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Seasonal Variation and Malaria in Endemic Mangalore City in South India

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Abstract

Background: In the year 2017 India has contributed to 4% of global malaria cases and Mangalore is endemic to malaria. Malaria transmission also depends on the season of the year, i.e. the wet or dry season. Regardless of huge endemicity and massive health burden, at present limited data has been documented on malaria prevalence and factors contributing to prevalence of malaria and its association with seasonal factors in Mangalore region.

Objective: To study the seasonal variations in malaria burden and species prevalence in Mangalore.

Settings and Design: This is a cross-sectional study conducted at District hospital

Methods and Material: Patients with microscopically confirmed malaria attending the District hospital were included in the study. Demographic details were collected from participants.

Statistical analysis used: Descriptive statistics

Results: In this region malaria is present all around the year and *Plasmodium vivax* is more predominant than *Plasmodium falciparum*. The number of cases peaks during the rainy season suggesting that high rains provide an ideal environment for malaria transmission.

Conclusions: A complex relationship exists between rainfall, temperature, occupation and malaria. Implementing malaria elimination interventions such as preventing water clogging, cleaning the water bodies and increasing awareness for use of prevention practices might help in reducing malaria burden in Mangalore.

Keywords: *Malaria, Infectious disease, Public Health, Mangalore, India*

Introduction

According to the WHO there were 219 million cases and 4,35,000 deaths due to malaria worldwide in 2017. Though most of the malaria burden is in the African countries, a considerable number of cases are reported from South-East Asia, where, India accounts for the highest malaria burden of around 70%.[1]

The National Malaria Control Program launched in 1953 resulted in a decrease of malaria cases to lower than 50,000 in mid-sixties. However, after its near eradication malaria staged a dramatic comeback with nearly 2 million recorded cases every year since 1995 and a clear change in malaria epidemiology: an increase in insecticide resistance, rise in proportions of *Plasmodium falciparum* malaria and rise in urban

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malaria[2]. Between 2010 to 2014, annually there have been 7–16 lakh confirmed cases of malaria and 400-1,000 deaths.[3] In the year 2017 India has contributed to 4% of the global malaria cases.[1]

Malaria was unknown in the coastal city of Mangalore till 1990 but as a consequence of industrialization and urban development it has become endemic in the recent times.[4]

Despite the endemicity and health burden, limited data has been documented on malaria prevalence, contributing factors and its association with seasonal variations in Mangalore region.

Objective: The purpose of this study was to evaluate the seasonal variations in malaria burden and species prevalence in Mangalore.

Materials and Method

Study area: Mangalore is located 12.91°N, 74.85°E on the shores of Arabian Sea in Dakshina Kannada district, Karnataka, South India. Mangalore city has hot and humid tropical climate with two seasons, rainy and summer. The climate of the city makes it a perfect place for breeding of *Anopheles* species and malaria transmission, thus making the city highly endemic to malaria.

Study Setting: Wenlock District hospital, a tertiary care centre

Study design: A cross-sectional study was carried out among patients attending the malaria clinic. Giemsa-stained thick and thin blood smear examination was done and confirmed cases of malaria were recruited in the study. Demographic details were collected from the participants.

Study duration: The study was carried out for a period of one year from January 2017 to December 2017.

Ethical considerations: The study was started after getting permission from the Institutional Ethics Committee, Kasturba Medical College, Mangalore, India. Written informed consent was taken from all the participants.

Results

Data was collected from 1095 consecutive patients with confirmed malaria. Table 1 depicts the demographic details of the participants. The mean age was 32 years. Males outnumbered females presenting to the hospital.

Table 1: Demographic details of Participants

Mean age (± SD)	**32 (±12) years**
Males	1038
Females	57
Occupation	
Construction workers	411
Labourers	154
Hotel workers	145
Others*	385

*Others included security guards, police personnel, bus drivers and conductors, businessmen, fishermen, students, homemakers, retired people

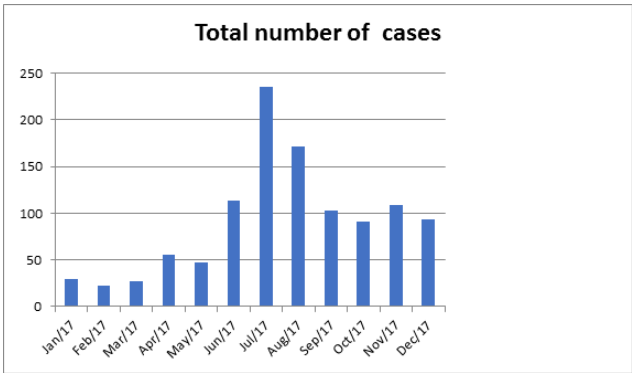

Figure 1 - Summary of total number of smear positive malaria cases and the average temperature every month (2017)

Figure 1 shows the total number of microscopically positive cases of malaria every month and average temperature in the year 2017.[5] This shows that highest number of cases were recorded during the peak rainy season during July and August. The highest recorded temperature during the year is in April and May at around 33 °C while later the temperature gradually reduces to 26 °C in December. During the dry season, though the cases reduced, it was still substantial in number.

