Research Article

Prevalence of mosquito-borne *Plasmodium* infection in patients attending fever clinic in a tertiary-care teaching hospital, western India

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Received July 3, 2015. Accepted July 15, 2015

Abstract

Background: Malaria is a serious vector-borne parasitic infection worldwide in distribution, and it is still one of the important causes of morbidity and mortality in India. In a developing country such as India, it has dramatic socioeconomic consequences.

Objective: To study the prevalence of fever cases being diagnosed as malaria and to determine the trend of malaria.

Materials and Methods: The blood samples of about 2,047 patients who presented with fever between the time period of May 2014 and April 2015 were examined by peripheral blood smear (PBS) for malaria.

Result: In this study, the blood samples of 2,047 fever cases suspected for malaria were sent for diagnosis to a microbiology laboratory in a tertiary-care teaching hospital. Among those, 48 (2.34%) of them showed positivity for malaria. According to the types of *Plasmodium* spp., *Plasmodium vivax* and *Plasmodium falciparum* accounted for 95.83% and 4.17% of malaria cases, respectively. The prevalence of malarial infection exhibited seasonal trend with many cases from the month of May to November with a peak in September. Malaria was reported in all age groups and both sexes, but commonly affected age group were between 21 and 30 years of age, and male patients were affected more than two times than the female patients.

Conclusion: This study about the survey on malaria reflected seasonal malarial transmission, and *P. vivax* was the most common type of malaria parasite. The lower socioeconomic and the younger aged groups were the mostly affected, causing serious health problems.

KEY WORDS: Peripheral blood smear, *P. vivax*, prevalence, seasonal trend

Introduction

Malaria is one of the vector-borne diseases. Nowadays, vector-borne diseases are the major causes of public health problems as they increase mortality and hinder the economic growth. Malaria is a protozoan disease caused by the parasites of the genus *Plasmodium*—*Plasmodium vivax*, *Plasmodium malariae*, *Plasmodium falciparum,* and *Plasmodium ovale,* which are transmitted by the bite of female *Anopheles* mosquitoes and pose a diagnostic challenge to the clinicians worldwide.[1] More than 90% of malaria is caused by *P. vivax* and *P. falciparum*. It is one of the leading causes of illness and death in the world. On the basis of the World Malaria Report 2014 given by the WHO, it was found that there were about 1.4 billion people at risk for malaria in 10 malaria-endemic countries in southeast Asia. Globally, many number of countries are focussing on eradication of malaria. In 2013,

Access this article online	
Website: http://www.ijmsph.com	Quick Response Code:
DOI: 10.5455/ijmsph.2015.03072015328	

worldwide, 198 million cases of malaria and 584,000 deaths caused by malaria were estimated. Approximately, 12.8 crores suspected malaria cases are present in India.[2] More than one-fifth (22.6%) of clinical episodes of *P. falciparum* are prevalent in India and 42% of episodes of *P. vivax* are present worldwide. By 2015, 55 countries have decided to bring down the incidence rates of malaria cases by 75%.[3] Malaria exerts socioeconomic burden in India owing to its high prevalence, virulence, and drug resistance. In tropical countries such as India, owing to existence of an ideal environment for the breeding of mosquitoes such as warm climate, heavy rain, and stagnant water, every year, approximately 2 to 3 million new cases are being reported.[4] Expanding urbanization, industrialization, and a steady humid temperature are the factors attributed toward the mosquito breeding and consequent urban epidemic of malaria. The incidence of malaria peaks in monsoon (June to October), as stagnant water provides the optimal conditions for the breeding of mosquitoes.[5] In India, National Vector-Borne Disease Control Program (NVBDCP) auspices the control measures for malaria that should be vertically implemented all over the nation.

Typical case of malaria consists of a series of febrile paroxysm including cold stage, hot stage, and sweating stage and other symptoms such as fever with chills, body pain, headache, nausea, vomiting, diarrhoea, etc. Malaria caused by *P. falciparum* is associated with fatal complications such as cerebral malaria, algid malaria, septicemic malaria, severe anemia, kidney failure, respiratory distress, metabolic acidosis, etc.[2] The clinical diagnosis of malaria is not an easy task even for an experienced medical practitioner. Reliable laboratory methods are required to aid the clinical diagnosis of malaria.

