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Pattern of Malaria Infections at Tertiary Care Hospital of Haldwani (Nainital) Uttarakhand - A Hospital Based Retrospective Study

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Abstract
Malaria is a serious vector-borne parasitic infection caused by protozoan parasites of the genus Plasmodium. It is worldwide in distribution and continues to be a major public health problem. It is still one of the important causes of morbidity and mortality in India. *Plasmodium falciparum* was considered to be the main cause of complicated malaria, but now severe clinical consequences resulting from vivax malaria have been reported. The present retrospective study was undertaken to determine the prevalence of malarial parasites in a tertiary care hospital in Kumaun region, Uttarakhand. This was carried out at Dr. Susheela Tiwari Government Hospital, Haldwani during last 2 years (January 2015 to December 2016). 13696 fever cases suspected for malaria were diagnosed by rapid diagnostic test and peripheral blood smear examination. Among those, 291 (2.12%) showed positivity for malaria. Males 179 (61.5%) outnumbered females 112 (38.4%) and maximum number of cases were within the age group of 11-20 years. The majority of the patients were reported to be positive in the months of July to October. *Plasmodium vivax* was the major parasite type 271(93.12%) followed by mixed malarial infection 17(5.84%), *P. falciparum* 3(1.03%) and most of them received combination therapy. No deaths were reported in this study. There is high prevalence of *P.vivax* as compared to *P. falciparum* infections. The maximum number of cases was reported in month of August to October which concludes that malaria has its peak incidence during rainy season. Awareness, availability of treatment, control measurements help to decrease prevalence of malaria.

Keywords: Malaria, Retrospective studies, *P. falciparum*, *P. vivax*, Uttarakhand

Introduction

Malaria is common mosquito-borne illnesses in our country. It is a protozoan disease caused by the parasites of the genus plasmodium. Common species in India are *Plasmodium vivax*, *Plasmodium malariae*, *Plasmodium falciparum*, and *Plasmodium ovale*. Sporozoites of Plasmodium are transmitted by the bite of female Anopheles mosquitoes commonly from dusk to dawn. [1] *Plasmodium vivax* and *Plasmodium falciparum* are commonly seen the tropical countries like Africa, India, Pakistan, Afghanistan, Middle East and South East Asia. *Plasmodium malariae* and *Plasmodium ovale* are less common cause of disease and generally do not cause severe illness.[2] 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. According to World Malaria Report 2014, About 1.4 billion people are at some risk form malaria in the 10 malaria-endemic countries in South East Asian Region (SEAR), with 352 million at high risk. Globally, an estimated 3.2 billion people in 97 countries and territories are at risk of being infected with malaria and developing disease and 1.2 billion are at high risk. In 2013, worldwide, 198 million cases of malaria and 584,000 deaths caused by malaria were estimated. Approximately, 12.5 crores suspected malaria cases are present in India. [3]

In tropical countries such as India, malaria may be throughout the whole year but higher in autumn and spring. [4] An ideal environment for the breeding of mosquitoes such as warm climate, heavy rain, and stagnant water, industrialization, and expanding

urbanization are the factors attributed toward the mosquito breeding. The incidence of malaria peaks in monsoon (June to October).

The present study was planned to observe the occurrence and pattern of malarial infection and socioeconomic factor at a tertiary care hospital in Kumaun region. A constant watch on the changing pattern of the diseases provides us an opportunity for timely intervention as well as monitor the progress of the ongoing disease control programmes.

Materials and Methods

This retrospective study was conducted at Dr. Susheela Tiwari government hospital Haldwani, a tertiary-care teaching hospital, Northern India, over 2 years during the time period from January 2015 to December 2016.

A total of 13696 fever cases all age groups suspected for malaria were diagnosed by rapid diagnostic test and peripheral blood smear examination.

Methodology

Slide Microscopy-Peripheral blood smear were prepared and stained by standard methodology. Leishman's staining technique was used and these slides were examined under oil immersion microscopic objective (100X). [Figure 1 & 2]

Malaria Antigen detection

Malaria Antigen detection was done by commercially available Immunochromatographic test, ADVANTAGE MAL CARD (J. MITRA & Co. Pvt. Ltd). The test uses monoclonal anti-P.f pLDH antibody & monoclonal anti-Pan specific pLDH antibody immobilized on a nitrocellulose strip. The sensitivity of this kit for *P. vivax* and *P. falciparum* were 100% and Specificity is 99% (as per the manufacturers of the kit). [Figure 3 (a) & (b)]

Results

During the study period (2015–2016), out of 13696 fever cases suspected for malaria 291(2.1%) were confirmed microscopically and through malaria antigen card test kit.

Trend of malaria cases according to their gender in the study area showed that males were more affected (61.5%) than females (38.4%) by malaria parasites but vary year to year (Table 1).

