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FIVE YEARS TREND ANALYSIS OF MALARIA PREVALENCE IN JARDGA JARTE DISTRICT, WESTERN ETHIOPIA

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ABSTRACT: Retrospective study on malaria prevalence was conducted to determine a five-year malaria trend in three health facilities in Jardga Jarete district, western Ethiopia. All malaria cases reported from 2015 to 2019 in three health centers were carefully reviewed from the laboratory record books to determine the trends of malaria morbidity. The data were analyzed and presented in tables and figures. A total of 25,868 patients with malaria complaints were screened for malaria using microscopy within five years, of which 4,336 (16.8%) were confirmed positive cases. Higher percentage of malaria slide positivity rate was detected in Dandy (42%) followed by Haro Lago (38%) and Akeyu (20%) health centers. *Plasmodium falciparum*, *P. vivax*, and mixed infections accounted for 59.2%, 33%, and 7.8% of slide positive malaria rates, respectively. Males were more affected (n=2,465; 56.85%) than female ones (n=1,871; 43.15%). Malaria was higher in the age group ≥16 years (73.7%), followed by 6–15 years (13.4%), and 1-5 years (12.4%). The highest prevalence of malaria was observed through the months of September to November (27.1%), while the lowest infection rate was during the dry season months of December, January, and February, with a prevalence of 22.5%. This study revealed that malaria is a public health burden, with *P. falciparum* being the predominant malaria parasite followed by *P. vivax*. As a result, it is imperative to strengthen evidence-based malaria interventions that can contain the burden of the disease in the area.

Key words/phrases: Ethiopia; Jardga Jarete; Malaria; Prevalence; Retrospective

INTRODUCTION

Malaria is the most important parasitic disease that causes massive morbidity and mortality and poses a higher burden of disease in the tropics. More than 90% of malaria burden occurs in sub-Sahara Africa (SSA), causing severe morbidity and mortality among young children of rural areas with little access to health services (WHO, 2018). It mainly affects the poorest and most vulnerable communities due to the least access to effective services for prevention, diagnosis, and treatment. Of the four most common species of *Plasmodium* that infect humans, the vast majority of deaths in SSA are caused by *P. falciparum*, while *P. vivax*, *P. malariae* and *P. ovale* cause generally milder forms of malaria (WHO, 2018). Theses malaria parasites are transmitted by the bite of female *Anopheles* mosquito species.

In Ethiopia, malaria caused by *P. falciparum* and *P. vivax*, is a major challenge to both public health and socio-economic development. Three quarters of its landmass is considered endemic for malaria, putting 68% of the total population more at risk for infection (EPHI, 2016). This protozoan infection was responsible for 14% of outpatient visits and 9% of admissions in the country in 2009/2010 (FMOH, 2011). In 2016, there were an estimated 2,927,266 new malaria cases and 4,782 deaths (Tadele Girum *et al*., 2019). Varying topographical and climatic features contribute to the seasonal and unstable malaria transmission pattern in Ethiopia, which is usually characterized by frequent focal and cyclic, widespread epidemics. The transmission of malaria peaks bi-annually from September to December and April to May, coinciding with the major harvesting seasons (FMOH, 2010).

Similar to other regions in Ethiopia, malaria has continued to be a leading public health challenge in Oromia Regional State, primarily occurring in epidemic forms from the months of September to December, peaking in October and November (Wakgari Deressa *et al*., 2004; PMI, 2012). More than three quarters of the region, i.e., 262 of 297 (88%) districts and 4,237 of 6,765 (63%) *kebeles* are prone to malaria transmission, accounting for over 17 million persons at risk of malaria infection (PMI, 2012). This has been further substantiated by

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the report that clinical malaria in Oromia region accounts for about 30% of the total outpatient consultations and for 20–30% of the total inpatients (PMI, 2012). Various retrospective and cross-sectional studies conducted in parts of Oromia region have shown the overall malaria positivity rates ranged from 0.56% to 49.4% (Newman *et al*., 2003; Ashton *et al*., 2011; Kassahun Tegegne and Zalalem Kaba, 2019; Frew Tadesse *et al*., 2018; Dawit Hawaria *et al*., 2019).

