# PREVALENCE OF MALARIA AND ASSOCIATED FACTORS AMONG UNDER-FIVE CHILDREN AND PREGNANT WOMEN IN HIDABU ABOTE DISTRICT, NORTH SHOA, ETHIOPIA: A CROSS-SECTIONAL STUDY

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A THESIS SUBMITTED TO SCHOOL OF MEDICAL LABORATORY SCIENCES, FACULTY OF HEALTH SCIENCES, INSTITUTE OF HEALTH, JIMMA UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR MASTER OF SCIENCE DEGREE IN MEDICAL PARASITOLOGY

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# PREVALENCE OF MALARIA AND ASSOCIATED FACTORS AMONG UNDER-FIVE CHILDREN AND PREGNANT WOMEN IN HIDABU ABOTE DISTRICT, NORTH SHOA, ETHIOPIA: A CROSS-SECTIONAL STUDY

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## ABSTRACT

**Background**: Malaria is a disease of significant public health importance caused by protozoan parasites in the genus *Plasmodium.* Countries in sub-Saharan Africa bear a disproportionately high burden of global malaria cases. Most of the areas in Ethiopia are favourable for malaria transmission putting about 52% of the population at risk. Pregnant women and under-five children are at high risk of malaria due to their low level of resistance to the disease.

**Objectives**: This study aims to determine the prevalence of malaria and associated factors among under-five children and pregnant women in Hidabu Abote District.

**Methods:** A community-based cross-sectional study was conducted in selected kebeles of Hidabu Abote District from September to November, 2021. Blood samples were collected for investigation of *Plasmodium* infection from 281 under-five children and 221 pregnant women. Data on socio-demographic and malaria-associated factors were collected using questionnaire. Data were entered into epidata 4.6.0.2 version and analysed using SPSS version 23. And p-value less than 0.05 were considered statistically significant.

**Results:** A total of 502 study participants were included in the study of which 281 were under-five children and 221 were pregnant women. The prevalence of malaria using microscopy and RDT was 12 (2.4%) and 13 (2.6%), respectively. Malaria prevalence among under-five children and pregnant women was 2.5% (95%CI=0.7-4.3) and 2.7% (95%CI=1-5.8), respectively. *P.vivax* were the predominant species. The presence of stagnant water around the home [AOR=8.2(95%CI=1.35-49.04)] and living in houses that had not been sprayed with IRS in the last year [AOR=5.64(95%CI=1.09-28.89)] were identified as malaria risk factor for under-five children. Not attending ANC [AOR=9.24(95%CI=1.07-79.8)], absence of IRS [AOR=8.07(95%CI=1.01-64.47], living near stagnant water [AOR=8.34 (95% CI=1.06-65.57)] and previous malaria infection in the last one year [AOR=6.4 (95%CI=1.24-33.311)] were identified as malaria risk factor among pregnant women.

**Conclusion** This community-based study revealed that malaria is still public health problem among pregnant women and under-five children. Living near stagnant water and in houses with no IRS were the major malaria risk factors. Strengthening malaria control efforts emphasizing vector control interventions is recommended.

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# TABLE OF CONTENT

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| IPTP | Intermittent preventive treatment in pregnancy |
| ITN | Insecticide-treated net |
| IRS | Indoor residual spray |
| LLIN | Long-Lasting Insecticidal Net |
| PCR | Polymerase Chain Reaction |
| RDT | Rapid diagnostic test |
| sSA | sub-Saharan Africa |
| WHO | World Health Organization |

# CHAPTER ONE

## 1. INTRODUCTION

### 1.1. Background

Malaria is a disease of significant public health importance caused by protozoan parasites in the genus *Plasmodium* which affect red blood cells in humans. Five *Plasmodium* species are known to cause malaria in humans, *P. falciparum P. vivax, P. ovale, P. malariae,* and *P. knowlesi.* Among them, *P. falciparum* is the leading cause of severe malaria (1). More than 2 billion people are at risk of malaria infection worldwide(2). In 2020, 241 million malaria cases were estimated across 85 malaria-endemic countries. This showed a 14 million increment within one year as compared to the 2019 report (3). Malaria case incidence reduced from 80 cases per 1000 populations at risk in 2000 to 57 cases per 1000 populations at risk in 2019 globally (4). But, it raised to 59 cases per 1000 in 2020(3). *Plasmodium falciparum* is the predominant species in Africa(2). In Ethiopia, *P. falciparum, P. vivax, P. malariae,* and *P. ovale* are known to infect human beings (5, 6). But, *P. falciparum* and *P. vivax* are the most prevalent malaria parasites accounting for 70% and 30 % of infection, respectively (7).

*Plasmodium* species require two hosts to complete their life cycle, human as an intermediate host and *Anopheles* mosquito as the definitive host. Hence mosquito bite is the primary means of malaria transmission (1). *Anopheles* mosquitos have a cosmopolitan distribution in the tropical and temperate regions while they are not present in the pacific islands (8). In Ethiopia, *Anopheles arabiensis* takes the primary role followed by *An. pharoensis, An. funestus, and An. nili (6, 7). An. stephensi* has also been reported to be established in Ethiopia and is efficient in the transmission of both *P. vivax* and *P. falciparum* (9). Apart from a mosquito bite malaria can also be rarely transmitted via blood transfusions and blood contact as a result of poor infection control in hospitals (2).

Malaria afflicts human beings in several ways; at an individual level malaria infection can lead to a variety of health consequences and if left untreated can become life-threatening. Apart from this malaria has huge public health and socio-economic implications. It can disrupt the lives and abilities of individuals and their families and can lead to poverty. Low levels of socio-economic development as a result of endemic malaria can also cause political instability and conflict (10).

Malaria may present with several clinical signs and symptoms which is indistinguishable from other acute febrile illnesses. But, the most peculiar sign rigour, may lead to the diagnosis of malaria. In the modern sense, anyone who has been exposed to the parasite must be screened so that the complication and transmission can be blocked. The complications of malaria are associated either with parasite factors such as strain and parasitemia or human factor such as genetics and level of immunity(2). Owing to their low immunity pregnant women and under-five children are the most vulnerable groups to malaria infection, especially in sub-Saharan Africa (sSA) where transmission is high (11).

Thus, applying proper prevention mechanisms and effective treatment of malaria plays an indispensable role in saving lives. The world health organization (WHO) recommends that malaria treatment should be based on confirmation of parasites in a biological sample. Even though the molecular technique is the most sensitive and advanced, microscopic demonstration of the parasite is still the gold standard technique. Nowadays the use of rapid diagnostic tests (RDTs) is also increasing in areas where there is no good quality microscope-based diagnosis (12).

### 1.2. Statement of the problem

Despite the unwavering efforts of different stakeholders to eliminate malaria, it is still among the ten leading causes of mortality and morbidity on the African continent, according to the 2020 WHO malaria report (3). Though malaria was eliminated from some countries like North America and Europe and in a few countries in the Caribbean and Asia, developing countries like sSA which have insufficient access to diagnosis, treatment, and protective material, are still at high risk of malaria mortality and morbidity (10).

Of about 241 million malaria cases and 627000 deaths that occurred globally in 2020, 95% of the cases and 96% of deaths occurred in Africa (3). An estimated 1.5 billion malaria cases and 7.6 million malaria deaths have been prevented between 2000–2019 periods globally. However, in the recent years, malaria incidence rate has increased (4). About 68% of the Ethiopian landmass favours malaria transmission putting about 52% of the population at risk (13).

So far even if a lot of efforts were done to prevent malaria, it is not effective as such to achieve the expected goal. This may be due to the measures taken and the material distributed to the risky area was not sustainable. In malaria-endemic countries, the percentage of population protected by indoor residual spray (IRS) declined from 5.8% to 2.6% from 2010 to 2020. Especially in a country like Ethiopia, India, Pakistan, and Somalia, the number of people utilizing IRS was reduced by more than a million in 2020 in comparison to that of 2019 (3). In Ethiopia, a systematic review study conducted in 2019 reported a high prevalence of malaria and it associate that the highest prevalence was due to shortage and improper utilization of protective materials (14, 15).

Since pregnancy increases the disease susceptibility, pregnant women are at high risk of malaria infection. A study revealed that one out of five pregnant women in persistent transmission areas had *Plasmodium falciparum* infection (16). Moreover, those febrile pregnant women have three times more chance of having positive malaria tests than other febrile populations (17). In 2018, worldwide, about 28.7% of pregnant women were infected with malaria (18). Infection with malaria in pregnant women can lead to anemia and low birth weight or stillbirth (18). Worldwide wide, about 15.7% of children with low birth weight were due to malaria infection (19). In 2019, about 35% (12 million) women in Africa were exposed to malaria infection during pregnancy which resulted in 822 000 children with low birth weight and 213 deaths (4).

The WHO recommends utilization of intermittent preventive treatment in pregnancy (IPTP) with sulfadoxine-pyrimethamine in areas with moderate to high malaria transmission rates. IPTP reduces maternal malaria episodes, maternal and fetal anemia, placental parasitemia, low birth weight, and neonatal mortality (19). 35 African countries have adopted IPTP to reduce the burden of malaria during pregnancy. Even though there is a slight increase in IPTP3 coverage from 17% in 2015 to 32% in 2020 and IPTP2 from 61% to 62% from 2018 to 2019, the coverage remains below the target of at least 80% and even no increase is observed in IPTP1 during this period (3, 4).

Under-five children are more prone to malaria-related deaths and complications than other groups. In 2017 and 2018, 61% and 68% of the total deaths due to malaria were in under-five children, respectively. Moreover, about 79% of infected under-five children were found to be anemic (18, 19). In 2020 death of under-five children accounts for 80% of total death in the African region (3). Malaria infection can also expose children to malnutrition and stunting (20, 21). Having this burden of malaria infection, under-five children in SSA are deprived of prompt access to malaria treatment. This is due to several factors including country of residence, a wealth of household, and maternal education (22).

In Ethiopia, a study revealed that the availability and affordability of life-saving drugs including anti-malaria were low for under-five children (23). As a result, less than 30% of under-five children presumed to have malaria infection took appropriate treatments (24). Additionally in infants and pregnant women, there is a challenge of *Plasmodium vivax* elimination since primaquine is contraindicated in those groups (11).

Health-seeking behaviour of the individual, access to the health facility, and lack of knowledge about the disease can affect the infection rate of malaria. Detecting malaria cases passively cannot address those groups and results in an undiagnosed and untreated case in the community which can lead to complications and persistent transmission. Indeed there is a need for a community-based assessment of malaria prevalence that depicts the real status of malaria prevalence. Thus this study aims to assess the community-level prevalence of malaria through active case detection among under-five children and pregnant women who are the most vulnerable groups for malaria and its associated factors in the Hidabu Abote district.