Table 1: Malaria distribution by gender (2015-2016)

Year	Screened cases (N)	Positive cases (N)	Male positive (N)	Female positive (N)
2015	5954	123	81	42
2016	7742	168	98	70
Total	13696	291	179	112

Malaria was reported in all age groups in the area but the age group of 11–20 years were affected more with a prevalence rate of 82 (28.17%) followed by 21–30 years and 0–10 years with the prevalence rate 78 (26.8%) and 48 (16.5%) respectively. (Table 2)

Table 2: Age and Year wise distribution of malaria cases

AGE (Y)	Positive (N) Year 2015	Positive (N) Year 2016	Total Positive (N)
0-10	19	29	48
11-20	34	48	82
21-30	29	49	78
31-40	22	18	40
>40	19	24	43
Total	123	168	291

Out of 291 patients, *Plasmodium vivax* were most common (93.12%) infection reported. *Plasmodium falciparum* accounted for 1.03% and 5.84% were found to be positive for both *Plasmodium vivax* and *Plasmodium falciparum*. (Table 3)

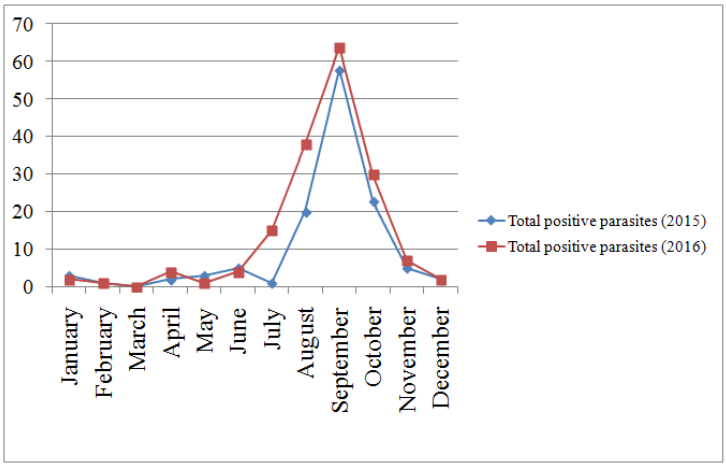
Table 3: Total no. of different positive parasites

Total positive cases	Malaria parasite	No. Positive
291	*P. vivax*	271 (93.12%)
	P. falciparum	3 (1.03%)
	P. falciparum + *P. vivax*	17 (5.84%)

In our study maximum number of cases was from August to November peak in September because the rains provide good breeding sites for mosquito vectors. (Table 4, Graph 1)

Table 4: Month-wise Distribution of malaria cases

Months	Total positive cases (2015)	Total positive cases (2016)	Grand Total (n)
January	3	2	5
February	1	1	2
March	0	0	0
April	2	4	6
May	3	1	4
June	5	4	9
July	1	15	16
August	20	38	58
September	58	64	122
October	23	30	53
November	5	7	12
December	2	2	4
Grand Total	123	168	**291**



Graph 1: Month-wise distribution of malaria cases

Majority of patients came from rural area of District Nainital and Udham Singh Nagar and mostly belonged to lower class families.

Discussion

During the study period (2015–2016), out of 13696 fever cases suspected for malaria 291(2.1%) were confirmed positive for malaria parasitic infection microscopically. In the present study, malaria cases occurred in almost every month and season of the year. Many investigators also reported seasonal trends of malaria in tropical countries like India. The optimal temperature range for the development of most Anopheles vector species of malaria lies within 20°C to 30°C. However, transmission of *Plasmodium vivax* requires a minimum average temperature of 15°C and transmission by *Plasmodium falciparum* requires a minimum temperature of 19°C. That may be a reason for more cases of malaria during August to November month [5] However, Positive cases of malaria are reported throughout the year in India [6,7] as a right combination of average temperature, rainfall and precipitation conditions persists across the country over all the seasons in some part or the other. It is also noted that the average relative humidity range (55 to 80%) remains conducive to malaria transmission, only between the months of May to October, which coincides with the maximum number of positive malarial cases reported during this period. In rainy season, improper disposal of excreta and stagnant water around house, working in fields bare footed, bare body are the major factor to spread of malaria. Agravat *et al.* (2012) in their study also found direct relationship with average rainfall and malarial infection during monsoon. As well as they also found that water stagnation & accumulation plays a major role in mosquito breeding and subsequent spread of malaria and reported maximum number of malaria cases in lower socioeconomic class due to poor sanitation. [8, 9] Males (61.5%) were more affected than females (38.4%) in the present study. Similar results were found by Jimmy Antony *et al.*, from Kerala [10] and Kumar P *et al.*, from Rajasthan [11] Other studies also reported similar findings Balpande L *et al.* [12]; Ruby Naz *et al.*[13]. Males were more affected than female due to more outdoor activities and fields work which makes them more prone to mosquito bites. In our study, Maximum patients were from age group 11-20 yr (28.17%) followed by 21-30 yr (26.8%). Balpande *et al.* [12] also reported most common affected group 11-20 years (23.9%). Murawala *et al.* [1] from Ahmadabad reported more malaria cases in age group 21-30 yr (31.25%). This study is in contrast with the study done by A Praveen Kumar *et al.* [11] from Rajasthan who reported (71.4%) malaria cases in age group 15-44 Years. Abebe Alemu *et al.* [4] also reported higher malaria cases in age group 15-44 Years (50%). Difference may be due to difference in area and clubbing

