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Malaria Incidence and Trend of Prevalence in and around Anger Gute Town, Western Ethiopia

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Authors' contributions

This work was carried out in collaboration among all authors. Author OK designed the study and wrote the protocol. Author GT performed the statistical analysis. Author MD wrote the first draft of the manuscript and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The study aims to assess malaria incidence, trend of prevalence and associated risk factors in the study area.
Study Design: A cohort of 41,996 residents in five kebeles (the lowest government administrative unit) in 8,750 households was followed for malaria incidence study. Whereas, facility-based cross-sectional study was undertaken for malaria prevalence trend analysis.
Place and Duration of Study: In and around Anger Gute town, Western Ethiopia. The malaria incidence study was undertaken for seven months from June to December 2018.Whereas, the malaria prevalence trend analysis was carried out for six years from 2013-2018.
Methodology: To determine the malaria incidence, cases coming from purposefully selected five kebeles to three health posts and one health center were diagnosed in which a total of 462 respondents participated. Parasitological data were collected using malaria parasite diagnostic tools. Structured questionnaires were used to assess the malaria incidence associated risk factors. In addition, to determine malaria trend prevalence retrospective malaria data were taken from Anger Gute health center. Data analysis was performed using SPSS version 20.0. P values of less or equal to 0.05 were considered significant.

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Results: Of 462 blood samples taken from febrile patients, 26.4% had *Plasmodium* infection. Among positive cases, 64.75 %, 32 % and 3.75% of malaria was caused by *P. falciparum, P. vivax* and both *P. falciparum* and *P. vivax* infections respectively. Malaria incidence was found to be 0.343 %. No significant difference in incidence of malaria was found by sex and age categories of study participants (P>0.05). Incidence of malaria was significantly lower in urban kebeles compared to rural kebeles (COR= 0.359 and significantly associated with presence of stagnant water nearby living house (AOR=186.3, P=0.000), utilization of bed net (≥0.08, P=0.000), and IRS (AOR=0.056, P=0.03).The overall malaria incidence was 3.43 per 1000 population at risk of the disease during the study period.Whereas, the six years retrospective data showed decrease in malaria prevalence trend from 2014 - 2018 as compared to 2013.

Conclusion: Incidence of malaria was 3.43 per 1000 population at risk of the disease during the study period and was lower than recent incidence of malaria reported from Ethiopia. The six years retrospective data showed decrease in malaria prevalence trend from 2014 - 2018 as compared to 2013.

Keywords: Anger Gute; Ethiopia; incidence; malaria; prevalence; risk factor.

1. INTRODUCTION

In 2011, the World Health Assembly, Roll Back Malaria Partnership, set the objectives to reduce malaria case by 75% and malaria deaths to near zero [1]. Progress reports thereafter showed that global, malaria case decreased from 227 million in 2000 to 198 million in 2013 [2]. The incidence was then projected to fall by 35% globally and by 40% in the African region by 2015. In Ethiopia, malaria is one of the leading causes of morbidity and mortality. It is estimated that about 75% of the total area of the country and 68% of the population were exposed to malarial infection [3]. The important infectious agents of malaria in the country are: *Plasmodium falciparum* and *Plasmodium vivax,* that account for 60% and 40% of malaria cases, respectively [4]. Malaria is seasonal in most parts of Ethiopia and its transmission peaks twice in a year, from September to December (major transmission) and from April to May (minor transmission) [5]. The sole prime malaria vector in Ethiopia including in the study setting is *Anopheles arabiensis* a member of *Anopheles gambiae* sensu lato complex [6].

In Ethiopia, regardless of implementation of control interventions for a couple of decades and achievements of a 50% reduction target [7], malaria remain a major public health problem [8]. Nevertheless, the country is planning to eliminate malaria in the upcoming decades. The current core malaria control and elimination interventions are prompt treatment of cases using artemisinin-based combination therapy (ACT) and massive operational deployment of long-lasting insecticidal nets (LLINs) and indoor residual spray (IRS) [5].

In the derive to eliminate malaria, evidence about local and focal transmission of the disease as well as status of local community exposure to the frontline malaria intervention tools such as LLINs and IRS is needed for good knowledge and informed decisions about the effectiveness and efficacy of interventions in routine malaria control programs. To consolidate such evidence generation and informed decisions for malaria control and elimination goals, the Ethiopian National Malaria Control Program (NMCP) has established 25 Malaria Surveillance Sentinel Sites (MSSs) across the country [9].

