Prevalence of Malaria and Its Associated Factors Among Malaria Suspected Patients Attending at Hamusite Health Center, Northwest Ethiopia, a Cross Sectional Study, 2020

Getu Abeje Negatu (getuabeje12@gmail.com)
Samara university
https://orcid.org/0000-0003-1624-3464

Getaneh Alemu Abebe
Bahir Dar University

Woyneshet Gelaye Yalew
Bahir Dar University

Research

Keywords: Prevalence of Malaria, Health Center, Northwest Ethiopia

DOI: https://doi.org/10.21203/rs.3.rs-146195/v1

License: ©  This work is licensed under a Creative Commons Attribution 4.0 International License.  Read Full License
Abstract

Background

Malaria is a major public health problem which still results in illness and death. Despite efforts to reduce the mortality and morbidity of malaria, the disease is still a prominent health problem in Ethiopia. This study, therefore, was undertaken to assess the prevalence of malaria and associated factors among symptomatic patients in northwest Ethiopia.

Method

A facility based cross-sectional study was conducted from February to March 2020 among 210 febrile patients attending at Hamusite health center, northwest Ethiopia. Thin and thick blood films were prepared from blood collected by finger puncture and from capillary blood buffy coat. Data were analyzed using SPSS version 20.

Results

Out of 210 malaria suspected participants, 61 (29.0%) were confirmed to be infected by *Plasmodium* species. *Plasmodium falciparum* mono-infection was detected in 41 (19.5%) participants while *P.vivax* mono-infection and mixed infections were detected in 10 (4.3%) participants each. Female participant and those having family members with history of malaria were at higher risk of acquiring *Plasmodium* infection

Conclusion

The present study revealed that malaria continued to be the major public health problem in the study area. Therefore, community mobilization should be strengthening in order to improve implementation of malaria control activities.

Background

Malaria is caused by a protozoan parasite belonging to the genus *Plasmodium*. Five species namely: *Plasmodium (P) falciparum, P. vivax, P. ovale, Pmalariae, and Pknowlesi* infect humans [1]. *P falciparum* and *P. vivax* are the most prevalent species in the world, and the former is the most virulent species in terms of both morbidity and mortality [2,3]. Malaria is a major public health problem and prevalent throughout the tropics and subtropics [4]. Most of the malaria cases occur in African region (90%) followed by the Southeast Asia (7%) and Eastern Mediterranean (2%) regions [5]. In 2018, about 228 million cases were reported globally with 405 thousand deaths and about 67% of the deaths occurred among under 5 years-old children. About 93% of the deaths were in Africa [6].

In Ethiopia, 68% of the population lives in malaria risk areas [7]. Hence, about 1.5 million confirmed cases and 356 deaths were reported in 2017 [8]. Moreover, the most pathogenic species, *P. falciparum*, was found to be the predominant species in the country being responsible for 69% of confirmed cases [9]. The risk of malaria is highest in the Western lowlands of Oromia, Amhara, Tigray regions and almost the entire regions of Gambella and Benishangul Gumuz [10].
Humans are primarily infected through the bite of an infected female *Anopheles* mosquito that inoculates sporozoites during blood meal [11]. *Anopheles arabiensis*, a species responsible for malaria epidemics, is the primary vector in Ethiopia leaving the country at risk of repeated outbreaks [1]. After inoculation, parasites circulate with blood and those reaching to the liver undergo one cycle development. Then after, parasites infect and multiply inside red blood cells to bring the characteristic sign and symptoms [12]. The clinical manifestations include fever, headache and vomiting which usually appears between 10 and 15 days after the mosquito bite. If not treated, it can become life-threatening by disrupting the blood supply to vital organs [13] which results complications including anemia, impaired consciousness, respiratory distress, hypoglycemia, jaundice and finally it may cause death [14]. Despite efforts to reduce the mortality and morbidity of malaria in endemic areas by utilization of insecticide treated nets (ITNs), environmental control, chemoprophylaxis, and rapid case detection followed by prompt case management [15], the disease incidence shows little decline in the country. Hamusite, located in northwest Ethiopia, is among the top malaria affected areas in Amhara Region. An updated data in such high risk areas helps for timely and targeted intervention. Therefore, this study was undertaken to assess the prevalence of malaria and associated factors among malaria suspected patients attending at Hamusite health center.

