



Research article

Retrospective analysis of urban malaria cases due to *Plasmodium falciparum* and *Plasmodium vivax*: the case of Batu town, Oromia, Ethiopia

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ABSTRACT

Malaria is a major health problem in the world particularly in sub-Saharan Africa where 90% of malaria deaths occur. Likewise malaria is one of the leading causes of morbidity and mortality in Ethiopia. It has been reported that about 75% of the country is malarious where 60% of its population is at risk of this infection. Like many African countries, Ethiopian urban settings are characterized by poor housing, lack of sanitation and drainage of surface water which provide conducive environment for the breeding of vector mosquitoes for the transmission of malaria. There are few researches on urban malaria under the urban settings of Ethiopia. The purpose of this study was to assess the magnitude of malaria cases due to *Plasmodium falciparum* and *Plasmodium vivax* in Batu town, Oromia, Ethiopia. Retrospective laboratory confirmed malaria case record data of six years (2012–2017) were used to analyze the magnitude of malaria cases due to *P. falciparum* and *P. vivax*, in Batu town, Oromia, Ethiopia. The retrospective data analysis revealed an overall 21,797 malaria confirmed cases; of which 49.5% were due to *P. falciparum* and 50.5% were due to *P. vivax*, with a slight decline in malaria between 2012 and 2017. Malaria cases were recorded in both sexes and all age groups in the study area. From the result of the present analysis it can be concluded that both *P. falciparum* and *P. vivax* were the cause for malaria cases indicating malaria is still public health problem in Batu town. Therefore, appropriate strategic control measures must be designed to protect the public and eventually eliminate malaria from the area and the country as a whole.

1. Introduction

World Health Organization (WHO) estimates over 200 million cases of malaria each year with 90% of cases and 90% of deaths to occur in the African region [1, 2]. Of the five *Plasmodium* species: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale*, *Plasmodium malariae* and *Plasmodium knowlesi* that causes human malaria infection, *P. falciparum* is the deadliest parasite in terms of its morbidity and mortality. *P. falciparum* is the most prevalent malaria parasite in sub-Saharan Africa accounting 99% for malaria cases in 2016, whereas *P. vivax* spread geographically in the most densely populated regions [2, 3]. Malaria is one of the major public health problems in Ethiopia where about 75% of the country is malarious and 60% of its population is at risk of this infection. The nature of malaria transmission in Ethiopia is seasonal and unstable; higher transmission is from September to December following heavy summer rainy season and lower transmission lasts from April to May following short rainy season [4, 5].

Although malaria is typically considered mainly a problem of the rural poor, the disease has not been a concern in urban settings for

centuries [6] due to the assumption of economic development, improved housing and drainage system, household mosquito proofing, expanded personal protection, effective diagnosis and treatment and other factors that exist in urban area [6, 7]. But, for many African countries, including Ethiopia, in most urban areas, although there are rapid developments, they are characterized by poor housing, lack of sanitation and drainage of surface water that would provide favourable conditions for malaria vector breeding [8, 9]. As a result of this situation, it has been revealed that in some African cities malaria transmission persists and in some cases even at higher levels than in surrounding rural areas [10, 11]. For instance, a recent analysis estimated that urban sub-Saharan Africa accounting for 6–28% of the global malaria burden [12]. Thus as urbanization is increasing, factors that contribute to the urban malaria become more important. In view of the rapidly growing number of small and medium-sized towns, where Batu town is the one among them where its population increased there is a pressing need to enhance our understanding of malaria epidemiology in those settings. Therefore, the present study was aimed to assess malaria cases due to *P. falciparum* and *P. vivax* in Batu town, Oromia, Ethiopia.