The NMCP collaborates with various institutions from the health and education sectors such as the academia, research institutes and Non Governmental Organizations (NGOs) for evidence generation, evaluation of program implementation and research at each MSS. One of the 25 MSSs targeted for malaria research in collaboration with Wollega University, NMCP, Ethiopian Public Health Research Institute (EPHI) and other stakeholders is Anger Gute MSS. Empirical evidence on malaria transmission incidence, prevalence and associated risk factors has been lacking and warrant basic and operational research at the MSS. This study therefore, aims to assess malaria incidence, trend of prevalence and associated risk factors in and around Anger Gute town, East Wollega zone, Oromia Regional State, Western Ethiopia.

2. MATERIALS AND METHODS

2.1 Study Area and Period

The study was conducted in two malarious kebeles of Anger Gute town (Anger Gute 01, and 02) and from three selected kebeles (Warabo, Tulu Lencha and Dalasa Makanisa) from the surrounding kebeles. The study was undertaken from June to December 2018 including the seven months for a parasitological study and a six years (2013-2018) retrospective trend analysis. Anger Gute area is found in Gida Ayana district in the East Wollega Zone of Oromia Regional State, western Ethiopia (Fig. 1). The study area is located about 360 km west of Addis Ababa along the main road connecting Jimma to Bahir Dar via Nekemte and set in the Anger River Valley (upper Blue Nile Valley) in western Ethiopia. The population of this sub-district is 59,445 [10]. The altitude of the area is between 1200m to 1500m above sea level and on global positioning, the study area is located at latitude of $N9^0$ 33'57" and longitude of $E36^0$ 37'57". The daily mean temperature is 28^0C and the area is affected by seasonal/unstable malaria transmission.

2.2 Study Design

A cohort of 41,996 residents in the five kebeles in 8,750 households was followed for malaria incidence study from June December 2018.Whereas, facility-based cross-sectional study was undertaken for malaria prevalence trend analysis from 2013-2018.

2.3 Study Population

The study population included all patients with febrile illness and history of fever for the last 48h that visited the three health posts of the rural kebeles namely Warabo, Tulu Lencha and Dalasa Makanisa health posts and one urban health center (Anger Gute health center). All categories of the target people such as sex, age, pregnancy and other socio-demographic factors were considered. Participant inclusion criteria include all patients with febrile illness and history of fever for the last 48h and that visited the health care services and diagnosed by clinicians for malaria during the study months.

2.4 Sample Size Determination and Sampling Method

The five study localities were selected purposely, based on their proximity to mosquito breeding areas (streams) and most recent reports of malaria transmission and vector interventions [10]. The convenient sampling method was used for the participant selection for the incidence study in which 462 study participants were engaged in the study. In addition, a six years (2013-2018) retrospective clinical malaria data were used to determine the trend of malaria at the study setting by available sampling method.

2.5 Data Collection Methods

2.5.1 Malaria parasite diagnosis

Data on malaria parasite infection was collected using blood film microscopy in the urban health center and rapid diagnostic tests (RDTs) in health posts from June-December 2018 every day. Once patients were suspected of malaria mainly based on fever (body temperature ≥37.5 °C and/or history of fever in the last 48 h), a finger prick blood samples were collected for RDTs and microscopic slide examination. Thick and thin blood films were made separately on a single glass slide. The procedure was performed by a trained medical laboratory technician as per the standard [11]. The slides were labeled, air-dried and the thin film was fixed with methanol before staining with Giemsa. Slides were subjected to 3% Giemsa for 30–45 min at Anger Gute health center laboratory unit. A minimum of 200 fields were scanned to report negative slides. Discordant slides were read by independent microscopist.

2.5.2 Structured questionnaire survey

For the health-facility based cross-sectional study, structured questionnaires addressing the socio-demographics and risk factors of malaria among patients attending three health posts and one health center in the study area were used. The survey questionnaire was based on the malaria indicator survey household questionnaires, which were filled by the participants. The questionnaire was administered to 462 participants who gave their blood samples at the health care and who were volunteers to fill the questionnaire by trained interviewers considering the schedule of the participants.

2.6 Health-Facility Based Record

For the retrospective study, secondary data on malaria parasite infection in the past six years (2013-2018) were retrieved from the health service laboratory unit registry to compute the trend of malaria in the community.