of age groups. Various studies done in various geographical area reported different pattern of malaria. In the present study, the frequency of *Plasmodium vivax* cases was remarkably high (93.1%). *Plasmodium falciparum* accounted for 1.03% and mixed malarial infection 5.84%. Similar findings were also reported in the study of Murawala *et al.* [1] where *Plasmodium vivax* was the most commonly reported species (95.83%) and *P. falciparum* accounted for 4.17%. A study carried out by Balpande *et al.* [12] reported higher frequency of *P. vivax* (95.1%) than *P. falciparum* (4.8%). Madhu Muddaiah *et al.* [16] in their study on malaria in South Canara, Karnataka states also reveal the *Plasmodium vivax* as major parasite type (52.54%) followed by *Plasmodium falciparum* (33.75%) and mixed malarial infection (13.69%). While the study conducted by I Jamaiah *et al.*[15] reported *Plasmodium falciparum* as the most common species (57%) in their study followed by *Plasmodium vivax* (38%) and 5% mixed infection. The other studies conducted in different states of India on this regard also second the preponderance of *Plasmodium falciparum*. Jimmy Antony *et al.* from Kerala [10] reported higher cases of *Plasmodium falciparum* (46.04%) followed by *Plasmodium vivax* (27.33%) and 26.61% were due to unspecified malaria infection. Similar findings also reported in the study of Abebe Alemu *et al.* [4]; they found *Plasmodium falciparum* as predominant species and accounted for 75% of malaria morbidity.

Conclusions

Malaria is responsible for major health concern in this region, particularly in rainy season. This study reported the prevalence of malaria cases as 2.1%. *P. vivax* was the major parasite type causing malaria. Malaria was common among males than females; the commonly affected age group was younger adult population, which is a key factor responsible for the transmission of parasites to children and is relevant in the malaria eradication strategy. Therefore, 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.

Fig 1: Leishman-stained thin blood films showing *P. vivax* gametocytes and Ring stage

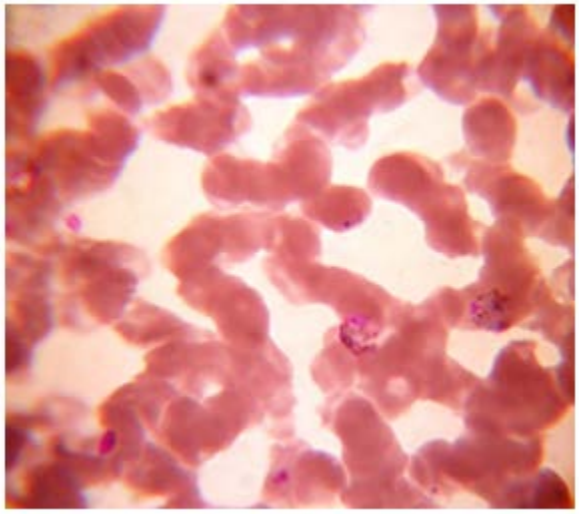


Fig 2: Leishman-stained thin blood films showing *P. falciparum* gametocyte and Ring stages

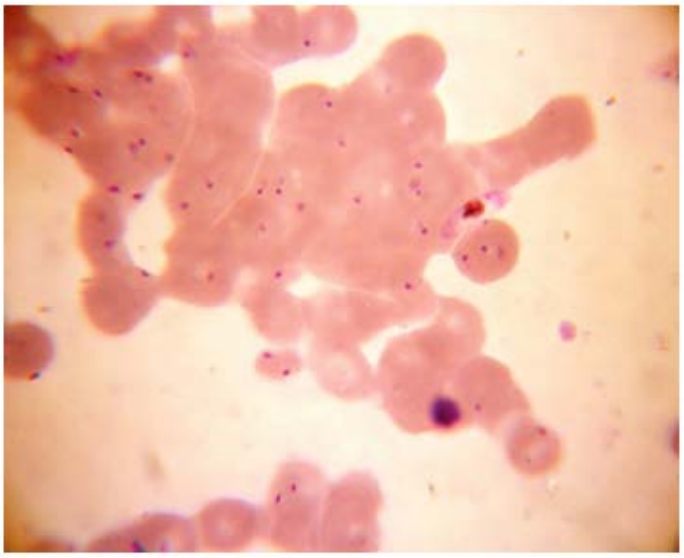


Fig 3: Immunochromatographic test device for the detection of pLDH. [PAN+Pf antigen Card test Positive]
(a) PAN+Pf Card test Positive for *P. vivax*

(b) PAN+Pf Card test Positive for *P. vivax* and *P. falciparum*

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