Early detection of the disease is the most important criterion to start a prompt treatment for the patients to prevent complications. The characteristics of an ideal tool for malaria diagnosis are simplified methods and quick availability of results, minimal training requirements, use of minimal materials that do not require refrigeration, reproducible results, ability to detect malarial species and low parasitic density, and cost-effective.[6] Some of the control strategies that can help to reduce the vulnerability to malaria include—early diagnosis and prompt treatment, improved medical health services and easy accessibility, identification of high-risk areas by spatial mapping, improved active surveillance and monitoring systems, improved infrastructure to avoid mosquito breeding sites, promotion of urban architecture to minimize water collection and facilitate water harvesting, use of insecticide-treated bed nets for personal protection, and public education. Along with the efforts of the government to control malaria through National Malaria Eradication Program, all the above-mentioned control measures can be used to reduce malaria in the future.

The purpose of the study was to calculate the outpatient department (OPD)-based prevalence of fever cases being diagnosed as malaria and to determine the epidemiological trend of malaria. Collectively, these data will help to build some base for the development of policies to reduce malaria in western India.

Materials and Methods

This study was conducted at a tertiary-care teaching hospital, western India, over 12 months during the time period from May 2014 to April 2015. A total of 2,047 patients who attended the fever clinic were enrolled in our study. On the basis of their clinical manifestations, blood samples were collected by finger prick, which is the ideal method, and examined for malarial parasites by peripheral blood smear (PBS) examination (n = 2047), which remains as the gold standard method for confirming the presence of malaria parasite according to the WHO till today. The blood samples were collected when the temperature was elevated.

Peripheral Blood Smear

Thick peripheral smears of blood samples were immediately prepared and dried as per standard procedure, and then, they were stained with the field stain. The thin film was used to identify the *Plasmodium* species. Field stain is a compound stain formed by the interaction of methylene blue and eosin, which is used for thick films without fixation and for thin films with ethanol fixation. The staining process is done quickly within a few minutes with the help of this stain. Then, these stained smears were microscopically examined for malarial parasites under oil immersion objective. A total of 200 to 300 microscopic fields were examined before the film was declared negative. Peripheral parasitemia was defined by the presence of parasites in the blood smear.

The patients identified as parasitemic through the blood smears were immediately referred to a clinician so that the treatment could be started, as per Indian national program guidelines. The treatment consisted of administration of chloroquine in cases caused by both *P. falciparum* and *P. vivax*. Iron and folic acid were given to all the positive parasitemic patients under the National Anemia Prophylaxis Program. Information of the patients was collected at the time of examination of PBSs. The patients were informed about the purpose of the study. Various epidemiological parameters such as name, age, sex, address, income, and education were collected. The information collected was compiled and analyzed with Microsoft Excel, and conclusions were drawn.

Result

The survey was conducted for over a 12-month period on the patients who attended the fever clinic in a tertiary-care teaching hospital and found that the overall prevalence of peripheral parasitemia was 2.34%.

P. vivax was the predominant species identified in PBS examinations (95.83% of all infections, 46/48), while *P. falciparum* was much less-frequent identified species (4.17% of all positive cases, 2/48).

The prevalence of peripheral parasitemia was relatively low among female subjects who presented with fever (1.32%, 13/988) and relatively high among male subjects (3.31%, 35/1059).

In this study, the malaria cases were predominant in the age group 21–30 years (31.25% of the total positive cases).

Discussion

During the study period from May 2014 to April 2015, a total of 2,047 fever cases suspected for malaria were examined of which 48 (2.34%) fever cases were confirmed positive for malaria parasitic infection by microscopic examination. There was a fluctuating seasonal trend of malaria during the study period, as there was a complete absence of microscopically confirmed malaria cases being reported from February to April 2015, and the maximum microscopically confirmed cases of malaria were reported from May to November 2014, with a peak in September as a result of relative humidity and rainfall [Figure 1]. *P. vivax* was the most commonly reported species during the study period (95.83%) and *P. falciparum* accounted for 4.17%. In this study, the distribution of malaria cases based on the gender showed that the male subjects (72.92%) were more affected than the female subjects (27.08%), which was statistically significant ($p = 0.036$). In this study, the malaria cases were found more in the age group 21–30 years (31.25%) [Table 1].

