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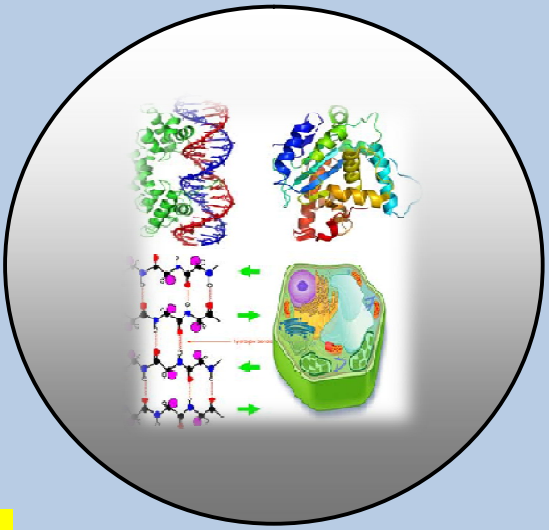

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Trends of Malaria Prevalence in Ilu Galan, BakoTibe, and Danno Districts of West Shoa Zone, Oromiya Region, Ethiopia

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ABSTRACT

Malaria is caused by protozoan parasites of the genus Plasmodium. Being one of the leading causes of illness and death it became a major public health problem in the world; especially, in sub-Saharan Africa countries including Ethiopia. Over the past years, the disease has been consistently reported as the first leading cause of morbidity and mortality of population at risk across the country. The same malaria trends are reported from the Ilu Galan, Bako Tibe, and Danno districts of west Shoa zone, Oromiya region. A retrospective study was conducted to determine the trend of malaria prevalence from blood film/smear test records in Ijaji, Bako, and Sayo health centers of Ilu Galan, Bako Tibe, and Danno districts, respectively within the past five years (2008–2012). The case registration note books of all malaria suspected cases requested for blood film tests within the past five years were carefully reviewed and analyzed from each health center of the districts. Additionally, any malaria intervention activities that may have been implemented to control malaria were collected using an open ended interview questions from the heads of the health center offices of each district. Within the past five years an overall total of 44563, 27590, and 5381 blood films were tested for malaria suspected cases in Ijaji, Bako, and Sayo health centers respectively. Of these 29580 (66.38%), 4726 (17.13%), and 2660 (49.43%) were microscopically confirmed malaria positive cases at Ijaji, Bako, and Sayo health center, respectively. However, a decline in prevalence started since 2010. Plasmodium falciparum and Plasmodium vivax were identified, with P. vivax exceeding P. falciparum cases accounting for 50.70%, 64.51%, and 51.01% of malaria case in Ijaji, Bako, and Sayo health centers, respectively.Although malaria was reported from both sexes, males were more affected.

Malaria prevalence fluctuated seasonally in the districts with the highest cases during spring in the earlier years. However, the malaria peak season which is low in magnitude has shifted to early summer in the most recent years (2011 – 2012). It appears that the overall malaria prevalence in the districts was reduced as a result of the malaria prevention and control program in use. However, regardless of the existing control efforts malaria is beginning to increase in Ilu Galan and Bako Tibe districts in the form of epidemics becoming a serious public health problem, with P. vivax is predominating. Therefore, interventions must be strengthened and expanded including malaria free fringe areas together with assessment of drug and insecticide resistant malaria parasites and vectors in the districts.
Key words: Malaria prevalence, Plasmodium falciparum, Plasmodium vivax, and Blood film.

INTRODUCTION

Malaria is caused by protozoan parasites of the genus Plasmodium which is transmitted through the bite of infected anopheles mosquitoes. Naturally, four different species of Plasmodium are causing malaria, namely *Plasmodium falciparum, P. vivax, P. malariae* and *P. ovale,* in the world.Of these *P. falciparum* and *P. vivax* are the most common and *P. falciparum* is causing life-threatening malaria in the world. Although all of the four malaria parasites species occur in Ethiopia *P. falciparum* is the dominant and followed by *P. vivax*, which is rare in sub-Saharan Africa except Eritrea and Ethiopia.

According to World malaria report (2011) there were 216 million cases of malaria, of which 91% were due to *P. falciparum*, and an estimated 655 000 deaths worldwide. The majority of cases (81%) were in the African Region followed by South-East Asia (13%) and Eastern Mediterranean Regions (5%) (http://www.rbm.who.int/keyfacts.html). Malaria is the leading causes of morbidity and mortality across Africa. It accounts for 30%–50% of outpatient visits to health facilities; resulting in more deaths annually (pan African MVC conference, 2009). In Ethiopia, half a million microscopically confirmed cases of malaria are reported to the Federal Ministry of Health from basic health services annually. However, the actual number of malaria cases in the country is estimated to be more than 5 million each year (MOH, 2008) of which most cases are from Oromiya region where malaria is widely distributed in about 82% of the districts found in the region including the current study districts. Because, Oromiya is geographically diverse, encompassing arid lowlands, fertile and well-vegetated areas with high rainfall, and cool mountainous areas (Ashton et al., 2011). Malaria in the region accounts for about 17% of outpatient visits, 15% of admissions and more than 25% of hospital deaths (ACIPH, 2009).

