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Original Article

Microbiology Section

Trend Analysis of Malaria Prevalence in a District of Western Ghats, Karnataka, India: A Retrospective Study

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ABSTRACT

Introduction: Malaria, among vector-borne diseases, has remained a major threat to public health for decades due to its course and complications. As an endemic region, malaria poses a great threat as it can cause multi-organ failure. Despite continuous monitoring and effective implementation of control measures, India still contributes to the majority of cases in the sub-Asian region.

Aim: To estimate the prevalence of malaria, to determine the seasonality and to analyse the trend of the disease over a period.

Materials and Methods: This was a retrospective study conducted at Chikamagalur a district in Karnataka, India, in the year 2022 over a period of six months. The study was done by collecting the data of patient details from the laboratory register. The results were analysed, positive results were calculated for disease burden by *Plasmodium vivax* (*P. vivax*) and *Plasmodium falciparum* (*P. falciparum)*.

Results: Out of 27,474 samples, 94 were found positive for malaria parasite of which *P. vivax* cases were 90 (95%) and 4 (5%) were *P. falciparum* cases. The prevalence rate was 0.34%. There was a 24% drop in malaria cases from 2019-2021 when compared to 2015-2018.

Conclusion: The present study shows decline in the number of malaria cases from 2015 to 2021. The cases showed seasonal variation with maximum cases being reported in September. As India is in the decline phase of cases, with the collective efforts of clinicians, laboratory personnel and community health workers, elimination of malaria could be a possibility.

Keywords: Burden, Decline, Elimination of malaria, Malaria, Prevalence

INTRODUCTION

In the tropical regions, of all the vector borne diseases, malaria is a constant major health problem due to its morbidity and mortality. According to the data published, it gains global attention, as nearly 300-500 million cases and 1.5-2.7 million deaths are reported annually [1,2]. As per the National Vector Borne Disease Control Program (NVBDCP) [3] incidence records, in most parts of India the Annual Parasite Index (API) was five [3]. The API is an index to express malaria cases per thousand populations. In India, high API index was reported from Rajasthan followed by Gujarat, Karnataka etc., [3].

Malaria is a mosquito-borne illness which remains an important public health problem in both under developed and developing countries and a major cause of morbidity and mortality in both rural and urban areas. It spreads to people through the bite of female Anopheles mosquitoes [4]. The four important species that cause human infection are *P. falciparum, P. vivax, Plasmodium malariae* and *Plasmodium ovale.* Malaria is endemic in India and the most common species spreading infection are *P. falciparum* and *P. vivax*. A typical attack of malaria comprises of-cold stage, hot stage and sweating stage [5]. Clinical symptoms can vary from headache, fever, shivering, vomiting, haemolytic anaemia, jaundice, haematuria, altered sensorium and convulsions [6].

Due to the complications arising from *P. falciparum*, it is considered more fatal than *P. vivax* [7,8]. The geographical location and climatic conditions are favourable for transmission of malaria in India like climate, season, temperature, humidity, rainfall, altitude and host factors like gender, race, population mobility, housing, occupation socio-economic status etc., having an influence on malaria epidemiology [9,10]. Also, location of mosquito breeding sites in and around the housing areas and clustering of human habitations which act as reservoirs of parasites that makes the transmission rate higher and poses a great challenge in the control of cases in endemic areas of India [11]. Chikkmangalur is a hill station in Karnataka, a state in southwest India, with an area of 30 km^2. Chikkamagalur situated in the Western Ghats covered with trees and waterfalls. The town's elevation of 1,090 m above sea level makes it an ideal place for breeding and also transmission of the same. Effective implementation of insecticide spraying, prevention of water stagnation, using larvicidal agents helped in countries like India and Srilanka, severely reducing the Anopheline population [12]. The objective of the study was to estimate the prevalence of malarial parasitic infection among patients attending tertiary care hospital, to determine the seasonality of the disease and to analyse the trend of the disease over the period.

MATERIALS AND METHODS

This was a retrospective study, to determine the prevalence of malaria. The present study was done from Chikkamagalur area which is a hillock in Western Ghats. The data was collected retrospectively from January 2015 to December 2021 from District hospital Chikkamagaluru and analysed over six months. The study was presented to ethical committee clearance board and approval was obtained with the number bearing RMCH/IEC12/2023.

Inclusion criteria: The study population included all the patients (both sexes and any age groups) with fever as chief complaint, associated with chills, rigors, who either attended Outpatient Department (OPD) or patients admitted in ward.