### 1.3. Significance of the study

Institution-based studies on the prevalence of malaria are commonly conducted globally and in Ethiopia. However, there is a paucity of information on community-based studies on the prevalence of malaria. This study will provide information that is important to know the current status of the malaria prevalence in the community among under-five children and pregnant women in the study area. This study will also be able to determine different associated factors that may contribute to malaria infection among the study groups. Moreover, the study will help the study participants to know their status and to prevent complications that might be caused due to delays in treatment. This study will also contribute to the current elimination efforts of malaria in the study area enabling the concerned bodies to allocate appropriate resources accordingly. Moreover, the finding of this study will serve as a baseline for other researchers and different stakeholders for further work.

# CHAPTER TWO

## 2. LITERATURE REVIEW

Malaria case detection is mostly based on passive detection. In passive detection, only those who came to a health facility may get treated while the others are left untreated and even undiagnosed in the community (25). This may happen for the reason that some groups may be asymptomatic carriers of malaria due to several factors affecting the clinical outcomes of the disease (26). According to a study conducted in Tanzania only about 0.37% of infected individuals had been treated while about 88% of them are not treated because they had not experienced signs and symptoms (27).

A systematic review conducted in Iran emphasized that detection of asymptomatic and sub microscopic malaria plays an indispensable role in the journey to achieve malaria elimination programs (28). Because it is responsible for the on-going transmission of the parasite and can be associated with the recurrence of parasitemia, chronic anemia, and maternal and neonatal mortality (29).

Several factors may contribute to the high prevalence of malaria in some groups over others. The socio-economic level of the community is one of the factors found to increase the burden of malaria infection. A systematic review conducted in SSA revealed that the odds of infection by malaria are high in those who have low-quality houses, uneducated, farmers, and those who have a low wealth index (30).

Lack of access to health services and awareness about the disease may also hinder malaria not to being diagnosed. Some individuals may treat themselves at home using antibiotics, anti-pain, and traditional medicine (31). This in turn can lead to the progress of the disease from uncomplicated to severe form. A study revealed that about 42.8% of childhood and 48.5% of adults have developed severe malaria due to delays in treatments that could have been prevented with early diagnosis and treatment (32).

### 2.1. Malaria among under-five children and its associated factors

A study conducted in the South Kivu/Democratic Republic of Congo showed that the Prevalence of asymptomatic *Plasmodium* infection in under-five children was 15.9% with microscopic and 34% with loop-mediated isothermal amplification in under-five children (33). And it is estimated to be 38.2% in Burkina Faso and a significant variation was observed between different districts ranging from 11.1% to 77.8% (34).

According to statistical analysis and mapping of malaria risk in under-five children in Ghana the overall prevalence of malaria among under-five children was 22.1% (35). There were several studies conducted to determine the overall prevalence of malaria in different countries. Accordingly, a high prevalence of malaria (52.67%) was reported in sierra leone (36). Followed by 33.8% and 35.4 % in the Chikawawa district in Malawi and central Malawi respectively (37, 38).

A study conducted in Huye District, Southern Rwanda shows that the prevalence of malaria among under-five children was 12.2% (39). And it was 10.3% according to a study conducted in Nigeria (38) while it was 16.5% according to the study conducted in the province of Nyanga, Gabon (40). Trend analysis in southern Ethiopia showed that the prevalence of malaria among under-five children was 23.9% (41). This is almost similar to the study conducted in Arbaminch on the prevalence of malaria among febrile under-five children (22.1% ) (21). A trend analysis conducted in East Wollega Zone, Oromia Regional State, Western Ethiopia conducted from July 2018 to June 2020 also revealed that among total malaria reported in this period 13% were accounted for by under-five children (42).

In Ghana study estimates revealed that the odds of malaria infection are significantly lower in children who sleep under IRS as compared to those who are not protected ( [OR] = 0.31) while there is no association with ITN utilization (43). But in Huye District, Southern Rwanda children who do not sleep under ITN were 15 times more likely to be infected with malaria (39). A malaria indicator survey in Nigeria also revealed that children who slept under LLIN are less likely to develop an infection than others and living in a room not sprayed with insecticide is risky for malaria infection (44). There is evidence from Ethiopia that supports children living in households who have ITN are more protected than those who do not have (21).

The age of the children is also one of the factors which contribute to infection variability among individuals. According to evidence from several studies, Older children are at high risk of infection than younger (34, 35, 45). Similarly, children aged 24–59 months are more prone to malaria infection according to a study conducted in Nigeria (44). A study conducted in sierra leone also reported that children aged 48-59 months were highly infected as compared to other age groups (36). In Ethiopia study from Arba Minch revealed that younger children are less likely to be infected (21).

In contrast to the above result study from Huye District, Southern Rwanda reported that children from 1-12 months were more likely to be infected than children aged from 13-59 (39).

Some studies also evidenced that sex of the child also affects the chance of malaria infection. Accordingly, some studies revealed that malaria infection is slightly higher in male children than in female children of the same age (35, 39, 45). There are also contrasting results from some study results, which revealed that there is no significant difference between male and female infections (21, 38). Additionally, some studies revealed that children from uneducated families and the poorest families are at high risk of infection (35, 36, 44). Moreover, a study revealed that children living in rural and near mosquito breeding sites are more prone to malaria infection (21).

### 2.2. Malaria among pregnant women and associated risk factors

According to the study conducted in the province of Nyanga, Gabon prevalence of malaria among pregnant women was 20% (40). An almost equal percentage of 20.4% was reported from Ghana among pregnant women (16). A slightly higher prevalence (24.9%) in Nigeria (46) and a high prevalence of pregnant malaria (53.4%) in the West Region of Cameroon were also reported (47). On the other hand, a low prevalence of 0.81% malaria in pregnant from the Chhattisgarh state of India was reported (17).

A Systematic Review and Meta-Analysis conducted in Ethiopia up to August 2018 reported a 12.72% estimated pooled prevalence of malaria among pregnant women. Among them, 7.83% and 17.97% were accounted for by asymptomatic and symptomatic cases respectively (48). According to a study conducted in Sherkole district, Benishangul Gumuz, the prevalence of malaria among pregnant women was 10.2% (49). A study conducted on pregnant women in the Merti district, Oromia regional state, revealed that the prevalence of asymptomatic *Plasmodium* infection is 3.6%. according to this study lack of insecticide-treated bed net use, and living close to stagnant water was significantly associated with malaria infection (50).

A study from different countries revealed that decreasing age increases the risk of getting an infection with malaria in pregnant women. According to the study conducted in Cameron Women aged from 15 to 34 were at high risk of malaria infection. Parity may also affect the chance of being infected in pregnant women. Accordingly in Cameron highest infection was recorded from primigravida followed by secondigravidae (47). Again secundigravidae and those who are in the first trimester are found to be more likely infected according to data

from Benishangul Gumuz (49). Other factors such as lack of consultation, health education, and preventive materials were also associated with malaria infection (40, 47, 49).

### 2.3. Conceptual framework

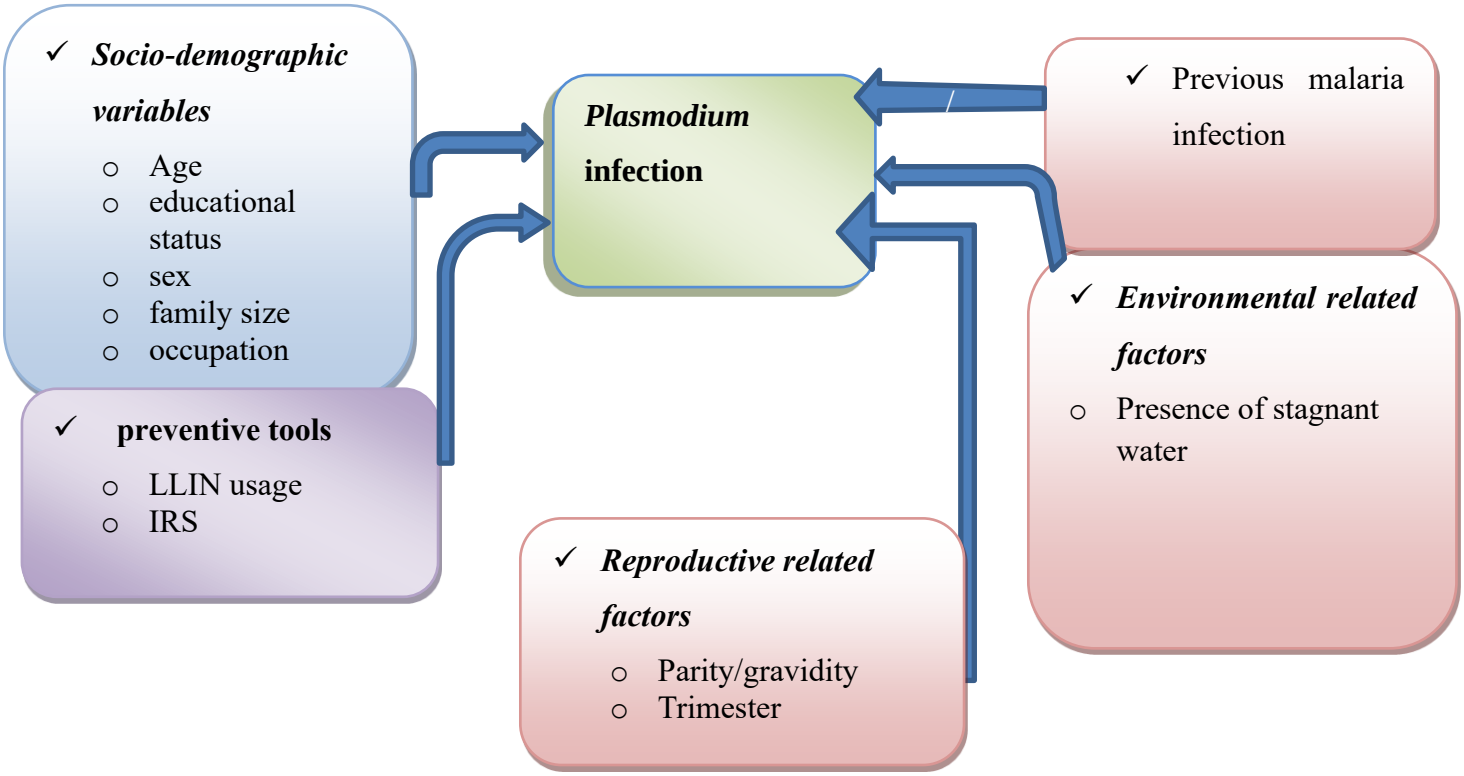


Figure 1: Conceptual framework

# CHAPTER THREE

## 3. OBJECTIVES

### 3.1. General objective

This study aims to determine the prevalence of malaria and associated factors among under-five children and pregnant women in Hidabu Abote district.