**Methods**

**Study Design, Area and Period**

A facility based cross-sectional study was conducted at Hamusite Health center, northwest Ethiopia from February to March 2020. Hamusite town is administratively part of Dera district and it is located at geographic coordinates of 11° 43’ 0” North and 37° 38’ 0” East. The climate of the area is woyna dega and has an average annual rain fall of 1300 mm and mean annual temperature of 26°C (source: Woreda office of agriculture). The health center serves for 55, 422 people in the catchment area. Owing to low altitude and irrigation activities, malaria is a common public health problem in the area.

**Sample size Determination and Sampling Technique**

The sample size was calculated using single population proportion formula based on the 95% confidence limits ($Z_{α/2} = 1.96$) and 4% margin of error (d) and previous prevalence (p) of 8.7% in from previous study conducted in Aysaita primary hospital, Northeast Ethiopia [16].

\[
\text{Sample size} = \left(\frac{Z_{\alpha/2}}{d}\right)^2 \frac{p (1-p)}{d^2} = (1.96)^2 (0.087) (1-0.087)/(0.04)^2 = 191
\]

After compensating for non-respondersents, 19 (10%), the final sample size was 210. Patients who visited the health center laboratory for blood film examination and met the eligibility criteria were recruited by systematic random sampling technique considering the case flow in the health center from February to March of the previous year. Febrile patients clinically suspected of malaria who were 5 years-old or above and willing to participate in the study were included. Individuals who took anti-malarial and antibiotics therapy with in the past one month before enrollment were excluded.
**Data Collection**

**Malaria Risk Factor Assessment**

A structured and pre-tested questionnaire was adapted from the 'National Malaria Indicator Survey Household Questionnaire'. It was administered to gather information on socio-demographic variables that included sex, age, family size, residence, marital status, level of education, occupation, clinical data of study participants. Data about malaria control activities including indoor residual spraying (IRS) in the past 12 months, number of ITNs owned per household, presence of hole in the wall, presence of surface water within 500m from home, type of surface water, distance of surface water from home, habit of sleeping or working outside at night were also collected.

**Blood Sample Collection and Processing**

Capillary blood was obtained via finger puncture. In order to collect capillary blood, the patient’s finger was cleaned with 70% ethyl alcohol and the side of fingertip was pricked with a sterile lancet. The first drop of blood was wiped away and approximately 2µl and 6µl of blood were placed on a glass slide to prepare thin and thick blood films, respectively. Furthermore, buffy coat was prepared from capillary blood samples using heparinized capillary tube. The Capillary tube containing blood was centrifuged at 1200 revolution per minute for 5 minutes and the buffy coat and the red cell layer just below the plasma (approximately 1-2 mm) was aspirated using a micropipette and used for thin and thick film preparations. Thin and thick blood films were simultaneously prepared from each participant and stained with 10% Giemsa for 10 minutes and then examined microscopically following standard protocol for detection and identification of *plasmodium* species. Asexual parasite stages and gametocytes were counted separately from each positive smear against 500 and 1000 WBCs, respectively [17].

**Data Processing and Analysis**

Data were coded, entered, cleaned and then analyzed using Statistical Package for Social Science Software version 20. Descriptive statistics like frequency, percentage and mean were manipulated to explain the study participants and to show the malaria prevalence and parasite load. Binary logistic regression and multivariate analysis were run to assess the association between socio-demographic and other independent variables with malaria infection. Odds ratio (OR) with the corresponding 95% confidence interval (CI) was used to determine the strength between dependent and independent variables. Associations were considered as significant only if P-value was less than 0.05.

**Results**

**Socio-demographic Characteristics of study Participants**

Among 210 malaria suspected patients participated, 105 (50%) were males while the rest 105 (50%) were females. Regarding to their age composition, 153 (72.9%) and 57 (27.1%) participants were >15 and 6-15 years-old, respectively. One hundred ninety three (91.1%) participants were rural residents while the remaining 17 (8.1%) were urban dwellers. More than half of the respondents (57%) had no formal education while 61.4%
of the interviewed participants were married. One hundred and eighteen (56.2%) of them had family size ≥ 5 (Table 1).

