonal pattern of malaria transmission in Ethiopia, the population protective immunity is generally low as a result all age groups are at risk of infection and disease and Ethiopia is shared the highest burden of malaria infections in all ages in the East African region (WHO, 2015). The most vulnerable to malaria case are observed in children under five and pregnant women (MOH, 2014).

Malaria remains the major health problem in Ethiopian, generally malaria in Ethiopia is characterized by widespread epidemics occurring every five to eight years, with the most recent epidemic occurring in 2003/2004 (MOH, 2004). The problem of malaria is very severe in Ethiopia where it has been the major cause of illness and death for many years (Aregawi *et al*., 2014). In 2014/2015 the total number of laboratory confirmed and clinical malaria case were 2,174,707. Of those cases 1,867,059 (85.9%) were confirmed by either microscopy or rapid diagnostic test (RDT) out of which 1,188,627 (63.7%) were *P. falciparum* and 678,432 (36.3%) were *P. vivax* (MOH, 2015).

In Ethiopia the location of the household are found in various distance and altitudes from the mosquitoes breeding sites, malaria infection risk is not evenly distributed and varies within district and kebeles (PMI, 2015). Moreover due to the expansion of irrigation and construction of dams in the country increase the population of mosquito vector that increase malaria transmissions among the dwellers and workers in that area (Jalata *et al*., 2013).

2.4. Malaria in Amhara region

Amhara region is one of the nine regions of Ethiopia, which is found in the North western part of Ethiopia. The region has a significant variation in altitude, in seasonal, temperature and annual rain fall resulting in areas of differing malaria risk and transmission for *P. falciparum* and *P. vivax*. Malaria transmission is seasonal, unstable and characterized by frequent epidemics, with the major transmission season being between June to December following main rainy season and April to May following short rainy season (Aleme *et al*., 2014). *P. falciparum* is the dominant infection in the higher transmission low altitude and *P. vivax* infections appear to be lower but relatively more stable across geography and altitude. In this FY a total of 280,199 malaria cases were reported in the region. From

January 2017 up to June 2018, a total of 1,528,422 malaria suspected cases, 279,918 malaria cases were diagnosed and treated in the region. The prevalence rate was 18.3%, where 2.6% and 97.4% were accounts for inpatients and outpatients in the region respectively. Moreover, 26,516 malaria confirmed cases were children under five years of age and 1,908 were pregnant mothers.

The situation of malaria in the region from 2013-2017 shows a decreased trend, when 2017 compared to 2016, malaria suspected cases decreased by 26.7% (102,092) and except Awi zone and North Wollo malaria cases decreased in the other zones of the region. Out of 2, 497 deaths registered in the region, 3 (0.12%) were due to malaria. In 2015, LLINs were distributed to all households and in 2017 for 55 highly malarious woredas, 3,425,647 LLINs were distributed in the region. With regard to IRS, from 3,441,62 spray chemicals MOH assigned to Amhara region, 98.2% (3,380,07) spray chemicals were sprayed (Amhara Region Health Bureau, 2018).

Malaria remain to be the major public health challenge in Amhara region, among 12 Zones and three town administrations in the region Awi Zone accounts for 41,852 (14.9%) next to North Gondar 139,296 (49.7%) of the malaria burden of the region. Chagni town administration is one of malarious town in Awi Zone.

2.5. Global malaria control interventions

Malaria is generally preventable and curable disease, that the currently WHO recommended control interventions are properly implemented. WHO's Global Malaria Programme recommends the following three primary interventions that must be scaled up in countries to effectively respond to malaria, towards achieving the Millennium Development Goals for malaria by 2015 and other health targets: diagnosis of malaria cases and treatment with effective medicines, distribution of insecticide treated nets to achieve full coverage of populations at risk of malaria, indoor residual spraying as a major means of malaria vector to reduce and eliminate malaria transmission.

The WHO Global Technical Strategy For malaria 2016-2030 put goals to reach a vision of malaria free world, the goals include reduce malaria mortality rates at least 90% in 2030, reduce malaria case incidence globally at least 90% in 2030 and at least 35 countries

eliminate malaria in 2030 (WHO, 2015). Global Technical Strategy For malaria 2016-2030, built the strategy that guide global efforts to move closer to malaria elimination. National malaria programmes need to ensure that all people living in areas where high risk of malaria has universal access to malaria prevention, diagnosis and treatment. The WHO recommended package of core interventions to prevent infection and reduce morbidity and mortality comprises vector control, chemoprevention, diagnostic testing and treatment.

Vector control is an essential component of malaria control and elimination. At present, the two core broadly applicable vector control interventions are long-lasting insecticidal nets and indoor residual spray. National malaria programmes need to ensure that all people living in areas where the risk of malaria is high are protected through the provision, use and timely replacement of long-lasting insecticidal nets or, where appropriate, the application of indoor residual spraying. To enable an effective vector control response, entomological surveillance and monitoring of coverage and impact of vector interventions must be included in national surveillance systems (WHO, 2015).

Chemoprevention, preventive treatment strategies are key elements of the multipronged strategy to reduce disease burden and transmission, and they need to be substantially expanded to help countries to reduce their malaria burden. WHO-recommended preventive treatment against malaria presently includes intermittent preventive treatment of pregnant women, intermittent preventive treatment of infants, and seasonal chemoprevention for children aged under five years (WHO, 2012). These interventions are recommended in areas of moderate to high malaria transmission in Sub-Saharan Africa, with seasonal malaria chemoprevention being in areas of highly seasonal transmission for *P. falciparum*.

Diagnostic testing and treatment, all patients who are suspected to have malaria should have the diagnosis confirmed by parasite detection methods such as quality assured microscopy or a rapid diagnostic test. WHO recommended antimalarial medicines is crucial in all settings in order to prevent the progression of uncomplicated malaria to severe illness and death. After diagnostic confirmation, every patient with uncomplicated *P. falciparum* malaria should be treated with quality assured artemisinin-based combination therapy. Either chloroquine or artemisinin based combination therapy are effective to treat malaria in areas where chloroquine-susceptible *P. vivax* is present and uncomplicated non

falciparum malaria. All non-pregnant adults and children with *P. vivax or P. ovale* who are not glucose-6-phosphate dehydrogenase deficient should receive a 14-day course of prmaquine to prevent future relapse (WHO, 2015).

Due to the result of expanded access to key control interventions such as ITNs, IRS and ACTs, an estimated 663 million malaria cases were prevented in Sub Saharan Africa between 2001 and 2015. Among the interventions 69% of malaria cases prevented through ITNs. In Africa region between 2010 and 2015 malaria incidence rate decreased by 21% and malaria mortality rate decreased by 31% following the scale up of interventions (WHO, 2016).

2.6. Malaria Control in Ethiopia

The control of malaria in Ethiopia was started more than five decades ago, that was initially began as a pilot control project in 1950s and for the first time it was launched as a national eradication campaign in the 1960s followed by a control strategy in the 1970s (WHO, 2016).

In Ethiopia the main malaria prevention and control activities are implemented based on the national strategic plan for malaria control and prevention that operates in line with the WHO recommendation. The national strategic plan for malaria control and prevention in Ethiopia, NSP 2011-2015, aimed at strengthening and scale-up of malaria control interventions though prompt and effective diagnosis and treatment, case management though roll out of the highly efficacious antimalarial drugs (MOH, 2010). Artemisinin-based combination therapies (ACTs) and selective vector control with special emphasis to scaling up LLINs coverage and ensuring its utilization at house hold level, and targeted and timely application of IRS of households with insecticide and environmental management.

The strategic plan has set goals to achieve malaria elimination in areas with historically low malaria transmission and near zero malaria deaths in all the remaining parts of the country by 2015. To attain these goals it has set out the following specific targets such as, 100% of households in malarias areas own one LLINs per sleeping space, at least 80% of people at risk of malaria use LLINs, IRS coverage increased and maintained to 90% of households in IRS-targeted areas and 100% have access to effective and affordable malaria treatment.

Ethiopia has adapted the WHO/RBM technical strategies to improve provision of prompt access to effective treatment, selective vector control IRS and LLINs, early detection and control of malaria epidemics (MOH, 2012). LLINs, IRS and early diagnosis and treatment are primary interventions of malaria control in Ethiopia where malaria transmission is unstable, seasonal, characterized by frequent and wide spread focal epidemics (Kebede *et al*., 2010).

In Ethiopia, national malaria control strategic plan for 2014-2020 which serve as a guiding document of malaria control program in the country has been developed (MOH, 2014). The goals of malaria control strategic plan are: By 2020, to achieve near zero malaria deaths, no more than one confirmed malaria death per 100,000 populations at risk. By 2020, to reduce malaria cases by 75% from the 2013 base line. By 2020, to eliminate malaria in selected areas with historically low malaria transmission.

The above national malaria strategic plan achieved through; Community empowerment, early diagnosis and case management of confirmed malaria cases, selective vector control (LLINs, IRS and Larval control), surveillance and response, elimination of malaria in low transmission areas and monitoring and evaluation and program management.

The burden of malaria in Ethiopia has significantly minimized in the last decade due to the coverage of high impact interventions such as prompt treatment of cases using artemisinin-based combination therapy (ACT), prevention and control of malaria among pregnant women intermittent preventive treatment (IPTp), use vector control methods including insecticide-treated bed nets (ITNs), and indoor residual spray (IRS) (Abeku *et al.*, 2015).

In addition, in some areas of the developing countries community participation and health education strategies promoting awareness of malaria and the importance of control measures play a great role to minimize the incidence of malaria. Besides community participation knowing the malaria disease, its causative agent, means of transmission and its symptoms can stop the disease at the early stage of its life cycle before the disease becoming fatal. Health education about management of mosquito breeding sites such as stagnant water drainage, filling holes, cleaning the surrounding, larviciding activities and screening windows are successful in the reduction of malaria morbidity and mortality (Chipwaza *et al*., 2014).