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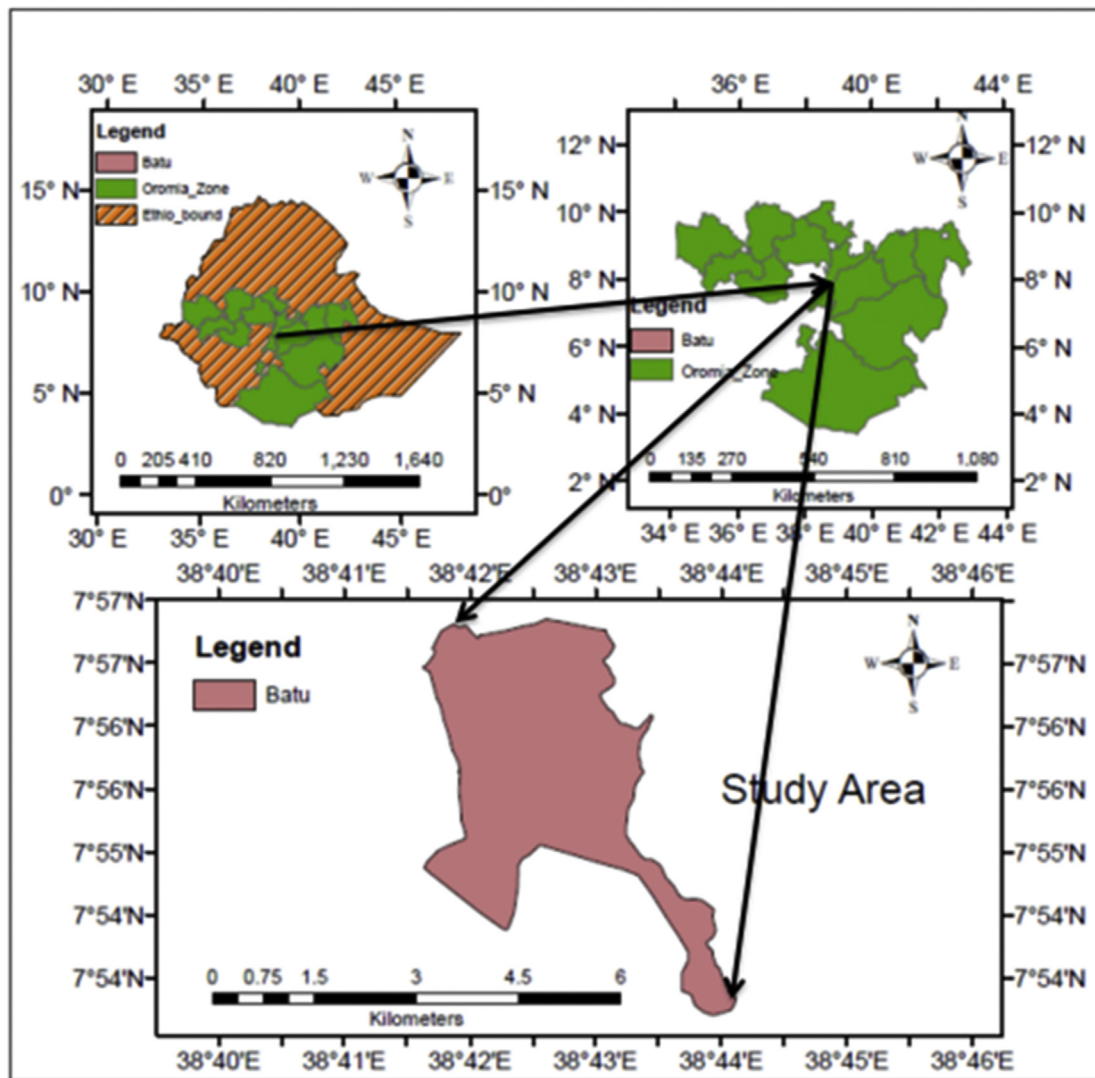


Figure 1. Map of the study area.

2. Methods

2.1. Description of the study area

Batu, formerly known as Zeway town, is located at 7°56' N and 38°42' E, at an average altitude of 1657m above sea level, about 165km south of Addis Ababa. The town is located in the middle of Ethiopian Rift Valley (Figure 1) with a total population increasing from 49,416 in 2000 to 78,784 (40,180 males and 38,604 females) in 2018 due to the flourishing of industries such as floriculture and agro-processing industrial park. Batu town has two hospitals (one government and one private), two government health centers and eight private medium clinics providing limited services to their customers.

Batu area receives between 700 – 800 mm of annual rainfall and annual temperature of 15–29 °C (Southeast District Meteorological Agency, 2018, unpublished data), with the heavy rains during the months of June to September and short rains in April and May. Malaria transmission in Batu area is generally unstable (seasonal), with peak transmission occurring between the months of September and November, immediately after the main rainy season, while the second less pronounced transmission period falls between April and May in the short-rainy season [13].