Although malaria affects the whole population, it disproportionately upsets the most susceptible groups, such as pregnant, children under five, and the frequently ill individuals. Malaria also constitutes a major economic burden on communities across sub-Saharan Africa. Most deaths occur among children living in Africa where a child dies every minute of malaria and the disease accounts for approximately 22% of all childhood deaths (http://sciencenordic.com/forecasting-malaria). Because, malaria affects mainly children in highly endemic areas where adults can develop partial immunity to the disease in contrast to the areas of low end emicity where the disease may affect all age groups.

In such malaria low endemic areas, changes in weather conditions may lead to major epidemics. In Ethiopia, such epidemics have imposed high mortality among the largely non-immune population from time to time (Abeku et al., 2002).

Historically, in Ethiopia rapid rise and change in malaria epidemiology is associated to the development projects, resettlement, and villagization policy of the previous regime that moved more than half-of a million of non-immune highlanders to fertile lowland areas to overcome the ecological disruption and famine in the mid-1980s. Comparatively the epidemiology of malaria in Ethiopia is generally, lower than in other sub-Saharan Africa countries and the transmission is heterogeneous with *P. vivax* malaria endemic causing up to 40% of clinical cases (Yeshiwondim et al., 2009). The epidemiology of malaria in Ethiopia is also more variable and unstable than in any other country in Africa due to Ethiopia's extremely diverse topography and climatic conditions.

Recently it has been shown that malaria is seasonal in most parts of Ethiopia, with unstable transmission that lends itself to the outbreak of epidemics. The transmission patterns and intensity vary greatly due to the large diversity in altitude, rainfall, and population movement; areas below 2,000m are considered to be malarious (MIS, 2011). Consequently, over the past years, the malaria has been consistently reported as the leading cause of illness and death in Ethiopia where more than 75% of the landmass (altitude <2000 m) of the country is either malarious or potentially malarious, and an estimated 68% of the total population resides in areas at risk of malaria infections (Adhanom et al., 2006). *P. falciparum* and *P. vivax* are the two predominant malaria parasites, distributed all over the country accounting for 60% and 40% of malaria cases, respectively (MOH, 2008). However, current studies indicated that the prevalence of *P. vivax*exceeding P*. falciparum* in some parts of the country (Alemu et al., 2011).It has been shown that *P. falciparum* malaria transmission declines, largely due to increased distribution of long-lasting insecticide-treated nets (LLINs) or ITNs and a shift to artemisinin-based combination therapy (ACT) drugs (http://www.rbm.who.int/keyfacts.html)

Malaria mortality rates have fallen by more than 25 per cent globally since 2000 and by 33% in the African Region (WHO, 2011). In most African countries including Ethiopia, the number of malaria cases reported annually also fell by at least a quarter and, in some instances, by more than a half, between 2000 and 2010; this variation among the countries is most likely due to great differences in malaria burden, trends, and the success of control measures across the continent (World malaria report, 2011). Similarly, O'Meara et al. (2010) have reviewed studies that have reported recent changes in the incidence or prevalence of malaria in sub-Saharan Africa countries indicating that the reduction of the burden of malaria in these countries is due to scaling up of prevention, diagnosis and treatment.

In Ethiopia prevention and control activities of malaria is also applied following major malaria intervention strategies such as early diagnosis and prompt treatment, selective vector control that involves use of indoor residual spraying (IRS), insecticide-treated mosquito nets (ITNs) and environmental management to ultimately reduce the burden of malaria in the country(http://www.theglobalfund.org/programs/country/countryid=ETH&lang=en).Consequently , in Ethiopia current reports are indicating that malaria burden is reducing although the trends and the factors attributed to this reduction are not well known. The same is true in different districts of west Shoa zone, especially, from the current study districts.

Despite the presence of effective control and prevention measures, malaria remains an important public health problem throughout the tropical and sub-tropical world causing enormous human suffering and hindering economic development. The disease continues to exert a heavy burden, especially, on sub-Sahara African countries (http://www.rbm.who.int/keyfacts.html) although current reports indicating the decline of malaria in different settings of Africa as a result of effective use of control measures. Because, malaria control is challenging due to many factors such as the success of malaria control is mostly bare to the emergence of resistant malaria parasites and vectors to drugs and insecticides, respectively. Consequently such area depends on the vital commanding for sustained malaria control funding (Schwartz et al., 2012).

The other major challenges is the difficulty to evaluate the strengths and weaknesses of chemicals used for IRS and ITNs and environmental management in estimating malaria incidence and time trends, especially as malaria control programs are intensified worldwide (Murphy and Breman, 2001). Similarly, the widespread co-existence of *P. falciparum* and *P. vivax*over wider geographical areas, like in Ethiopia, hasbeen one challenge for malaria treatment due to the use of different antimalarial drug regimens for both species. For instance, the artemisinin-based combination therapies (ACTs) is used as a first-line treatment for uncomplicated falciparum malaria while Chloroquine for vivax malaria (ACIPH, 2009).

Generally, the struggle against vector-borne disease has become a serious challenge;this is partly due to the aforementioned factors and lack of effective reliable vaccines (Karunamoorthi and Sabesan, 2009).

Malaria cases which are routinely recorded provide useful information on malaria transmission for the health services to target appropriate malaria interventions and to allocate resources in a timely manner to control outbreaks of malaria epidemics (Ndyomugyenyi and Magnussen, 2001). Hence, health facilities case records are important sources of malaria data, as they are readily available and they can provide useful indicators on the situation of malaria at a lower cost. These records are useful for planning malaria control; evaluating the impact of health services; and for epidemiological surveillance as well (Deressa et al., 2004).