After the scale up of control interventions, malaria death and admission in children under 5 age decreased by 81% and 73% respectively between 2006 and 2011 (Aregawi *et al*., 2014). However, in Ethiopia malaria remains a major health problem where only 25% of the population live in areas that are free from malaria (WHO, 2014).

2.6.1. Malaria prevention through Long- Lasting Insecticidal Nets

Long lasting insecticidal nets (LLINs) are a factory treated mosquito net made up of materials in to which insecticide is incorporated or bound around the fibres. It must retain its effective biological activity for at least 20 WHO standard washes under laboratory conditions and for three years of recommended use under filed conditions (WHO, 2016). This treatment creates physical barrier around the net, repelling or killing the mosquitoes. LLINs are increasingly popular as they last longer than ITNs, repelling mosquitoes up to four years. Mosquitoes that carry malaria are most active at night and in the early morning, bed nets are particularly vital during these times.

Ethiopia has produced tremendous results in its fight against malaria. LLIN is a key intervention towards preventing mosquitoes that cause malaria; the country's national malaria control program conducted mass distributions of LLINs in 2005 and 2006. By the end of 2007, 20 million LLINs had been distributed; this distribution resulted in an estimated coverage of almost two LLINs per household in the malaria endemic regions of the country (WHO, 2009). Between 2008 and 2009, 2.1 million nets were distributed and between 2010 and 2011, 17.1 million nets were distributed. Thus in all regions of Ethiopia between 2005 and 2011 a total of 39.2 million LLINs were distributed to people living below 2,000 m (Aregawi *et al*., 2014).

According to Ethiopian Public Health Institute 2011, the national target is to sustain 100% LLINs coverage in malaria risk areas, however, the malaria indicator survey showed that the ownership of LLINs in household in malaria area below 2,000 m was 54.8% owning at least one LLIN and 23.6% owning more than one LLIN. Net ownership at higher altitudes above 2,000 m was also found to be lower with 37.9% of household owning at least one net. In Ethiopia the existing policy guide that used to determine the required number of LLINs per household based on family size (MOH, 2012). Table 1 indicates the distribution guide line criteria to determine number of LLINs per household.

Table 1. Guideline criteria to determine the number of LLINs per household in Ethiopia

No	Family size	Number of LLINs to be supplied
1	1 to 2	1
2	3 to 5	2
3	6 to 7	3
4	≥ 8	4

Source: MOH, 2012

WHO recommends LLIN coverage for all people at risk of malaria. Effective behaviour change communication strategies can help ensure that people at risk of malaria sleep under LLIN every night, and that the net is properly maintained. LLINs are designed to kill mosquitoes for three years, after which time they need to be replaced. Mechanisms are needed to replace nets that are damaged before this period has elapsed (WHO, 2017).

As per the NMSP 2014-2020, the MOH conducted a mass campaign in 2014-2016, distributing 29.6 million Long lasting insecticidal nets to protect all Ethiopians living in areas with on-going malaria transmission, representing 60% the total population (MOH, 2015). The Global Fund contributed the majority of the LLINs with PMI supporting the remaining gap. PMI cumulatively procure over 23 million LLINs between 2008 and 2015. With FY 2015, and FY 2016 funds, PMI plans to procure 10.4 million LLINs for distribution to high risk communities to replace lost net and protect new households and new household member With FY 2017 funds PMI plans to procure on additional 3.6 million LLINs for distribution as part of Ethiopia's 2018 universal coverage campaign. With FY 2018 funds, PMI plans to procure an additional 2,113,000 million ITNs for distribution as part of Ethiopia's universal coverage campaign. PMI also plans to continue supporting the development and implementation of ITN distribution tracking to ensure all ITNs are reaching their intended (PMI, 2017).

2.6.2. Malaria prevention through Indoor Residual Spray

Indoor Residual Spray (IRS) is one of the main malaria control strategies in Ethiopia. IRS is the process of spraying the inside walls and ceilings of houses and buildings with insecticide that include DDT, Pyethroid and Deltamitrin chemicals. IRS is effective control intervention to kill adult vector mosquitoes that land and rest on the surface of walls and

roofs of houses and domestic animal shelters thus in areas of intense malaria transmission the impact of IRS is highly effective strategy to combat malaria (MOH, 2012). This method has been proved effective in minimizing malaria infection and incidence however its effectiveness is influenced by the development of some mosquitoes resistance to some chemicals used in IRS. WHO recommends the use of combined interventions to solve the mosquitoes challenge to developing IRS resistance that could influence the control intervention when implementing malaria control programme. The MOH's NMSP aim to provide 100% IRS coverage as a key malaria prevention measure in area where malaria burden is high and in highland fringe areas with the potential for malaria outbreaks. The new MOH malaria risk stratification, 14.8% of the country's total population is targeted for IRS as compared to 17% in the 2014 stratification (PMI, 2017).

2.6.3. Malaria prevention through Artemisinin-based Combination Therapies

World Health Organization currently recommended combination drug therapies as a result of the resistance of the disease to conventional drug therapies, such as Sulfadoxine-pyrimethan, chloroquin and amodiaquine, has increased. The Artemisinin-based Combination Therapies (ACTs) recommended by WHO include artemether lumfantrin (AL), artesunate-amodiaquin (AS-AQ) and artesunat-mefloquine (AS+MQ). Recently ACTs are the most effective drug treatments and they able to produce a very rapid therapeutic response to malaria. Artemisinis are highly potent, short-half-life anti-malarial drugs and they act very fast against the parasite. The drugs able to remove more than 90% of the parasite load within the first 6 hours of administration and the remaining parasite load is progressively cleared by the partner drugs that usually has longer half-life and acts slowly (WHO, 2015).

2.6.4. Diagnosis and treatment

Among the core malaria control interventions, prompt and accurate diagnosis of malaria is part of the effective case management based on detection of parasites on the blood through microscopy or RDT. The contribution of early diagnosis and effective treatment of malaria remains effective intervention with regard to in the preventing mortality and reduction of the incidence of severe illness of malaria (WHO, 2017). Diagnosis through blood smear

microscopy is the most accessible, affordable and reliable technique for malaria infection diagnosis (Fentahun *et al*., 2014).

The NMSP 2014-2020 aims for universal access to prompt malaria diagnosis and highly effective treatment service for the entire Ethiopian population, the objective of the strategy for malaria diagnosis specifies that by 2017, 100% of suspected malaria cases are diagnosed using microscopy or RDT within 24 hours of fever onset (PMI, 2016). The MOH's policy microscopy is the primary means of malaria diagnosis at hospitals and health centres and for rural health posts RDT is a method of malaria diagnosis. The NMSP states that ACTs, especially artemether-lumefantrine (AL) should be available at all public health facilities to treat all *P. falciparum* infections, whereas chloroquine continues to be first line treatment for *P. vivax* cases. For pregnant women oral quinine remains the treatment of choice for uncomplicated *P. falciparum* during the first trimester of pregnancy.

2.6.5. Environmental control

In Ethiopia environmental control is the most popular malaria prevention method, communities are participated in destroying mosquito breeding sites that reduce the mosquito human contact (Muhamed *et al*., 2015). Mosquito breeding site in Ethiopia such as water accumulation near roads, borrow pits used to extract soil and stones for house constructions, micro ponds to harvest rain water for horticulture and small scale irrigation, rivers and creeks created after rainy season's leads to environmental manipulations (Jaleta *et al*., 2013). Environmental modification for mosquito breeding source reduction and larviciding are also widely used in Ethiopia in addition to IRS and LLINs as a vector control (WHO, 2016).

2.7. Knowledge about malaria and its control studies

The success of malaria 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 community based cross sectional study conducted on the knowledge, attitude and practice on 249 participants in south western Ethiopia, reveals that all respondents had 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 owner ship 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). 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 have 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 this 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).

3. Materials and Methods

3.1. Description of the study area

The study was conducted in Chagni town administration, northwest Ethiopia, which is located at 505 km from Addis Ababa. The town found in Awi zone of Amhara region, this town has a longitude and latitude of 10°57'N 36°30'E and an elevation of 1,650 meters above sea level with an area of 1,986.5 Km^2. Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia, this town had a total population of 39,292 among these 19,165 were men and 20,127 women. The town had five kebeles. Major ethnic groups of the study area include 74.3% Amhara 19.7% Agew 2.2% Oromo 1.6% Shinasha and 2.2 others. The mean annual temperature is about 21.6°C which is ranging from minimum 13.7°C to a maximum 29.6°C and the mean annual rainfall is 1,896.6 millimetres (Chagni administration office).

The town surrounded by three permanent rivers, the Ardi river which flows from north to west south, the Dondor river which flows from north to west and third river Dura flows west north direction. The three rivers are the major sources of small irrigation and sanitation purposes in the town.

According to the clinical records from the health centre malaria disease is common in the town. Hence, malaria prevention and control interventions are being implemented. Among the interventions that are implemented in the town include indoor residual spray (IRS), distribution of long lasting insecticidal nets (LLIN) and environmental control and promote treatment of Malaria cases using Coartem for *P. falciparum* and Chloroquin for *P. vivax* as a first line treatment. Based on examination they use compound microscope and when there is no electric light they use a generator as a reserve rather than using RDT. In this study area, peak malaria transmission is bi-annually from September to December and April to June.

3.2. Study design and population

The study was conducted at Chagni health centre. A health centre based on cross sectional survey study was carried out to assess malaria prevalence and community knowledge about its control tools in Chagni town. First six month recorded data from September 2017 to

February 2018 was taken, therefore the study participants were patients of malaria suspected individuals microscopically tested in the health centre 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 health centre for any kind of healthcare, formed the sampling population. Adults above or equal to 18 years of age were selected randomly from all kebeles considering probability proportional to size allocation for survey of household questioner. In addition Chagni town head of health centre and malaria control and prevention focal person were interviewed in order to generate data to assess malaria prevalence and community knowledge about its control tools in Chagni health centre.

