Trends and Current Status of Malaria in Berahle Health Center, Afar Region, Northeast Ethiopia

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Acronyms

ACT.....Artemisinin based Combination Therapies
AL .....Artemether Lume fantrine
ARHB .....Afar Regional Health Bureau
ARS.....Afar Regional State
BHC……Berahale Health Center
CDC .....Centers of Disease Control and Prevention
CSA.....Central Statistical Agency
DDT .....Dichloro Diphenyl Trichloro Ethane
DHS.....Demographic Health Survey
EHNRI .....Ethiopian Health and Nutrition Research Institute
FMOH .....Federal Ministry of Health
HCs .....Health Centers
HEWs.....Health Extension Workers
HF .....Health Facility
HPs.....Health Posts
IRS .....Indoor Residual Spraying
ITNs .....Insecticide Treated Nets
MIS .....Malaria Indicators Survey
MOP.....Malaria Operation PlanRDTs Rapid Diagnostic Tests
SPSS.....Statistical Package for Social Sciences
SSA .....Sub Saharan Africa
UNICEF .....United Nations International Children's Fund
USAID .....United States Agency for International Development
WHO.....World Health Organization

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Abstract

The global health burden of malaria has been substantially reduced recently. Encouraged by this, many endemic countries set a plan of eliminating or at least entering a pre-elimination phase and some even declared malaria free. Ethiopia planned to eliminate the disease in selected low-transmission settings by 2020 and many other endemic areas are set to be in a pre-elimination phase soon. For this to be achieved regular surveillance of malaria status across the country is necessary. The objective of this study was part of this nationwide effort. As such, the study assessed malaria status in Berahle Health Center in northern Afar, northeast Ethiopia where malaria is endemic. Patients visiting the Health Center between September 2016 and January 2017 and suspected of malaria were successively recruited. Blood samples were drawn and examined following standard procedures. Reported malaria cases in the past five years (2012-2016) were also extracted from the Health Center record system. Out of 1600 febrile patients tested between September 2016 and January 2017 prospectively, 310(19.4%) were malaria slide-positive. Of this 202(65.2%) were attributed to *Plasmodium falciparum* and 108(34.8%) to *P. vivax*. The retrospective data revealed 8868(28.8%) malaria slide-positive cases in the past-five years with 88.4% *P. falciparum* and 11.6% *P. vivax* cases. Malaria slid-positivity was not significantly associated with age. Although a declining trend was noticed the number of confirmed malaria cases was considerable. Incrimination of local risk-factors is in urgent need to further scale-up targeted control interventions to put the study area on track to at least a pre-elimination phase.

Keywords: Malaria, *Plasmodium*, Berahle, retrospective, prospective

1. Introduction

1.1 Global Burden of Malaria

Although malaria incidence is reduced by 37% globally and by 42% in Africa between 2000 and 2015, the disease remains a formidable public health threat. It is estimated that there were 214 million clinical cases and 438000 deaths in 2015 due to malaria (WHO 2015).

Malaria is an infectious disease of man and animals. The causative agents of malaria are apicomplexan protozoa of the genus *Plasmodium*. There are five different plasmodium species are known to cause infection in humans. These are *Plasmodium falciparum, P.vivax, P.ovale, P.malariae* and *P.knowlesi*. Most of malaria cases and deaths are caused by *P.falciparum* and *P.vivax*. While *P.faciparum* mostly predominates in Africa, *P.vivax* cases are distributed more frequently in Asia, Latin America and some areas of Africa(Darymple *eta l*,2015)

Malaria is transmitted through the bite of infected female anopheline mosquitoes. When an appropriate infected mosquito species bites the plasmodia (sporozoite stages)cross peripheral circulation and after a while enter hepatocytes. The sporizoites undergo multiple fission forming schizonts that later release merozoites which migrateto the peripheral blood circulation once again and infect erythrocytes. Inside the erythrocytes the parasites multiply eventually resulting in the rupture of the host cells. The second-generation merozoites infect new erythrocytes and the cycle continues. At a certain stage in the repetitive life cycle of the parasites some parasites differentiate into gametocytes which are infective to vector mosquitoes (CDC, 2014).

Combating malaria was among the eight millennium development goals. Early diagnosis and effective treatment, vector control, easy and universal accessibility to bed nets, residual periodic spray of dwellings, environmental management and continued efforts in epidemic prevention control strategies that are currently being implemented in most malaria endemic areas (Sheleme,2007).