Few retrospective studies have been carried out using such malaria records to assess changes in malaria trends and decide the appropriate control measure sal though health facilities are expanding in Ethiopia. Analyzing health facility records is one of the easiest, cost effective and effective methods to assess the prevalence and trends of malaria in particular environs. In fact, studying malaria trends is one of the most important features of employing effective control strategies in malaria-prone areas (Karunamoorthi and Bekele, 2012).

Accordingly the present retrospective study has important implications on the current malaria situation, then intervention of the disease in the present study districts (Ilu Galan, Bakotibe, and Danno districts, west Shoa zone, Oromiya). Thus, this study was initiated to determine the trend of malaria prevalence by analyzing or reviewing the five year (2008 – 20012) documented blood film test records found at each district's health center and to assess the factors that affect the trend in the three districts.

MATERIAL AND METHODS

Study area and Population

The study was conducted from March to June 2013 at Ijaji, Bako, and Sayo health centers located in administrative town of Ilu Galan, Bako Tibe, and Danno districts, respectively, west Shoa zone, which is one of the 18 administrative zones in Oromiya region, a malarious area in Ethiopia. The administrative town of Ilu Galan, Bako Tibe, and Danno are 90km, 125km, and122km, respectively away from the zonal administrative town, Ambo. These districts are located in western and southwestern parts of the Zone and are found adjacent to each other. Ilu Galan district which formerly was part of Cheliya district is a confluence area, being in between the Bako Tibe and Dannodistricts. All the stream/rivers from these districts drain into the upper Gibe River, which pass bordering west Shoa zone with east Wellega and Jimma zones. These three study districts bounded by Horoguduru zone (formerly part of east Wellega zone) and Cheliya district in north and north east; by east wellega zone and Jimma zone in western and south western; by Nonno district in south; and by Cheliya and Jibat districts in the east.

Ilu Galan, Bako Tibe, and Danno districts are located to the southwestern part of the zone approximately ranging from 1564 – 2890m, 1600 – 2870m, and 1600 – 1880m a.s.l., respectively. These districts are characterized by dissected plateaus, mountains, hills, plains/undulating plain, and valleys with perennial and seasonal streams/rivers. Most of the districts' total areas are arable and largely under cultivation. There are also natural protected and planted forests containing woodland, riverine, shrub, bush, and savanna in the districts.

The population of the study districts is predominately Oromo. Muslim and Protestants Christianity are the main religions consecutively. The majority of the populations of the districts depend on subsistence farming mainly producing maize, sorghum, teff, beans, lentil, and neug; rarely wheat and barley (Agricultural Development Office of the districts).

These districts are known as malarious area in the zone and region as well. Malaria is a leading cause of morbidity and mortality among the top ten diseases reported from their health centers. The transmission is unstable and usually occurring in epidemics in these districts. Both *P. vivax* and *P. falciparum*are common co-existing in the districts (heads of each district's health office).

According to the health office of the districts currently there are five, three, and four health centers; health postsin Ilu Galan, Bako Tibe, and Danno districts respectively including the earlier health centers where the present study undergone.

Study Methods

A retrospective review study was conducted to analyze the five year trends of malaria prevalence in the health centers of Ilu Galan, Bako Tibe, and Danno districts which were categorized as malarious area in west Shoa zone (west Shoa zone health office) although malaria cases are also reported from the other districts of the zone. Microscopically confirmed malaria cases was analyzed from blood films examined following the staining techniques and blood film examination for malaria parasite detection, the standard operating procedure in each health center throughout Ethiopia.

The malaria records within the past five years in each health center of each district, where the five year malaria cases records could be available were used, excluding the newly established health centers. Because the new health centers have no the past five years blood films examined records. In addition, each district's health center office head were also interviewed for the malaria control activities had been implemented (community awareness, accessibility of malaria commodities such as antimalarial drugs, ITN, IRS) to the communities who are at risk in each districts.

Data collection

Records on malaria cases from January 2008 to December 2012 were collected from monthly blood films examined malaria suspicion records of the Ijaji, Bako, and Sayo health Center from March to May 2013 by the laboratory technicians and other assistants of each health center. These health centers render outpatient services for patients from both urban and rural villages found in the districts. New malaria cases were also assessed during this period, because, April to June expected for minor malaria transmission as in the other parts of the country. The demographic data such as the sex and age groups of all study subjects were also collected from the malaria case registration note- books.

Data analysis

The collected data were managed and analyzed using Excel Microsoft office 2010. The summation and frequency were calculated using the Microsoft excels function (f_x) and the analyzed data presented intable and graphs using the software's graph and chart.

Ethical issues

Official letter from Department of Microbial Cellular and Molecular Biology, Addis Ababa University was written and sent to west Shoa zonal health department office. Support letter was obtained from the zone and the district health office administrative consecutively to the head of health centers where the past five years malaria case records could be available.