3.3. Sample size

A total of 4,077 malaria suspected patients registered in the health centre from September 2017 to February 2018 was the sample size to determine the current prevalence of malaria and hence the second part of the study was looking at assessing the knowledge of the study participants on malaria, its symptoms, transmission and its control, the sample size for questionnaire was determined by single population proportion estimate considering the level of significance at 0.05 and the proportion (P) for the sample size determination was taken from Malaria Indicator Survey 2015 estimated that 78% of the population have knowledge of malaria and prevention in Amhara region as there were no studies done in this area.

Using the formula $n = Z^2 P (1-P)/d^2$ (Henok *et al*., 2015); where n = sample size, Z = 1.96 at 95% confidence interval, d = margin of error 5% and P = expected proportion of population (P = 0.78), 261 sample size was determined. Hence considering 5% non-response rate, the total sample size was 274 respondents were interviewed for household questionnaire and in addition the head of Chagni health centre and malaria prevention and control focal person were interviewed.

3.4. Sampling procedure

A simple random sampling method was used to select study participants. First, the total sample size of each kebele was determined using proportional to population size (Figure 2). Then after individual participants of each kebele who came to health centre were selected randomly by taking every third attendant from random start on the health centre up to the sample size of the population is reached.

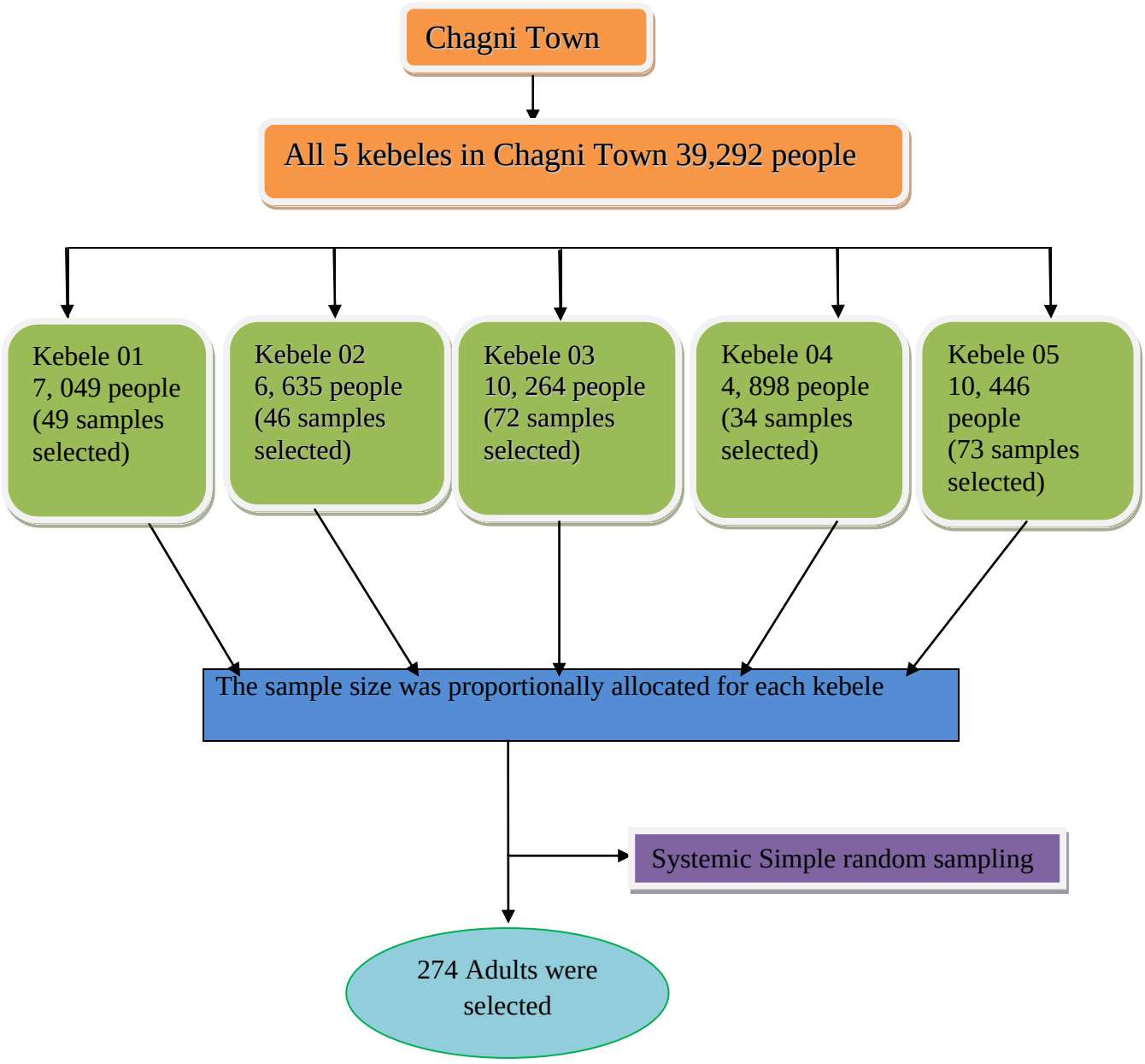

Figure 2. Sampling procedure flow diagram

3.5. Data collection and procedure

3.5.1. Blood sample collection and analysis

Using blood film examination format blood slides were collected from compliance of febrile patients at Chagni health centre and patients socio-demographic data were collected on patient registration book from September 2017 to February 2018. In this health centre thick and thin blood smears were prepared to observe the presence of malaria parasite under the microscope. Both blood films were stained with Giemsa stain for 10 minute. To identify the parasite species and infective stages thin films were fixed with methanol before Giemsa staining and to determine the parasite densities thick films were used. Following established protocol, examination of blood films were done by experienced laboratory technician at the health centre.

3.5.2. Questionnaire

A structured and pre-tested questionnaire was developed based on Malaria Indicator Survey Household Questionnaire (WHO, 2005). In which the questionnaire was modified and translated for the local conditions in to Amharic language. The respondents were asked in the household questionnaire about socio-demographic characteristics, socio-economic status, environmental characteristics, and knowledge about malaria which include transmission, symptoms and control methods. Chagni town health centre head and malaria control and prevention focal person were interviewed open ended questions. The discussion points include situation of malaria, malaria control and prevention intervention strategies, the coverage of LLINs and IRS and problem of community to the successes of control intervention. The discussion points were tape recorded and notes were taken that was summarized and report written.

3.6. Data quality control

The recorded data were taken from patient registration book of the health centre. Data was collected, checked and confirmed. The questionnaire was first translated in to local language Amharic and edited by a nurse and one sanitary to avoid ambiguity questions to assure the quality of the data before analysis. The Amharic version was later translated

back into English. 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 recorded 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. Ethical consideration

Supportive letter was obtained from Addis Ababa University Zoological Science Department. After discussing the purpose of the study, Chagni health centre administration approved the study to collect the data.

3.9. Operational terms

Long lasting insecticidal net (LLIN): a bed net coated or impregnated with insecticide that is designed to remain effective for 3-5 years and 20 washes.

Insecticide-treated net (ITN): a net dipped in an insecticide for protection against mosquito bite.

Indoor residual spraying (IRS): is the process of spraying the inside of houses with an insecticide to kill mosquitoes that spread malaria.

Malaria prevalence: the proportion of malaria cases in a population at a given time.

Use: Proportion of high-risk groups who slept under LLIN in the previous night.

(Source: WHO malaria terminology, 2016)

4. Results

4.1. Current malaria prevalence

In the study area from September 2017 up to February 2018 a total of 4,077 malaria suspected patients were diagnosed microscopically, of which 296 (7.3%) of patients were microscopically confirmed malaria cases. Among the patients there were 2,103 males and 1,974 females, of which 164 (55.4%) and 132 (44.6%) were slide positive respectively. Malaria confirmed cases were greater in males than females (Table 2). The association of malaria with sex was not statistically significant (P=0.172). Regarding to age distribution of malaria confirmed patients age belongs to <5 (4.7%), 5-14 (7.1%) and ≥ 15 (8.5%) were slide positive, that indicates in all age group malaria cases was detected. The highest number of malaria suspected 2,179 (53.4%) and confirmed cases 185 (8.5%) in the health centre based on age were recorded belongs to the age groups ≥15. The prevalence of malaria in this age group was 8.5% which is relatively the highest. The lowest prevalence of malaria registered in the age group <5 years of age was 4.7%. There was statistically significant association between age and malaria slide-positivity (P=0.001).

In relation to seasonal distribution of malaria (Table 3), the number of patients examined and confirmed for malaria shows a progressive decrease after September and October. Relatively malaria prevalence was high in October than the other months. From September to November malaria confirmed cases was 194 and prevalence was high (7.8%) following rainy season and during the dry season from December to January malaria confirmed cases was 102 and prevalence was low (6.4%). In the health centre on average 49.3 malaria confirmed cases visited each month. The average monthly malaria prevalence was 7.3%.
According to the data from Table 2, *P. falciparum* is the dominant species than *P. vivax* in the study area, that out of the total confirmed cases 163 (55%) were *P. falciparum* and 131 (44.3%) were *P. vivax*. There were two mixed cases detected in both male and female individuals of age groups ≥15 years of age. Generally in the study area from September up to February there was no mentioned sever cases and death of malaria.

Table 2. Current malaria prevalence based on sex, age and *Plasmodium* species distribution at Chagni health centre from September 2017-Feburary 2018.