Exclusion criteria: The patients without symptoms suggestive of malaria were excluded from the study.

Methodology: A total of 27,474 samples were examined during the study period. The data regarding the patient details (like age, gender, year of hospital visit) were collected from the laboratory registers maintained. All the samples received were processed according to the standard protocols. Peripheral blood smear examination was done on all samples. Two types of smears were done. One was the thick smear for screening and other was a thin smear which helped in the identification of different stages of malaria parasite. The smears were stained with pararosaniline dye (leishman stain),

smears were dried and observed under microscope [13]. Additional immunochromatographic assay done using commercially available kit (Meriscreen Malaria Pf/Pv Ag, Meril life manufacturers) in which precoated antibody specific to histidine rich protein II of *P. falciparum* and antibody specific to lactate dehydrogenase of *Plasmodium* series was used. The above antigens were detected [13]. The results were entered in log registers and maintained. The data included patient details, chief complaints, number of blood samples collected, number of samples tested positive for *P. vivax and P. falciparum.* The data was collected, compiled and analysed to understand the prevalence of malaria in the area.

STATISTICAL ANALYSIS

The data were entered into Statistical Package for the Social Sciences (SPSS) software 28.0 for analysis. Descriptive statistics were used to summarise the study participants and the frequency of malaria on different independent variables and presented by tables, figures and texts. Z-test was applied to determine the significance and statistical analysis was carried out at 5% level of significance and p-value <0.05 was considered as significant.

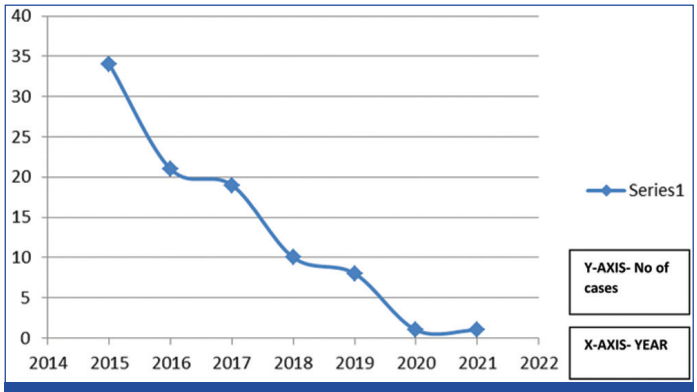
RESULTS

A total of 27,474 samples were examined from 2015 to 2021 out of which 94 samples were found microscopically positive for malaria parasite of which *P. vivax* cases were 90 (95%) and 4 (5%) were *P. falciparum* cases. Prevalence rate was 0.34%.

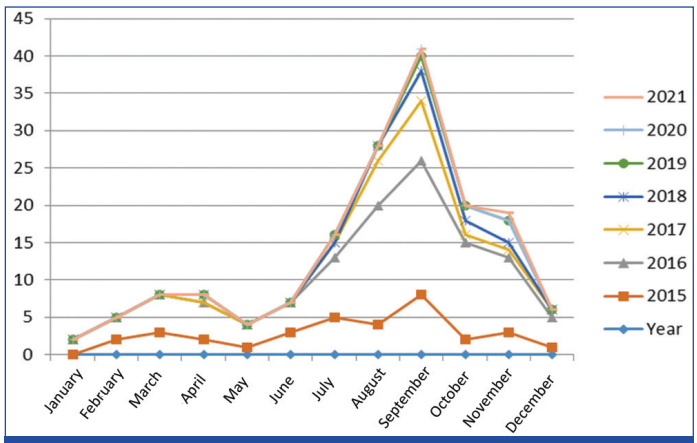
Prevalence of malaria in the present study was more in males 64/94 (68%) as compared to female 30/94 (32%) with male to female ratio 2:1 [Table/Fig-1]. Maximum number of cases was seen among the age group of 11-40 years (86, 91.4%) with peak in 21-30 years. Considering different species of *Plasmodium* causing the disease, between 11-40 years are group, *P. vivax* accounted for 82 (96%) and *P. falciparum* was in 4 (4%) patients. There was decline in the number of cases from 34 positive cases in 2015 to one positive case in 2021 as shown in [Table/Fig-2]. The cases showed seasonal variation. As shown in [Table/Fig-3], maximum numbers of cases were seen from July to November with peak in September which corresponds to monsoon and post monsoon seasons of the year.