**Clinical Data of Study Participants**

Out of 210 study participants, 177 (84.3%) had axillary temperature of 37.5°C and above where as 96 (45.7%) and 114 (54.3%) had malaria history with in the previous 1 year and had family members with history of malaria, respectively. Two hundred three (96.7%) participants were with fever while 179 (85.2%) and 191(91%) patients complained for headache and nausea, respectively (Table 2).

**Malaria Control Activities and Conditions**

Insecticide treated bed net and draining stagnant water were the most commonly mentioned malaria prevention measures reported by 71.9% and 8.1% of the respondents, respectively. Forty one (27.1%) patients responded that their households owned two ITNs. Nearly one-third (31.5%) of the participants responded that their homes were sprayed with IRS within a year before data collection (Table 3).

**Prevalence of Plasmodium Species**

Overall, 61 (29.0%) participants were confirmed to be infected by *Plasmodium* species. *Plasmodium* distribution at species level revealed that *P. falciparum* mono-infection accounted for the highest frequency, detected in 41 (19.5%) participants. Asexual parasite stages were detected in 59 participants while only gametocytes were detected in 2 patients (Table 4).

**Factors Associated with Plasmodium infection**

The prevalence of malaria regarding to sex of the participants was 21.9% in males and 36.2% in females. Females were 2.261 times more likely to be infected with malaria than males (AOR=2.261; 95%CI=1.118-4.571). In addition, individuals who had family members with history of malaria were about 2.598 times more likely to be infected with malaria than those having family members with no history of malaria (AOR=2.598; 95%CI=1.26-5.340). The distribution of malaria was higher among rural residents (29.5%) than that of urban residents (23.5%); however the difference was not statistically significant (Table 5).

**Discussion**

Malaria is a major health burden widespread throughout tropical and subtropical regions of the world including Ethiopia. In the present study, the overall prevalence of malaria infection (29.0%) was lower than previous study findings ranging from 33.8% to 53.68% in Ethiopia [18-21].The present results were also lower than prevalence of 64.5%, 32.4% and 41.6% from Tanzania [22], Liza [23], and Nigeria [24], respectively. The low prevalence in the present study might be due to difference in the study period (since our study was conducted in minor transmission season from February to March), variation in implementation of malaria control and prevention activities and variation in local epidemiology of malaria parasites. However, the present prevalence was higher than similar study results conducted in different geographical settings of Ethiopia where the prevalence ranged from 4.7% to 25.8% [25 - 31]. It was also higher than 27.6% prevalence report from India [32]. Malaria parasitemia in this study was also higher as compared to similar study results from
Bangladesh (0.76%, 3/400) [19]; India (0.08 %, 14/17209) [31] and north Ethiopia (1%, 6/600) [27]. The high prevalence in the present study might be due to application of buffy coat examination in the present study, which is more sensitive technique than conventional blood film examinations. Moreover, variation in the transmission of the disease across geographical settings also matters.

Majority of the infections (19.5%, 41/210) in the present study were caused by *P. falciparum* while each of *P. vivax* and mixed infections contributed for 4.8% (10/210) of the infections. This was in agreement with previous study finding conducted in Arsi Negele where the prevalence of *P. falciparum, P. vivax* and mixed infections were 19.8%, 7.4% and 6.2%, respectively [32]. The present species level distribution is in line with the national species distribution in Ethiopia where *P. falciparum* accounts more than 60% of the infections while *P. vivax* is responsible for approximately 40% of the infections [33].