Age	Examined number	Confirmed. No (%)	*P. falciparum*. No (%)	*P. vivax*. No (%)	Mixed. No (%)	P-Value
<5	1012	48(4.7)	23(47.9)	25(52.1)		
5-14	886	63(7.1)	36(57.1)	27(42.8)		0.001
≥15	2179	185(8.5)	104(56.2)	79(42.7)	2(1.1)	
Total	4077	296(7.3)	163(55)	131(44.3)	2(0.7)	
Sex						
Male	2103	164(55.4)	89(54.3)	74(45.1)	1(0.6)	
Female	1974	132(44.6)	74(56)	57(43.2)	1(0.8)	0.172
Total	4077	296(100)	163(55)	131(44.3)	2(0.7)	

Table 3. Seasonal pattern of malaria and *Plasmodium* species distribution at Chagni health centre from September 2017-Feburary 2018

Month	Examined number	Confirmed. No (%)	*P. falciparum*. No (%)	*P. vivax*. No(%)	Mixed. No (%)	P-Value
September	718	37(5.2)	21(56.8)	16(43.2)		
October	986	97(9.8)	55(56.7)	42(43.3)		
November	773	60(7.8)	31(51.6)	28(46.6)	1(1.6)	0.004
December	662	46(6.9)	18(39.1)	27(58.7)	1(2.1)	
January	547	32(5.9)	21(65.6)	11(34.4)		
February	391	24(6.1)	17(70.8)	7(29.2)		
Total	4077	296(7.3)	163(55)	131(44.3)	2(0.7)	

4.2. Socio-demographic characteristics

A total of 274 respondents were participated in this study (Table 4). From the total respondents 154 (56.2%) were males and 120 (43.8%) were females. The age of the respondents ranged from 18 years to 74 years, the median age of the respondents was 32.43. Regarding to the educational status most of the respondents were illiterate (43.1%) followed by read and write (35%). The remaining respondents were 10.6% primary school and 11.3% were attended their secondary school and above (Table 4). Their marital status indicated that 46.7% of the respondents were married and 31.4% were single, while the rest 5.1% and 16.8% were divorced and widowed respectively. Ninety five (34.7%) of the respondents were daily labourer, 23.4% were civil servant, 17.5%were merchant, 12% were farmer and 12.4% were others include house wife and alcohol seller. One hundred twenty one (44.2%) of the respondents had an estimated monthly family income between 500-1000 Ethiopian birr, 39% of the respondents had monthly income above one thousand Ethiopian birr and 16.8% had family income less than 500 Ethiopian birr. One hundred twenty (43.8%) of the participants had family size 1and 4, 42% had 5 and 7 and 14.2% had family size ≥8. The average family size of the respondents was 3.84. Majority of the respondents 77.7% had television, 8.8% had radio and 13.5% of the respondents in the study area had no mass media. Religion wise majority of the respondents 66.8% were followers of orthodox, 28% were Muslims and the rest 3.3% and 1.5% were protestant and catholic respectively.

Table 4. Socio-demographic characteristics of respondents in Chagni town, 2018 (n = 274).

Variable	Category	Frequency	Percent
Sex	Male	154	56.2
	Female	120	43.8
Age	18-24	90	32.8
	25-34	73	26.6
	≥35	111	40.5
Marital status	Single	86	31.4
	Married	128	46.7
	Divorced	14	5.1
	Widowed	46	16.8
Number of family	1-4	120	43.8
	5-7	115	42
	8 and above	39	14.2
Educational status	Illiterate	118	43.1
	Read and write	96	35
	Primary school	29	10.6
	≥Secondary school	31	11.3
Occupation	Civil servant	64	23.4
	Farmer	33	12
	Merchant	48	17.5
	Daily labourer	95	34.7
	Other	34	12.4
Family income	<500	46	16.8
	500-1000	121	44.2
	>1000	107	39
Religion	Orthodox	183	66.8
	Muslim	78	28.5
	Protestant	9	3.2
	Catholic	4	1.5
Mass media	Radio	24	8.8
	Television	213	77.7
	No	37	13.5

4.3. Knowledge about malaria symptoms, transmission and control

In order to know and analyse the knowledge of the study participants about the symptoms of malaria disease, the transmission mechanisms of malaria and the possible control mechanisms they are using, a total of 274 members are addressed with the designed questionnaire. The collected analysed data shows that 266 (97%) members responded as they have information and heard about malaria disease while the remaining 8 (3%) respondents have responded as they have not heard about malaria disease. The respondents who have heard about malaria are also asked about the source of information they have heard and responded as they heard from mass media (86%) and government health workers (14%). Asked their knowledge about whether malaria is a health problem in the study area, 97% of the respondents are informed about malaria as health problem while 3% of them responded as they don't consider malaria as health problem (Table 5).

Table 5. Knowledge of respondents about malaria transmission and preventability in Chagni town, 2018 (n=274)

Variable	Category	Frequency	Percent
Heard of malaria	Yes	266	97
	No	8	3
Message source	Health worker	37	14
	Mass media	229	86
Malaria a health problem	Yes	266	97
	No	8	3
Malaria transmissible	Yes	162	59
	No	112	41
Malaria preventable	Yes	262	96
	No	9	3
	I don't know	3	1
Contracted of malaria	Yes	263	96
	No	11	4
Place of treatment	Health centre	243	92
	Purchase drug	15	6
	Other	5	2
Method of transmission	Mosquito bite	156	96
	Drinking contaminated water	6	4

And also, the study has tried to assess the extent to which the participants of the study area are contracted with malaria disease. Accordingly, out of the total sample members interviewed, 263 of them are used to be contracted by malaria disease while the remaining 11 members of the sample are not contracted by malaria disease. This shows that almost the 96% of the participants in the area is victim and subject to malaria disease (Table 5). Therefore, given that malaria disease is prevalent in the study area, the study has tried to deal with the treatment mechanisms that the victims are using when they are contracted by the case. The analysis shows that, almost 243 (92%) of the victims go to health centre to get formal treatment from medical professionals while 15 (6%) of the people purchase drugs from shops by themselves. The analysis shows also that the remaining 5 (2%) of the victims use traditional medicines such as eating garlic and eating leaf of neem tree.

The awareness of the study participants also assessed on whether a malaria disease is transmissible from one victim to another. Hence, out of the total sampled people responded to the question, 162 (59%) of them responded and consider that malaria disease is transmissible while 112 (41%) of them have responded as malaria disease is not transmissible. Out of those with the understanding that malaria disease is transmissible, the study has tried to assess their knowledge on how the disease transmits. The finding shows that almost 156 (96%) of the respondents understand that malaria diseases is transmitted through mosquito bites while the remaining 6 (4%) understand that malaria diseases transmitted through drinking of contaminated water (Table 5). Regarding knowledge of malaria prevention, the collected analysed data shows that 262 (96%) of the respondents said malaria is preventable, 9 (3%) respond malaria cannot be prevented and 3 (1%) of respondents did not know malaria can be prevented or not (Table 5).

Those respondents who have knowledge about the preventability of malaria also asked how malaria is prevented (Figure 3) and majority of the study participants 226 (86.3%) respond that malaria is prevented by taking tablet, followed by using mosquito net 192 (73.3%), removing stagnant water 178 (68%) and 173 (66%) house spray with insecticide.

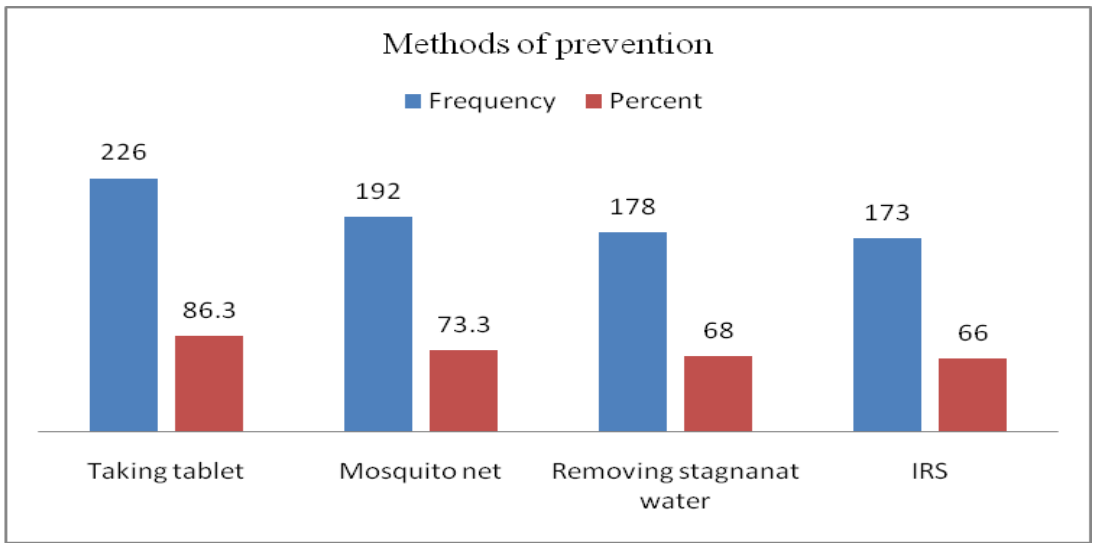

Figure 3. Knowledge of respondents on malaria prevention methods in Chagni town, 2018.

Malaria as diseases has its own symptoms identified as common (Figure 4). Among these are, fever, vomiting, chills and shivering, loss of appetite and joint pain are most commonly observed symptoms in the study area. As the collected data analysed and shows on average these symptoms constitute 93.3% of the malaria diseases.