### 3.2. Specific objectives

- To determine the prevalence of malaria among under-five children in Hidabu Abote district.
- To determine the prevalence of malaria in pregnant women in Hidabu Abote district.
- To assess factors associated with malaria among the study participants in Hidabu Abote District.

# CHAPTER FOUR

## 4. METHODS AND MATERIALS

### 4.1. Study area and period

The study was conducted from Sep to Nov 2021 in selected kebeles of the Hidabu Abote district. Hidabu abote is one of the districts in North Shoa of Oromia Regional State. It is bordered by Kuyu in the south, Wara jarso in the west, Jema River in the North which separates it from Dera wereda, and Degem in the east. According to the information obtained from the district health office, the total population of Hidabu Abote district was 121,820, of whom 60,300 were men and 61519 were women. In 2021, the total number of under-five children and pregnant women in the district was 19978 and 4227, respectively. Only 7.71% of its population were urban dwellers. The district is located at approximately 9.8333 N and 38.5000 E, at an altitude ranging from1160 to 3000 meters above sea level. The average annual temperature and rainfall of the district are between $13^{O}$C-$20^{O}$C and 800mm-1200 mm, respectively (Figure 2).

Hidabu Abote district has an estimated area of 497.82 square kilometers and an estimated population density of 180.5 people per square kilometer, which is greater than the Zone average of 143. It has 20 kebeles, among them; six kebeles of this district (Adea nacho, Amdo hariro, Gidabo jemma, Gidabo giorgisi, Haro chelenko, and alkochi kare) reside along the Jema River. The livelihood of the population in the district mainly relies on subsistent farming. Teff is the main crop grown in the area. Malaria prevention and control measures in the area include distribution of ITN, IRS spray, and drainage of stagnant water.

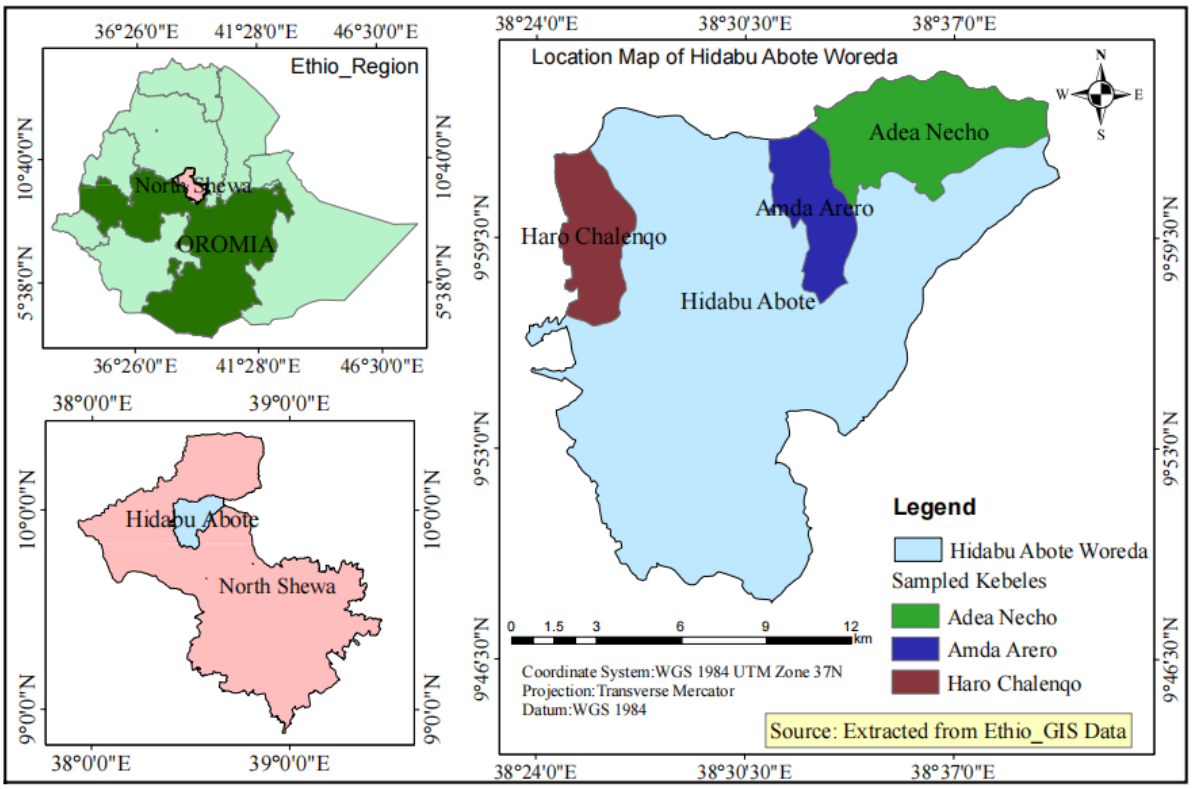


Figure 2: Maps of Hidabu Abote district

## 4.2. Study design

A community-based cross-sectional study was conducted in the selected kebeles of Hidabu Abote district from 22 Sep to 5 Nov, 2021

## 4.3. Population

### *4.3.1 Source population*

All under-five children and pregnant women residing in malarious kebeles of Hidabu Abote district in 2021

### *4.3.2. Study population*

All under-five children and pregnant women in the selected malarious kebeles of the district during the study period.

### *4.3.3. Study unit*

Selected and recruited under-five children and pregnant women

## 4.4. Eligibility criteria

### *4.4.1. Inclusion criteria*

- Under-five children and pregnant women who reside in the selected kebeles during the study period.

### *4.4.2. Exclusion criteria*

- Any individual who takes malaria treatment during the study period.

## 4.5. Sample size and Sampling technique /Sampling procedures

### *4.5.1. Sample size determination*

The sample size was calculated using the sample size determination formula for a single population proportion.

$$n = \frac{(Z/2)^2\, p\,(1-p)}{d^2}$$

Where n = the sample size, z = 1.96 at 95% confidence level (CI), d = margin of error (5%), p = expected malaria prevalence in the area, design effect =1.5. The final calculated sample size after adding a 10% none response rate was 287 for under-five children by taking p = 13% from the study conducted in Heben Arsi District, West Arsi Zone, Oromia Regional State (51) and it was 233 for pregnant women by taking p = 10.2 % from a Community based cross-sectional study conducted in Benishangul Gumuz on pregnant women (49).

### *4.5.2. Sampling techniques*

Multi-stage sampling techniques were applied to select representative study individuals. First kebeles with high malaria prevalence were identified based on their topography and the previous prevalence of malaria indicators obtained from the district health office. The six kebeles were Adea nacho, Amdo hariro, Gidabo Jemma, Gidabo giorgisi, Haro Chelenko, and Alkochi Kare. From these, three kebeles (Adea Nacho, Amdo Hariro, and Haro Chelenko) were selected randomly using lottery method. Before participant selection households with under-five children and pregnant women were identified. The numbers of the participant were proportionally allocated to each kebele. Accordingly for under-five children, 115, 92, and 80 individuals were allocated to Adea Nacho, Amdo Hariro, and Haro Chelenko respectively. For pregnant women 94, 75, and 64 individuals were allocated to Adea Nacho, Amdo Hariro, and Haro Chelenko respectively. Then the eligible individuals were selected by selecting the household using systematic random sampling techniques. In case, where there is more than one subject in the house hold lottery methods were applied to select one subject. To reduce none response rate if one of the selected individuals was not volunteered to participate in the study individual in the next household were included in the study.

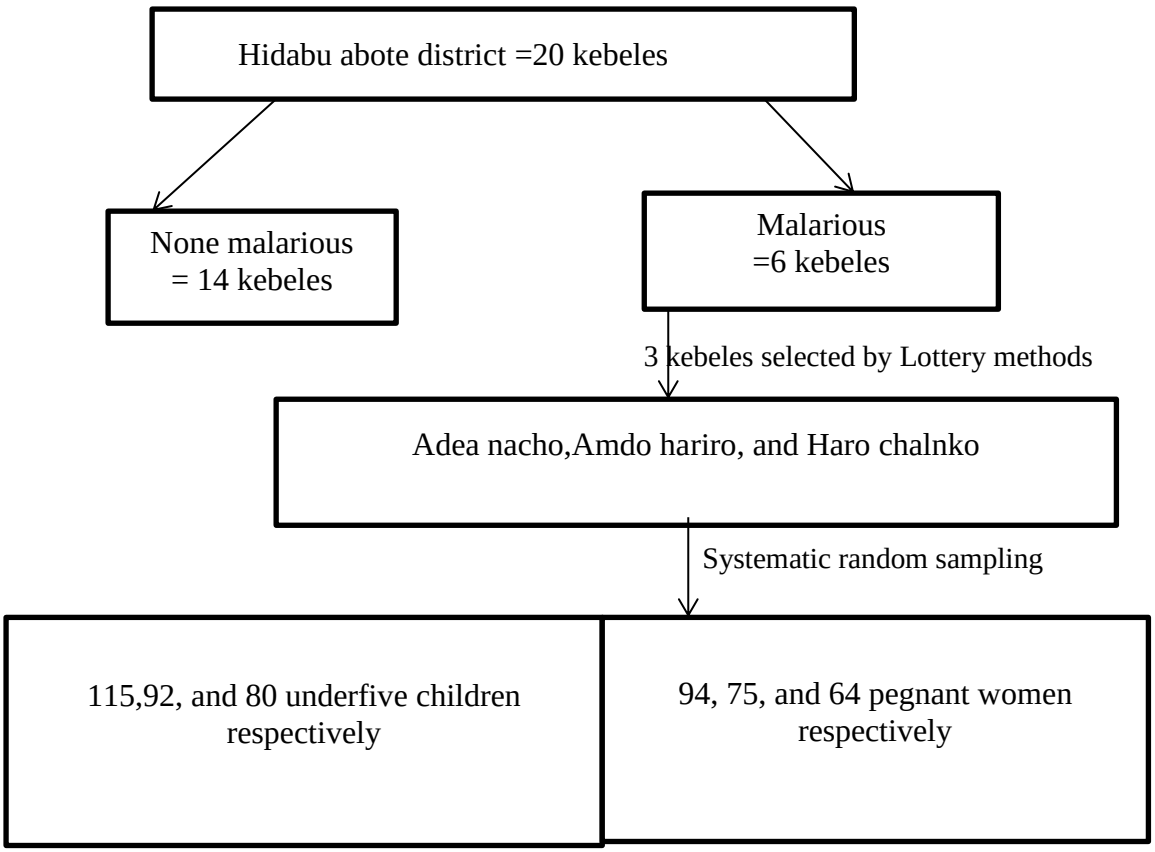


Figure 3: Schematic presentation of sampling procedures

## 4.6. Data collection procedures

### 4.6.1. Demographic and factors associated with malaria

A structured questionnaire was developed and it was administered to gather information on markers of sociodemographic data that include sex, age, family size, the status of pregnancy, marital status, level of education, the main source of drinking water, house distance from nearby mosquito breeding site, the main material of room's roof and wall, presence of latrines, the incidence of anti-malarial spraying in the past 12 months, possession, use, and number of ITNs. Every selected pregnant woman and parents or guardians of under-five children was interviewed in Afan Oromo language which is the local language by trained kebele's health extension workers. Pregnancy status of the women was self-reported, with no confirmatory test being done.