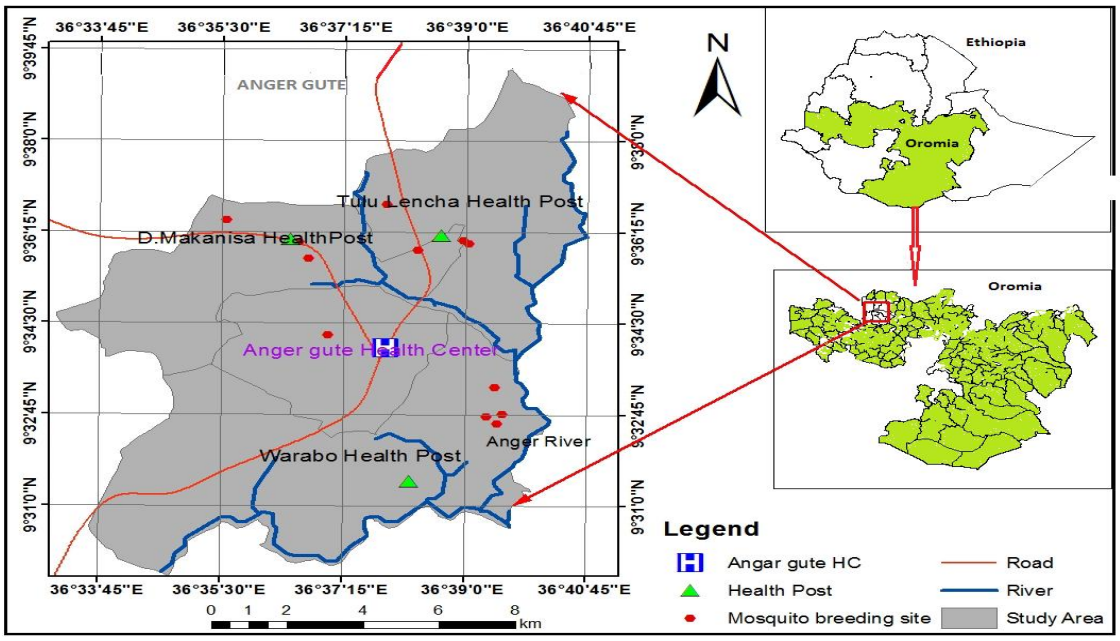

Fig. 1.Study area map, in and around Anger Gute town, East Wollega Zone,Oromia Regional State, Western Ethiopia

2.7 Data Entry and Analysis

Data entry and analysis were performed using SPSS 20.0 for windows software. Logistic regression analysis was used to determine presence of association between incidence of malaria and associated risk factors. P values of less than or equal to 0.05 were considered significant.

3. RESULTS

3.1 The Incidence of Malaria Parasite Infection among the Study Participants

The overall prevalence of malaria parasite infection among the study participants was 26.4%. Among malaria positive cases, 64.75 % (79/122) and 32 % (39/122) of malaria parasite infection was caused by *P. falciparum* and *P. vivax* respectively. Incidence of mixed infection with *P. falciparum* and *P. vivax* was 3.75% (4/122). *P. falciparum* is the predominant species (Fig. 2).

3.1.1 Socio-demographic characteristics and incidence of malaria

In the assessment of incidence of malaria over seven months from June to December 2018, incidence was not associated with sex, age categories and educational status of study participants (P>0.05). Incidence of malaria was significantly lower in urban kebeles compared to rural kebeles of Anger Gute (AOR= 0.243, P=0.00) (Table 1).

3.1.2 Incidence of malaria in relation with risk factors

Sleeping behaviors such as outdoor, covering hands and faces while sleeping and living house roof type were not associated with incidence of malaria (P>0.05). However, incidence of malaria was significantly associated with presence of stagnant water nearby living house; utilization of bed net and IRS (P< 0.05).Individuals that practiced living near stagnant water was more likely to acquire malaria when compared to their counterparts (Table 2).

3.2 Six Years Malaria Trend of Prevalence at Anger Gute Health Center

Six years retrieved data from Anger Gute health center laboratory unit registry showed that number of confirmed malaria cases was significantly decreased from 2014- 2018 as compared to 2013. Whereas, since 2014 it has been more or less nearly unchanged. Over the six years, confirmed malaria cases showed three peaks. The most peak was observed in

September, 2013 followed by November, 2013 and March, 2013. The least peak was observed in January 2018 (Fig. 3).

4. DISCUSSION

4.1 Incidence of Malaria

Out of all patients with febrile illness and history of fever for the last 48h that visited the health services about one forth of them were positive for *plasmodium* infection, while three forth or majority of them were negative. The overall incidence of malaria in and around Anger Gute town was 3.43 per 1000 population/seven months from June to December 2018 at risk of the disease. This incidence rate was lower than global incidence rate of malaria reported in 2017 which 59 cases per 1000 population at risk [12] .This was finding was also lower than recent incidence of the disease reported from Ethiopia which was 29.0 cases per 1000 population/year [13]. Reduction in incidence of malaria in and around Anger Gute malaria endemic areas is evident toward malaria elimination. Among malaria positive cases, majority of them were due to *P. falciparum* followed by *P. vivax*. Indicating that *P. falciparum* is the predominant species. The higher *P. falciparum* prevalence rate could be attributed to problems with emerging drug resistance and is in agreement with reports by [14].