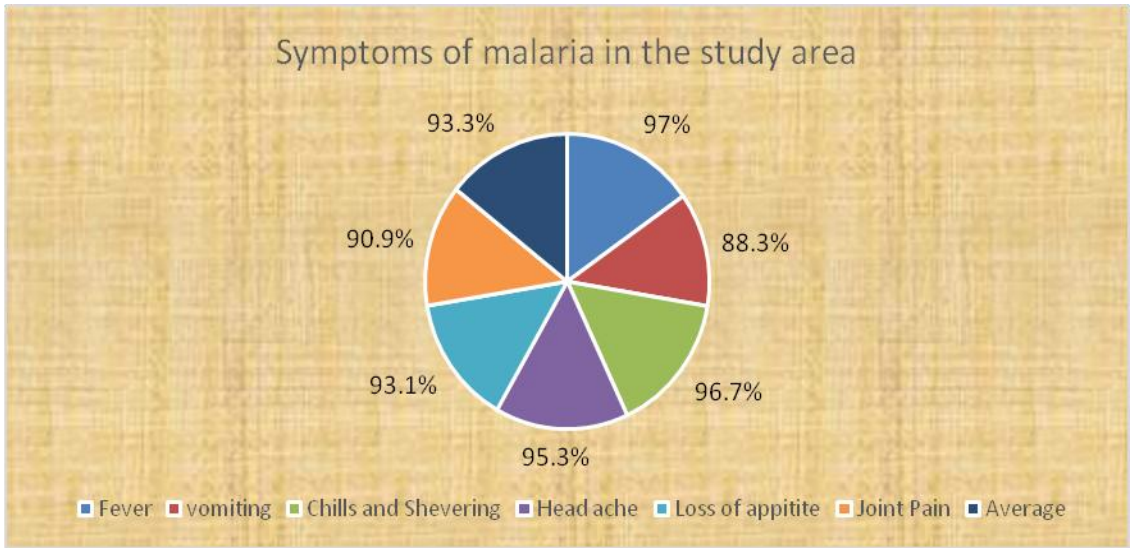

Figure 4. Knowledge of respondents about symptoms of malaria in Chagni town, 2018 (n=274)

As we can see from the figure above, the commonest symptoms of malaria mentioned by the study participants were fever 97%, chills and shivering 96.7% head ache 95.3%, loss of appetite 93.1%, joint pain 90.9% and vomiting 88.3%.

Table 6. Knowledge of respondents on mosquito breeding site, mosquito net use and mosquito biting time in Chagni town, 2018 (n=274)

Variable	Category	Frequency	Percent
Mosquito breeding site	Stagnant water	244	89
	Waste material	30	11
Mosquito biting time	Night	255	93
	I don't know	17	7
Mosquito net use	Protects from mosquito bite	222	81
	Good sleep	26	9.5
	Protects other insect bite	26	9.5

As concern to the respondent's knowledge of mosquito breeding site 244 (89%) recognized that stagnant water is the main breeding site of mosquito and 30 (11%) responded that mosquito breed in the waste material. The respondents also asked about the biting time of mosquito, majority of the respondent 255 (93%) respond that mosquito bite humans at night and the remaining 19 (7%) does not know mosquito biting time (Table 6). Two hundred twenty two 222 (81%) respondents reported that sleeping under mosquito net protect mosquito bite. Others respond 26 (9.5%) sleeping under the net proved comfortable environment for sleeping and the remaining 26 (9.5%) respond that mosquito net protect the biting of other insect during sleeping (Table 6).

Table 7. Respondents participation to environmental activity and housing condition in Chagni town, 2018 (n=274).

Variable	Category	Frequency	Percent
Environmental management for mosquito control			
	Yes	21	7.7
	No	253	92.3
Types of activities taken	Drainage and filling stagnant water	21	7.7
Presence of mosquito breeding site			
	Yes	270	98
	No	4	2
House eve	Yes	13	5
	No	261	95
House wall opening	Yes	58	21
	No	216	79

The study tries to assess the application of environmental management activities to control mosquito vector in the area. 21 (7.7%) of the participants participated in the activity whereas most 253 (92.3%) of the participants were not participated in the environmental management activity to control mosquito vector. Those respondents participated in the malaria control activity were also asked the type of activity they are involved, all of them participated in removing stagnant water only (Table 7). The finding shows that the activity of environmental management to malaria control is insufficient and the other control activity is not practiced in the study area, therefore it needs great attention to the concerned bodies.

With regard to participants housing environment (Table 7), majority 261 (95%) of participants lived in houses that had no opening on their eaves and 13 (5%) had opening on their eaves. 58 (21%) of the participants lived in house that had opening on their wall. Concerned to the occurrence of mosquito breeding site, only 4 (2%) of the participants house found with no mosquito breeding site where as 270 (98%) of the houses of participants surrounded by mosquito breeding site.

Table 8. Coverage of LLIN and IRS in the households of respondents in Chagni town, 2018 (n=274)

Variable	Category	Frequency	Percent
LLIN owned	Yes	268	98
	No	6	2
Number of net	One	20	8
	Two	167	62
	Three and above	81	30
Previous night LLIN used	Yes	201	75
	No	67	25
Last night LLINs used	Father and Mother	44	22
	Children and Pregnant mother	149	74
	Other Family	8	4
Why not use net	Do not prevent malaria	24	36
	Afraid of toxicity	43	64
Unavailability of net	Lost	2	33
	Thrown away	4	67
LLIN delivered	Month ago	41	15
	Before three years	224	84
	A year ago	3	1
When sleep under net	Daily	201	75
	During malaria season	67	25
House sprayed	Yes	271	99
	No	3	1
Last sprayed	Before 6 month	210	77.5
	Before 12 month	61	22.5

Keys: LLIN- Long lasting insecticidal net

4.4. LLIN and IRS coverage

In the study area where LLIN are distributed, only 6 (2%) of the participants lacked the mosquito net. The study shows that the mosquito net coverage was 98% (Table 8).

Concerning to the number of nets in their family 20 (8%) respond that their family owned one LLIN, 167 (62%) two and 81 (30%) owned more than three. Not all LLINs are used currently, only 201 (75%) nets are used in the previous night whereas 67 (25%) nets are not used in the previous night and asked the reason why not used they respond 24 (36%) of respondents do not believe the preventability of the net, the others 43 (64%) respond fear of its toxicity. This shows that there is a knowledge gap on the use of mosquito net in the study area. The reason of not having mosquito net also asked (Table 8), 2 (33%) of participants respond that it is impossible to get the net to replace the lost or damaged nets and 4 (67%) thrown away. One hundred forty nine (74%) of the participants respond the LLIN were used by children and pregnant mother, 44 (22%) father and mother and the remaining 8 (4%) of the LLIN were used by the whole family.

The time of the delivered net also assessed in the study area, they revealed that 41 (15%) of respondents respond the nets were delivered before a month ago, 3 (1%) a year ago, while majority 224 (84%) of the respondents respond the nets were delivered back three years ago (Table 8). In addition the IRS coverage and frequency were assessed in the study area, the IRS coverage was 99%. Out of this 210 (77.5%) of the participants house were sprayed in the last six month and 61 (22.5%) in the last 12 month.

4.5. Health officers interview

Two male individuals were interviewed. The respondents were the head of Chagni town health centre and the other focal person of malaria control and prevention. They had 8 and 14 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 centre malaria situation shows a remarkable decrease than in the past decades. However, malaria is still a health problem in the study area.

The implemented malaria control and prevention interventions strategy also asked and they respond that, in this health centre malaria suspected patients are diagnosed through blood smear microscopy rather than using RDT which is applicable in rural health posts. 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 around the religion places, schools, during meeting time and for patients who came to the health centre. 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, the coverage in 2016, 2017 and 2018 was 97. 4%, 99. 67% and 100% respectively. In this and last year's nets was not distributed. The last delivered LLINS was distributed before two years, the coverage was

100% and distributed based on the WHO recommended criteria, that priority was given to pregnant women, children and based on the number of family. With regard to the problems of the community to the success of malaria control interventions, they mentioned that lack of awareness on malaria prevention methods was observed among illiterate households. They use mosquito net for other purposes rather than sleeping with in it such as for screening windows, protect chickens against predators, to hunt fish as a net, to carry hay for market, make rope to tie wood and put under the bed to protect fleas. Others lack willingness to participate environmental control activities and ready their home for spraying.

5. Discussion

In this study area, from September 2017 to February 2018 the overall prevalence of malaria was 7.3%. 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 (55.4%) than in females (44.6%). 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.

Regarding to age, all age groups in the study area was infected by malaria. Age group belongs to ≥15 shows the highest prevalence rate which is 8.5%. This might be due to a relatively higher outdoor exposure to mosquito bite. On the other hand a reduction of malaria prevalence observed under the age group <5 (4.7%). This may be due to parental protection to their children that they sleep under the net. There is also a comparative decrease in malaria prevalence in the age group between 5-14 (7.1%), that the reason may be due to the awareness of malaria control measures. The prevalence of malaria in this study was statistically significant with age and malaria positivity (P=0.001).

Seasonal distribution of malaria in the study area indicated that maximum number of malaria cases was observed in September to November. This might be the reason that following the rainy season which create stagnant water which is suitable environment to mosquito breeding. The lower malaria cases reported in December to February. This might

be associated with small rains and small scale irrigation. This was in agreement with the major and minor transmission season of Ethiopia. There is a significant association between season and malaria positivity (P=0.004)

The study revealed that the predominant *plasmodium* species was *P. falciparum* (55%) followed by *P. vivax* (44.3%) and mixed infection (0.7%). 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. vivx (*40%) are the two predominant species in the country (MOH, 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. Most (86%) of the study participants get the information about malaria from mass media and 14% from health workers, which was lower than the study conducted in Tepi town where 38.6% from health workers and 13.5% mass media (Henok *et al*., 2015).

Most of the respondents were able to recognized 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 59% of the respondents understand malaria was a transmissible disease and 41% not transmissible. This is comparable with the study carried out in Gondar, north Ethiopia which is 57.9% (Tilaye, 2005). However, 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 (Astatki, 2010). In this study the response of malaria transmissible or not are put on too extreme or opposite side while the

gap between the numbers of the respondents is too small. This shows that, the knowledge of the participants about whether malaria disease transmissible or not is very low. This could be misconception of the respondents knowledge about the transmission of malaria and needs due attention of the concerned sectors and professionals too.