Specifically, in East Wellega zone, western Oromia, malaria has widespread occurrence and is a major public health burden (Desalegn Amenu, 2014; Kassahun Tegegne and Zalalem Kaba, 2019; Dawit Hawaria *et al*., 2019). Analyzing the morbidity pattern of malaria in endemic areas would help to understand the dynamics of disease transmission and to evaluate the effectiveness of proven malaria control interventions to curb the disease burden in a locality. However, such information is lacking from different malaria endemic areas of Horo Guduru Welega zone, including Jardega Jarete district, where higher prevalence of malaria was recorded (Jardega Jarete District Health Bureau, unpublished data). Thus, this retrospective study aimed at determining the prevalence and trends of malaria among patients attending three health centers in Jardga Jarete district, western Ethiopia, from 2015 to 2019.

METHODS AND MATERIALS

Description of study area

The study was conducted in Jardega Jarte district, Horo Guduru Wellega Zone of Oromia Regional State, western Ethiopia (Fig. 1). It is located 368 km west of Addis Ababa. The district lies between 9°39′ to 10°10′N latitude, 36°50′ to 37°30′E longitude. The elevation of Jardega Jarte district ranges from 1400 to 2700 ms above sea level (Hika Wana and Afsaw Lemessa, 2019). The district has a bimodal rainfall pattern, with an annual average rainfall of about 1236-2000 mm per year as well as a mean annual temperature that ranges from 16°C to 27°C (Ethiopian Meteorology Agency, unpublished data). Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia, the district has a total population of 48,943 of whom 24,475 were men and 24,468 were women (CSA, 2007). Currently, there are 3 public health centers and 18 health posts in the district. From these, only three had five years (2015-2019) of recorded data of malaria patients (Dandy, Haro Lago, and Akeyu) in health centers. However, the remaining health facilities did not have complete recorded data of five years microscopic confirmed results. Therefore, the study focused on only three health centers (Dandy, Haro Lago, and Akeyu).

Study design and population

A health facility-based retrospective study was conducted to determine the five-year trend of malaria prevalence at the three health centers in Jardega Jarete district. The target populations for the study were all malaria suspected individuals who had complaints of febrile illness in the three health centers (Dandy, Haro Lago, and Akeyu) during 2015-2019. The selection of these health centers was done using purposive sampling technique because malaria morbidity records were complete compared to other health facilities in the study district.

Data collection

A five-year (2015-2019) retrospective data on the trend of malaria prevalence were carefully reviewed from the laboratory logbook of the three health centers. Individual data such as total clinically treated, confirmed cases in month and year, types of malaria species, and socio-demographic data (age, sex) were extracted. Experienced medical laboratory technicians collected the data. Any data such as the socio demographic, and malaria diagnosis results, which were not properly documented, were excluded. Throughout the reviewed period, microscopy was used as the gold standard for the detection and species identification of *Plasmodium* parasites by examination of peripheral smears of stained blood films, as per the WHO protocol (WHO, 1991). In the health centers, thick and thin blood smears were prepared to observe the presence of malaria parasites by direct microscopy techniques. The blood smears were prepared on microscope slides and stained using 10% Giemsa to be examined under 100x microscope for the presence of malaria parasites. The blood slides were read and then classified qualitatively as either negative, *P. falciparum* positive, *P. vivax* positive, or mixed infection. All individuals who had fever on physical examination and were positive for malaria parasites during blood film examination were offered anti-malarial treatment as per national guidelines (FMOH, 2004).