4.2 Socio-demographic Characteristics and Incidence of Malaria

Over seven months from June to December 2018, significant difference in incidence of malaria were not found by sex (COR=1.167, P=0.468) and age categories of febrile patients (P>0.05). Incidence of malaria was significantly lower in the urban kebeles compared to the rural

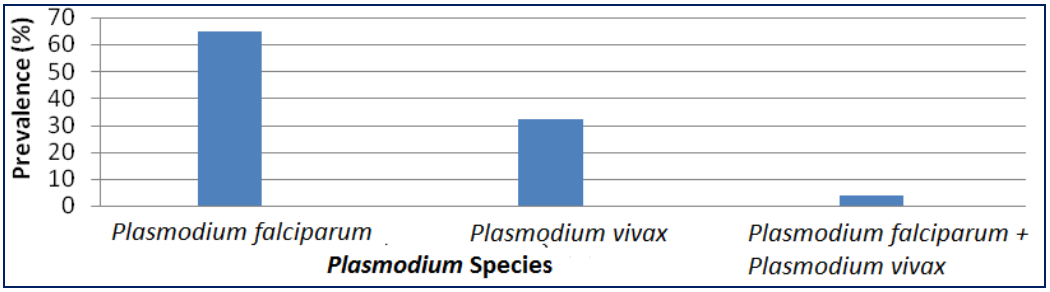

Fig. 2. *Plasmodium* species identified among malaria cases in and around Anger Gute town (n=122)

Table 1. Association between socio-demographic characteristics and incidence of malaria in and around Anger Gute town (n= 462)

Variable	Variable categories	*Plasmodium* infection		COR*	P value	AOR**	P value
		Yes	No				
Gender	Male	61	157	1.167	0.468	1.14	0.56
	Female	61	183	1		1	
Age	<5	3	17	3.76	0.247	3.52	0.29
	5 – 14	23	89	2.43	0.413	1.68	0.64
	15 – 29	42	90	2.93	0.22	2.7	0.37
	30 – 49	53	136	3.12	0.29	3.2	0.3
	>49	1	8	1			
Educational status	Illiterate	149	59	1.58	0.684	1.48	0.74
	Primary	142	51	1.44	0.75	1.7	
	Secondary	45	11	0.9	0.985	0.96	0.65
	Tertiary	4	1	1			0.97
	Urban	14	110	0.359	0.00	0.243	0.00
	Rural	108	230	1		1	

**COR means Crude Odd Ratio; **AOR means Adjusted Odd Ratio*

Table 2. Incidence of malaria in relation with risk factors or preventive measures of malaria in and around Anger Gute town (n= 462)

Variable	*Plasmodium* infection		COR*	P value	AOR**	P value
	Yes	No				
Stagnant water near living house	92	11	91.72	0.000	186.3	0.00
	30	329	1		1	
Sleep out door	24	98	2.53	0.002	1.68	0.346
	30	310	1		1	
Hand & face covered while sleeping	36	86	0.363	0.00	2.05	0.11
	182	158	1		1	
Roof type						
Corrugate	99	292	0.71	0.215	0.425	0.35
Straw	23	48	1		1	
Wall of house						
Cracked	33	52	1.991	0.007	1.178	0.874
Hole	2	15	0.42	0.253	0.529	0.557
No crack or hole	87	273	1		1	
Bed net presence	26	264	0.078	0.000	1.075	0.905
	96	76	1		1	
Bed net utilization	3	249	0.009	0.00	0.08	0.00
	119	91	1		1	
IRS	2	178	0.015	0.00	0.056	0.03
	120	162	1		1	