RESULTS

Overall malaria prevalence trend within past five years in the study districts

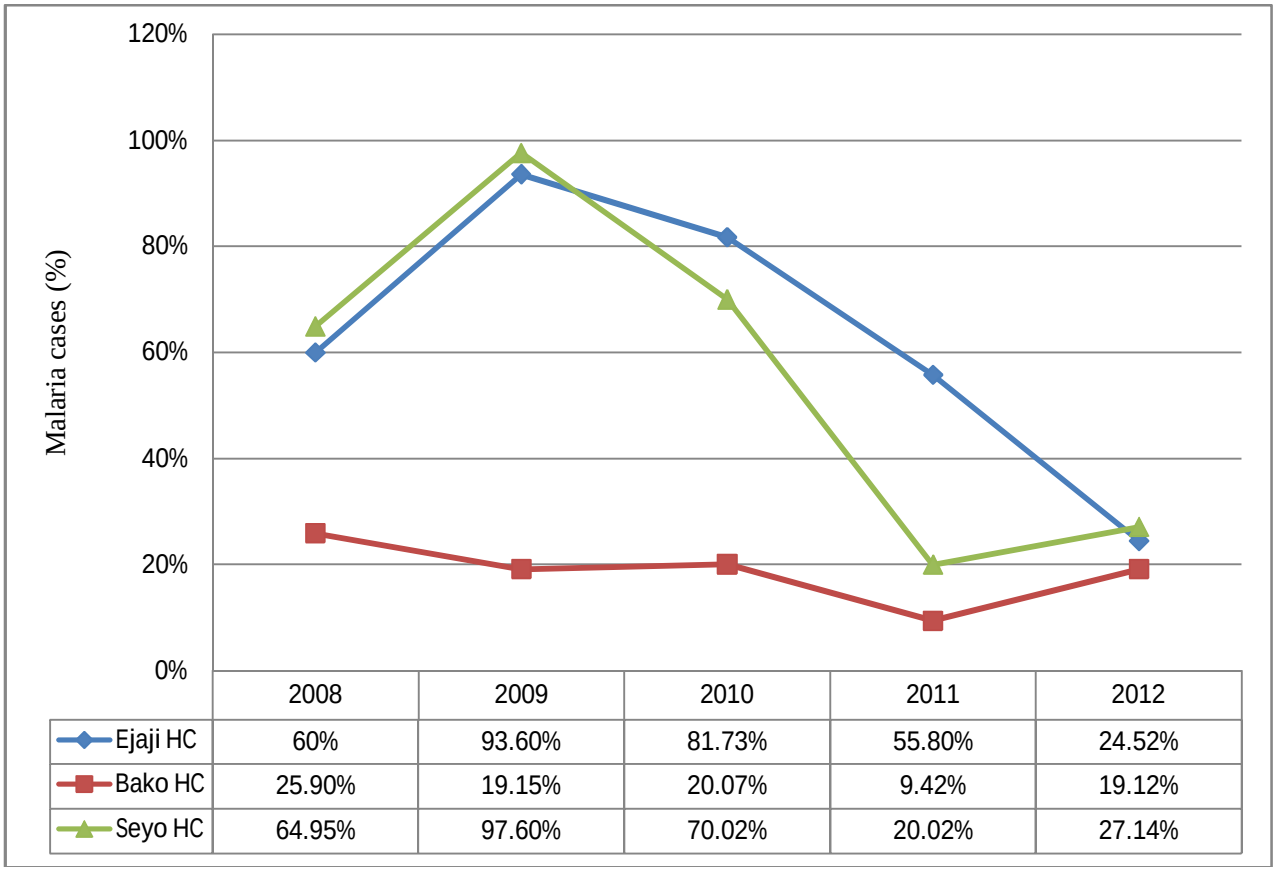
The overall trend of malaria prevalence in the health centers of Ilu Galan, Bako Tibe, and Danno districts was analyzed from records review within the past five years (2008–2012). A total of 44563 in the Ijaji health center, 27590 in Bako health center, and 5381 in Sayo health center blood films were tested microscopically of which 29580 (66.38%), 4726 (17.13%), and 2660 (49.43%) were confirmed malaria positive cases respectively in the health centers. Malaria prevalence was observed declining within the past five years in Ilu Galan and Danno districts. However, it was slightly constant in the past four years in Bako Tibe district but it begins to rise in the fifth year (2012) (Table 1; Fig. 1). The overall record review within the past five years indicated that *P. vivax* and *P. falciparum* species are the common malaria parasite in the districts. The overall recorded data review (2008 – 2012) obtained from the respective health centers showed that *P. vivax* outweighs the *P. falciparum* accounting for (50.70%), (64.5%), and (51.01%) in the Ilu Galan, Bako Tibe, and Danno districts, respectively (Table 1; Fig. 2).

Table 1. The five years (2008 – 2012) malaria prevalence records collected from Ijaji, Bako, and Sayo health centers, west Shoa, Oromiya, 2013.

Health centers	Years	Total number of blood film tested	Total number of malaria positive cases	Malaria parasites species (%)	
				P. vivax	*P. falciparum*
Ejaji	2008	3504	2106 (60%)	841 (39.90%)	1265 (60.1%)
	2009	13592	12724 (93.6%)	5570 (43.78%)	7154(56.22%)
	2010	10169	8311 (81.73%)	4173 (50.21%)	4138(49.79%)
	2011	7022	3919 (55.8%)	3096 (79.00%)	823 (21.00%)
	2012	10276	2520 (24.52%)	1319 (53.34%)	1201(46.66%
	Total	44563	29580 (66.38%)	14999 (50.70%)	14581 (49.30%)
Bako	2008	2243	581 (25.9%)	436 (75.04%)	145 (24.96%)
	2009	4089	783 (19.15%)	476 (60.79%)	307 (39.21%)
	2010	7170	1439 (20.07%)	1032 (71.71%)	407 (28.29%)
	2011	7942	748 (9.42%)	513 (68.58%)	235 (31.42%)
	2012	6146	1175 (19.12%)	592 (50.38%)	583 (49.62%)
	Total	27590	4726 (17.13%)	3049 (64.51%)	1677 (35.49%)
Sayo	2008	699	454 (64.95%)	262 (57.71%)	192 (42.29%)
	2009	668	652 (97.60%)	261 (40.03%)	391 (59.97%)
	2010	1718	1203 (70.02%)	721 (59.93%)	482 (40.07%)
	2011	1014	203 (20.02%)	133 (65.51%)	70 (34.49%)
	2012	1282	348 (27.14%)	180 (51.72%)	168 (48.28%)
	Total	5381	2660 (49.43%)	1357 (51.01%)	1303 (48.99%)