### 4.6.2. Specimen collection and processing

Experienced laboratory technicians and kebele's health extension workers were given training on the study protocol and data recording formats. For the RDT test, a drop of blood specimen was applied to the sample pad on the test card along with a buffer. After 15

minutes, the presence of specific bands in the test card window indicated the presence of infection and species of human malaria parasites. For microscopic examination, both thick and thin blood smears were prepared as per the protocol. Blood samples (about 2µl for thin film and 6µl for thick film) were collected on a clean microscopic slide and then the slides were labelled and packed into a slide porter after being air-dried. Slides were transported to the nearby health center.

**4.6.3. Laboratory work**

For each participant, two blood films (thick and thin blood smears on the same slide) were prepared from finger prick blood and labeled with code. The thin blood smears were fixed with methanol for 30 seconds. Then, it was stained with 3% Giemsa solution for 30 minutes after being air-dried. Following the standard protocols, the stained smears were investigated with a light microscope by high power magnification (100x) objective to detect the presence of malaria parasites. Thick film preparations were examined first by high power magnification (100x) objective for the presence of parasites. Accordingly, when the slide was found to be positive, the parasite species were identified by examining the thin blood smears under 100x objective. Species identification was done based on shape of ring stage, infected red blood cell size, gametocyte shape, presence of dots and merozoites number in schizont etc. The results were classified qualitatively as either negative (no malaria parasite seen), positive for specific plasmodium species, or mixed infection. At least 200 high power fields (100x objective) were examined before reporting a negative result. Parasite density for the asexual stage per microliter (µl) was determined by counting the number of parasites per 200 white blood cells on a thick blood film assuming a total standard WBC count of 8000/µl.

**Parasites/µl = Number of asexual stages × 8000 leukocytes /200 leukocyte**

**For RDT test**

The test was performed according to manufacturer's instruction (SD BIOLINE Ag P.f/P.v). The kit was labeled with respective sample code and 5 µl of blood specimen was added into sample well of the test device. Four drops of lysis buffer were added into the buffer well to lyse the cells, release the antigen and facilitate antibody recognition. The RDT test results were read after 15-30 min and interpreted as follows:-

Two bands: one band in the control area and another band in the Pv area (test line Pv) indicates a positive result for P. vivax

Two bands: one band in the control area and another band in the Pf area (test line Pf) indicating infections due to P. falciparum

Three bands: bands in the control area, Pv area and Pf area indicates a mixed infection;

Only one band in the control area in the result window indicates a negative result and

In case when the control line did not appear, the result is interpreted as invalid.

## 4.7. Study variables

### *4.7.1. Dependent variable*

Malaria parasite infection status

### *4.7.2. Independent variables*

Sociodemographic variables

Housing condition

Level of education

Proximity to mosquito breeding site

Previous malaria infection

Gravidity

Insecticide spraying

ITN

## 4.8. Data analysis procedures

Data were coded and entered into epidata version 4.6.0.2, cleaned, and exported to SPSS version 23.0 for analysis. The outcome of interest dependent variable in the study was the infection status by malaria parasites which has a binary outcome of positive or negative. The independent covariates comprised the information obtained via questionnaire. Then descriptive statistics were used to characterize the population. Bivariate and multivariable logistic regression analyses were employed to examine the association between socio-demographic variables and other risk factors of malaria infection. Odds ratio and 95% CI were calculated to show the strength of the association. A p-value of less than 0.05 was considered statistically significant.

## 4.9. Data quality management

Questionnaire data quality control was assured by reviewing and checking for errors, completeness, accuracy, and consistency during data collection and before entry into Epidata, and corrective measures were taken. For the malaria test, the RDTs and reagents for blood film preparation were checked for the expiration date, and quality control was done for every new batch. The availability, current use, condition, type of ITN, and other observable

conditions were checked by observation during the survey. And all the verifiable information was verified by the principal investigator.

### 4.10. Ethical consideration

Ethical clearance was obtained from the Institute Review Board of Jimma University Institute of Health. Permission to conduct the study was obtained from Hidabu Abote health office. Then written consent was obtained from all selected pregnant women and parents of under-five children before the sample was collected. The name of the study participants was omitted from the questionnaire and the code number was used instead of the name to ensure confidentiality. Malaria positive study participants were referred to the nearby health center for treatment.

# CHAPTER FIVE

## 5. RESULTS

### 5.1 Socio-demographic characteristics of the population

A total of 520 study participants were selected for the study and data were collected from 502 participants of which 281 were under-five children and 221 were pregnant women. All participants of the study were rural dwellers and the majority of the pregnant women were illiterate and farmers in occupation. Concerning the family size of the study participants, the majority of them have a family size of less than five.

Of the participated under-five children 182(64.8) were females and 99(35.2) were males. The age of the under-five children ranged from 3 months to 59 months with a mean age of 30.07(±14.72SD) months. Under-five children between 12 and 23 months account for 27.8 %(78/281) followed by under-five children between 24 and 35 months (21.0 %). The majority of the pregnant women 91.9% (203/221) were married and their ages ranged from 15 to 47 years with a mean age of 26.39(±6.86SD). About a third of the pregnant women (32.1%) were aged between 20-24 years (Table1).

Table 1: Socio-demographic characteristics of under-five children and pregnant women

| **Under-five children** | | |
|---|---|---|
| Socio-demographic variables | Category | N (%) |
| Sex | Male | 99(35.2) |
| | Female | 182(64.8) |
| Age in months | <12 | 40(14.2) |
| | 12-23 | 55(19.6) |
| | 24-35 | 78(27.8) |
| | 36-47 | 59(21.0) |
| | >47 | 49(17.4) |
| Kebele | Adea/nacho | 115(40.9) |
| | Amdo/hariro | 92(32.7) |
| | Haro/chalanko | 74(26.3) |
| Family size | ≤5 | 191(68) |
| | >5 | 90(32) |
| **Pregnant women** | | |
| Age group in years | 15-19 | 34(15.4) |
| | 20-24 | 71(32.1) |
| | 25-29 | 47(21.3) |
| | 30-34 | 36(16.3) |
| | >34 | 33(14.9) |
| Marital status | Married | 203(91.9) |
| | Separated | 11(5) |

| | | |
|---|---|---|
| | Single | 4(1.8) |
| | Widowed | 3(1.4) |
| Kebele | Adea/nacho | 89(40.3) |
| | Amdo/hariro | 72(32.6) |
| | Haro/chalanko | 60(27.1) |
| Family size | ≤5 | 157(71) |
| | >5 | 64(29) |
| Educational status | Illiterate | 184(83.3) |
| | Can read and write | 26(11.8) |
| | Primary | 9(4.1) |
| | Secondary and above | 2(0.9) |
| 3Occupation | Farmer | 197(89.1) |
| | Daily labor | 12(5.2) |
| | Private work | 6(2.7) |
| | Employed | 6(2.7) |

N (%): Number (percentage)

### 5.2 Malaria prevalence

The overall prevalence of malaria among the study participants was 2.6% (13/502). Of these 12(2.4%) were detected by both the RDT and microscopy while the remaining one was detected by RDT only. Of the confirmed cases 7/281 (2.5%) (95%CI=0.7.4.3) were under-five children and 6/221 (2.7%) (95%CI=1-5.8) were pregnant women (Table 2).

Table 2: Prevalence of malaria among pregnant women and under-five children

| Individual | RDT and Microscopy | RDT only | Total |
|---|---|---|---|
| Under five children | 7/281(2.5%) | 0 | 7/281(2.5%) |
| Pregnant women | 5/221(2.3%) | 1/221(0.45%) | 6/221(2.7%) |
| Total | 12/502(2.4%) | 1/502(0.2%) | 13/502(2.6%) |

Among laboratory-confirmed under-five malaria, the relative proportion of *P.falciparum* and *P.vivax* were 4/7 (57.1%) and 3/7(42.9%) respectively. For pregnant women, *P.vivax* accounts for 3/6(50%) of confirmed malaria cases while 2/6(33.3%) were accounted for by mixed infection and the rest were accounted for by *P.falciparum*. Of microscopically confirmed cases 2 (16.7%) had a gametocyte stage. The mean parasite density of the asexual stage among pregnant women and under-five children was 1184(±SD343.6) parasite/µl and 1091.4(±291.9SD) parasite/µl respectively. Generaly *Plasmodium vivax, Plasmodium falciparum,* and mixed infection accounted for 46.2%, 38.4%, and 15.4% of the *Plasmodium* species respectively (Table3).

Table 3: Relative proportion of *Plasmodium* species among pregnant women and under-five children

| Individual | Microscopy | | | | RDT | | | |
|---|---|---|---|---|---|---|---|---|
| | Pv | Pf | Mixed | Total | Pv | Pf | Mixed | Total |
| Under five children | 3(42.9) | 4(57.1) | 0 | 7 | 3(42.9) | 4(57.1) | 0 | 7 |
| Pregnant women | 3(60) | 0 | 2(40) | 5 | 3(50) | 1(16.7) | 2(33.7) | 6 |
| Total | 6(50) | 4(33.3) | 2(16.7) | 12 | 6(46.2) | 5(38.5) | 2(15.3) | 13 |

### 5.2.1 Prevalence of malaria among under-five children

The overall prevalence of malaria among under-five children was 2.5% (7/281), which was 5% (5/99) among males and 1.1% (2/182) among females. Regarding the age of the participant, the highest prevalence of malaria was observed among under-five children ranging from 24-35 months which was 3.8 % (3/78). The highest malaria prevalence was observed in Haro Chalanko kebele (4.1%) followed by Adea/nacho (2.6%) (Table4).