According to the present study, individuals who had family history of malaria were 2.598 times more likely to be infected by *Plasmodium* species as compared to their counterparts (*p* = 0.009). This might be due to the fact that family members with history of malaria infection may become reservoirs for *Plasmodium* parasites and serve as sources of infection for the rest of the family members. In addition, the present data showed that females were 2.261 times more likely to get infected as compared to males (*p* = 0.023). On the contrary, a study conducted at Kola Diba Health center reported that males were more affected than females [34]. Variations in nature of occupation and outdoor sleeping habit among males and females might bring such differences. All the other considered factors (Table 5) were not significantly associated with *Plasmodium* parasitemia. However, it is difficult to justify why those factors were not associated because we have recruited small number of participants. Moreover, we collected at health institution which was not supplemented with observation to increase the data quality like how they are using ITN.

**Conclusions**

The prevalence of malaria among febrile patients attending Hamusite Health center is significantly considerable. Moreover, *P. falciparum* was identified as the most pathogenic species responsible for the majority of the infections in the area. Individuals with female sex and those having family history of malaria infection were at higher risk of *Plasmodium* infection. Therefore, efforts must be made to expand and sustain the combined application of ITNs, IRS and larval source management at Hamusite town and the rural localities. In addition, encouraging family members infected with *plasmodium* species to seek timely treatment is also important to minimize the risk of infection among other family members.

**Abbreviations**

- APHI Amhara Public Health Institute
- FMOH Federal Ministry of Health
- HHs Households
- IRS Indoor Residual Spraying
- ITNs Insecticide Treated Mosquito Nets
**Declarations**

**Ethics approval and consent to participate**

Ethical approval was obtained from Bahir Dar University, College of Medicine and Health Sciences Ethical Review Committee with project code of 008/2020 prior to the commencement of the study. Permission letter was obtained from APHI and Support letter was also obtained from South Gonder Zonal Department, Dera Wereda Health Office and Hamusite Health Center. Informed consent and assent (for <18 years-old participants) was obtained from each study participant. Study participants with positive result for any malaria parasite were linked to the health center for appropriate treatment.

**Consent for Publication**

Not applicable

**Availability of Data and Materials**

The original data for this study is available from the corresponding author

**Competing interests**

The authors declare that they have no competing interests

**Funding**

Samara University was give fund for execution of the study

**Authors' contributions**

Getu A: undertook the data collection and participated in statistical analysis and manuscript preparation. Woyneshet G: participated in data analysis and write up of the manuscript. Getaneh A: conceived the study, participated in data analysis and write up of the manuscript. All authors read and approved the final version of the manuscript.

**Acknowledgments**

We are grateful to ethical review board of Bahir Dar University for giving ethical clearance. Our regards also go to the study participants for participating in the study. We also thank APHI, South Gonder Zonal Health Department, Dera Woreda Health Office, and Hamusite Health center for giving permission to perform data collection.

Co Authors Information

Institution Email Phone No
References

1. WHO. World Malaria Report 2011. World Health Organization. 2012; Geneva, Switzerland. Accessed 20 Jun, 2020.
2. Ferri, Protozoal infections. Ferri’s Color Atlas and Text of Clinical Medicine. Elsevier Health Sciences. 2009; Chapter 332.
3. World Health Organization. Guidelines for the treatment of malaria: 2015; ISBN: 978 92 4 154912 7 Accessed 15 Dec, 2019.
4. WHO. World malaria report 2017. 2017. Reference Source. Accessed Dec 20, 2019.
5. Alonso P, Noor A. M. The global fight against malaria is at crossroads. The Lancet, 2017; 390 (10112), 2532-2534.
6. World Health Organization. 2017c; ISBN: 978-92-4-156552 Accessed 15 Dec, 2019. https://www.who.int/malaria/publications/world-malaria-report-2017.
7. Federal Ministry of Health (FMOH). 2010. National five-year strategic plan for malaria prevention and control in Ethiopia 2006-2010. Addis Ababa, Ethiopia.
8. World Health Organization. Global Malaria Programmed Global action plan on physical activity 2018-2030: More Active People for a Healthier World, 2019; ISBN: 978-92-4-156572.
9. World Health Organization. The prevalence of symptomatic and asymptomatic malaria and its associated factors in Debreelias district communities, Northwest Ethiopia. (2017a); http://localhost:80/xmlui/handle/123456789/17811. Accessed 10 Dec, 2019.
10. Wudneh, F. Evaluation of the Efficacy of Artemether Lumefantrine (AL) in Patients with Uncomplicated Plasmodium Falciparum Malaria in Gende Wuha Health Center, North West Ethiopia (Doctoral dissertation, Addis Ababa University, 2015). Accessed 10 Dec, 2019.
11. Kayser. Medical Microbiology, part V (Parasitology), 2nd edition, 2005; p520.
12. Antia M, Herricks T, Rathod K. Microfluidic Modeling of Cell–Cell Interactions in Malaria Pathogenesis. PLoS Pathogens, 3(7): e99.
13. ClarkI, Cowden W. 2003. The pathophysiology of Plasmodium falciparum malaria. Pharmacology and Therapeutics, 2007; 99(2): 221-260. doi:10.1016/s0163-7258(03)00060-3.
14. Schellenberg D, Kahigaw E, Font F, Galindo C, Acosta C., et al. African children with malaria in an area of intense Plasmodium falciparum transmission: features on admission to the hospital and risk factors for death. American Journal Tropical Medicine Hygiene, 1999; 61(63): 431–438.
15. Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS. How many child deaths can we prevent this year. Lancet, 2003; 362:65–71.
16. Biniam B. A Four Year trend analysis of malaria prevalence in Asyta primary Hospital. 2018. Accessed 25 April, 2019.