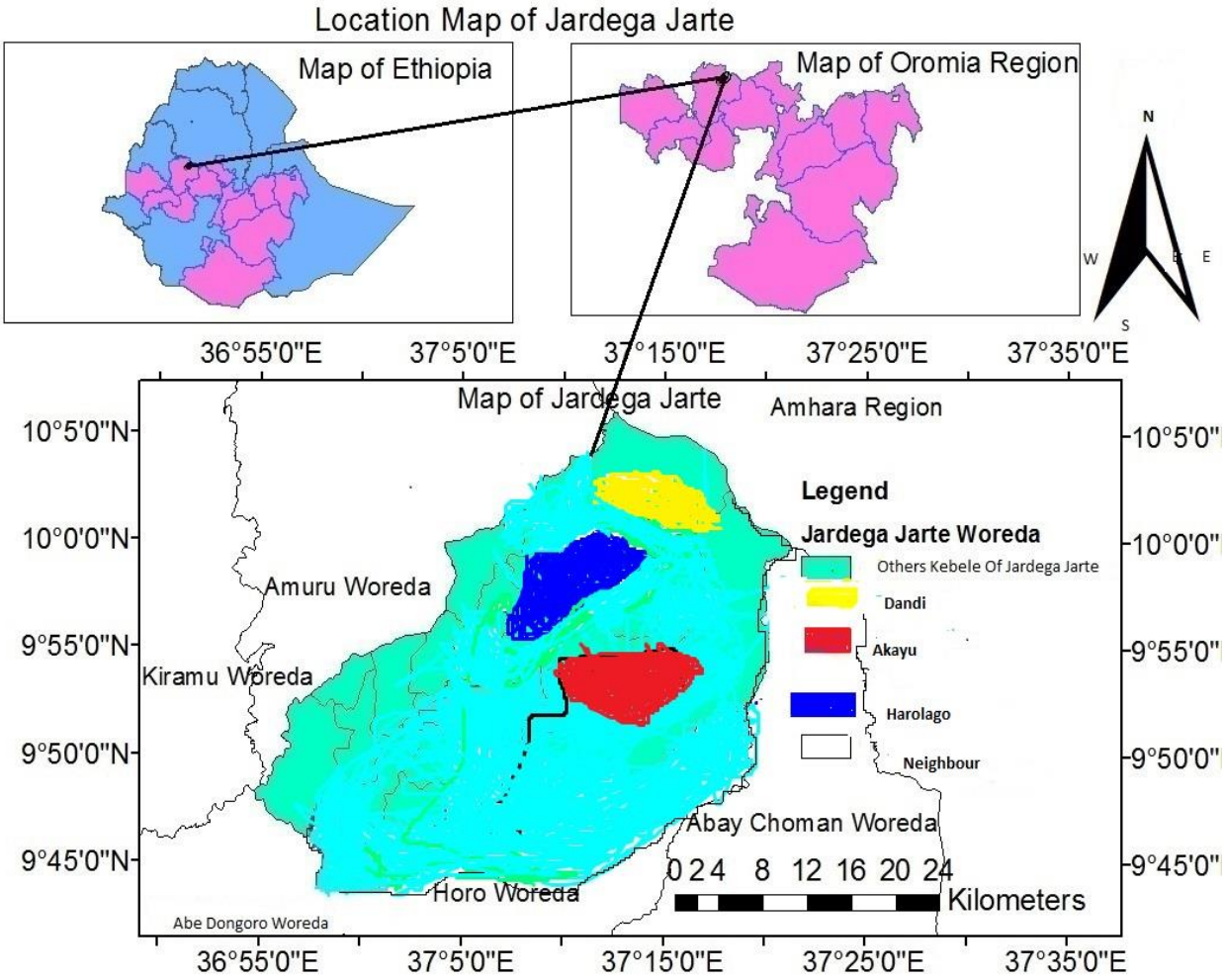

Figure: 1. Map of the study villages in Jardega Jarte district in Horo Guduru Wellega Zone of Oromia Regional State, western Ethiopia (Source: GIS Output).

Data quality control

The completeness of the malaria registration books in the health center was first assessed to ensure the quality of data. Then, data collection format sheet was prepared and used for data recording. Prior to data extraction, data collectors were adequately trained about the data extraction. The investigators, where a sample of the completed data collection forms was randomly selected and checked daily for accuracy, completeness, and consistency, followed the overall process of data extraction. We have also checked the number of confirmed cases with the number of suspected cases throughout the reviewed data.

Data analysis

All data from clinical records were checked for completeness and cleaned for any inconsistencies to analyze. The data were entered into excel and analyzed using SPSS statistics, version 20 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to show the trends of malaria transmission in terms of seasons, years, gender, age, and species of malaria parasite. To compare the trend of malaria prevalence in sex, age groups, and seasons chi-square test was used. Statistical significance was considered at $P<0.05$. The analyzed data were presented using tables and figures.