1.2 Malaria in Ethiopia

Malaria is one of Ethiopia's foremost health problems. About 60% of its population lives in malarious areas and 68% of its landmass is favorable for malaria transmission. Malaria transmission and clinical cases in Ethiopia after the main rainfall season, July to September, each year. However, many areas in south and west of the country have a rain fall season beginning earlier in April and May or have no clearly defined rainfall season (FMoH, 2014). Consequently, malaria transmission tends to be highly heterogeneous geo-spatially within each year as well as between years. A relatively long transmission season exists in the western low land areas, river, basins, valley, and irrigation schemes. Due to the unstable and seasonal transmission of malaria, protective immunity is generally low and all age groups of the population are at risk of the disease.

Malaria in Ethiopia is characterized by widespread epidemics occurring every five to eight years, with the most recent epidemic occurring in 2003/2004 (FMOH, 2004). In 2014/2015, the total number of laboratory confirmed plus clinical malaria cases were 2,174,707.Of those cases 1,867,059(85.9%) were confirmed by either microscopy or rapid diagnostic tests (RDT) out of which 1,188,627(63.7%) were *P. falciparum* and 678,432(36.3%) *P.vivax*(FMoH,2015).

1.3 Malaria Control in Ethiopia

Ethiopia's fight against malaria was started more than half a century ago. Originally malaria control began as pilot control project in the 1950s and it was launched for the first time as a national eradication campaign in the 1960s followed by a control strategy in the 1970s (CDC, 2012).

The NMCP formulated a goal to reduce morbidity and mortality due to malaria through scaling-up and sustaining the coverage of key malaria interventions. In this plan, areas below 2000m above sea level were generally classified as malarious and considered eligible for intervention.

The National Strategic Plan for malaria control and prevention in Ethiopia (NSP) 2006-2010 aimed to rapidly scale-up malaria control interventions to achieve a 50% reduction of the malaria burden, in the line with global roll back malaria (RBM) partnership objectives (EHRI, 2012).

The status of coverage of the major interventions was measured in the malaria indicator survey (MIS, 2007). The MIS 2007 results show tremendous achievements by Ethiopians malaria control program. Thus, between 2005 and 2007ITNs coverage increased 15 fold, with ITN use by children under five years of age and pregnant women increasing to nearly 45% in malaria- endemic areas and to over 60% in households that owned at least one ITN. Overall, 68% of households in malaria endemic areas were protected at least by one ITN and IRS. It is believed that the vector control interventions have contributed greatly to a reduction in the burden of the disease more than 20 million long-lasting insecticidal nets (LLINs) have been distributed to 10 million households between 2005 and 2007. With respect to IRS activities, evidence shows that 30% of IRS- targeted areas were sprayed in 2007 and in 2008 the coverage increased to 50%. So far, the main vector control activities implemented in Ethiopia include: IRS, LLINs and mosquito larval source reduction. The malaria vector control guidelines also addresses vector control interventions found to be effective in past decades. The insecticides commonly used in the country include dichlorodiphenyl-trichloroethane (DDT), malathion and deltamethrin (Balkew *et al.* 2010).

According to the EMIS,2015 the trends showed that in LLIN use by all house hold members, children under five years old and pregnant human living in malarious areas in 2007, 2011 and 2015.There have been slight increase in LLIN use among children under five and pregnant human (38% and 35%) in 2011 compared with 45% and 44% in 2015). However, the use of LLIN by thus population groups is almost similar. Moreover, the trends in malaria parasites prevalence since 2007 by RDT and microscopy in malarious areas. There were a reduction in malaria prevalence by RDT in 2015 (1.2%) compared to the in 2011 (4.5%).Similarly, main when comparing the microscope results, malaria prevalence in in 2015 is lower than that of 2007 and 2011 (FMOH, 2015).

Due to resistance of malaria vectors to DDT, the use of this insecticide for IRS has been discontinued in 2009. Deltamethrin is currently being used as an interim substitute insecticide for DDT in IRS operations (Abate,2011). However, the selection of insecticides for indoor insecticidal residual (IRS) use in Ethiopia will be determined annually based on the insecticide resistance pattern of vectors another factors. Recently the propoxur or bendiocarb are in use as per the WHO recommendation (http://www.who. int/whopes/Insecticides-IRS-2-March-2015.Pdf?ua=1).