17. Bisoffi Z, Gobbi F, Buonfrate D, Van den Ende J. Diagnosis of Malaria Infection with or without Disease. *Mediterr Journal of Hematoloy Infectious Disease*, 2012; 4(1): e2012036. doi:10.4084/MJHID.2012.036

18. Alemu A, Muluye, M. Mihret, M. Adugna and M. Gebeyhew. Ten year trend analysis of malaria prevalence in Kola Diba, North Gonder North west Ethiopia. *Parasites and vectors*, 2012; 5: 173.

19. Haque U, Hossain S, Huda M, et al. Malaria Prevalence in Endemic Districts of Bangladesh. *PLoS ONE*, 2009; 4 (8), 6737:1371.

20. Tesfaye. Prevalence of Malaria Among Patients Attending Assosa General Hospital, Western Ethiopia. 2017. Accessed 20 April, 2020.

21. Yimer, F, Anmut A, Erko B, Mamo H. Past five-year trend, current prevalence and household knowledge, attitude and practice of malaria in Abeshge, South central Ethiopia *Malaria Journal*. 2015; 14: 230. Accessed 20 April, 2019.

22. Sumari D, M. F, Selemani M, Mugasa J, Mugittu K, Gwakisa P. Malaria prevalence in asymptomatic and symptomatic children in Kiwangwa, Bagamoyo district, Tanzania. *Malaria Journal*, 2017. 16:222.

23. Huang F, Liu H, Xu J, Yang H, Adams M., et al. Prevalence of Clinical and Subclinical *Plasmodium falciparum* and *Plasmodium vivax*. Malaria in Two Remote Rural Communities on the China–Myanmar Border. *American Journal of Tropical Medicine Hygiene*, 2017; 1-16.

24. Fana SA, Anka SA, Imam AU, Nataala SU. Prevalence and risk factors associated with malaria infection among pregnant women in a semi-urban community of north-western Nigeria, *Infectious Disease Poverty*, 2015; 4(24), 1-5.

25. Tadesse F, Deressa W. Prevalence and associated risk factors of malaria among adults in East Shewa Zone of Oromia Regional State, Ethiopia: a cross-sectional study. *BMC Public Health*, 2018; 18: 25.

26. Delil RK, Habtu YA, Gone TF, Leta TJ. Magnitude of Malaria and Factors among Febrile Cases in Low Transmission Areas of Hadiya Zone, Ethiopia: A Facility Based cross-sectional Study. *PLoS ONE*, 2016; 7, 11(5), 1-17.

27. Molla. Prevalence of Malaria and Associated Factors in Dilla Town and the Surrounding Rural Areas, Gedeo Zone, Southern Ethiopia. *Journal Bacteriol Parasitol*, 2015; 6 (5), 1-7.