Table 4: Distribution of malaria among under-five children

| Variables | Category | Positive N (%) | Total |
|---|---|---|---|
| Sex | Male | 5(5) | 99 |
| | Female | 2(1.1) | 182 |
| | Total | 7(2.5) | 281 |
| Age in month | >12 | 0(0) | 40 |
| | 12-23 | 1(1.8) | 55 |
| | 24-35 | 3(3.8) | 78 |
| | 36-47 | 1(1.7) | 59 |
| | >47 | 2(4.1) | 49 |
| Kebele | Adea/nacho | 3(2.6) | 115 |
| | Amdo/hariro | 1(1.2) | 92 |
| | Haro chalanko | 3(4.1) | 74 |

N (%): number (percentage)

### 5.2.2 Prevalence of malaria among pregnant women

The overall prevalence of malaria among pregnant women was 2.7% (6/221). The prevalence of malaria among the pregnant women in the age group 30-34 years, primigravidae, and those in the second trimester was 5.6%, 5.3%, and 3.8%, respectively. The highest percentage of malaria was observed in Amdo/hariro (Table 5).

Table 5: Distribution of malaria among pregnant women by demographic and obstetric characteristics

| Variables | Category | Positive N (%) | Total |
|---|---|---|---|
| Age | 15-19 | 0(0) | 34 |
| | 20-24 | 3(4.2) | 71 |
| | 25-29 | 0(0) | 47 |
| | 30-34 | 2(5.6) | 36 |
| | >34 | 1(3) | 33 |
| Gravidity | Primgravidae | 3(5.3) | 57 |
| | Secondigravida | 1(1.4) | 70 |
| | Multigravidae | 2(2.1) | 94 |
| Trimester | First | 1(3.8) | 26 |
| | Second | 4(3.8) | 105 |
| | Third | 1(1.1) | 90 |
| Kebele | Adea/nacho | 1(1.1) | 89 |
| | Amdo/hariro | 3(4.2) | 72 |
| | Haro chalanko | 2(3.3) | 60 |

### 5.3. Factors associated with malaria among under-five children.

After adjusting for other variables, under-five children who live in a house that had not been sprayed with IRS were 5.6 times more likely to be infected with malaria compared to those who live in a sprayed house[AOR=5.64(95%CI=1.09-28.89)]. Moreover, children who live near stagnant water were at high risk of malaria infection [AOR=8.2(95%CI=1.35-49.04)] (Table 6).

Table 6: Bivariate and multivariable logistic regression analysis of factors associated with malaria among under-five children

| Variables | Category | Malaria | | Bivariate analysis | | Multivariable analysis | |
|---|---|---|---|---|---|---|---|
| | | Positive N (%) | Negative N (%) | COR(95% CI) | P-value | AOR(95%CI) | P-value |
| Sex | Male | 5(5) | 94(95) | 4.79(0.91-25.144) | 0.064 | 2.98(0.51-17.569) | 0.227 |
| | Femal | 2(1) | 180(99) | Ref | | ref | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | e | | | | | | |
| Age | <12 | 1(2.4) | 40(97.6) | Ref | | | |
| | 12-23 | 1(1.9) | 54(98.1) | 0.74(0.45-12.2) | 0.834 | | |
| | 24-35 | 3(3.8) | 75(96.2) | 1.6(0.16-15.89) | 0.688 | | |
| | 36-47 | 0(0) | 58(100) | NA | 0.997 | | |
| | >47 | 2(4.1) | 47(95.9) | 1.7(0.15-19.47) | 0.669 | | |
| Family size | ≤5 | 4(2.1) | 190(97.9) | Ref | | | |
| | >5 | 3(3.4) | 84(96.6) | 1.6(0.35-7.36) | 0.539 | | |
| ITN possession | Yes | 3(1.6) | 185(98.4) | ref | | ref | |
| | No | 4(4.3) | 89(95.7) | 2.77(0.607-12.649) | 0.188 | 4.1(0.75-22.4) | 0.104 |
| IRS | Yes | 3(1.3) | 231(98.7) | Ref | | Ref | |
| | No | 4(8.5) | 43(91.5) | 7.16(1.548-33.143) | 0.012 | 5.64(1.1-28.9) | 0.038* |
| Stagnant water | Yes | 5(7.2) | 64(93.8) | 8.2(1.554-43.295) | 0.013 | 8.2(1.36-49.04) | 0.022* |
| | No | 2(1) | 210(99) | Ref | | Ref | |
| Malaria infection in the last one year | Yes | 1 | 22 | 1.91(0.22-16.577) | 0.558 | | |
| | No | 6 | 252 | Ref | | | |
| Roof construction | Thached | 5(4.3) | 112(95.7) | 3.62(0.689-18.969) | 0.0129 | 1.88(0.32-11.16) | 0.488 |
| | Iron sheet | 2(1.2) | 162(98.8) | Ref | | Ref | |

COR: Crude Odds Ratio, AOR: Adjusted Odds Ratio, CI: Confidence level, *significant at p<0.05

### 5.4.Factors associated with malaria among pregnant women

Multivariable regression showed that pregnant women who didn't follow ANC were 9.2 times more likely to be infected with malaria compared to those who follow ANC [AOR=9.24(95%CI=1.07-79.8)]. Pregnant women who live in unsprayed houses [AOR=8.07 (95%CI=1.01-64.47], and those living near stagnant water [8.34(95%CI=1.06-65.57)] had also significantly higher prevalence of malaria. Moreover, pregnant women who had a history of malaria within the last year were 6.4 times more likely to be infected with malaria than those who didn't have malaria infection within the last year [AOR=6.4 (95%CI=1.24-33.311)] (Table 7).

Table 7: Bivariate and multivariable logistic regression analysis of associated factors for malaria among pregnant women

| Variables | Category | Malaria status | | Bivariate analysis | | Multivariable analysis | |
|---|---|---|---|---|---|---|---|
| | | Positive | Negative | COR(95% CI) | P-value | AOR(95%CI) | P-value |
| Age | 15-24 | 3(2.9) | 102(97.1) | Ref | | | |
| | >24 | 3(2.6) | 113(97.4) | 0.9(0.18-4.57) | 0.902 | | |
| ANC | Yes | 3(1. | 176(98.3) | Ref | | Ref | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 7) | | | | | |
| | No | 3(7) | 39(93) | 4.5(0.878-23.205) | 0.017 | 9.24(1.07-79.8) | 0.043* |
| Gravidity | Primigravidae | 3(5.3) | 54(94.7) | 2.56(0.41-15.78) | 0.321 | | |
| | Secondigravidae | 1(1.4) | 69(98.6) | 0.667(0.06-7.5) | 0.743 | | |
| | Multigravidae | 2(2.1) | 92(97.9) | Ref | | | |
| Trimester | First | 1(3.8) | 25(96.2) | 3.56(0.22-58.96) | 0.375 | | |
| | Second | 4(3.8) | 101(96.2) | 3.53(0.39-32.12) | 0.264 | | |
| | Third | 1(1.1) | 89(98.9) | Ref | | | |
| Family size | ≤5 | 4(2.5) | 153(97.5) | Ref | | | |
| | >5 | 2(3) | 62(97) | 0.81(0.15-4.54) | 0.811 | | |
| ITN possession | Yes | 1(0.8) | 119(99.2) | Ref | | Ref | |
| | No | 5(4.9) | 96(95.1) | 6.2(0.712-53.948) | 0.098 | 7.49(0.66-84.4) | 0.103 |
| IRS | Yes | 2(1.3) | 153(98.7) | Ref | | Ref | |
| | No | 4(6.1) | 62(93.9) | 4.94(0.881-27.64) | 0.069 | 8.07(1.01-64.47) | 0.049* |
| Stagnant water | Yes | 4(7) | 52(93) | 6.27(1.12-35.216) | 0.037 | 8.34(1.06-65.57) | 0.044* |
| | No | 2(1.2) | 163(98.8) | Ref | | Ref | |
| Roof construction | Thatched | 5(4.3) | 112(95.7) | 4.6(0.528-40.017) | 0.167 | 6.12(0.5-74.8) | 0.156 |
| | Iron sheet | 1(1) | 104(99) | Ref | | Ref | |
| Malaria in the last one year | Yes | 3(9.4) | 29(90.6) | 6.4(1.235-33.311) | 0.027 | 9.9(1.11-87.95) | 0.040* |
| | No | 3(1.6) | 186(98.4) | Ref | | Ref | |

COR: Crude Odds Ratio, AOR: Adjusted Odds Ratio, CI: Confidence interval, *Significant at $p<0.05$

# CHAPTER SIX

## 6. DISCUSSION

Malaria disease is a public health problem widely distributed throughout the tropical and subtropical regions. It results in severe consequences in under-five children and pregnant women. This community-based cross-sectional study was conducted to determine the prevalence and associated factors of malaria among under-five children and pregnant women.

Accordingly, the overall prevalence of malaria among pregnant women and under-five children in Hidabu abote district was 2.7% and 2.6% respectively. This prevalence is low as compared to studies conducted in different areas. The prevalence of malaria among pregnant women in this study was 2.7% which is low as compared to the study conducted in Sherkole district, West Ethiopia which is 10.2% (49), Arbaminch Town, South Ethiopia 9.1%(52), Jawi District, North west Ethiopia 11.2 (53), in the province of Nyanga, Gabon 20% (40). Cameron 53.4% (47), Ghana 20.4 %(16), Nigeria 24.9 %(46), and Southeast, Tanzania 36.4%(54). The lowest prevalence in this study area might be due to the spatiotemporal variability of *Plasmodium* species and the sensitivity of applied diagnostic tests.

This result was in agreement with the study conducted in Merti district, Ethiopia which is 3.6%(50), North-Shoa, Ethiopia 3.4% (55), and Lagos, South West, Nigeria2% (56).

This study showed a higher prevalence of malaria among pregnant women as compared to the study conducted in **a** high malaria-burden state of India on symptomatic and asymptomatic pregnant women which is 0.81% (17). The source of variation in this study might be the seasonal variation of the study period and variation of malaria endemicity in the study site. For instance, our study is conducted during the major malaria transmission season and in the malarious kebele of the district which may result in a relatively high prevalence.