As outlined in the NSP 2011-2015, Ethiopia has a target of 100% access to effective and affordable malaria treatment. This requires improving diagnosis of malaria cases using microscopy or using multi-species rapid diagnostic techniques (RDTs), and providing prompt and effective malaria case management at all health facilities in the country. Thus malaria diagnosis and treatment are essential components of anti-malaria interventions in the country (EHRI, 2012).

Artimisinin combination therapies are the first-line drug for treatment of uncomplicated *P.faciparum* malaria in Ethiopia since 2004 (FMOH, 2008). Oral quinine is used as the first-line treatment for pregnant women during the first trimester and for children of less than 5kg chloroqunine is used for treatment of *P.vivax*. Radical cure with primaqunine is recommended for patients with *P.viviax*, residing in non-malaria endemic areas that are treated at the health center or hospital levels (Alemu *eta l*,2013). Primaqunine is not currently recommended at health post level because the prevalence of glucose-phosphate-dehydrogenate deficiency is not known in Ethiopia. As a result, it is difficult to detect and manage complications of primaqunine at this level. Artemether-lumefantrineis used for mixed infections due to both *P. falciparum* and *P.vivax*.

Sufficient resources have been secured, through the Global fund, World Bank, US President's Malaria Initiative (PMI) and others to support universal coverage of key malaria interventions by the end of 2010. Thus, Ethiopia will move from scaling-up for Impact (SUFI) to sustained control, as key steps in the process toward, malaria elimination by 2020 (PMI,2016). In the coming years, Ethiopia will need to build on and sustain tremendous progress that has already been made, ensure that the quality of the

services delivered is high, and will need to further strengthen some key areas such as IRS, diagnosis and rational drug use, and surveillance including epidemic surveillance and response. These steps will form part of the roadmap in preparation for pre-elimination by 2015, geographical elimination especially in areas of historically low transmission (FMOH, 2004).

The 2011-2015 NSP will focus on sustained control and moving towards malaria elimination through an integrated community health approach, especially in areas of unstable malaria transmission, building on SUFI achieved by the 2005-2010 strategic plan (FMOH, 2011).

1.4 Malaria Status in Afar Region

The Afar Regional State (ARS) is located in North-Eastern part of the country. The region borders four National Regional States that is in the North and North-West; Tigray region, in the west and South-west; Amhara region, in the south; Oromia region and in South-east; Somalia region. The ARS also shares international borders with Djibouti and Eritrea to the east and North-east, respectively. Administratively, the region is divided in to five zones, which are further subdivided in to 32 woredas and 404 kebeles. The total surface area of the region is estimated at 278,000km^2(CSA, 2012)

According to official statistics, the region's population is about 1.5 million; of which 90% are pastoralists and 10% are agro-pastoralists. Semera is the administrative capital of the region. The overall health status of the Afar population is poor, with women and children particularly vulnerable to poor health maternal mortality (720/100,000)and under-five child mortality (229/1000) are double the national average(WHO, 2010). According to the 2014/2015 Regional Health Bureau data, there are 4 hospitals, 68 health centers, 251 health posts and 88 health stations in the region. These are run by the government. In addition, there are 25 small and medium level privately-owned clinics and only one hospital which operated by a non-governmental organization. Malaria transmission in the Region is generally unstable, with perennial transmission in areas along the Awash River valley. In 2014/2015, there were a total of 289,852 cases of all types of malaria (FMOH, 2015).

There were 20,323 under-five and 1605 pregnant women with malaria who attended the outpatient department the same year. Moreover, there were 625 under-fives and 64 pregnant mothers with severe malaria admitted in the region. In the Demographic and Health Survey (DHS) estimates (FMOH, 2OO8) for Afar Region, 61% of households owned at least one type of mosquito net, and only 16% had more than one net. About 16% of households reported owning at least one ITN. According to the survey carried out in 2015 (FMOH, 2O14), about 45% of under-five children slept under a net the preceding night and only 32% of the children slept under an ITN. About 33% of all women (15-49 years) and 44% of pregnant women slept under a net the preceding night. Similarly 18.8% of all women aged 15-49 years and 30.5% of pregnant women slept under an ITN.