28. Debo. Prevalence of malaria and associated factors in Benna Tsemay district of pastoralist community, Southern Ethiopia. *Trop Dis Travel Med Vaccines*, 2016; 2(16), 1-9.

29. Gebretsadik. Eight-year trend analysis of malaria prevalence in Kombolcha, South Wollo, north-central Ethiopia: a retrospective study. *Parasites and Vectors*, 2018; 11: 55.

30. Abbeaw, A. The prevalence of symptomatic and asymptomatic malaria and its associated factors in Debre Elias district communities, northwest Ethiopia (Doctoral dissertation, Addis Ababa University). 2019; Accessed 7 December, 2019.

31. Chourasia, Bhatt R, Swain D, Valecha N, Kleinschmidt. Burden of asymptomatic malaria among a tribal population in a forested village of central India: a hidden challenge for malaria control in India *Public health*, 2017; 47, 9 2-9 7
32. Mengistu, H. Trend Analysis of Malaria Prevalence in Arsi Negelle Health Center, Southern Ethiopia. 2014; *Academic Journal*, 7(1), 1-6.

33. Federal Ministry of Health (FMoH). 2008. Ethiopia National Malaria Indicator Survey 2007. FMoH

34. Alemu A, Muluye M, Mihret M, Adugna M, Gebeyhew. Ten year trend analysis of malaria prevalence in Kola Diba, North Gonder North west Ethiopia. *Parasites and vectors*, 2012; 5:173.

**Tables**

**Table 1: Sociodemographic characteristics of (N=210) of study participant, Hamusite Health center, northwest Ethiopia from February to March 2020.**
| Variable            | Category                                | Frequency | Proportion (%) |
|---------------------|-----------------------------------------|-----------|---------------|
| Age group (in years)| 6-15                                    | 57        | 27.1          |
|                     | >15                                     | 153       | 72.9          |
| Sex                 | Male                                    | 105       | 50            |
|                     | Female                                  | 105       | 50            |
| Residence           | Urban                                   | 17        | 8.1           |
|                     | Rural                                   | 193       | 91.9          |
| Educational status  | Unable to read and write                | 121       | 57.6          |
|                     | Able to read and write                  | 18        | 8.5           |
|                     | Primary school                          | 48        | 22.9          |
|                     | Secondary school and above              | 23        | 11.0          |
| Marital Status      | Single                                  | 81        | 38.6          |
|                     | Married                                 | 129       | 61.4          |
| Family size         | <5                                      | 92        | 43.8          |
|                     | ≥5                                      | 118       | 56.2          |
| Occupation          | Farmer                                  | 148       | 70.5          |
|                     | Student                                 | 51        | 24.3          |
|                     | Private busines                         | 6         | 2.9           |
|                     | Employed                                | 5         | 2.4           |
| Kebele              | Kulala and Tanadenbiso                  | 6         | 2.9           |
|                     | Mestelie                                | 22        | 10.5          |
|                     | Wonchet                                 | 44        | 21.0          |
|                     | Geteba and Gegna                        | 10        | 4.8           |
|                     | Gergra and Silasie                      | 36        | 17.1          |
|                     | Zara                                    | 46        | 21.9          |
|                     | Hamusit                                 | 18        | 8.6           |
|                     | Emashnkuru Georgis                      | 28        | 13.2          |

Table 2: Clinical data of study participants among malaria suspected patients attending Hamusite Health center, northwest Ethiopia from February to March 2020.
| Variable                                      | Category | Frequency | Proportion (%) |
|-----------------------------------------------|----------|-----------|----------------|
| Malaria history within the previous 1 year    | Yes      | 96        | 45.7           |
|                                               | No       | 114       | 54.3           |
| Family members with history of malaria        | Yes      | 114       | 54.3           |
|                                               | No       | 96        | 45.3           |
| Axillary temperature (°C)                     | >37.5    | 177       | 84.3           |
|                                               | ≤37.5    | 33        | 15.7           |
| Duration of the present fever/illness         | ≤24 hrs  | 147       | 70.0           |
|                                               | >24 hrs  | 63        | 30.0           |
| Participants with fever                       | Yes      | 203       | 96.7           |
|                                               | No       | 7         | 3.3            |
| Sweating                                      | Yes      | 179       | 85.2           |
|                                               | No       | 31        | 14.8           |
| Headache                                      | Yes      | 191       | 91.0           |
|                                               | No       | 19        | 9.0            |
| Nausea                                        | Yes      | 160       | 76.2           |
|                                               | No       | 50        | 23.8           |
| Vomiting                                      | Yes      | 60        | 28.6           |
|                                               | No       | 150       | 71.4           |
| Weakness                                      | Yes      | 179       | 85.2           |
|                                               | No       | 31        | 14.8           |
| Loss of apetite                               | Yes      | 163       | 77.6           |
|                                               | No       | 47        | 22.4           |