2.2. Study design and data collection

Retrospective laboratory record data of six years (2012–2017) malaria cases were obtained from the documents of Batu town administration health office. It was the data record microscopically confirmed malaria cases by experienced laboratory technicians. This dataset is the one regularly monitored and reported to the regional health bureau from the town health office.

2.3. Data analysis

Collected data of microscopically confirmed malaria cases were checked for their completeness and consistency, and entered into Microsoft Excel worksheet 2010. Descriptive statistics was used to calculate frequencies and percentages where results were presented in tables and graph.

2.4. Ethics and consent

The study protocol was reviewed and approved by Adama Science and Technology University Research and Ethical Review Board. Permission letter was obtained from Batu town health office.

Table 1. Slide-confirmed malaria cases by *Plasmodium* species from 2012 – 2017 in Batu town.

Year	Total number of blood film examined	No. of slide positive cases (%)	<i>P. falciparum</i> (%)	<i>P. vivax</i> (%)
2012	32,108	6004 (18.7)	2847 (47.5)	3157 (52.5)
2013	31399	5220 (16.6)	2593 (49.7)	2627 (50.3)
2014	33433	4045 (12.1)	1853 (45.8)	2192 (54.2)
2015	25973	3012 (11.6)	1597 (53.0)	1415 (47.0)
2016	26031	1739 (6.7)	811 (46.6)	928 (53.4)
2017	26479	1777 (6.7)	1090 (61.3)	687 (38.7)
Total	175,423	21797 (12.4)	10791 (49.5)	11006 (50.5)

3. Results

The retrospective data analysis indicated that among patients diagnosed or suspected cases (175,423) for malaria during the six years (2012–2017) a total of 21,797 (12.4%) were found slide positives (Table 1). Annually on average, 3632 malaria confirmed cases were recorded. A successive reduction in malaria cases was registered from 2012 to 2017 though in 2017 the number was a little bit higher than in 2016. As presented in Table 1 malaria cases due to *P. vivax* was slightly higher than that of *P. falciparum* during the year 2012–2014 and 2016, even though in 2015 and 2017 *P. falciparum* was found to be slightly higher than *P. vivax*. However, during this study period malaria cases due to other *Plasmodium* species such as *P. ovale* and *P. malariae* were not recorded.

Among the patients confirmed slide positive for malaria at Batu health facilities from 2012 -2017 malaria cases were recorded in all age groups: > 14 years old (44.5%), between 5–14 years (31.9%) while between 0 and 4 years old (23.6%) (Figure 2).

Our investigation from the recorded data regarding the cases of malaria by sex group in Batu town revealed that in the early years (2012 and 2013) slightly more malaria cases were registered in females than males. However, from 2014 – 2017 more cases were recorded in males than

Table 2. Number of malaria cases recorded during 2012–2017 by sex in Batu town.

Year	No. of Malaria Cases	No. of Male Cases, n (%)	No. of Female Cases, n (%)
2012	6004	2975 (49.6)	3029 (50.4)
2013	5220	2575 (49.3)	2645 (50.7)
2014	4045	2358 (58.3)	1687 (41.7)
2015	3012	1670 (55.4)	1342 (44.6)
2016	1739	958 (55.1)	781 (44.9)
2017	1777	1001 (56.3)	776 (43.7)
Total	21,797	11537 (52.9)	10220 (47.1)

females. Overall, higher malaria cases were recorded in male sex groups (52.9%) than their female counter parts (47.1%) during the study period (Table 2).

4. Discussion

In Ethiopia, the two dominant *Plasmodium* species known for causes of malaria infection with annual prevalence were 60–70% by *P. falciparum* and 30–40% by *P. vivax* [4] which is in agreement with the present retrospective analysis where both *P. falciparum* and *P. vivax* were recorded as dominant species that varied from year to year. For example retrospective study [14] showed that almost 50.0% of malaria cases were found to be due to *P. falciparum* whereas 46.0% by *P. vivax*. On the other hand 10 years data documented in Metema Hospital, in North Western Ethiopia, showed that *P. falciparum* alone accounted for 90.0% of malaria cases [15], while 64% and 25% due to *P. falciparum* and *P. vivax*, respectively reported from South Nation and Nationalities and Peoples (SNNP), Arbaminch hospital [16].