Ethics consideration

The five-year retrospective data was collected from the health centers after ethical clearance was obtained from the College of Natural Sciences Institutional Ethics Review Board, Addis Ababa University. Support letter was also obtained from the Department of Zoological Sciences and submitted to Health center of Jardega Jarete district, where all information gathered from recorded data. After discussing the purpose and method of the study, verbal consent was sought from the Head of the district Health Bureau before the data collection.

RESULTS

Annual trends of malaria case prevalence

Over a period of five years, a total of 25,868 blood smears from malaria suspected patients were microscopically diagnosed in the health facilities at the study area (Table 1). Of the total Blood smears examined, 4,336 (16.8%) were positive for malaria. The prevalence of malaria was highly variable across years ranging from 29.8% to 4.9% (χ^2 =33.25, df=4, *P=0.001*, Fig.2). There were variations in the number of malaria cases, with the minimum (333) confirmed cases reported in 2016, and the maximum (1157) ones in 2017. The prevalence had shown a sharp fall from 2015 to 2016. Then, from 2016 to 2017, it had shown a sharp rise. Through 2017 to 2019, the prevalence had shown a slight increment, peaking in 2018 (29.8%) (Fig. 2).

Table1: Annual trend of malaria cases at Jardga Jarete district health centers, western Ethiopia (2015-2019).

Year	Number of Blood Smear Examined	No. of Positive Malaria Smear (%)	P-value
2015	6600	856	
2016	6756	333	P=0.001
2017	5640	1157	
2018	3450	1029	
2019	3422	961	
Total	25,868	4,336 (16.8)	

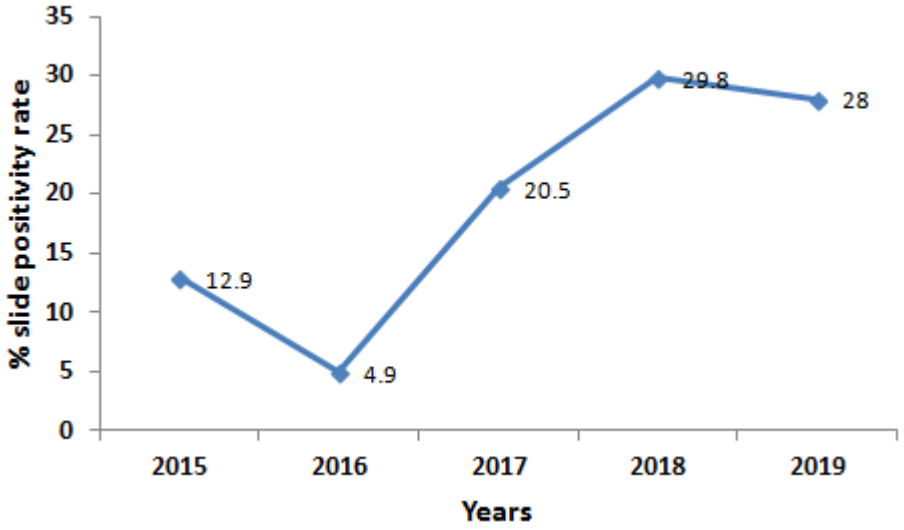

Figure 2: Trend of blood film positive rate of malaria at three health centers in Jardga Jarete district, western Ethiopia (2015-2019).

The data collected from the three health centers in the district showed variations in the prevalence of malaria (P<0.05). The highest prevalence (42%) was recorded in Dandy health center followed by a prevalence of 38% and 20.02% from Haro Lago and Akeyu health centers, respectively (Fig. 3).