Coming to species distribution *P.vivax, P.falciparum,* and mixed infections account for 50%, 16.7%, and 33.3% of confirmed malaria cases respectively in pregnant women, and 57.1% and 42.9 % of confirmed malaria cases were accounted for by *P.vivax* and *P.falciparum* in under-five children. Generally, *P.vivax* is the predominant species in this study area. This is contradicting result as compared to a study conducted in different regions of Ethiopia such as Afar Region, Ethiopia (57), Arba Minch Zuria district(21), Sherkole district, Benishangul Gumuz regional state, West Ethiopia (49). and with Ethiopian national survey report as well which reported *P.falciparum* as the predominant *Plasmodium* species (58).

Living in proximity to vector breeding sites may enhance vector-human contact ultimately increasing malaria risk. This study also showed that there was a significant association between malaria infection and living near stagnant water. A previous study also suggested that living near stagnant water is a risk factor for malaria infection (50).
The other contributing factor to malaria transmission is living in a house that is not sprayed with IRS. This study also showed a significant association between malaria infection and living in houses with no IRS. Similar findings were reported in Fendeka town, North west Ethiopia (53).

Antenatal care follow-up is essential for monitoring maternal and fetal health during pregnancy. In this study, the odds of malaria infection were significantly higher in women who didn't visit the health center for ANC follow-up compared to those who did. This might happen because those who visited the health facility may get health information on the prevention of malaria. In this study, having a history of malaria infection in the last year was also significantly associated with malaria infection. This result was supported by a study conducted in the Merti district, Ethiopia (50).

The prevalence of malaria among under-five children in this study was 2.5 % which is in agreement with the study conducted in the Benishangul-Gumuz region which is 3.6% (59). This result also agreed with the Ethiopian national survey report in 2015 which is 1.3 % (58). The poled prevalence of asymptomatic malaria in Ethiopian children was reported at 6.67% which is in line with our study (60).

The finding of this study showed lower prevalence as compared to the studies conducted in Arba Minch Zuria District, Afar Region, Wogera district, and Damot Gale Woreda in Ethiopia, where prevalence ranging from 8.7% to 64% have been reported (21, 61-63). This study also showed lower prevalence compared to the study conducted in the province of Nyanga, Gabon, Ekiti State, Southwest Nigeria, and in the Niger Delta Region of Nigeria, where prevalence ranged from 7.4% to 63% (40, 64, 65). This difference might be due to the difference in the geographical and climatic conditions of the different areas. Moreover, this study considers all individuals regardless of malaria signs and symptoms while several studies conducted so far in our country were institutional-based which may result in a high prevalence of malaria as they consider only symptomatic individuals.

In this study, living near stagnant water was significantly associated with malaria prevalence among under-five children. Similar findings were reported in the studies done elsewhere (59, 62, 66, 67). Vector mosquitoes can breed in a range of water bodies including small pockets of water such as hoofs and footprints to larger water bodies, partly depending on the species of the mosquitoes. It was also found that under-five children living in houses that had not been sprayed with IRS were 5.6 more likely to be infected with malaria compared to those living in sprayed houses. Indoor residual spraying is one of the key vector control interventions contributing to the control of malaria. Similar reports were documented in other studies (67, 68).

It should be noted that this study has some limitations. First, malaria was diagnosed using microscopy and RDT which have their own limitation. More sensitive molecular-based diagnostic tools could have detected more cases as it can allow detection of sub-microscopic malaria cases.

# CHAPTER SEVEN

## 7. CONCLUSION AND RECOMMENDATION

This study revealed that malaria is still a public health problem among pregnant women and under-five children in Hidabu Abote district. Living near stagnant water and in houses with no IRS were the major malaria risk factors of malaria among under-five children and pregnant women. Moreover, pregnant women who had history of malaria and those who do not follow ANC were at higher risk of malaria infection. Strengthening malaria control efforts with focus on vector control interventions is recommended. Community-driven larval source management and timely application of IRS is essential for the control and anticipated elimination of malaria. Moreover, creating awareness to pregnant women to follow ANC is required.

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## ANNEX 1: Participant information sheet

**A. Participant information sheet (English Version)**

My name is **Belay merkeb** and I am an MSc student in Medical parasitology at Jimma University, Institute of Health, Faculty of Health Sciences, School of Medical Laboratory Sciences, Department of Medical Parasitology. I am researching the prevalence of malaria and associated risk factors among under-five children and pregnant women in Hidabu abote district

**Purpose:** To determine the prevalence of malaria and associated factors among under-five children and pregnant women in Hidabu abote district. The outcome can have its role in the malaria prevention program, which can be very important to design an effective mechanism to reduce morbidity and mortality of malaria patients and important to provide information on the control and prevention of malaria diseases. Therefore, at the end of the study based on the result found all the necessary recommendations will be forwarded to all responsible bodies.

**Participation:** I am asking you to participate voluntarily in this study; if you agree to participate you will be asked to sign a consent form and respond to a short questionnaire interview.

- Participation in the study is based on your willingness.
- The participants have the right to participate or not, discontinue their participation, or withdraw from the study at any time and cannot be asked by the researcher.
- Withdrawal from the study does not have any impact on the participants' right of getting the health service.

**Risks associated:** With this study, there are no risks associated during sample collection procedures.

**Benefits:** If there is any positive finding in laboratory examination, the result will be reported to the nearby health facility for necessary treatment.

**Confidentiality:** All information you give and data obtained from laboratory analysis will be kept confidential and will be communicated only to the responsible body. Formats containing data will be kept locked.

- Records are kept confidential
- Your name will not be mentioned.
- Your specimens are used only for this study.

**Result sharing:** Report will be written about the finding of the study either through publications or any other means. The result will not bear any information relevant to your personality in anyway.

**Contact Address:**

If you have any question or doubt you can contact: **Belay Merkeb**

Jimma University, Institute of Health, Faculty of Health Sciences, School of Medical Laboratory Sciences, Department of Medical Parasitology.

**Tel:** O926811736**, E-mail:** belaymerkeb19@gmail.com

**B. Ibsa odeeffannoo waa'ee qorannichaa maamiltootaaf (Afaan Oromootiin)**

Harka fuune! Akkam jirtu?

Maqaan koo **Belay Merkeb** jedhama.

Ani Yunivarsitii Jimmaatti barataa digrii lammaffaa muummee barnoota saayinsii fayyaatti kutaa qorannoo saayinsii fayyaa namaa fi maxxantootaati. Ani turtii yeroo ji'a lamaaf taasisu keessatti, qorannoo waa'ee dhibee busaa fi wantoota dhibee busaaf nama saaxilan daa'iman waggaa shani gadi fi dubartoota ulfa irratti xiyyeeffatee anaa Hidhabuu Abootee irratti kan hojjatuudha.

**Kaayyoo qorannichaa:** Hamma dhibee busaa fi wantoota dhibee busaaf nama saaxilan daa'iman waggaa shani gadi fi dubartoota ulfa irratti qoratee addaan kan baasuudha. Bu'aan qorannoo kanarraa eegamuus gahee mataa isaa danda'e kan qabuudha. Innis odeeffannoon waa'ee hamma dhibee busaa fi wantoota dhibee busaaf nama saaxiluu danda'an beekuun baay'ee barbaachisaadha. Sababni isaas bakka tokkotti namarratti mul'achuun dhibee busaa caalatti namni akka miidhamuufi du'aatiifillee namni akka saaxilamu waan taasisuufi, dursanii waa'ee odeeffannoo kanaa qabaachuun yeroon tarkaanfii barbaachisaa ta'e qaamni dhimmi kun ilaallatu hundi irratti mar'achuun furmaanni akka kennamu kan kakaasuudha. Dhuma qorannicha kanaarrattis bu'aan qoraannoo qaamoota dhimmi kun ilaallatu hundaafuu ni gabaafama.

**Hirmaannaa maamiltootaa ilaalchisee:** Hirmaannaan qorannichaaf maamiltoonni godhan fedhii isaanii irratti kan hundaa'eedha. Haaluma fedhii fi walii galtee isaaniitiin, gaaffileen qorannichaa muraasni deebii isaanirraa ni argattu. Akkasumas fedhuma isaaniitiin dhiiga qorannoo kanaaf barbaachisu ni gumaachu. Walumaa galatti maamiltootni mirga diduus tahee hirmaachuu, akkasumas yeroo barbaadanitti hirmaannaa isaanii addaan kutuus tahee dhaabuuf mirga guutuu qabu. Garuu, hirmaannaan maamiltootaa fi shoorri isaan taphatan galma gahiinsa kayyoo qorannichaaf baay'ee murteessaadha.

**Miidhaa isaa:** Qorannichaan walqabatee miidhaan maamiltootarra dhufu tokkolleen hin jiru. Hirmaachuus tahee dhiga kennuun rakkoo tokkollee hin qabu.

**Bu'aa qorannichaa**: Yeroo qorannoon laboratorii dhiiga irratti gaggeeffamutti wanti dhibeen walqabatu tokkollee yoo mul'ate, bu'aan isaa gara dhaabilee fayyaatti geeffamuun yaaliin barbaachisaa tahe maamiltootaaf bilisaan akka kennamu ni taasifama.

**Iccitii odeeffannoo maamiltootaan wal-qabatee**: Odeeffannoon maamiltoonni kennaniis tahe kan gama laboratoriin argamu, guutumaa guututti iccitiin isaa kan eegamuu fi qaama dhimmi kun ilaalu qofaaf kan gabaafamuudha. Kuniis kan tahu maqaan maamiltootaa osoo hin tuqamin karaa iccitii taheen kan gabaafamuudha. Akkasumaas dhiigni isaan kennan kaayyoo qorannichaa kana qofaaf kan ooluudha.

Yoo wanti gaaffii ykn ifa isiniif hin taa'in tokkolleen jiraate, yeroo barbaadanitti teessoo fi lakkoofsa bilbila keenya kan armaan gadii kanaan nu qunnamuu dandeessu.

Maqaa I/gaafatamaa qorannichaa: **Belay Merkeb**

**Teessoo:** Yunivarsitii Jimmaa Muummee saayinsii fayyaatti kutaa qorannoo saayinsii fayyaa namaa fi maxxantootaati.

**Lakkoofsa bilbilaa**: o926811736 **Email:** belay merkeb19@gmail.com

## ANNEXE 2: Consent form

**English version consent form**

I _____: here by giving my consent for me or my child to participate in the mentioned study. I understand that this study will be used to improve prevention and control for malaria. I also trust that at the end of study, the results will be shared with the concerned body, Jimma university institute of health science,North Shoa health office and to the local health facilities.