It was observed that 96% 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) and slightly similar to a study done in India which reported 93% of respondents knew that a mosquito bite is the means of malaria transmission (Dhawan *et al*., 2014). However, it is greater than a study conducted in Shewa Robite town, north eastern Ethiopia; where 85% of the respondents respond mosquito bite transmit malaria (Abate *et al*., 2013) and Assosa where 48% of the participants knew that malaria transmitted by mosquito bite (Legesse *et al*., 2007). 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. Though 96% of the respondents knew the transmission of malaria through mosquito bite, 4% had recognized drinking contaminated water transmit malaria. In addition 3% of the respondents lack information on malaria and majority (86%) of information gained from mass media. This shows that respondents had misconception on malaria, which might be due to health education intervention through health workers are inadequate in the area.

From the study most (96%) of the respondents believed that malaria is preventable. This finding almost agrees with the study conducted in Gondar (Tilaye, 2005), which was 94. 3% and Mandura West Ethiopia 96.7% (Mitiku and Assefa, 2017). However, it is higher than reported study from Abeshge, South Ethiopia, which is 89.8% (Yimer *et al*., 2015) and in Amhara region, North Ethiopia, which is 86.6% (Zewdie and Molla, 2013). This could be due to level of education status of the participants in the study area. Taking tablet 86.3%, use of mosquito net 73.3%, removing stagnant water 68% and IRS 66% were the malaria prevention methods mentioned by the study participants. This is relatively similar with study made in Amhara region, Berehet district where 85% use of mosquito net, 68.9%

removing stagnant water, 47.5% taking tablet and 56.6% IRS as the commonest methods of prevention (Aleme *et al*., 2014) and in Southern Ethiopia, Areka town study participants respond that 85.2% use of antimalaria drugs, 78% removing stagnant water and 82% IRS mentioned as a preventive methods (Kebede *et al*., 2017).

Majority of the respondents have good knowledge of malaria prevention methods. This could be due to the implemented control measures create awareness and their level of education in the study area. However, the other methods of malaria prevention such as disposal of water holding containers, mosquito gauze at doors and windows of the house to prevent entrance of mosquitoes and wearing protective cloth were not mentioned by the participants.

Regarding to patients place of treatment, 92% of the respondents seek treatment from health care facilities, which coincide with the finding from Southern Ethiopia, where 91.8% seek treatment from health care facilities (Kebede *et al*., 2017). And greater than a study conducted in Amhara region, where 69% seek treatment in the health care facilities (Aderaw and Gedifew, 2013). These are encouraging figures in relation to World health organization recommends that anyone suspected of having malaria should receive diagnosis and treatment in the health care facilities. This study indicated that majority of the participants follow the World Health Organization recommendation to seek treatment from the health care facilities, which could be due to awareness of the participants. On the other hand, a few respondents seek treatment by purchasing drugs from shop and use traditional means rather than health care facilities, the possible reason might be the familiarity of patients to malaria symptoms to buy drugs, lack of acceptance to laboratory result and patience to diagnosis. Therefore, the study is open for further detailed assessment on the awareness of the study participants who use traditional medicines and those who purchase drugs from shops by themselves. And also, the implication of using traditional medicines as means of treatment from malaria diseases needs to be given due attention and action.

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.

The study also revealed that 98% of households owned at least one LLIN bed net and 75% had used the net in the previous night, which is higher than the study conducted in South west Ethiopia, where 90% owned at least one LLIN bed net and 68.3% had used the net in the previous night (Hambisa *et al*., 2018) and in Gambella region 81.7% of the households owned at least one bed net, of which only 52.3% used the previous night (Watiro and Awoke, 2016).

The current study indicated that, the coverage of LLIN is encouraging and near to achieving the current national strategic plan to control malaria. The reason may be the area is malaria endemic; priority might have been given by the concerned stalk holders and fair distribution of LLINs in the study area. However, only 75% of them used their LLINs on the previous night. The most common reason reported from those not using LLINs were afraid of its toxicity, in doubt of preventability and unavailability due to is oldness thrown away. And the other problem might be they use their nets for other purposes such as to collect hay, protect chickens against predators, make rope to tie wood, to hunt fish as a net, screening window and put the net under the bed to protect fleas. These problems also understood by the malaria control and prevention focal person and head of health centre.

The LLIN coverage in the study reported that 8%, 62% and 30% of the households owned at least one, two and three and above LLIN per household respectively, which is nearly similar to a study reported from Jiga, North west Ethiopia, where 9%, 54.3% and 36.7% households owned at least one, two and three LLIN per household respectively (Ayalew *et al*., 2016). Majority (74%) of the LLINs were used by children and pregnant mother, 22% father and mother and 4% used by the whole family, which is in line with World Health Organization recommends priority given for highly risk groups than in Tepi, Southern Ethiopia where 50.7% used by children and pregnant mother (Henok *et al*., 2015). Although the coverage of LLINs in the study area was encouragingly high, majority (84%) of the nets were delivered before three years, which is comparable to a study done in Jiga

93% of nets was delivered two month back (Ayalew *et al*., 2016). This study indicates the nets are not replaced timely in the area and contrary to WHO recommends LLINs are designed to kill mosquitoes for three years, after which time they need to replaced and mechanisms are needed to replace nets that are damaged before this period has elapsed (WHO, 2017).

The coverage of IRS was 99% in the study area. Among the households who sprayed, 75.5% spray before six month and 22.5% before twelve month, which is higher than the study done in North Ethiopia 42.75% their houses sprayed (Zewdie and Molla, 2013) and South central Ethiopia 73% of their house sprayed (Yimer *et al*., 2015). In Ethiopia malaria transmission is seasonal. IRS is one of the key strategies of NMCP, its required coverage must be achieved before and throughout the transmission for effective prevention and control of malaria (PMI, 2018). This finding near to achieve the strategic plan and indicates that the study participants recognize the importance of having their house sprayed. From the study, 21% of the respondents house has wall opening 5% has house eve. Moreover, 98% of the respondents house are surrounded by water which create suitable environment to mosquito breed. The reason of this could be collection of water after rain and small scale irrigation practices hence the area is covered by three rivers. However, the practice of environmental activity is low only 7.7% of the study participants had participated in removing stagnant water, which is lower than the report from South Ethiopia, where 67.7% of the participants had practiced (Kebede *et al*., 2017) and 47% of the participants from Amhara region had participated in removing stagnant water (Aderaw and Gedefew, 2013).

Environmental vector control through elimination of mosquito vector breeding site at an early stage is an important malaria preventive measure. The national malaria strategic plan states that community's participation to environmental management by eliminating mosquito breeding sites through draining and filling stagnant water is one of the control measures of malaria (MOH, 2015). However, in this study the participation of the respondents on environmental control activity is low and shows that the knowledge of the population to prevention of malaria through removing mosquito breeding site does not translated in to greater community participation. The possible reason for this might be the health workers creation of awareness on environmental control activity is inadequate and attitude of the respondents is less in the study area.

6. Conclusions and Recommendations

6.1. Conclusions

The prevalence of malaria in the study area was high and *P. falciparum* was the dominant species. The knowledge of the study participants on malaria was good. However, there were misconceptions in malaria transmission and prevention and control methods. The participant's participation to environmental control activities was also poor and the contribution of health workers to health education as a message source on malaria was inadequate.

Although, the coverage of LLINs and IRS in this study area was encouragingly high, the current six months malaria recorded data showed that high malaria prevalence was recorded and malaria is still a major health problem in the study area. The findings are believed to contribute towards reduction of malaria prevalence by improving knowledge about malaria and its control activities in the study area.

6.2. Recommendations

1. Further comprehensive study is required based on primary data to both blood samples and samples for questionnaire to have clear reliable data on malaria prevalence and knowledge of the participants about malaria and its control measures, which is vital to scale up and evaluate the implementation and effectiveness of proven control interventions of malaria.

2. Healthcare education on malaria should be intensified and continued regularly, the source of getting information on malaria through health workers and multimedia means need to be encouraged, strengthened and widely promoted.

3. Active involvement of the households should be encouraged as it is essential for effective personnel protection and vector control intervention. Concerned health workers and professionals should mobilize the households to environmental management.

4. The coverage of LLINs and IRS was encouragingly high, however as it is not yet 100% and LLINs should be replaced timely. Therefore, continuous distribution of LLINs should be applied and IRS required coverage must be achieved before and throughout the transmission season in the study area.

5. Priority should be continued to the most vulnerable groups of population, such as children under five years of age and pregnant mothers during bed net distribution.

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8. Appendix

Appendix I: English questionnaire

Date_____

Code No_____

The purpose of this questionnaire is prepared to assess the prevalence of malaria and the knowledge of the study population towards malaria and its control in Chagni town, Awi zone, Northwest Ethiopia.

My name is_____I am an MSC student at Addis Ababa University. I am here to collect data about socio- demographic characteristics, socio-economic status and knowledge about malaria and its control for the study conducted on prevalence of malaria and the knowledge of the study population towards malaria and its control. Participation is based on your willingness but your participation is great contribution for the success of the study. Therefore your answers remain confidentially and all the information you provide in the questionnaire will be used for the purpose of the study. I kindly request you to respond the questions genuinely.

Thank you in advance!

I. Socio-demographic Characteristics

House hold locality_____

1. How old are you? _____
2. What is your sex? _____
3. Marital status A. Single B. Married C. Divorced D. Widowed
4. Educational status A. Illiterate B. Read &write C. Primary school D. ≥Secondary School
5. What is your Occupation? A. Civil servant B. Farmer C. Merchant D. Daily labourer E. Other specify_____
6. What is your religion? A. Orthodox B. Muslim C. Protestant D. Catholic E. Other__
7. What is the average monthly family income? A. <500Birr B. 500-1000 C. >1000
8. Number of your family_____
9. Does your family have any of the following mass media?