Table 3: Malaria control activities and conditions among febrile patients in Hamusite health center, northwest, Ethiopia, 2020.
| Variable                                      | Category                        | Frequency | Proportion (%) |
|-----------------------------------------------|---------------------------------|-----------|----------------|
| Availability of ITN                           | Yes                             | 151       | 71.9           |
|                                               | No                              | 59        | 28.1           |
| Reason for unavailability of ITN              | Never received                  | 26        | 44.1           |
|                                               | Lost/given to somebody else     | 10        | 16.9           |
|                                               | Old and thrown away             | 23        | 39.0           |
| Proportion of one ITN to family members       | For 1-1.5 persons               | 41        | 27.1           |
|                                               | For 1.6 – 2.5 persons           | 64        | 42.4           |
|                                               | For more than 2.5 persons       | 46        | 30.5           |
| Habit of sleeping under ITN                   | Always                          | 127       | 60.5           |
|                                               | Sometimes                       | 24        | 11.4           |
|                                               | Never                           | 59        | 28.1           |
| House sprayed with IRS within 12 months       | Yes                             | 65        | 31.0           |
|                                               | No                              | 145       | 69.0           |
| Time of IRS spray                             | <6 months ago                   | 21        | 32.3           |
|                                               | ≥6 months ago                   | 44        | 67.7           |
| Presence of hole in the wall                  | Yes                             | 92        | 43.8           |
|                                               | No                              | 118       | 56.2           |
| Presence of surface water with in 500m from home | Yes                           | 160       | 76.2           |
|                                               | No                              | 50        | 23.8           |
| Type of surface water                         | River                           | 140       | 66.7           |
|                                               | Lake/pond                       | 3         | 1.4            |
|                                               | Swmp/small stagnant water       | 17        | 8.1            |
| Distance of surface water from home (meter)   | 0-100                           | 125       | 78.1           |
|                                               | 101-500                         | 35        | 21.9           |
| Habit of sleeping or working out side at night | Yes                             | 54        | 25.7           |
|                                               | No                              | 156       | 74.3           |
| Primary source of health information          | Radio/television                | 15        | 7.1            |
|                                               | Health proffesionals            | 144       | 68.6           |
| Heard about malaria | None | 51 | 24.3 |
|---------------------|------|----|------|
| Yes                 | 99   | 47.1 |
| No                  | 111  | 52.9 |

Table 4: The prevalence of Malaria Parasite in Hamusite kebeles, Northwest Ethiopia from February to March 2020.

| Total examined | Number positive | Prevalence (in %) |
|----------------|-----------------|-------------------|
| Commulative    |                 |                   |
| Overall prevalence | 210   | 61    | 29.0 |
| *P. falciparum* only | 41    | 19.5  |
| *P. vivax* only | 10   | 4.8   |
| Mixed infection | 10  | 4.8   |
| Parasite stage detected |       |       |       |
| Trophozoite only | 61  | 44    |
| Schizont only   | 1   |
| Gametocyte only | 2   |
| More than 1 stage | 14   |
| Gametocyte prevalence | Over all | 210 | 16 | 7.6 |