Name _____ signature _____Date_____

Data collector

Name _____ signature _____

Thank you for Your Participation.

**Afaan oromoo version consent form**

Ani adde_____ anis ta,ee daimni koo qorannoo kana irratti hirmaachuuf waligaluu koo maltoo kootiin nan mirkaneessa. Qoranichis haala tatamsain dhukkuba busaa barufis ta,e toachuf akka nu garagaaru bareera. Bu,aan qoranoo kanaas dhuma irratti qaama ilaaltuuf jechunis dhabata fayyaa yunivaristy jimmaa, qajelcha fayyaa godiina shawaa kabaa fi dhabilee fayyaa nanawa kana jiranifa akka tamsasamu nan amana.

Maqaa _____ mallattoo _____ guyyaa _____
Maqaa nama samuda sassaabee _____ mallattoo _____
Qoranicha irratti wan hirmataniif galatoomaa

## ANNEXE 3: Assent form

**English version assent for child (<18 years of age of study participant)**

You are being asked to give a blood samples that will be examined for plasmodium infection.

You do not have to do this if you do not want to do but there is no danger in doing so.

Do you agree to give your blood specimen for plasmodium examination?

Yes---------- No----------

Child's name----------

Child's signature----------

Name of the person obtaining assent----------

Signature of the person obtaining assent----------

Witness name_____ Signature---------- date_____

**Afaan oromoo version assent form**

Amma kan sigaafachaa jirru saamuda dhigaa qorannoo dhukkubaa busaatiif akka nu kenituufi. Kennus kennuu dhisuus ni dandeessa garuu keennuu keetiin wantti midhamtu tokko illeen hin jiru. Saamuda dhigaa nu Kennuuf waligalteettaa?

A. Eeyyee B. lakki

Maqaa da'imaa _____

Mallattoo _____

Maqaa nama gaafatee _____ mallattoo

Ragaa _____ mallattoo _____ guyyaa

## ANNEXE 4: Questioners

**English version questioners for pregnant women**

**Part I: Socio-demographic Characteristics**

| S.no | Question | Alternatives | Skip |
|---|---|---|---|
| 101 | Kebele | _____ | |
| 102 | Code | _____ | |
| 103 | How old are you? | _____years | |
| 104 | Highest educational attainments | 1. Illiterate<br>2. Can read and write<br>3. Primary<br>4. Secondary and above | |
| 105 | Marital Status | 1. Single<br>2. Married<br>3. Widowed<br>4. Separated | |
| 106 | Occupation | 1. Daily labour<br>2. Employed<br>3. Private Work<br>4. Farmers | |
| 107 | Residency | 1. Urban<br>2. Rural | |
| 108 | Family size | _____ | |
| **Part II: Obstetrics Characteristics** | | | |
| 201 | Gravidity | 1. Primigravida<br>2. Secondigravida<br>3.Multigravida | |
| 202 | Are you currently pregnant? | 1. Yes 2. No | |
| 203 | Are you following ANC at health facility? | 1. Yes 2. No | |
| 204 | How many weeks pregnant are you? | _____ | |
| **Part III: Clinical characteristics of the patient** | | | |
| 301 | Does the patient currently have any of the following symptoms? | | |
| | Fevers | 1. Yes 2. No | |
| | Chills | 1. Yes 2. No | |
| | Sweats | 1. Yes 2. No | |
| | Headache | 1. Yes 2. No | |
| | Muscle pains | 1. Yes 2. No | |

| | | | |
|---|---|---|---|
| | Nausea<br>Vomiting:<br>Tiredness:<br>Temperature | 1. Yes 2. No<br>1. Yes 2. No<br>1. Yes 2. No<br>_____ | |
| 302 | Have you taken anti-malarial medication in the last three weeks? | 1. Yes 2. No | |
| **Part IV: Ownership and practice of malaria protective equipment** | | | |
| 401 | Do you have mosquito bed nets? | 1. Yes<br>2. No → | 404 |
| 402 | If yes for Q401, how many do you have? | _____ | |
| 403 | If yes for Q401, did you sleep under mosquito's bed nets last night? | 1. Yes<br>2. No | |
| 404 | Did you spray IRS your home in the last 12 months? | 1. Yes<br>2. No | |
| 405 | Is there stagnant water around your home? | 1. Yes<br>2. No | |
| 406 | If yes for Q405, the distance of home from stagnant water? | _____ | |
| **Part V: About *plasmodium* parasites infections** | | | |
| 501 | Have you been infected with malaria in the last one year? | 1. yes<br>2. no | |
| 502 | Have you been infected with malaria in the last one month? A. yes B. no | 1. yes<br>2. no | |
| 503 | If yes for Q501or Q502 21 where did you diagnosed? | 1. Hospital 2. health centre<br>3. health post<br>4. not tested at all | |
| 504 | Did you utilize all the prescribed doses of antimalarial? | 1. Yes 2. No | |
| **Part IV: Economic condition of the participant condition** | | | |
| 601 | What is the major construction material of the external wall? | 1. Mud and Timber<br>2. Cement<br>3.Other_____ | |

| | | | |
|---|---|---|---|
| 602 | What is the major construction material of the roof? | 1. Thatch, Straw<br>3. iron sheet | |
| 603 | What is the main source of water for drinking for your household? | 1. Tap water<br>2. Public taps<br>3. Protected spring<br>4. Unprotected spring F. River, stream, lake, pond | |
| 604 | What is the type of toilet that is mainly used in your household? | 1. Covered pit latrine private<br>2. Covered pit latrine shared<br>3. Uncovered pit latrine<br>4. Uncovered pit latrine shared 5. Bush | |
| | How many rooms do you have for sleeping? | _____ | |
| **Laboratory findings** | | | |
| | **RDT result;** | 1. None reactive<br>2. P. falciparum<br>3. P. vivax<br>4. Mixed | |
| | **Microscopy result** | Negative<br>Positive | |
| | If positive for microscopic finding | Species_____<br>Stage _____<br>Density _____ | |

**English version questioners for under-five children and their guardian**

**Part I: Socio-demographic Characteristics**

| S.no | Question | Alternatives | Skip |
|---|---|---|---|
| 101 | Kebele | _____ | |
| 102 | Code | _____ | |
| 103 | Sex | 1. Male<br>2. Female | |
| 104 | Age of the child | _____month | |
| 105 | Highest educational attainments of the guardian | 1. Illiterate<br>2. Can read and write<br>3. Primary<br>4. Secondary and above | |
| 106 | Occupation of the guardian | 1. Daily labour<br>2. Employed<br>3. Private Work<br>4. Farmers | |

| | | | |
|---|---|---|---|
| 107 | Residency | 1. Urban<br>2. Rural | |
| 108 | Family size | _____ | |
| **Part II: Clinical characteristics of the patient** | | | |
| 201 | Does the patient currently have any of the following symptoms?<br>Fevers<br>Chills<br>Sweats<br>Headache<br>Muscle pains<br>Nausea<br>Vomiting:<br>Tiredness:<br>Temperature | <br><br>1. Yes 2. No<br>1. Yes 2. No<br>1. Yes 2. No<br>1. Yes 2. No<br>1. Yes 2. No<br>1. Yes 2. No<br>1. Yes 2. No<br>1. Yes 2. No<br>_____ | |
| 202 | Have you taken anti-malarial medication in the last three weeks? | 1. Yes 2. No | |
| **Part III: Ownership and practice of malaria protective equipment** | | | |
| 301 | Do you have mosquito bed nets? | A. Yes<br>B. No → | 404 |
| 302 | If yes for Q401, how many do you have? | _____ | |
| 303 | If yes for Q401, did (name) sleep under mosquito's bed nets last night? | 1. Yes<br>2. No | |
| 304 | Did you spray IRS your home in the last 12 months? | 1. Yes<br>2. No | |
| 305 | Is there stagnant water around your home? | 1. Yes<br>2. No | |
| 306 | If yes for Q405, the distance of home from stagnant water? | _____ | |
| **Part IV: About *plasmodium* parasites infections** | | | |
| 401 | Have (name) been infected with malaria in the last one year? | 1. yes<br>2. no | |

| | | | |
|---|---|---|---|
| 402 | Have (name) been infected with malaria in the last one month? A. yes B. no | 1. yes<br>2. no | |
| 403 | If yes for Q401 or Q402 where did (name) diagnosed? | 1. Hospital 2. health centre<br>3. health post<br>4. not tested at all | |
| 404 | Did (name) utilize all the prescribed doses of antimalarial? | 1. yes 2. No | |
| **Part V: Economic condition of the participant condition** | | | |
| 501 | What is the major construction material of the external wall? | 1. Mud and Timber<br>2. Cement<br>3.Other_____ | |
| 502 | What is the major construction material of the roof? | A. Thatch, Straw B. Wood, Planks C. iron sheet D. Other_____ | |
| 503 | What is the main source of water for drinking for your household? | 1. Tap water<br>2. Public taps<br>3. Protected spring<br>4. Unprotected spring F. River, stream, lake, pond | |
| 504 | What is the type of toilet that is mainly used in your household? | 1. Covered pit latrine private<br>2. Covered pit latrine shared<br>3. Uncovered pit latrine<br>4. Uncovered pit latrine shared 5. Bush | |
| 505 | How many rooms do you have for sleeping? | _____ | |
| **Laboratory findings** | | | |
| | **RDT result;** | 1. None reactive<br>2. P. falciparum<br>3. P. vivax<br>4. Mixed | |
| | **Microscopy result** | Negative<br>Positive | |
| | If positive for microscopic finding | Species_____ | |

| | | | |
|---|---|---|---|
| | | Stage _____<br>Density _____ | |

**Afan oromo version questioners for pregnant women**

**Kutaa I: Odeeffannoo waliigalaa**

| S.no | Gaafanno | Filannoo | skip |
|---|---|---|---|
| 101 | Ganda | _____ | |
| 102 | Lakk | _____ | |
| 103 | Umurii | _____wagaadhaan | |
| 104 | Sadarkaa barnootaa | 1. Hin baranne<br>2.dubbisuuf bareessu kan dandechu<br>3.Sadrkaa 1ffaa<br>4. Sadrkaa 2ffaa fi isaa ol | |
| 105 | Haala Gaa,eelaa | 1. Kan hin herumne<br>2. Kan herumte<br>3.kan dhirsi due<br>4. kan wal hikan | |
| 106 | Ga'ee hojii | 1. Hojii humnaa<br>2.Hojjatuu motummaa<br>3. Hojii dhunfaa<br>4. Qonnaan bultu | |
| 107 | Iddoo jireenyaa | 1. Magaalaa 2. Baadiyyaa | |
| 108 | Baayina maatii | _____ | |
| **Kutaa II: Haala ulfaa** | | | |
| 201 | Meeqa ulfoofte | 1. A. Tokko<br>2. Lama<br>3. Lamaa ol | |
| 202 | Yeroo amma kan ulfaa | 2. Eyyee 2.Lakki | |
| 203 | Hordoffii dhala duraa dhabata fayyatti ni hordoftaa ? | A. Eyyee<br>B.Lakki | |