Gradual malaria species trend shift was observed from *P. falciparum* to *P. vivax* beginning from 2010 through 2012 in Ilu Galan and Danno, but the trend shift was begun ahead in 2008 in Bako Tibe district. Generally, mixed malaria case was not considered, because, it very rare to deal with.

Despite the apparent fluctuation of malaria trends in the study districts, malaria cases occurred in almost every month and season of the year in Ilu Galan and Bako Tibe, but it fluctuate in Danno district. The highest of malaria cases prevalence was observed in 2009 and 2010 during spring (September, October and November);but the malaria prevalence was observed declined in spring season and become relatively high at early summer season in recent years (2011 and 2012); and the minimum malaria cases was observed during winter (December, January and February) season in the study districts. However, the malaria prevalence decline and remain almost the same throughout 2011 and 2012 in Ilu Galan (fig. 3). The same trends were observed in both Bako Tibe and Danno districts. Although the malaria infection rates vary among the gender year to year the overall record review in the past five years in the districts showed that males were more affected than females in Ijaji (86.18%) and Sayo (91.88%), but in Bako females were more affected than males (51.50%) (fig. 4).



	2008	2009	2010	2011	2012
Ejaji HC	60%	93.60%	81.73%	55.80%	24.52%
Bako HC	25.90%	19.15%	20.07%	9.42%	19.12%
Seyo HC	64.95%	97.60%	70.02%	20.02%	27.14%

*HC stands for health centers

Figure 1. The overall trend of malaria prevalence recorded (2008 – 2012) in each health center of the districts, west Shoa zone, Oromiya, 2013.

Factors affecting malaria trends in the study districts

During the retrospective malaria data collection, any malaria intervention activities that may have been taken in each district within the past five years were collected using an open ended interview questions from the head of each health center office. Each head of the health centers responded that they were/are using different chemicals such as Malathion, Deltamethrin, and Bedocarbon (currently in use) consecutively for indoor residual sprays (IRS) focusing on the swampy/marshy area of the districts, but they did not know why chemicals changed for IRS. The insecticide treated nets (ITN) was distributed before three years ago to all households based on the number of family and risk groups found in each district. In addition, they also stated that prompt diagnosis and treatment using ACT as first-line antimalarial drug for *P. falciparum* and Chloroquine for treatment of *P. vivax* malaria in the three districts' health centers were provided to the malaria patients.