**COR means Crude Odd Ratio; **AOR means Adjusted Odd Ratio*

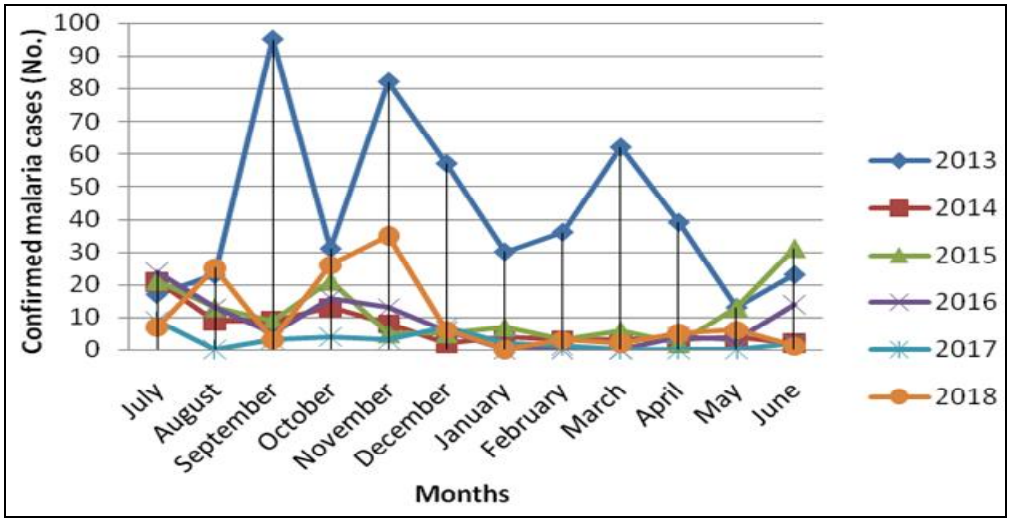

Fig. 3. Six years malaria trend of prevalence among confirmed cases at Anger Gute health center

ones (COR= 0.359, P=0.00).Results also underscore that incidence of malaria was higher in rural areas than urban. This is in agreement with study conducted by [15] and could be expected because rural areas are considered to be at higher risk of malaria compared to urban areas because of less improved housing, lower socioeconomic status and large number of breeding sites for malaria vectors in rural than urban areas.

It was also found that the occurrence of malaria in and around Anger Gute town was hundred and eighty six times more among study participants who had stagnant water nearby their living house as compared to those who did not have proximity

to such mosquito breeding sites. This is also in line with findings reported by [16] and showed importance of source reduction in control of malaria through environmental modification, draining and filling. Incidence of malaria was not also associated with educational status of study participants. This finding is important and provides baseline information for community based malaria intervention and elimination programs, particularly in the study setting.

4.3 Incidence of Malaria in Relation with Risk Factors

Outdoor sleeping behavior, hand & face covering while sleeping and living house roof type were not associated with incidence of malaria ($P>0.05$). However, incidence of malaria was significantly associated with presence of stagnant water nearby living house, utilization of bed net and IRS ($P< 0.05$). Use of mosquito net as protective measure against mosquito bites in the last 12 months was high in the study setting. This result coincides with a study conducted by [17] in Arba Minch Southern Ethiopia in which use of mosquito net as malaria preventive measure was high while, other preventive measures such as environmental modification and draining and filling was low among residents. This study has shown that core malaria preventive measures such as insecticide treated bed net utilization and IRS have protective role for occurrence of malaria. Among the surveyed individuals, three variables (living near stagnant water, utilization of bed net and IRS) were found to become predictors of malaria prevalence. An individual who practiced living near stagnant water was more likely to acquire malaria when compared to their counterparts and this finding is coincides with a study conducted by [16].

4.4 Trend of Malaria Parasite Infection in the Study Area

Six years trend analysis of confirmed malaria cases at Anger Gute health canter indicated a decrease in number of cases in the past five years as compared to 2013 which is in line with research conducted by [13] .However, number of malaria cases were nearly unchanged in 2014 to 2018, indicating low sustained malaria transmission in the study area. Intervention tools available currently can most likely reduce transmission and gains made during recent years in reducing number of malaria cases as compared to 2013. As reported by [18] this findings also shows that lowering number of cases may comparatively be easy, but complete elimination of the disease may not be so easy due to factors such as insecticide resistance. Previous studies show that the major malaria vector *Anopheles arabiensis* is resistant to pyrethroids [19], indicating further efforts are needed to suppress transmission that lead to elimination of the disease.

5. CONCLUSION

Seven months of malaria incidence in and around Anger Gute town was lower than recent incidence of malaria reported from Ethiopia. Trend analysis of malaria from 2014 to 2018 indicated nearly unchanged numbers of malaria cases and shows presence of low sustained malaria transmission. Malaria preventive measures such as insecticide treated bed net utilization and IRS have protective role for occurrence of malaria.

6. RECOMMENDATIONS

The findings of this study underscore the presence of active malaria transmission over the study periods.Therfore,community based sustainable malaria intervention including destruction of stagnant water nearby living house, utilization of bed net and IRS are needed to suppress transmission that lead to elimination of the disease in the study setting.

CONSENT

Verbal consent was obtained from study participants.

ETHICAL APPROVAL

Ethical approval was obtained from Wollega University Research Ethics Review Committee with a Ref/No. of: WU, RD, 214, 2011

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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