The 2014 Ethiopian DHS also showed that among 10,000 under-five children, 18.7% had experienced fever with in the previous two weeks (17% in Afar). While fever is a common symptom of malaria on set, 16.6% of those surveyed had received an anti-malaria drug within 48 hours (Yeshiwondim *eta l*, 2011)

1.5 Malaria in Zone-2 of Afar Region and the Project

Administrative Zone-2 is one of five Zones of the Afar Region. This Zone is bordered on the South by Administrative zone 1, on the South- west by Administrative zone 4, on the west by the Tigrai region and on Northeast by Eritrea. The administrative center of zone 2 is Abala (also known in the highlands Shiket). Also located in this zone is the former mining settlement of Dallol, which set the record for the hottest inhabited place on earth, with an average temperature of 34^0C. Based on the 2007 conducted by the central statistical Agency of Ethiopia (CSA), this Zone had a total population of 350,111. While 26,217(7.49%) are urban in habitants a further 38,249(10.93%) were pastoralists. There are 7 Woredas in zone- 2.

In 2013/2014 totally 116,704 nets were distributed out of 210,067 LLINs required. In 2014/2015 out of 73,570 needed 180,650 nets were provided with percentage of coverage of 96% (ARHB, 2015). Malaria remains one of the major health problems in zone two, out of seven Woredas, all are affected by malaria.

But little published reports are available on recent malaria impact in the woreda although malaria is expected to be throughout the year in Berahle. No detailed report from the FMOH and ARHB is available about woreda-level malaria. Accurate assessment of the levels and time trends in malaria status are essential for measuring of progress towards goals and planning to achieve health services and focusing future efforts. Useful data on the distribution of malaria cases and death is crucial for monitoring malaria status in a locality and possible to adjust malaria control efforts. It is important to determine which groups of population or areas are most affected by malaria in order to target the population most in need. Understanding the season pattern of transmission is equally important to implement control interventions.

The present study was, therefore, aimed at analyzing malaria cases and deaths in Berahle Woreda. The study focused on past five-year (2012-2016) retrospective data. A prospective study was additionally undertaken by recruiting febrile patients visiting Berahle Health Center (September 2016 - January 2017) to evaluate the current malaria situation.

2. Objectives

2.1 General objective

- ✓ To investigate past-five year trend and current status of malaria in Berahle in North Afar, north-east Ethiopia.

2.2 Specific objectives

The study had the following specific objectives. It was to:

- ✓ Determine past-five year trend and current status of malaria in Berahle area.
- ✓ Identify *plasmodium* species distribution in Berahle.
- ✓ Evaluate age, sex, and seasonal distribution of malaria in Berahle Health Central.

3. Materials and Methods

3.1 Study Area

The study was conducted in Berahle Woreda of Afar Region Zone-2, Northeast Ethiopia. Berahle is located 898km from Addis Ababa in the north direction, 115km from Mekelle town in northeast and 709km from the administrative capital of the Afar Region, Semera, in the north. The woreda is bordered on the south by Afdera and Abala, north by Dallol which are sister woredas in the Zone and in the northeast by Eritrea, and to the southwest by the Tigray Region (Fig 1). Its total population is 78,881.According to population projection in 2014 the total population of Berahle woreda was 90,115. The average elevation of the area is 233 meters above sea level. The climate is arid with annual rainfall of below 400mm.

The woreda has four health centers and 10 health posts. Berahle is the third malarious woreda out of seven woredas in Zone two, next to the Afdera and Erebti woredas (ARS health bureau annual report 2015). The aforementioned same regional health bureau document shows that LLIN coverage was 96% (1LLIN per 2 people) for zone two which was indeed among the lowest compared to the coverage in other zones. Zone-2 Health Department report shows that malaria, typhoid, tuberculosis, cholera, and intestinal parasites are the major health problems in Berahle woreda.

The health facility record indicated that malaria is one of the leading causes of morbidity in Berahle town and its surrounding rural villages which have a suitable environment for the vector mosquitoes to breed. The common malaria control activities is bed net use, removal of the marsh area, chemical spray, prompt diagnosis and treatment were well activated in the town. The LLINs coverage was 95% in 2017 (for households having 3, 4-6 and 7-9 members, 1, 2, 3 LLINs respectively).