Table 5: Bivariate and multivariate logistic regression analysis of associated factors for malaria, in Hamusite kebeles, Northwest Ethiopia from February to March 2020.
| Variables                  | Category                        | Number examined | Rate of Plasmodium infection | COR (95%CI)          | P-value | AOR (95%CI)          | P-value |
|---------------------------|---------------------------------|-----------------|-------------------------------|----------------------|---------|----------------------|---------|
|                          |                                 |                 | N (%)                         |                      |         |                      |         |
| Sex                       | Male                            | 105             | 23 (21.9)                     | 1                    |         |                      |         |
|                          | Female                          | 105             | 38 (36.2)                     | 2.022 (1.099-3.722)  | 0.024   | 2.261 (1.118-4.571)  | 0.023   |
| Age group (years)         | 6-15                            | 57              | 32 (56.1)                     | 5.473 (2.825-10.602) | 0.000   | 2.463 (0.723-8.394)  | 0.150   |
|                          | >15                             | 153             | 29 (19.0)                     | 1                    |         |                      |         |
| Residence                 | Urban                           | 17              | 4 (23.5)                      | 1                    |         |                      |         |
|                          | Rural                           | 193             | 57 (29.5)                     | 1.362 (0.426-4.356)  | 0.602   |                      |         |
| Educational status        | Unable to read and write        | 121             | 36 (29.8)                     | 0.656 (0.226-1.902)  | 0.437   |                      |         |
|                          | Able to read and write          | 18              | 4 (22.2)                      | 0.972 (0.219-4.309)  | 0.970   |                      |         |
|                          | Primary school                  | 48              | 16 (33.3)                     | 0.556 (0.174-1.769)  | 0.320   |                      |         |
|                          | Secondary school and above      | 23              | 5 (21.7)                      | 1                    |         |                      |         |
| Marital status            | Single                          | 81              | 37 (45.7)                     | 3.679 (1.974-6.858)  | 0.000   | 2.136 (0.660-6.913)  | 0.205   |
|                          | Married                         | 129             | 24 (18.6)                     | 1                    |         |                      |         |
| Family size               | <5                              | 92              | 26 (28.3)                     | 1                    |         |                      |         |
|                          | ≥5                              | 118             | 35 (29.7)                     | 1.070 (0.586-1.954)  | 0.825   |                      |         |
| Malaria history within the previous 1 year | Yes                              | 96              | 28 (29.2)                     | 1.011 (0.556-1.838)  | 0.972   |                      |         |
|                          | No                              | 114             | 33 (28.9)                     | 1                    |         |                      |         |
| Family members with history of malaria | Yes                              | 114             | 44 (38.6)                     | 2.921 (1.532-5.571)  | 0.001   | 2.598 (1.264-5.340)  | 0.009   |
|                          | No                              | 96              | 17 (17.7)                     | 1                    |         |                      |         |
| Habit of sleeping under ITN | Always                          | 127             | 41 (32.3)                     | 1                    |         |                      |         |
|                          | Sometimes                       | 24              | 7 (29.2)                      | 0.816 (0.316-2.107)  | 0.674   | 1.134 (0.378-3.401)  | 0.822   |
|                                 | Never |  |     |             |     |     |     |
|---------------------------------|-------|---|-----|-------------|-----|-----|-----|
| House sprayed with IRS within 12 months | Yes   | 65 | 15(23.1) | 1.549(0.789-3.041) | 0.204 | 1.395(0.642-3.032) | 0.400 |
|                                  | No    | 145 | 46(27.6) | 0.620(0.301-1.276) | 0.194 | 0.947(0.419-2.140) | 0.895 |
| Presence of hole in the wall     | Yes   | 92 | 28(30.4) | 1.127(0.619-2.051) | 0.696 |       |     |
|                                  | No    | 118 | 33(28.0) | 1 |       |     |     |
| Presence of surface water within 500m from home | Yes | 160 | 53(33.1) | 2.600(1.140-5.932) | 0.023 | 2.225(0.884-5.597) | 0.809 |
|                                  | No    | 50  | 8(16.0)  | 1 |       |     |     |
| Habit of sleeping or working out side at night | Yes | 54  | 16(29.6) | 1.039(0.527-2.048) | 0.913 |       |     |
|                                  | No    | 156 | 45(28.8) | 1 |       |     |     |

AOR= Adjusted Odd Ratio; CI= Confidence Interval, COR= Crude Odd Ratio