Verma et al.[7] also reported the seasonal trend of malaria (maximum number of cases were in the months between September and November). A study carried out by Balpande et al.[8] reported that *P. vivax* and *P. falciparum* accounted for 95.1% and 4.8% of malaria cases, respectively. A study conducted by Kumar and Ramchandran[9] also reported that maximum number of malaria cases were observed in male subjects (71.45%), the reason because that male subjects are more engaged in outdoor activities; so, it makes them more prone to mosquito bites, but it may vary. Alemu et al.[10] also reported more malaria cases in the young age group. This might be associated with their daily outdoor activities for job, farming, etc., which might expose them to the bite of mosquitoes.

Among all the laboratory diagnostic methods such as PBS examination, quantitative buffy coat method, and rapid diagnostic tests such as ParaSight F test and Paracheck-Pf test, the PBS examination provides fast diagnosis with high sensitivity and specificity and is economic, but it has disadvantages such as the need of a well-trained microscopist.[6] The limitation of this study was that we could not trace the malaria cases who neglected fever and did not attend the clinic; so, the actual prevalence of malaria and its epidemiological trend in western India could not be calculated.

In order to monitor the transmission of malaria and for eradication strategies, epidemiological studies of malaria are essential.[11] There should be some policy and practice guidelines toward the factors that help in reducing the transmission, such as the use of insecticide-treated bed nets, indoor residual spraying, screening of all patients with fever, and a prompt treatment of the confirmed cases as a part of the integrated malaria control program.[12]

Conclusion

This study reported the prevalence of mosquito-borne *Plasmodium* infection cases as 2.30%. *P. vivax* was reported as the most common parasite to cause malaria. Malaria was most common in male subjects than female subjects. The commonly affected age group was between 21 and 30 years, which is a key factor responsible for the transmission of parasites to children and is relevant in the malaria eradication strategy. Thus, an active surveillance with adequate vector control measures can reduce the transmission of malaria by strengthening malaria control interventions effectively and, thus, ultimately, better patient care.

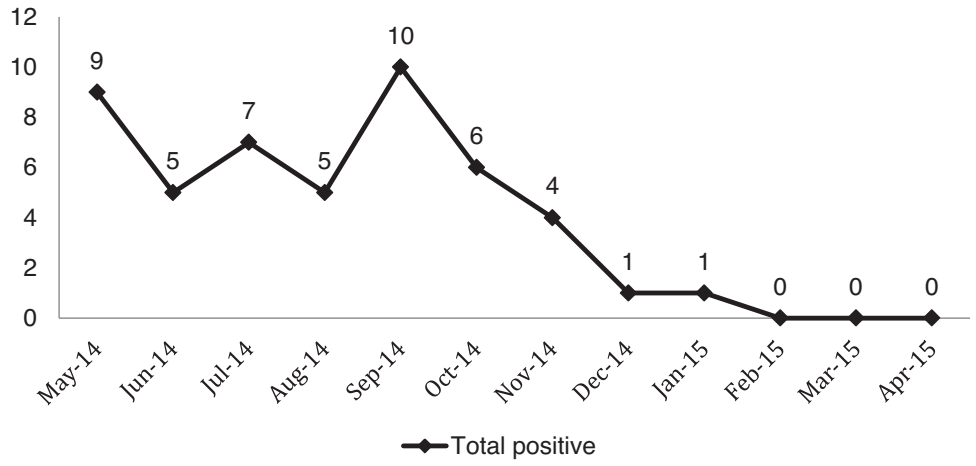

Figure 1: Distribution of confirmed malaria cases from May 2014 to April 2015 (seasonal trend of confirmed malaria cases).

Table 1: Distribution of confirmed malaria cases according to age from May 2014 to April 2015

Age characteristic(years)	Suspected malaria cases, (*n*)	Confirmed malaria cases, (*n*)	Prevalence of malaria cases according to age (%)
1–10	214	6	2.80
11–20	618	13	2.10
21–30	509	15	2.95
31–40	334	6	1.80
41–50	266	6	2.26
>50	106	2	1.89
Total	2,047	48	2.34

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How to cite this article: Murawala SM, Chudasama V, Vegad M . Prevalence of mosquito-borne Plasmodium infection in patients attending fever clinic in a tertiary-care teaching hospital, western India. Int J Med Sci Public Health 2015;4:1598-1601

Source of Support: Nil, **Conflict of Interest:** None declared.