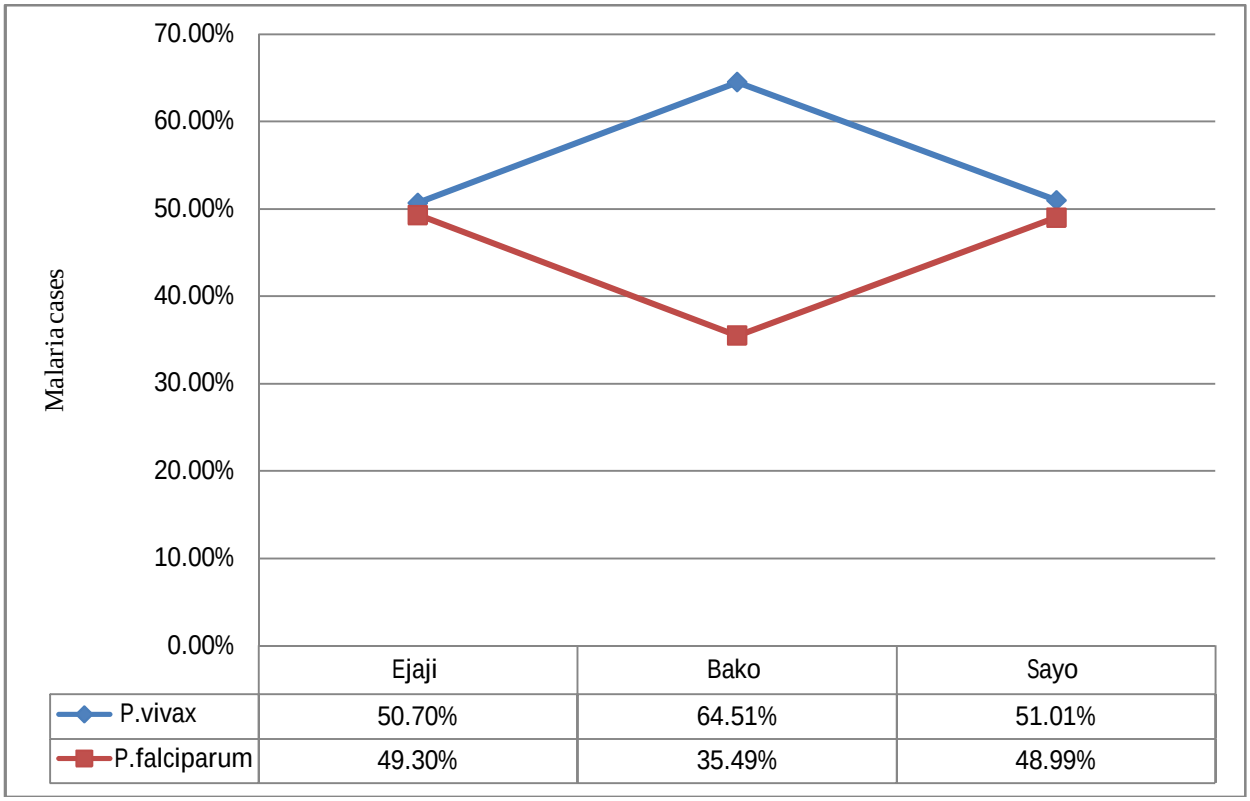


Figure 2. The overall malaria parasite species trend within the past five years in the three districts, west Shoa zone, Oromiya, 2013.

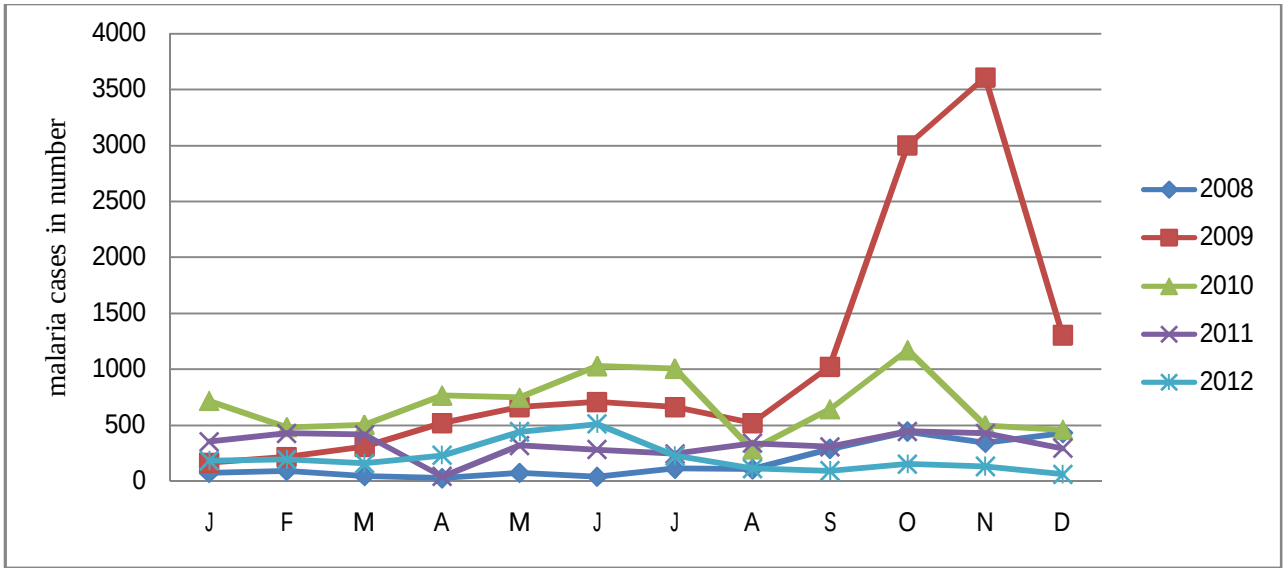


Figure 3.Monthly malaria case variation within the five years in Ilu Galan district, west Shoa zone, Oromiya, 2013.