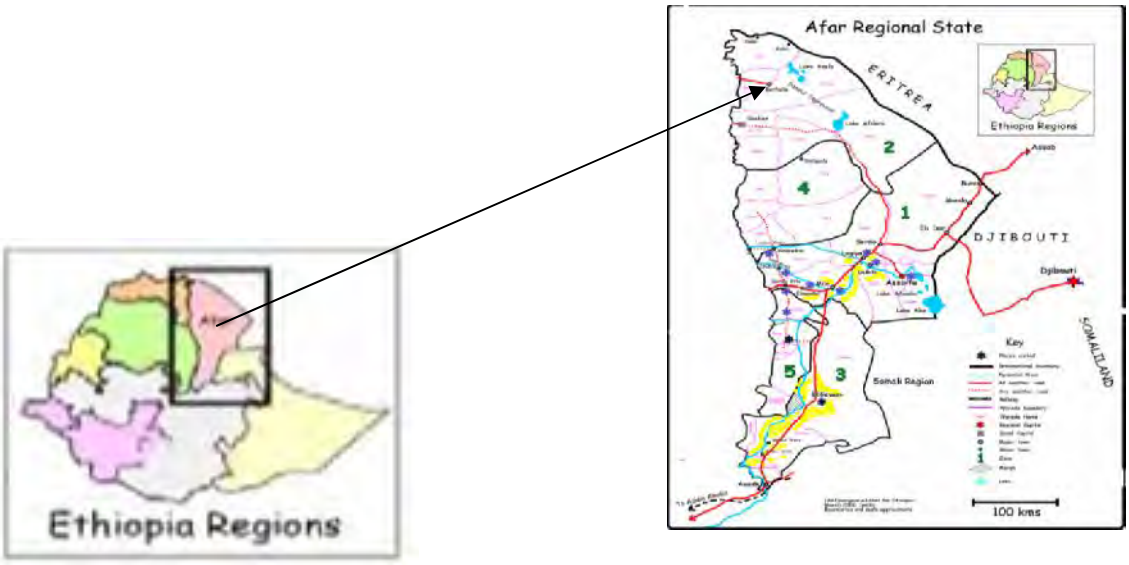

Figure 1: Map of the study area (http://www.hartford-hwp.com/archives/33/044.html)

3.2 Study Design and Population

The study design was health facility-based cross-sectional survey carried out from September 2016 to January 2017 (prospective). Past five-year (2012-2016) malaria trend in Berahle woreda was also evaluated (retrospective).

3.3 Blood Sample Collection and Analysis

Febrile patients at Berahle health center emergency or outpatient department were examined by attending health personnel and invited to participate in the current study. Consenting patients took part in the study. Careful procedures were adopted in the collection of finger-prick blood samples by swabbing the area to be sampled with 70% denatured alcohol and allowed to dry before collection. Thick and thin blood films were made on clean microscope slides and labeled accordingly for later microscopic examination. The thin films were fixed with methanol and all films were stained with 3% Giemsa stain for 30 minute. The thick films were used to determine the parasite densities by using high power magnification (immersion oil), while thin films were used to identify the parasites species and infective stages. The films were examined by experienced microscopists at the health center following established protocol.

3.4 Data Analysis

Data were checked for consistency and completeness and analyzed. The chi-squared test was used to determine difference between years, seasons (months), age, and sexes as well malaria parasite distribution for both retrospective and current cross-sectional data. Qualitative techniques were employed in the computation of statistical tables and bar graphs. Results were considered to be statistically significant when the two-sided p-value was <0.05.

3.5 Ethical Consideration

This study was presented to and approved by Department of Zoological Sciences of Addis Ababa University and supporting letter was obtained from Berahle woreda health center office. The participants were clearly informed about the nature and aim of the study and told that their participation was voluntarily. They gave written consent to take part in the study after adequate explanation about the significance of the study. Blood samples were collected by qualified laboratory technicians and malaria-positive participants got appropriate treatment by the health professionals.

4. Results

4.1 Retrospective Malaria Prevalence

The IRS coverage (past 5-month) in Berahle woreda was 100% (14 kebeles). However, the LLINs coverage was 95%. Based on the clinical records for the period 2012-2016 a total of 8868 malaria slide-positive patients were documented out of 3,0856.total examine, 1774 cases each year on average visited Berahle woreda health center. Concerning the distribution of plasmodium species, 88.4% of the cases were due to *P. falciparum* and *P. vivax* only 11.6%. The cumulative prevalence of malaria out of the whole clinical records on the past five years was 28.8%.