| | | | |
|---|---|---|---|
| 204 | Ulfa torbee meeqaati ? | _____ | |
| **kutaa III: Maltoolee hirmaataa irratti mulatan** | | | |
| 301 | Hirmaataan malatoolee kaneen armaan gadi ni qabaa?<br>Qaama ho,isuu<br>Dhaamochuu<br>Dafqisiisuu<br>Mataa bowwoo<br>Dhukkubbii qaamaa<br>Miira haammaachuu(loloojii.<br>Balqamsiisuu<br>Dadhabbii qaamaa<br>Ho'ina qaamaa | 1.Eeyyee 2. lakki<br>1.Eeyyee 2. lakki<br>1. Eeyyee 2. Lakki<br>1. Eeyyee 2. lakki<br>1. Eeyyee 2. lakki<br>1. Eeyyee 2. lakki<br>1. Eeyyee 2. lakki<br>1. Eeyyee 2. lakki<br>_____ | |
| 302 | Torbee sadan darban keessa qoricha busaa fudhatteettaa? | 1. Eeyyee<br>2. lakki | |
| **Kutaa IV: Ownership and practice of malaria protective equipment** | | | |
| 401 | Saaphana bookee busaa ittisu qabduu? | 1. Eeyyee<br>2. lakki → 404 | |
| 402 | Yoo eeyyee ta'e, meeqatu jira | _____ | |
| 403 | Halkan darbe Saaphana bookee busaa ittisu fayyadamteettaa | 1. Eeyyee 2. lakki | |
| 404 | Waggaa tokkoon asitti manni keessan keemikaala farra bookee buusaan biifamee? | 1. Eeyyee 2. lakki | |
| 405 | Bishaan kuufamaan naanawa keessan jiraa? | 1. Eeyyee 2. lakki | |
| 406 | Eeyyee yoo ta,e fageenya isaa | _____ | |

| | | | |
|---|---|---|---|
| **Kutaa V: Haala dhukkuba busaa** | | | |
| 501 | Wagga darbe kana keessa dhukkuba busaatiin qabamteettaa? | 1. Eeyyee 2. lakki | |
| 502 | Ji,a darbe kana keessa dhukuba busaatiin qabamteettaa? | 1. Eeyyee 2. lakki | |
| 503 | Eyyee yoo ta,e eessatti yaallamte? | 1.Hospitaala<br>2.Bufata fayyaa<br>3.keellaa fayyaa<br>4. hin yaallamne | |
| 504 | Qoricha sif ajajamee hunda fayyadamteetaa? | 1. Eeyyee 2. lakki | |
| **kutaa IV: Haala qabeenya hirmaataa** | | | |
| 601 | Qabiyyeen dhaaba mana keessani maali? | 1.Biyyoo<br>2.Simintoo<br>3.Kan biro _____ | |
| 602 | Qabiyyeen irra keessa mana keessani maali? | 1.Citaa ykn fur<br>2.Qorqoorroo<br>3.Kanbiroo_____ | |
| 603 | Maddi bishaan dhugaatii keessanii maali? | 1.Bishaan bombaa kan dhunfaa<br>2.Bishaan bombaa kan ummataa<br>3.Bishaan boollaa<br>4.Burqaa dallaa qabu<br>5.Burqaa dallaa hin qabne<br>6.Bishaan lagaa | |
| 604 | Mana fincaanii gosa kam qabdu? | 1.Mana fincaani dhuunfaa kan qaawwi isaa haguuggame<br>2.Mana fincaani ummataa kan qaawwi isaa | |

| | | | |
|---|---|---|---|
| | | haguuggame<br>3.Mana fincaani dhuunfaa kan qaawwi isaa hin haguuggamne<br>4.Mana fincaani ummataa kan qaawwi isaa hin haguuggamne<br>5.Dirree irratti | |
| 605 | Kutaa cisichaa meeqa qabduu? | _____ | |
| **Laboratory findings** | | | |
| | **RDT result;** | 1. None reactive<br>2. P. falciparum<br>3. P. vivax<br>4. Mixed | |
| | **Microscopy result** | 1.Negative<br>2.Positive | |
| | If positive for microscopic finding | Species_____<br>Stage _____<br>Density _____ | |

**Afan oromo version questioners for under-five children and their guardian**

**Kutaa I: Odeeffannoo waliigalaa**

| S.no | Gaafanno | Filannoo | skip |
|---|---|---|---|
| 101 | Ganda | _____ | |
| 102 | Lakk | _____ | |
| 103 | Saala | 1.Dhiira 2.dhalaa | |
| 104 | Umurii da,imaa | ji'aan | |
| 105 | Sadarkaa barnootaa haadhaa ykn gudiftuu | 1. Hin baranne<br>2.dubbisuuf bareessu kan dandechu<br>3.Sadrkaa 1ffaa<br>4. Sadrkaa 2ffaa fi isaa ol | |
| 106 | Ga'ee hojii haadhaa ykn guddiftuu | 1. Hojii humnaa<br>2.Hojjatuu motummaa<br>3. Hojii dhunfaa | |

| | | | |
|---|---|---|---|
| | | 4. Qonnaan bultu E. kan biraa | |
| 107 | Iddoo jireenyaa | 1. Magaalaa 2. Baadiyyaa | |
| 108 | Baayina maatii | _____ | |
| **kutaa II: Maltoolee hirmaataa irratti mulatan** | | | |
| 201 | Hirmaataan malatoolee kaneen armaan gadi ni qabaa?<br><br>Qaama ho,isuu:<br>Dhaamochuu<br>Dafqisiisuu<br>Mataa bowwoo<br>Dhukkubbii qaamaa<br>Miira haammaachuu(loloojii)<br>Balqamsiisuu<br>Dadhabbii qaamaa<br>Ho'ina qaamaa | <br><br>1.Eeyyee 2. lakki<br>1.Eeyyee 2. lakki<br>1. Eeyyee 2. Lakki<br>1. Eeyyee 2. lakki<br>1. Eeyyee 2. lakki<br>1. Eeyyee 2. lakki<br>1. Eeyyee 2. lakki<br>1. Eeyyee 2. lakki<br>_____ | |
| 202 | (maqaa) torbee sadan darban keessa qoricha busaa fudhatteettaa? | 1. Eeyyee<br>2. lakki | |
| **Kutaa III: Haala qabeenyaa fi itti fayadama meshaalee busaa ittisan** | | | |
| 301 | Saaphana bookee busaa ittisu qabduu? | 1. Eeyyee<br>2. lakki → 404 | |
| 302 | Yoo eeyyee ta'e, meeqatu jira | _____ | |
| 303 | Halkan darbe Saaphana bookee busaa ittisu fayyadamteettaa | 1. Eeyyee 2. Lakki | |
| 304 | Waggaa tokkoon asitti manni keessan keemikaala farra bookee buusaan biifamee? | 1. Eeyyee 2. Lakki | |
| 305 | Bishaan kuufamaan naanawa keessan jiraa? | 1. Eeyyee 2. Lakki | |
| 306 | Eeyyee yoo ta,e fageenya isaa | _____ | |
| **Kutaa IV: Haala dhukkuba busaa** | | | |

| | | | |
|---|---|---|---|
| 401 | (maqaa) wagga darbe kana keessa dhukkuba busaatiin qabamteettaa? | 1. Eeyyee 2. Lakki | |
| 402 | Ji,a darbe kana keessa dhukuba busaatiin qabamteettaa? | 1. Eeyyee 2. Lakki | |
| 403 | Eyyee yoo ta,e eessatti yaallamte? | 1.Hospitaala<br>2.Bufata fayyaa<br>3.keellaa fayyaa<br>4. hin yaallamne | |
| 404 | Qoricha sif ajajamee hunda fayyadamteetaa? | 1. Eeyyee 2. Lakki | |
| **kutaa V: Haala qabeenya hirmaataa** | | | |
| 501 | Qabiyyeen dhaaba mana keessani maali? | 1.Biyyoo<br>2.Simintoo<br>3.Kan biro _____ | |
| 502 | Qabiyyeen irra keessa mana keessani maali? | 1.Citaa ykn fur<br>2.Qorqoorroo<br>3.Kanbiroo_____ | |
| 503 | Maddi bishaan dhugaatii keessanii maali? | 1.Bishaan bombaa kan dhunfaa<br>2.Bishaan bombaa kan ummataa<br>3.Bishaan boollaa<br>4.Burqaa dallaa qabu<br>5.Burqaa dallaa hin qabne<br>6.Bishaan lagaa | |
| 504 | Mana fincaanii gosa kam qabdu? | 1.Mana fincaani dhuunfaa kan qaawwi isaa haguuggame<br>2.Mana fincaani ummataa kan qaawwi isaa haguuggame<br>3.Mana fincaani dhuunfaa | |

| | | | |
|---|---|---|---|
| | | kan qaawwi isaa hin haguuggamne<br>4.Mana fincaani ummataa kan qaawwi isaa hin haguuggamne<br>5.Dirree irratti | |
| 505 | Kutaa cisichaa meeqa qabduu? | _____ | |
| **Laboratory findings** | | | |
| | **RDT result;** | 1. None reactive<br>2. P. falciparum<br>3. P. vivax<br>4. Mixed | |
| | **Microscopy result** | Negative<br>Positive | |
| | If positive for microscopic finding | Species_____<br>Stage _____<br>Density _____ | |

## DECLARATION SHEET

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been fully acknowledged.

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Signature: _____

Name of the institution: Jimma University

Date of submission: _____

This thesis has been submitted for examination with my approval as University advisor

Name: **Dr. Teferi Eshetu** Signature _____ Date: _____

Name: **Dr: Endalew Zemene** Signature _____ Date: _____

**Examiners**

| | | |
|---|---|---|
| **Internal Examiner** | Signature | Date |
| **Dr. Teshome Degefa** | _____ | _____ |
| **External Examiner** | Signature | Date |
| **Dr. Lemu Golassa** | _____ | _____ |