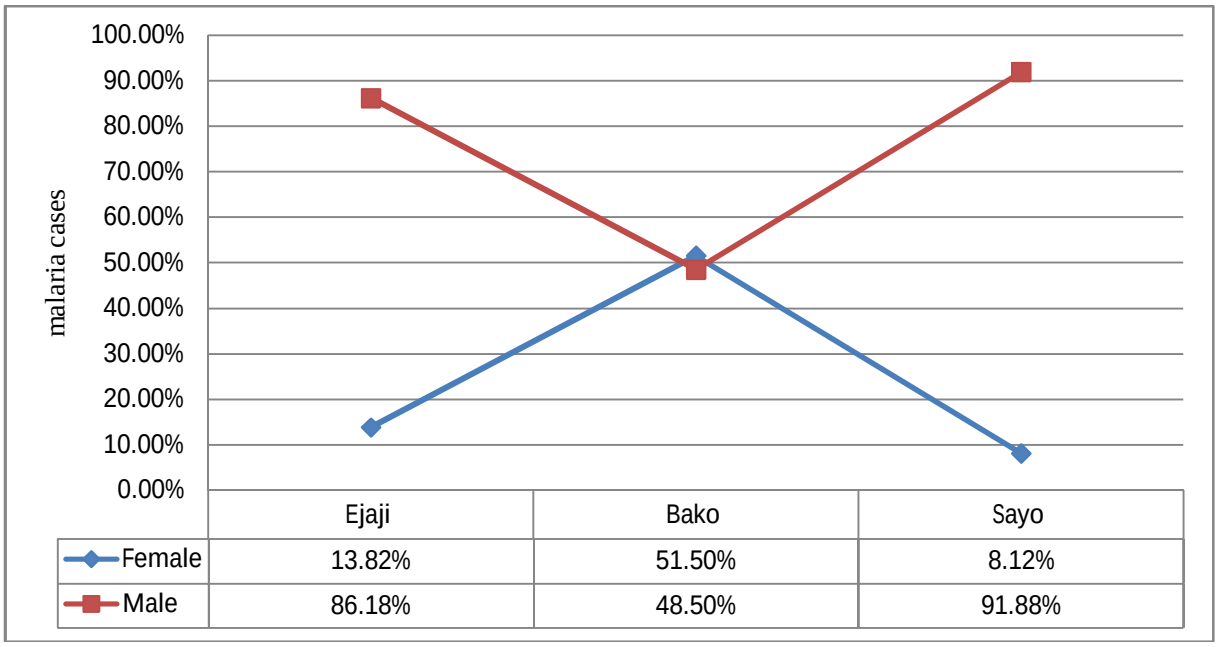


Figure 4. The malaria case distribution among the two sexes within the past five years in the Ilu Galan, BakoTibe, and Danno districts, west Shoa, Oromiya, 2013.

Recent malaria situation in the study districts

The current data which was obtained during the retrospective data collection indicates that malaria begin to rise in autumn with the *plasmodium* species fluctuationsin the districts. Within this period (beginning from late April to beginning of May 2013), the blood filmswere examined from malaria suspected cases. Of these,93/592 (15.71%) cases of which 28 were by *P. vivax* and 65 were*P. falciparum* in Ijaji health center; 35/517 (0.07%) cases of which 32 were by *P. vivax* and 3 by *P. falciparum* in Bako health center; and 14/115 (0.12%) cases of which 7 were by *P. vivax* and 7 by *P. falciparum* in Sayo health center.

DISCUSSION

The present study has shown that malaria prevalence trend was reduced in the Ilu Galan, Bako Tibe, and Danno districts consistent with studies that have shown a decline in the overall incidence of malaria in Ethiopia (Manuel et al, 2005; Karunamoorthi and Bekele, 2012).The present study revealed that malaria prevalence trend is principally reduced, especially, in Ilu Galan and Danno districts since 2011.The overall malaria prevalence reduction in the present study districts possibly attributed to the synergetic effect of drugs currently in use and ITNs and IRS against the malaria parasites and vectors together with the expansion of health centers and health posts in each districts. This is similar with the studies that O'Meara et al. (2010) have reviewed in the horn of Africa that the substantial decreases in the burden of malaria is linked to the introduction of malaria control measures. Nonetheless, community awareness and involvement on the environmental management to intervene with malaria is not much satisfactory (as health personnel of the districts indicated).

The present study suggested that the main approach/factor that contributed to the reduction of malaria prevalence is largely due to the ITN usage as it was provided to all households in the districts with simple orientation to use properly. In fact, ITNs is preventing vectors of both malaria parasites existing in the area; it is freely distributed; and does not need advanced knowledge to use where as the other malaria control approaches may either face technical faults or biological changes (resistance).However, different African countries have used different approaches of malaria control that resulted in malaria burden reduction for instance, in Eritrea, a major fall in morbidity and mortality is due to the application of IRS together with the distribution of ITNs and strengthening of malaria case management in the community (Nyarango et al., 2006).A reduction in malaria on the island of Zanzibar has been produced by effective use of ACT and an increased distribution of ITNs (Bhattarai et al., 2007). Highly organized programs for IRS have substantially reduced malaria rates in South Africa, part of Mozambique and Swaziland (Sharp et al., 2007).

Furthermore, in the past two years (since 2011) the number of blood film tested for malaria was decreased at each study district health center. This is probably, due to the expansion of health centers and posts where patients from remote area of the districts can get malaria first aid/treatments. Because of this, the current reduction of malaria prevalence analyzed at health centers may not permit the actual decline in the districts. Further investigation that incorporates malaria records of the whole health centers and posts is required so as to get the overall malaria trends in each study districts.

The treatments given in such health facilities are mostly based on rapid diagnostic tests for malaria (RDTs), which detect parasite specific antigen from a finger prick blood sample using immune chromatrographic kits. However, the RDTs currently in use at each district health facilities, is only sensitive to *P. falciparum* antigen but not to other species. This specific detection and prompt treatment of *P. falciparum* probably, the main cause of malaria prevalence reduction in general and *P. falciparum* in particular with relation to the co-existing *P. vivax* in the present study districts.

The present malaria prevalence reduction was accompanied with *P. vivax* predominating accounting for 50.70%, 64.51%, and 51.01% of malaria casesat Ijaji, Bako, and Sayo health centers, respectively of the study districts like in a study conducted by Manuel et al.(2005) elsewhere and contrasts with the reports and similar studies those indicated the infection with *P. falciparum*> 60% and *P. vivax* about 40% (MOH, 2008; Alemu et al., 2012). Similarly, Karunamoorthi and Bekele (2012) have also shown that *P. falciparum* is the most predominant parasite accounting for about 62.4% of malaria cases followed by *P. vivax* (37.3%); and other earlier reports have also been consistently observed in many parts of the country also implicate the dominance of the *P. falciparum* over the *P. vivax*. These all studies and reports indicate that malaria in Africa is mainly caused by *P. falciparum*, accounting for nearly 100% of malaria cases in most of sub-Saharan countries. This is because of the lack of Duffy receptors on the erythrocytes of African Bantu races, which makes them resistant to infection by *P. vivax*, the most common species in the rest of the world (Miller et al., 1976). In this regard, Ethiopia is an exception since it is the place where Semitic and African races are residing and where 25-35% of malaria cases are due to *P. vivax* (Zein and Kloos, 1988; Mathews and Armstrong, 1981).