The prevalence of malaria was 31.2% in 2012, 28.1% in year 2013, 28.7% in year 2014, 28.1% in year 2015, and 27.9% in 2016 (Table 1, fig 2). The data showed that the highest (31.2%) annual proportion (cumulative prevalence) of malaria cases was detected in the year 2012. This was slightly higher than in 2013, 2014, 2015 and 2016.

Malaria cases were found throughout the years studied. The difference was statistically significant (P=0.008).

There were 89.5%*P. falciparum* mono-infections in 2012 and in 2016 it was 86.1%. For the same years the proportions of *P. vivax* were 10.5%, 13.9% respectively. In 2014 and 2015 the proportions of *P. falciparum*were87.7% and 89.3 respectively and P. *vivax* were 12.3% and 10.7% respectively.

Malaria parasite species distribution varied seasonally, with *P. vivax* dominating in the dry season (March-June) and *P. falciparum* peaking in September-October, after the end of the main rainy season.

Table 1: Total examined and slide-confirmed annual malaria cases and species distribution at Berahle Woreda Health Office (2012-2016)

Year	Examined (n)	Slide-positive, n(%)	*P. falciparum*, n(%)	*P. vivax*, n (%)	p-value
2012	5553	1731(31.2)	1550(89.5)	181(10.5)	
2013	5807	1629(28.1)	1451(89.1)	178(10.9)	
2014	5748	1648(28.7)	1448(87.7)	200(12.3)	0.008
2015	7497	2110(28.1)	1884(89.3)	226(10.7)	
2016	6251	1750(27.9)	1506(86.1)	244(13.9)	
Overall	30,856	8,868(28.8)	7,839(88.4)	1029(11.6)	

n: number of patients, %: percent

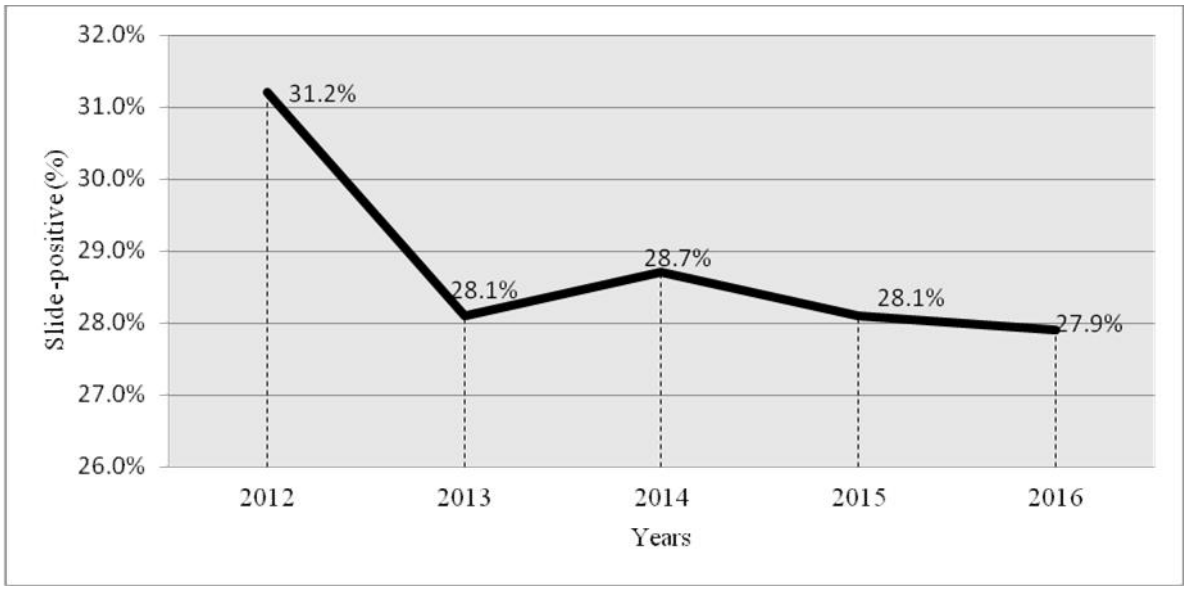

Figure 2: Yearly profiles of malaria slide-positive patients in Berahle woreda, Afar, Northeast Ethiopia.