Age (years)	Male	Female	*Plasmodium vivax (P. vivax)*	*Plasmodium falciparum (P. falciparum)*
0-10	2	1	3	0
11-20	14	5	18	1
21-30	32	12	42	2
31-40	12	11	22	1
41-50	2	1	3	0
51-60	1	0	1	0
61-70	1	0	1	0

[Table/Fig-1]: Age and gender distribution of malaria cases.



[Table/Fig-2]: Demonstration of trend of malaria cases from 2015-2021.



[Table/Fig-3]: Month wise distribution of cases from 2015 to 2021.

DISCUSSION

The present study aimed at determining the trend analysis of malaria cases in Chikmagalur, a hill station in Karnataka, India. The present study showed a decline in number of cases from 2015-2019. There was 24% drop in malaria cases from 2019-2021 when compared to 2015-2018. The results was concordant with the statistical data given by ministry of health family welfare which showed that there was a considerable decline in malaria cases in India [14]. India is the only high endemic country which has reported a decline of 17.6% in 2019 as compared to 2018. The API reduced by 27.6% in 2018 compared to 2017 and by 18.4% in 2019 as compared to 2018. India has sustained API less than one since year 2012 [15]. With the effective control and preventive measures and effective implementation of national programmes India is showing a decline phase in the number of cases reported as well as mortality because of malaria, which makes it assertive that India will be among one of the nations to eliminate malaria by 2025. When compared to other countries the prevalence rate in India shows a wide variations may be due to change in the geographical location and climatic conditions which affect mosquito breeding places also other factors like socio-economic conditions of patients, knowledge about healthcare and public health practices play a predominant role.

In India, malaria is found to be a seasonal disease. The cases are usually observed to increase from July to October. The conditions which favour transmission of malaria are good rainfall, relative humidity of 60% and temperature between 20-30°C [16]. Regarding seasonal variation, in the present study maximum numbers of cases were found in the months of July to November with a peak in September. Similar findings are reported by a study in Navi Mumbai, India which showed around 20% (161) cases in October of total 809 cases reported in a year [5]. Similarly studies done by Pandey S and Singh A, Jivabhai HT et al., showed an increase in number of cases in August, September and October which corresponds to the monsoon season of the year [17,18]. High prevalence of malaria in this period could be due to collection of water in rainy season and mosquito breeding which continues till November.

According to Park textbook of Preventive and Social Medicine, in India, about 70% of the infections are reported to be due to *P. vivax*, 25-30% due to *P. falciparum*, 4-8% due to mixed infection and 1% due to *P. malariae* [11]. The present study showed 90 (95%) of cases are due to *P. vivax* and 4 (5%) of total cases are due to *P. falciparum.* In another study done in Arunachal Pradesh *P. vivax* accounted for 80.8% of infection and *P. falciparum* caused 17.7% of total malaria cases [9] which was comparable with present study. The present study concords with the other studies from India that showed higher number of *P. vivax* positive cases compare to *P. falciparum*. On contrary, study from Navi Mumbai [5] showed high rate of mixed infection in addition to routine malarial infection.

Male to female ratio in this study was 2:1, This difference in number of cases could be attributed to various reasons like body odour which may attract mosquitoes among males, also movement of males to wider areas when compared to females [19]. All the above could be the reasons for more cases being reported among males than females. Similar difference in results were reported in a study done by Singh RK et al., from Gadchiroli (Maharashtra) [15].

Maximum number of cases of malaria occurred in the age group 21-30 years (46.8%) followed by age group 31-40 years (24.5%). The finding correlates with Singh G et al., (10%) who reported mean age group of 24.8 years and Sahar S et al., reported 16-30 years of age [20,21]. The reason of higher prevalence in this age group could be due to movement in wider areas possibly endemic, more chances of exposure to mosquito bites and most of carefree behaviour.

Limitation(s)

The data was restricted to one centre. Multicentric data may helps in better analysis of trend of the disease. Also, sample size during 2020 and 2021 was less because of COVID-19 pandemic. Restriction of mobility and transportation during pandemic might also affect in the case reporting.

CONCLUSION(S)

This study shows a decline in malaria cases from 2015 to 2021. The disease shows seasonal variation, with a higher number of cases being reported from July to November, with a peak in September. This corresponds to the rainy and winter seasons resulting in more water stagnation and dampness, making a perfect breeding place for mosquitoes. With the collective efforts of clinicians, laboratory personnel, and community health workers, eradication of malaria could be a possibility. The study data may provide significant resources for these communities, which will help them in decision-making in the near future.

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