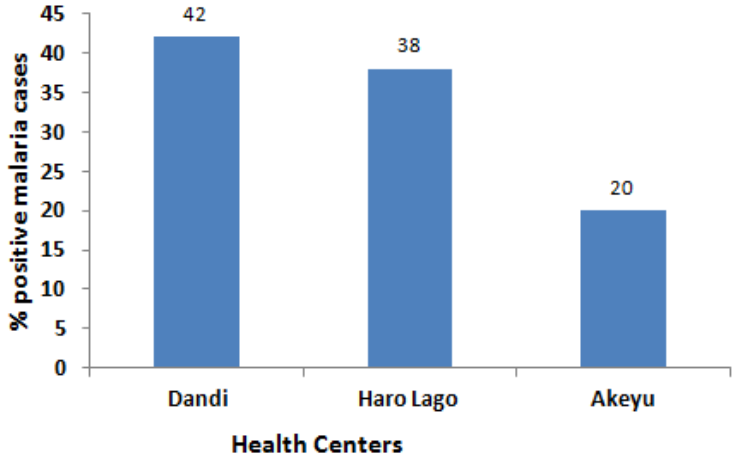

Figure 3: Prevalence of malaria in three health centers of Jardga Jarete district, western Ethiopia (2015-2019).

Prevalence of malaria cases in relation to sex and age

Table 2 shows the number and prevalence of confirmed malaria cases by sex and age over the past 5 years. Of the total patients examined, 15,361 (60%) were males and 10,507 (40%) were females. A statistically significant variation ($\chi 2$=284.15, d.f.=1, *P<0.05*) in malaria prevalence was observed between sexes. The prevalence of malaria among male and female patients was 2,465 (56.8%), and 1871 (43.2%), respectively (Table 2).

Regarding the age groups, malaria infection was recorded among all age groups. There was a statistically significant association between malaria burden and age groups ($\chi 2$ = 132.0, d.f.=5, *P<0.05*). The highest infection occurred in the age group 16 years and above, with a prevalence of 73.7%, followed by a prevalence of 13.4% in the age group of 6-15 years, and 12.9% in the age group of under five years (Table 2).

Table 2. Total malaria cases by sex and age category in Jardga Jarete district, western Ethiopia (2015-2019).

Sex	Age category			Total (%)	P-value
	1-5	6-15	≥16		
Male	322	329	1814	2465 (56.8%)	*P=0.001*
Female	238	253	1380	1871 (43.2%)	
Total (%)	560 (12.9%)	582 (13.4%)	3194 (73.7%)	4336 (16.7%)	

Distribution of Plasmodium species

In this study, *P. falciparum* and *P. vivax* were the only species in the study area, where *P. falciparum* accounted for 2,561 (59.1%), *P. vivax* was 1,434 (33.1%), and the rest 341 (7.9%) were mixed infections of both species (Fig. 3). There was a statistically significant difference in parasite positivity and years ($\chi 2$ = 115.0, d.f.=5, *P<0.05*). In the five-year trend analysis, the prevalence of *P. falciparum* was roughly 1.8 times than that of *P. vivax*. The prevalence of *P. falciparum* slightly declined from 60.9% to 60.3% during the year 2015–2018, with the highest rate (64.3%) in 2019 (Fig. 4). However, the prevalence of *P. vivax* that was 32.6% at the beginning of the study (2015) slightly rose to 33.2% through the year 2016–2018, and then decline to its lowest rate (25.7%) in 2019. The maximum and minimum prevalence rate of mixed infection was found to be in 2016, and 2015 and 2018, respectively.

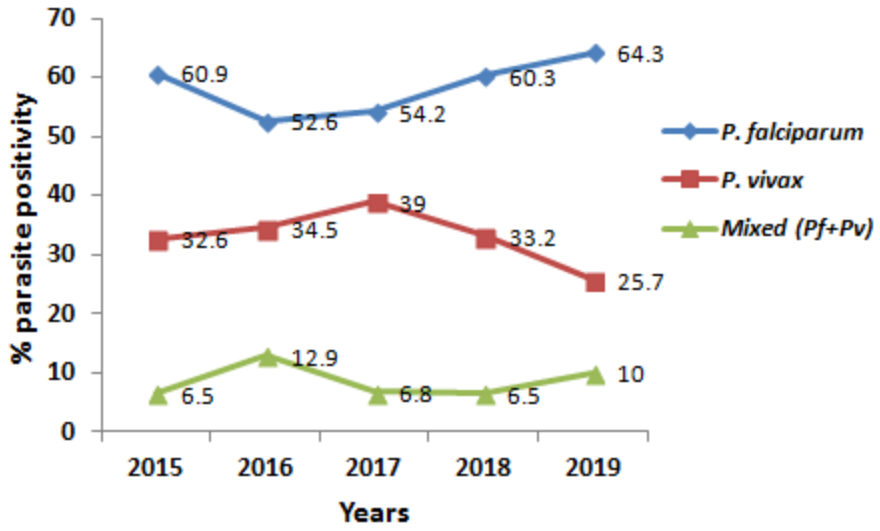

Figure 4. Distribution of *Plasmodium* species in different health centers of Jardega Jarete district, western Ethiopia (2015-2019).