A. Radio B. Television C. Internet D. No E. Other specify_____

II. Knowledge about malaria (Symptoms, transmission and Control measures)

10. Have you seen or heard of malaria education message? A. yes B. No
11. If yes, explain the source? A. health workers B. mass media C. religious institutions D. Other specify_____
12. Is malaria a health problem in your area? A. Yes B. NO
13. What are the symptoms of malaria? (You can tick more than one answer) A. Fever B. Vomiting C. Chills and Shivering D. headache E. Loss of appetite F. Joint pain G. Other
14. Have you or your family members ever contracted malaria? A. Yes B. No
15. If yes, where did you go for treatment? A. Health centre B. Hospital C. Traditional healers D. Purchase drugs form shops E. Other specify_____
16. Is malaria transmissible disease? A. yes B. No C. I don't know
17. If yes to question 16, how malaria transmitted? By A. mosquito bites B. Body contact with patient C. Sexual intercourse D. Drinking contaminated water E. Others specify__
18. Where do mosquitoes mostly breed?
    A. Stagnant water B. Running water B. Waste material C. Others specify_____
19. When do mosquitoes mostly bite? A. day B. night C. I don't know
20. Do you know malaria is a preventable disease? A. Yes B. No C. I don't know
21. If yes to question 20, what are the methods to prevent malaria? A. Use of mosquito net B. Take tablets C. House spray with insecticides D. Removing mosquito breeding site E. Other specify_____
22. What is the purpose of mosquito net? A. protect mosquito bite B. sleep better C. protect other insect bite D. Other specify_____
23. What is the advantage of insecticide residual spray?
    A. To kill mosquito B. To prevent malaria C. To kill other insect D. Other specify
24. Are there environmental management activity to control mosquito? A. Yes B. No
25. If yes to question 24. What type of actions being done? A. drainage and Filling stagnant water B. dispose water holding container C. Other specify_____
26. Are you ever participated in malaria control activities? A. Yes B. No
27. If yes to question 26. In what activity? A. Removing stagnant water B. In health Education campaigns C. Other specify_____

III: Mosquito Nets and Insecticide Spraying

28. Do your family have insecticide treated bed net in the house? A. Yes B. No

29. If yes, how many ITNs do you have in the house? A. 1 B. 2 C. 3 D. >3

30. Are they currently being used? A. Yes B. No

31. Did you or your family use it last night? A. Yes B. NO

32. Who uses the ITNs? A. Children B. Mother C. Father D. Father and Mother
E. Children and Pregnant mother F. Other family members

33. If your answer to question 30 is no, Reasons for not using the available ITNs
A. Nets do not prevent malaria B. Afraid of its toxicity C. Other (specify) _____

34. If your answer to question 28 is no, Reasons for unavailability of ITNs?
A. Not available B. Lost/stolen C. Used for other purposes D. Old; then thrown away
E. Other_____

35. How often do you or your family sleep under bed nets? A. Daily B. Occasionally
C. during Malaria season D. Almost weekly E. Other specify _____

36. Type of bed net? A. Untreated Net B. Locally Treated Net (ITN)
C. Long-Lasting Insecticide Treated Net (LLIN) D. Don't Know

37. Condition of the bed net? A. Good (no holes) B. Fair (no holes that fit a torch battery)
C. Poor (1-holes that fit a torch battery) D. Unsafe (>5 Holes that fit a torch battery)
E. Unused (still in package)

38. For how long have you used bed nets in this house? A. Months ago B. <1 month
C. >3 years D. don't know E. Other specify _____

39. Was the house sprayed with insecticide in the last 12 months? A. Yes B. No

40. If yes, when was last sprayed? A >6 months B. >12 months
C. Other specify_____

VI: Housing environment

41. Main material of the Room's Roof? A. Thatch B. Corrugated Iron sheet
C. Plastic sheet D. Other specify _____

42. Main material of the Room's Floor? A. Earth B. Cemented C. Other specify_____

43. Main material of the Room's Wall? A. Mud blocks B. Sticks
C. Corrugated metal D. sticks and mud E. Other specify_____

44. Is eave present? A. Yes B. No

45. Is hole present in the wall? A. Yes B. No

46. Is there any mosquito breeding sites around your home? A. Yes B. No

47. If yes to question 46, distance of the house from mosquito breeding site?

A. <1000 m B.1000m-2000 m C.>2000 m D. Other specify_____

48. What is the main source of drinking water for members of your family?

A. Spring B. Dug Well C. Surface Water (River/Dam/Lake/Pond/Stream)

D. Public Tap/Standpipe E. Other specify____

49. What kind of toilet facilities does your family use?

A. Pit Latrine (no cement slab) B. Cemented pit latrine C. Other specify_____

Appendix II: Amharic questionnaire

በአዲስአበባ ዩንቨርሲቲ የተፈጥሮ ሳይንስ ኮሌጅ

የዞሎጂካል ሳይንስ ትምህርት ክፍል

የህ መጠይቅ የተዘጋጀው የወባ በሽታን ስርጭት እና የማህበረሰቡን ስለወባ እና ስለ መከላከል ያላቸውን እውቀት ዳሰሳ በሚል ርዕስ ሲሆን ጥናቱ የሚካሄደውም በቻግኒ ከተማ አስተዳደር ነው፡፡

እኔ----------እባላለሁ፤ በአዲስአበባ ዩኒቨርሲቲ በስነ ህይወት ትምህርት የሁለተኛ ዲግሪ ተማሪ ስሆን እዚህ የመጣሁት በቻግኒ ከተማ አስተዳደር የወባ በሽታን ስርጭት እና የማህበረሰቡን ስለወባ እና ስለ መከላከል ያላቸውን እውቀት ዳሰሳ በሚል ርዕስ ጥናት ለማካሄድ አስፈላጊውን መረጃ ለመሰብሰብ ነው፡፡ መጠይቁ ላይ መሳተፍ በፍቃደኝነት የተመሰረተ ነው፡፡ ስለሆነም የሚሰጡት መረጃ ለዚህ ጥናት ብቻ የሚውልና ሚስጥራዊነቱም የተጠበቀ ነው፤ ስለዚህ ጥያቄዎችን ከልብ ከመነጨ እውነተኛ ሀሳብ ላይ ተመርኩዘው ትክክለኛውን መልስ በማከበብ እንዲሞሉልኝ በአክብሮት እጠይቃለሁ፡፡ ለትብብርህ(ሽ) በቅድሚያ አመሰግናለሁ፡፡

የወባ ጠቋሚ ጥናት የቤተሰብ መረጃ መሰብሰቢያ ቅፅ

መጠይቅ ክፍል አንድ፡የቤተሰብ ሁኔታ

የቤተሰብ ቀበሌ----------

1. እድሜ……

2. ፆታ…….

3. የጋብቻ ሁኔታ ሀ. ያላገባ ለ. ያገባ ሐ. የፈታ/ች መ. ባለቤቷ/ቱ በህይወት የሌለ

4. የትምህርት ደረጃ ሀ. ያልተማረ ለ. መፃፍና ማንበብ የሚችል ሐ. የመጀመሪያ ደረጃ መ. ≥ ሁ/ደረጃ

5. የቤተሰብ የስራ ሁኔታ ሀ. የመንግስት ሰራተኛ ለ. አርሶ አደር ሐ. ነጋዴ መ. ሌላ ካለ ይግለጹ----------

6. ሃይማኖትህ(ሰ) ምንድነው ሀ. ክርስቲያን ለ. ሙስሊም ሐ. ትሮቴስታንት

7. የቤተሰብ የወር ገቢ ሀ. ከ500ብር ያነሰ ለ. ከ500-1000 ሐ. ከ1000 ብር የበለጠ

8. የቤተሰብ ብዛት----------

9. በቤትዎ ውስጥ ከዚህ በታች ከተዘረዘሩት የመገናኛ ብዙሀን የትኞቹ አሉ

ሀ. ሬድዮ ለ. ቴሌቪዥን ሐ. ኢንተርኔት መ. የለም ሠ. ሌላ ካለ __

መጠይቅ ክፍል ሁለት፤ ስለወባ ከህሎትን(ምልከቱ፤መተላለፊያው እና መከላከል) በተመለከተ

10. ከዚህ በፊት ስለወባ እና ስለሚያስከትለው ችግር ትምህርታዊ መልዕክት ሰምተው ወይም አይተው ያውቃሉ ሀ. አዎ ለ. የለም

11. መልስዎ አዎ ከሆነ ትምህርታዊ መልዕክቱን ከየት አገኙ

ሀ. ከጤና ሠራተኞች ለ. ከመገናኛ ብዙሀን ሐ. ከዕምነት ተቋማት መ. ሌላ ካለ ይግለጹ----------

12. በአከባቢያችሁ ወባ የጤና ችግር ነው ሀ. አዎ ለ. የለም

13. የወባ በሽታ ምልክቶች ምንድን ናቸው(ከአንድ በላይ መመለስ ይቻላል ሀ. ትኩሳት

ለ. ማስታወክ ሐ. ብርድናማንቀጥቀጥ መ. የራስ ህመም ሠ. የምግብፍላጎት መቀነስ

ረ የመገጣጠሚያ ህመም ሸ. ሌላካለ--

14. አንተ(ቺ) ጨምሮ የቤተሰብ አባል በወባ ተይዞ ያውቃል ሀ. አዎ ለ. የለም

15. መልስዎ አዎ ከሆነ ለህክምና የምትሄዱት ወዴት ነው ሀ. ጤናጣቢያ ለ. ባህላዊ ህክምና ሐ. ከሱቅ መድሃኒት መ. ሌላ ካለ ይግለጹ----------

16. ወባ ተላላፊ በሺታ ነው ሀ. አዎ ለ. የለም ሐ. አላውቅም

17. መልስዎ አዎ ከሆነ እንዴት ይተላለፋል ሀ. በወባ ትንኝ ንክሻ ለ. ከበሺተኛ ጋር ንክኪ ሐ. በግብረ ስጋ ግንኙት መ. የተበከለ ውሃበመጠጣት ሠ. ሌላ ካለ ይግለጹ---------

