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

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Research

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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, P.malariae*, and *P.knowlesi* 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 arabiansis,* 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

Sample Size and Sampling Technique

The sample size was calculated using single population proportion formula based on the 95% confidence limits ($Z\alpha/2 = 1.96$) 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].

$$\text{Sample size} = (Z\alpha/2)^2\, p\,(1-p)/d^2 = (1.96)^2\,(0.087)\,(1-0.087)/\,(0.04)^2 = 191$$

After compensating for non-responsedents, 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 house hold, presence of hole in the wall, presence of surface water with in 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 *plasmodiu*m 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 (Table1).

Clinical Data of Study Participants

Out of 210 study participants, 177 (84.3%) had axillary temperature of 37.5^0C 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

PCR Polymerase Chain Reaction

WHO World Health Organization

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

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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.

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Tables

Table 1: Sociodemographic characteristics of (N=210) of study participant, Hamusite Health center, northwest Ethiopia from February to March 2020.

Variable	Catagory	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	Catagory	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	45.7
Axillary temperature (^{0}C)	>37.5	177	84.3
	≤37.5	33	15.7
Duration of the present fever/illnes	≤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	Catagory	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

	None	51	24.3
Heard about malaria	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 N (%)	COR (95%CI)	P-value	AOR (95%CI)	P-value
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	59	13(22.0)	0.620(0.301-1.276)	0.194	0.947(0.419-2.140)	0.895
House sprayed with IRS within 12 months	Yes	65	15(23.1)	1			
	No	145	46(27.6)	1.549(0.789-3.041)	0.204	1.395(0.642-3.032)	0.400
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							