The shift in dominance from *P. falciparum* to *P.vivax*is most likely due to the effectiveness of drug, the artemisinin-based combination therapy (ACT), which is currently in use, for the treatment of *P. falciparum* at every health center and health post of each study district consistent with the study that has shown that *P. falciparum* malaria transmission declines elsewhere largely due to increased distribution of long-lasting insecticide-treated nets (LLINs) and/or ITNs and a switchto artemisinin-based combination therapy (ACT) drugs (http://www.rbm.who.int/keyfacts.html). However, these possibilities need further investigation in the study districts as the shift may be attributed to drug resistant by the *P. vivax*.

During September to December, more malaria cases were detected at the Ijaji, Bako, and Sayo health centers before 2011, which is possibly associated with the increased and extended wet seasons, the summer, as in most parts of Ethiopia where the epidemiological pattern of malaria transmission is seasonal and largely unstable. Malaria in these districts is not only a public health problem, but it also hinders socioeconomic development, since the highest transmission season overlaps with the major harvesting period of the year as it was reported elsewhere in Ethiopia (Karunamoorthi and Bekele, 2009). Such a short transmission season that followed by a long interval of very low malaria transmission results in less effective immunity against malaria in the population. Consequently, children and adults are equally exposed to malaria infection as explained by Abeku et al. (2002). This could result again in extensive economic loss due to lost productivity of the workers, especially, that of productive age groups. This is similar with the clinical and epidemiological malaria conditions reviewed by Kiszewski and Teklehaimanot (2004) in Ethiopia.

Although malaria transmission varies annually, the highest caseswere observed during the spring season in the three study districts like in the other parts of the country (Alemu et al, 2012; Karunamoorthi and Bekele, 2012). However, in the most recent years (2011 and 2012) it was observed that the highest transmission rate is reduced and shifted relatively to the early summer season. This seasonal malaria transmission shift may be associated with the fluctuating and light rainfall encountered in the country in general and the study districts in particular, a perspective that needs further analysis. This unusual seasonal malaria transmission change may lead to sudden epidemics so case surveillance and readiness is important to combat such malaria outbreak.

In the study districts males were more affected than females, particularly, in the Ilu Galan, and Danno districts, in agreement with a study conducted at Serbo Health center, Jimma zone (Karunamoorthi and Bekele, 2012). In these districts the variation of malaria infection among the two sexes possibly associated to the working habit of males. They move down to upper Gibe River valley to search farm land while females stay at home where relatively high altitude, hence, malaria transmission is less. Because, peoples who are living at relatively high altitude have no adequate farm lands for cereal or commercial crop production so as to sustain and change their living status; however, this needs detail analysis. The other possibilities are comparable with an earlier studies carried out by Jamaiah et al. (1998) and Karunamoorthi and Bekele (2012) those suggested that males are more often in the outdoors in the early evening hours than females those who mostly stays back in the villages, thus their contact with malarial infection is minimized.

According to the heads of health center offices, there was increased attention to malaria control and preventive activities through health education such as awareness creation in the community on the use of ITNs although shortage is observed as Ethiopia faced the challenges in ITN coverage from 2007 to 2011 (MIS, 2011) and other malaria control activities such as health facilities seeking by the community to get early diagnosis and prompt treatment. Thus, artemisinin-based combination therapy (ACT) as first-line antimalarial drug for uncomplicated *P. falciparum*infection and Chloroquine for *P. vivax* malaria treatment as per expressed by MOH (2008) and ACIPH (2009), are used in the three study district health centers. Most likely these activities against malaria largely result in the current reduction of malaria prevalence in the present study districts.

On the other hand, malaria cases were examined and treated during autumn season (April – May) of 2013 although the rain was very small at the moment; with *P. falciparum*is predominating in reverse to the former years at Ijaji health center compared to the rest two study district health centers. This implies that there are active malaria vectors which are favoring the malaria transmission in the Ilu Galan district. Therefore, surveillance cases and assessing breeding sites of the vectors should be urged for the coming the usual transmission season to combat the outbreak may occur in the area.

CONCLUSIONS AND RECOMMENDATIONS

The present study has indicated that malaria prevalence declined over the study period, with *P. vivax* predominating in the study districts. This could be due to the use of malaria prevention and control approaches that included the early diagnosis and prompt treatment of malaria cases, indoor residual spraying, and free distribution of ITNs together with the expansion of health centers and posts in the districts. Although these approaches were found to be promising malaria prevalence has begun to raisein epidemic form at Danno and Ilu Galan districts regard less of the intensive malaria control and prevention activities as observed and checked during data collection.

This study has also revealed that malaria transmission is seasonal, unstable and epidemic in nature. Therefore, the early diagnosis and prompt treatment of malaria cases, awareness creation in the community, ITNs distribution to the whole population targeting high risk groups, indoor residual spraying in the high mosquitoes prevalent areas must be strengthened and expanded to include malaria free fringe areas.

Continuous health education/awareness creation on the importance of consistent and regular utilization of ITNs and other personal protection measures and the environmental management that complements the existing chemical vector control measures should be intensively provided to the community.

To prevent malaria epidemics the health centers and posts must be on a standby for the surveillance and managing of active cases and must communicate with the higher health offices. Furthermore, detailed investigations on the effectiveness of the malaria control measures in use are very important to determine the effective approaches against both the malaria parasites and vectors.

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