4.2 Current Cross-sectional malaria prevalence

Among 1600 malaria diagnosed people for malaria between September 2016 and January 2017, 310(19.4%) were slide-positive. On average 62 malaria-confirmed cases visited (BHC) each month. The average monthly malaria prevalence was 19.2%. But, the number of suspected and confirmed cases showed a fluctuating pattern in the months studied (Table 2). The highest number of cases was registered in October through November shortly after the rainy season. On the other hand, the lowest number of malaria cases was number of confirmed cases in September was higher than in January. In general, there was a decline in the number of confirmed cases of malaria in January compared to the previous four months indicating the seasonal trend although cases existed throughout the dry season (Fig 3).

There were only 45 cases (n=320) from Berahle town. The other 265 cases were from rural areas or *kebeles*, such as Adae 51 cases (n=150), Demale 48 cases (n=173), Shahigubi 29 cases (n=265), Garmyoyti 31cases (n=196), De'ar 49 cases (n=210) and others 57 cases (n=286).

There were no malaria severe cases and deaths were mentioned. On the whole, 202 (65.2%) and 108 (34.8%) malaria cases were *P. falciparum* and *P. vivax* patients respectively. But there were no mixed cases during the study time. *P. falciparum* was consistently more prevalent than *P. vivax* irrespective of season (table 2).

Totally, there were 820 (52.3%) male patients and 780 (48.7%) females. Among slide-positives, 51.6% were males and 48.4% females (Table 3). Malaria slide-positives among males were 160 (19.5%) and females 150 (19.2%). More males were examined than females but, there was little variation in the proportion of malaria positivity by sex. The association of malaria with sex was statistically significant.

In relation to age, malaria was detected in all age groups. The total number of patients examined aged <5 years was 200(12.5%), Among these, 32 (16%) were found to be slide-positive (22 *P. falciparum*, 10 *P. vivax*). Of the study participants of whom 29 (22.3%) were malaria slide-positive (20 *P. falciparum*, 9 *P. vivax*). Patients belonging to

the age group 5-14 years were 227 (14.2%) with 58 (25.6%) slide-positives (41 *P. falciparum*, 17 *P. vivax*). Among those aged from > 14years the number of examined was 1173(73.3%) of whom 220(18.8%) were slide-positive (139 *P. falciparum*, 81 *P. vivax*). There was no significant association between age and malaria slide-positivity.

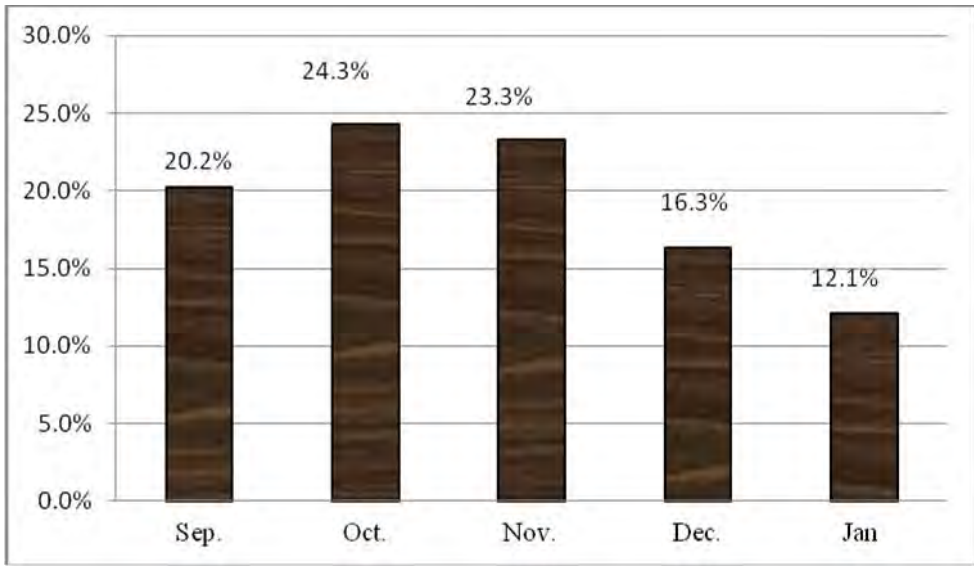

Figure 3: Monthly profile of malaria-positive patients at Berahle Health Center, September 2016-January 2017