Seasonal variations in malaria positivity rate

The seasonal distribution of malaria positivity rate is summarized in Fig. 5. Malaria prevalence had fluctuating trend across the different months of the study period in the study area ($\chi 2=553.5$, df=3, $P<0.05$). The highest prevalence of malaria was observed through the months of September to November (27.1%) followed by the months of June, July, and August (26.4%), while the lowest infection rate was during the dry season months of December, January, and February with a prevalence of 22.5%. Both *P. falciparum* and *P. vivax* peaked after the long rain in the months of September to November, while the minimum number for *P. falciparum* and *P. vivax* cases was observed in the dry months of December, January, and February (Fig. 5).

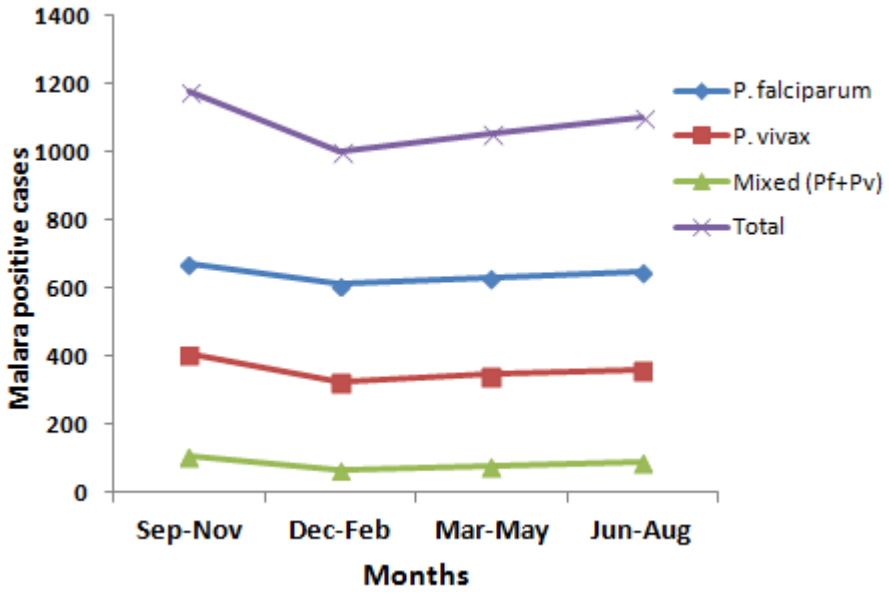

Figure 5. Trend of malaria cases in different months in three health centers of Jardega Jarete district, western Ethiopia (2015-2019).

DISCUSSION

An overall malaria positivity rate of 16.7% was recorded in the present five-year retrospective study in Jardga Jarete district. The present result is consistent with the previous retrospective studies conducted among patients attending public health facilities in Dilla town and surrounding rural areas, with 16% of prevalence (Eshetu Molla and Basha Ayele, 2015), and Metema town with 17% (Getachew Ferede *et al*., 2013). However, the finding of this study contradicts with previous studies from southern, southwest, and northwest Ethiopia, which reported overall malaria positivity rates ranging from 21.8% to 49.4% (Karunamoorthi and Bekele, 2009; Abebe Alemu *et al*., 2012; Dawit Hawaria *et al*., 2019; Kassahun Tegegne and Zalalem Kaba, 2019; Desalegn Dabaro *et al*., 2020). The observed variations might be attributed to differences in microclimate, altitude, expansion of development projects like dams or irrigation, community awareness about malaria transmission and control, and malaria intervention practices (Gari and Lindtjørn, 2018; Solomon Kibret *et al*., 2019).