In the present retrospective data analysis generally more malaria cases were recorded in males than females which are in a close similarity with the report from five regional states and one city administration namely: Oromia, Amhara, Tigray, SNNP, Harari regions and Dire Dawa city administration of Ethiopia where 60% of malaria cases were observed in males [14]. In the present analysis we also observed the occurrence of malaria cases in all age groups where we revealed slightly

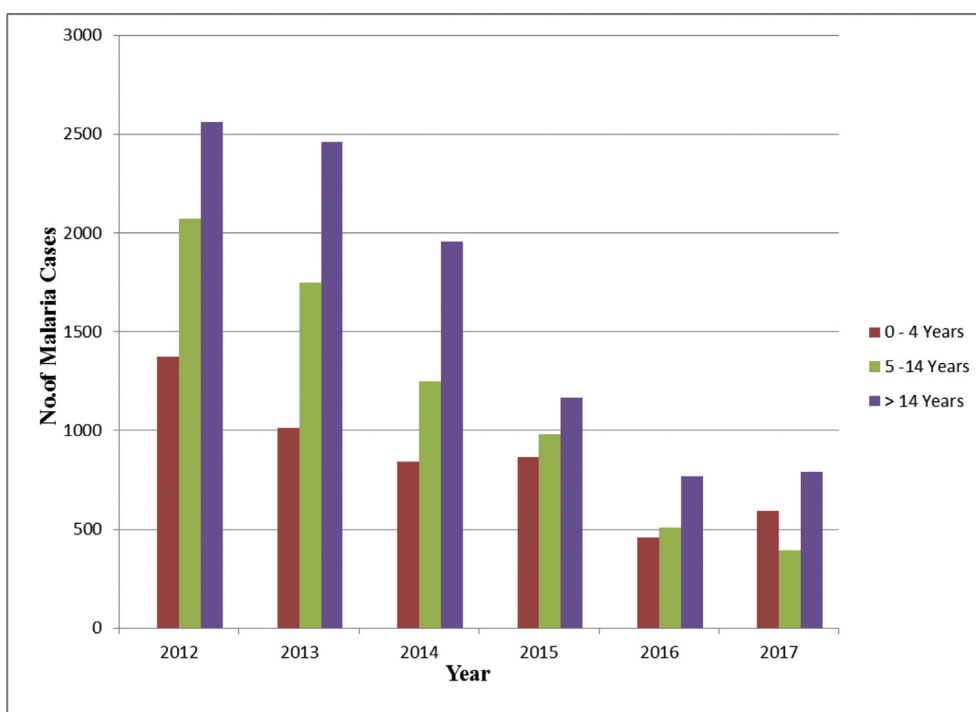


Figure 2. Malaria cases during 2012–2017 by age groups from Batu town.

more number of cases for the age groups >14 years which is in agreement with the retrospective studies conducted at Kombolcha, South Wollo, North-central Ethiopia and Kola Diba Health Centre [17, 18]. The reason why more malaria cases were recorded in males sex group and the age group >14 years, might be because this age groups are productive and are involved in various agricultural and day labour activities that can expose them to *Anopheles* mosquitoes breeding sites which transmit *Plasmodium* parasites. The other probable reason might be also their stay outside home at night during biting time of *Anopheles* mosquitoes.

In the present retrospective data analysis the almost continuously decreasing percentage of malaria cases from 2012 to 2017 is in line with the report of WHO [19] that showed a 50–75% decline in incidence and mortality rates of malaria between 2000 and 2013. In the same report between 2010 and 2015, malaria incidence and mortality rates, particularly due to *P. falciparum*, have declined by more than 50% in Ethiopia. The various efforts which might contribute to the reduction of malaria cases include an increase in the insecticides treated nets coverage and awareness among residents, wide use of indoor residual spray and spraying stagnant waters with larvicides. Other likely reason for reduction of malaria cases might be because of the effectiveness of Coartem® for the treatment *P. falciparum* malaria at national and local levels [20].

5. Conclusion

From the result of the present analysis it can be concluded that both *P. falciparum* and *P. vivax* were the cause for malaria cases indicating malaria is still public health problem in Batu town. Generally, the analysis revealed a declining trend of malaria cases from 2012 to 2017 at Batu town. However, control measures must be maintained and scaled up to protect the population and eventually eliminate malaria from the area and the country as a whole.

Declarations

Author contribution statement

J. Hassen: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

H. Dinka: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

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Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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