Table 2: Seasonal pattern of malaria suspected and slide-confirmed cases and *Plasmodium* species distribution in Berahle Health Center, September 2016 – January 2017

Month	Examined, n	Confirmed, n(%)	*P. falciparum*, n(%)	*P. vivax*, n(%)	p-value
September	302	61(20.2)	36(59.0)	25(41.0)	
October	375	91(24.3)	63(69.2)	28(30.8)	
November	292	68(23.3)	48(70.6)	20(29.4)	0.0029
December	326	53(16.3)	31(58.5)	22(41.5)	
January	305	37(12.1)	24(64.9)	13(35.1)	
Total	1600	310(19.4)	202(65.2)	108(34.8)	

Table 3: Proportion of malaria by age and sex of patients in Berahle Health Center, September 2016- January 2017 (N=1600)

Sex	# Examined	# Confirmed (%)	*P. falciparum +ve* (%)	*P. vivax +ve* (%)	p-value
Male	820	160(19.5)	105(65.6)	55(34.4)	
Female	780	150(19.2)	97(64.7)	53(35.3)	0.0029
Total	1600	310(19.4)	202(65.2)	108(34.8)	
Age (year)					
< 5	200	32(16.0)	22(68.8)	10(31.2)	
5-14	227	58(25.6)	41(70.7)	17(29.3)	
>14	1173	220(18.8)	139(63.2)	81(36.8)	0.2138
Total	1600	310(19.4)	202(65.2)	108(34.8)	

5. Discussion

From the retrospective data, the highest proportion of annual malaria cases (31.2%) was in 2012 and the lowest (27.9%) in 2016 showing a declining trend in the past five years. In the current prospective cross-sectional survey the overall slide-positivity rate was 19.4% which was lower than the previous year in the same season. This decreasing trend might be due to better awareness of the people about malaria and implementation of control strategies. The outcomes of the data showed that the effectiveness of control interventions being implemented in the area. Integrated control efforts are underway in the woreda as part of the nationwide malaria control efforts. In the retrospective as well as current data *P. falciparum* was higher than that of *P. vivax* indicating the dominant existence of this parasite in the study area which is arid. However, it was observed that both *P. falciparum and P. vivax* are disturbed throughout the dry season and after the end of the main rainy season with some variation across the seasons and localities.

In similar study, *P. falciparum* was more frequently (69.4%) observed than *P.vivax* (30.6%) earlier report (Graves et al. 2008) in Amhara, Oromia and Southern Nation Nationalities and peoples (SNNP) of Ethiopia.

The study had shown that more males were examined than females, but, there was little variation in malaria positivity by sex. In relation to age group malaria was detected in all age groups. So, in this study there is no significant association between age and malaria occurrence.

In similar studies made from Nigeria showed that the prevalence of malaria parasite was significantly higher in males than in females (Ilozumba and Uzozie, 2009).

Monitoring of non-malaria fever is critically essential. It is highly desired for malaria surveillance to be based on confirmed rather than suspected cases at all levels of the health system. As the malaria control measures increase and the proportions of fevers due to malaria falls rapidly, it becomes more important to track confirmed malaria cases, rather than non-malarious fevers. Resources can be targeted to areas where problems remain and progress in malaria control is accelerated. Accordingly the WHO revised its fever treatment guidelines in 2010 to recommend antimalarial treatment (WHO 2010).

6. Conclusion and Recommendation

This study showed a slightly declining trend (3.3%) in malaria cases in the past five-year people visited BHC. The results suggest the effectiveness of ongoing control interventions possibly implying increased community awareness about the transmission, symptoms and prevention of malaria. Better access to bed nets and development of appropriate public infrastructure projects via the participation of non-governmental organization in the health sector might have resulted in the reduced number of malaria patients.

Nevertheless, malaria remains a great public health concern in the locality. Malaria control interventions must be maintained and scaled-up to sustainably reduce its risk and possibly eliminate malaria from the study area.

Healthcare provision and advice should include education to increase community awareness and practice about the transmission and prevention methods of malaria. Epidemiological studies and regular surveillance are needed to assess local risk factors and generate updates on the status of malaria in the area.

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Declaration

I, the undersigned, declare that this thesis is my original work and all source materials are duly acknowledged.

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Statement of the Supervisor(s)

This thesis has been approved for submission to the Department of Zoological Science for Public defense.

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