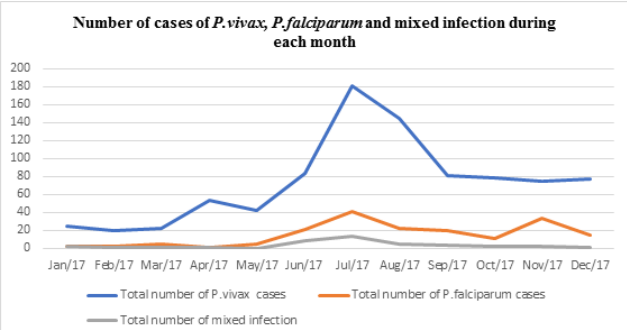

Figure 2-Month-wise distribution of *P.vivax, P.falciparum* and mixed infection cases

Figure 2 depicts the number of cases of *P.vivax, P.falciparum* and mixed infection during every month. *P.vivax* was found in highest number followed by *P.falciparum* and mixed infection.

Discussion

Malaria is a grave health problem in certain parts of India and Mangalore city is known to be endemic to malaria. In the present study the ratio of *P.vivax, P.falciparum* and mixed infections was 81%, 16 % and 3% respectively. The results found in our study are similar to results published in the study conducted by Dayanand KK et al[6].The data recorded by District Vector Borne Disease Control Programme (DVBDCP) office of Dakshina Kannada has shown 80% of malaria cases were by caused by *P.vivax* and 20% cases were by caused by *P.falciparum* which is compatible with results found in our study.[4,7]

The total of malaria cases in the year 2013 in Mangalore was 4714 which drastically increased to 11021 in 2015 and 11037 in 2016 which has now reduced to 8075 in the year 2017 and to 6110 in the year 2018.[4]Thus the decrease in number of cases suggests the success NVBDCP's strategies to reduce the cases. The framework for malaria elimination in India (2016–2030) launched by the government of India in 2016 also aims to control and eradicate malaria.[8]In the year 2018 the number of cases has reduced, and the deaths has drastically reduced to only 85.[3]

In various other endemic regions in the world including Africa, malaria usually affects younger age groups mainly children.[9]In Mangalore the majority of the cases with malaria are adults. It is similar with other cities in India and South East Asia. A high number of study participants were construction workers and labourers leading to skewing of the gender ratio towards males. Majority of the construction workers stay in and around the construction sites. These sites have stagnant water used for curing concrete and construction related activities making it an ideal breeding site for the *Anopheles* species. Lack of prevention methods like bed net use and mosquito sprays is putting these workers at a higher risk of malaria. Additionally, limited prevention practices against malaria is one the major factor for the high number of malaria cases as found by these studies[10,11].

Climatic conditions such as rainfall, temperature and humidity affect mosquito survival and malaria transmission rates. In various places the transmission is seasonal and usually peaks during and after the rainy season. The present study shows that there is a strong relationship between rainfall and malaria. Mangalore during the monsoon season from May to October receives an annual average of 3479 mm rainfall[12]. The number of cases peaked between June to August suggesting that high rains provide an ideal environment for malaria transmission. There was a decline in cases during the dry seasons. In the month of July even though the temperature was 32 °C the highest number of cases, 10 times more than number of cases during February was recorded, as in drier months when the weather is hot the breeding sites of the mosquitoes are dried, and the number of cases reaches low.

Both, *Plasmodium* parasite and *Anopheles* mosquitoes are known to be temperature sensitive. The optimal temperature for most of the *Anopheles* species is in the range of 20°C to 30°C.[13]

Mangalore has the optimum temperature throughout the year. Hence malaria is present in the city throughout the year. *P.vivax* predominates as the causative agent in urban malaria. In Mangalore too, the highest burden of malaria is caused by *P.vivax*. Both *P.vivax* and *P.falciparum* are present all around the year. *P.vivax* is in higher ratio of about 80% throughout the year compared to *P.falciparum*. In comparison, in other parts of the country like in Orissa *P.falciparum* is more predominant than *P.vivax;* in Tamil Nadu it is again *P.vivax* and in the west it is mixed species infections which are more prevalent.

P.vivax has the potential to act as a hypnozoite reservoir and cause multiple relapses leading to an increased burden. *P.vivax* which was earlier considered to be a benign form of malaria is now being found to be not so benign thus making it an issue of concern.

Conclusion: In summary high transmission is found in Mangalore area. The results depicted here show a complex relationship between rainfall, temperature, occupation and malaria cases. The results of this study will be useful for malaria elimination control program of India. Implementing malaria elimination interventions such as preventing water clogging, cleaning the water bodies etc and increasing awareness for use of prevention practices might help in reducing malaria burden in Mangalore.

Recommendation Malaria is a huge health burden in Mangalore. It has been found that the number of cases generally peaks with the rainy season. Thus, awareness and malaria preventive measures have to be concentrated mainly before and during the rainy season during which the number of cases are higher. We also found that the construction workers are mainly affected by malaria. Hence the results may help in targeting a seasonally focused malaria interventions to specific target population like construction workers. Further strategies have to be developed to create public awareness mainly among the construction workers and implement protective measures to reduce the risk of transmission.

Limitation of the study There are a few limitations in our study. Firstly, since it is a hospital based study it doesn't depict the exact picture of overall cases of malaria in Mangalore. Secondly, the study period is one year which is a little short to study the prevalence trends. Thirdly, doing a community based study would give clearer insight of seasonal variation.

Relevance of the study In Mangalore, malaria is highly endemic and a huge health burden to the society. Despite this, very limited data has been documented regarding the malaria cases, contributing factors and its association with seasonal variations in Mangalore region. This study depicts that in Mangalore a complex relationship exists between rainfall, temperature, occupation and malaria and further adds to the scientific evidence.

Conflict of Interest: NIL

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Ethical Considerations: The study was started after getting permission from the Institutional Ethics Committee, Kasturba Medcial College, Mangalore, India (IEC KMC MLR 06-15/126). Written informed consent was taken from all the participants.

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