18. የወባ ትንኝ በአብዛኛው የምትራባው የት ነው ሀ. የቆመ ውሃ ላይ ለ. ወራጅ ውሃ ላይ ሐ. ቆሻሻ ቦታ ላይ መ. ሌላካለ ይግለጹ------

19. የወባ ትንኝ በአብዛኛው የምትናደፈው መቼ ነው ሀ. ቀን ለ. ማታ ሐ. አላውቅም

20. የወባ በሽታን መከላከል እንደሚቻል ያውቃሉ ሀ. አዎ ለ. የለም ሐ. አላውቅም

21. መልስዎ አዎ ከሆነ የትኛውን የመከላከያ መንገድ የውቃሉ ሀ. የወባ አጎበር መጠቀም ለ. መድሀኒት መውሰድ ሐ. ፀረ ትንኝ ኬሚካል መርጨት መ. የወባ መራቢያ ቦታን ማስወገድ ሠ. ሌላ ካለ ይግለጹ-----

22. የወባ አጎበር ጠቀሜታው ምንድነው ሀ. የወባ ትንኝ ንድፊያን መከላከል ለ. ለጥሩ ምኚታ ሐ. ከሌሎች ነፍሳት ንድፊያ መከላከል መ. ሌላ ካለ ይግለጹ----------

23. የፀረ ትንኝ ኬሚካል ርጭት ጠቀሜታው ምንድን ነው ሀ. ትንኝዋን መግደል ለ. ወባን ለመከላከል ሐ. ከሌሎች ነፍሳት መግደል መ. ሌላ ካለ ይግለጹ----------

24. በአከባቢያችሁ የወባን ነፍሳት ለመቆጣጠር የሚደረግ እንቅስቃሴ አለ ሀ. አዎ ለ. የለም

25. መልስዎ አዎ ከሆነ ምን አይነት እንቅስቃሴ ተደረገ ሀ. ረግረጋማ ቦታዎችን መሙላትና ማድረቅ ለ. ውሃ የሚይዙ እቃዎችን ማስወገድ ሐ. ሌላ ካለ ይግለጹ-----

26. ወባን በመከላከል እንቅስቃሴውስጥ ተሳትፈው ያውቃሉ ሀ. አዎ ለ. የለም

27. መልስዎ አዎ ከሆነ በምን አይነት እንቅስቃሴ ተሳትፈዋል ሀ. ረግረጋማ ቦታን ማስወገድ ለ. ትምህርት መስጠት ዘመቻ ሐ. ሌላ ካለ ይግለጹ-----

መጠይቅ ክፍል ሶስት የአጎበርናየኬሚካልርጭት ስርጭት በተመለከተ

28. በቤትዎ ውስጥ አጎበር አለ ሀ. አዎ ለ. የለም

29. መልስዎ አዎ ከሆነ ምን ያህል አጎበር አለ ሀ. አንድ ለ. ሁለት ሐ. ከሦስት በላይ

30. በአሁኑ ሰዓት አጎበሩን ትጠቀማላችሁ ሀ. አዎ ለ. የለም

31. እርስዎ (ቤተሰብዎ) ትናንት ማታ የትንኝ መከላከያ አጎበር ውስጥ ተኝተው ነበር ሀ. አዎ ለ. የለም

32. ከቤተሰብዎ አባል በአጎለበር ውስጥ የሚያድር ማን ነው ሀ. ህፃናት ለ. እናት ሐ. አባት መ. እናትን አባት

ሠ. ነፍሰጡር እናትና ህፃናት ረ. ሌሎች የቤተሰብ አባል

33. ለጥያቄ ቁጥር 30 መልስዎ የለም ከሆን አጎበሩን የማይጠቀሙበትን ምክንያት ይግለጹ

ሀ. አገበር ወባን አይከላከልም ለ. መርዙን ስለምንፈራ ሐ. ሌላ ካለ ይግለጹ--

34. ለጥያቄ ቁጥር 28 መልስዎ የለም ከሆን አጎበር ከሌልዎት ምክንያቱ ምንድን ነው

ሀ. የአገበር አቅርቦት የለም ለ. ጠፍቶናል ሐ. ለሌላ ጥቅም አውለዋለሁ

መ. አሮጌ ስለሆነ ጥለነዋል ሠ. ሌላ ካለ ይግለጹ-----

35. እርስዎ (ቤተሰብዎ) በአጎበር ውስጥ መቼ ነው የምትተኙ ሀ. በየቀኑ ለ. አንዳንድ ጊዜ ሐ. በወባ ወቅት

መ. ቢበዛ በሳምንት ሠ. ሌላ ካለ ይግለጹ----------

36. የትንኝ መከላከያ አጎበር አይነት ሀ. ያልተነከረ ለ. ሀገር ውስጥ የሚነከር

ሐ. ፋብሪካ ውስጥ የሚነከር መ. አላውቀውም

37. ያለኦት አጎበር ሁኔታ ሀ. ጥሩ (ቀዳዳ የለውም) ለ. በቂ (ትንሿን የባትሪ ድንጋይ አያሳልፍም

ሐ. ጥሩ አይደለም ከ1-4 ያሉት ቀዳዳዎች የባትሪ ድንጋይያሳልፋሉ

መ. አስተማማኝ አይደለም ሠ. አልተጠቀሙበትም

38. የትንኝ መከላከያ አጎበሩን መቼ አገኙት ሀ. ከወራት በፊት ለ. ባለፈው አንድ ወር ውስጥ

ሐ. ከሦስት ወር በፊት መ. አላውቀውም ሠ. ሌላ ካለ ይግለጹ----------

39. ባለፉት 12 ወራት ውስጥ ቤትዎ በፀረ ትንኝ ፍሊት ተረጭቷል ሀ. አዎ ለ. የለም

40. መልስዎ አዎ ከሆነ ቤትዎ በፀረ ትንኝ የተረጨው መቼ ነው

ሀ. ከ6 ወር በፊት ለ. ከ12 ወር በፊት ሐ. ሌላ ካለ ይግለጹ----

መጠይቅ ክፍል አራት፤ የቤት አሰራርና አከባቢውን በተመለከተ

41. የቤትዎ ጣሪያ በዋናነት ከምንድን ነው የተሰራው ሀ. ከሳር ለ. ከቆርቆሮ ሐ. ሌላ ካለ ይግለጹ-----

42. የቤትዎ ወለል በዋናነት ከምንድን ነው የተሰራው ሀ. ከአፈር ለ. በሲሚንቶ ሐ. ሌላ ካለ ይግለጹ----

43. የቤትዎ ግድግዳ በዋናነት ከምንድን ነው የተሰራ ሀ. ከጭቃ ጡብ ለ. ከዕንጨት

ሐ. ከአሸዋ ግርፍ መ. ከዕንጨትና ከጭቃ ሠ. ሌላ ካለ ይግለጹ-------

44. በቤትዎ ግድግዳ እና በጣራው መካከል ክፍተት (ቀዳዳ) አለ ሀ. አዎ ለ. የለም

45. ቤቱ ግድግዳ ላይ ቀዳዳ አለ ሀ. አዎ ለ. የለም

46. በአካባቢያችሁ ለወባ ትንኝ መራቢያ አመቺ የሚሆን ቦታ አለ ሀ. አዎ ለ. የለም

47. ለጥያቄ ቁጥር 46 መልስዎ አዎ ከሆነ ቦታው ከቤትዎ በምን ያህል ይርቃል

ሀ.< 1000ሜትር ለ. ከ1000-2000ሜትር ሐ.> 2000ሜትር መ. ሌላ ካለ ይግለጹ--------

48. ለቤተሰብዎ በዋናነት የመጠጥ ውሃ የሚያገኙት ከየት ነው ሀ. ከምንጭ ለ. ከጉድጓድ ውሃ

ሐ. የከርሰ ምድር ውሃ (ወንዝ፣ኩሬ ወ ዘ ተ) መ. ቦኖ ውሃ ሠ. ሌላ ካለ ይግለጹ---

49. ቤተሰብዎ የሚጠቀምበት የመፀዳጃ ቤት ዓይነት ሀ. መፀዳጃ ጉድጓድ ሲሚንቶ የሌለው ወለል

ለ. መፀዳጃ ቤት ሲሚንቶ ያለው ሐ. ሌላ ካለ ይግለጹ----------

Appendix III. Interview for health center head and Malaria control and Prevention focal person.

The purpose of this interview is prepared to assess the prevalence of malaria and the knowledge of the study population towards malaria and its control in Chagni town, Awi zone, Northwest Ethiopia.

My name is_____I am an MSC student at Addis Ababa University. I am here to collect data about situation of malaria, malaria control and prevention strategies, the coverage of LLIN and IRS and the problem of the community to the success of control interventions for the study conducted on the assessment of the prevalence of malaria and the knowledge of the study population towards malaria and its control in Chagni town. Participation is based on your willingness but your participation is great contribution for the success of the study. Therefore your answers remain confidentially and all the information you provide in the questionnaire will be used for the purpose of the study.

I kindly request you to respond the questions genuinely.

Thank you in advance!

1. Situation of malaria.
2. Malaria control and prevention intervention strategies.
3. The coverage of LLIN and IRS.
4. Problems of the community to the success of control interventions.

Appendix IV: Picture captured in the study area

Figure: Mosquito net used for other purpose, a photo taken by an investigator December 2017

Figure: 2 Mosquitoes breeding site photo taken by the investigator November 2017

Declaration

I, the undersigned, declare that this thesis is my original work and all source materials are duly acknowledged.

Name Bogale Belay

Signature……..

Date…….

Statement of the Supervisor(s)

This thesis has been approved for submission to the Department of Zoological Science for Public defense.

Name Tegenu Gelana (PhD)

Signature……..

Date……..