In the current retrospective study, a fluctuating trend in occurrence of malaria cases was observed in the study area. A decrease in the number of malaria cases occurred from 2015 to 2016 with a minimum number of malaria cases reported in 2016. However, there was an increase in the number of malaria cases from 2016–2019 with the peak number of malaria cases being reported in 2018. The fluctuating occurrence of malaria cases has been observed in various similar studies from several malaria endemic areas of Ethiopia (Abebe Alemu *et al*., 2012; Deresse Legesse *et al*., 2015).

The predominant *Plasmodium* species detected among the current study participants was *P. falciparum*. This finding is in agreement with national figures and other similar studies in parts of Ethiopia that reported preponderance of *P. falciparum* than *P. vivax* (FMOH, 2010; Abebe Alemu *et al*., 2012; Desalegn Amenu, 2014; Seid Ali and Yaregal Animut, 2019). However, this result contradicts with the previous report from Jimma Town that reported a higher prevalence of *P. vivax* than *P. falciparum* (Abebe Alemu *et al*., 2011a). These discrepancies might be attributed to the severity of disease, drug resistance, and gap of program performance.

The present study also revealed higher positivity rate of malaria among males (56.8%) than females (43.2%), which is concurrent with studies from several localities in Ethiopia that reported higher malaria burden among males than females (Abebe Alemu *et al*., 2012; Desalegn Amenu, 2014; Dawit Hawaria *et al*., 2019; Desalegn Dabaro *et al*., 2020). The higher prevalence rate in males might be connected to the fact that males are usually engaged in outdoor activities at dusk and dawns, coinciding with the peak biting hours of the exophagic mosquito species (Oljira Kenea *et al*., 2016). In addition, males often travel as seasonal migrant laborers to different malarious parts of Ethiopia to perform agricultural activities, thereby exposing them to the higher risk of contracting malaria infection. However, this finding is in disagreement with a study conducted in Amhara region where the prevalence of malaria was relatively higher among females (60%) than males (40%) (Awoke Derbie and Daniel Mekonnen, 2017).

Regarding the age groups, the burden of malaria morbidity was more concentrated in the age group >15 years (73.66%), followed by 6–15 years (13.4%), and 1-5 years (12.4%). Studies elsewhere in Ethiopia have also shown that the risk of malaria infection varied by age with some reporting more susceptibility to malaria infection among males in the age groups above 15 years (Temesgen Gemechu *et al*., 2015; Daniel Gebretsadik *et al*., 2018; Dawit Hawaria *et al*., 2019). Such higher burden of disease among adults might be due to their frequent engagement in different activities like agriculture, trade, and other occupational risks that increase the exposure to infective mosquito bites. Lower cases of malaria in children under 5 years of age were detected, which could be linked to their reduced exposure to infected mosquito bites due to good malaria awareness and control and prevention practices by their guardians.

In the study area, malaria was observed in almost every month of the year, although there was significant ($P<0.05$) fluctuation in the number of malaria cases. The highest cases of malaria were observed after heavy rainfall from September to November (27.1%) while the lowest infection rate was during the dry season months of December, January, and February with a prevalence of 22.5%. The seasonality observed in the current study is in accordance with studies in different parts of

Ethiopia (Deresse Legesse *et al*., 2015; Temesgen Gemechu *et al*., 2015; Dawit Hawaria *et al*., 2019). Often, the major malaria transmission season in most parts of Ethiopia is from September to December, following the rainiest season from June to September (FMOH, 2010). It has been underlined that climatic variables such rainfall and temperature, and altitude are important drivers of malaria dynamics in Ethiopia by affecting both malaria parasites and vectors directly or indirectly (FMOH, 2010; Abebe Alemu *et al*., 2011b; Lelisa Sena *et al*., 2015).

CONCLUSIONS

In conclusion, the findings of this study demonstrated that malaria is a serious health burden in the area, in which *P. falciparum* is the predominant malaria parasite. The malaria prevalence appeared to follow a fluctuating trend, where it peaks from September to November. It has also been indicated individuals of males above 15 years were more affected by malaria, suggesting the serious consequences regarding the subsistence economy in this area in particular. Therefore, due attention should be given to these segments of the population groups and control activities should be continued and scale up in the study area.

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