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Original Research Article

Clinico-epidemiological profile of malaria cases admitted in a tertiary care hospital, in South India

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ABSTRACT

Background: Malaria is a global health problem leading to huge morbidity and mortality. India accounts for 4% of global malaria cases and 52% of malaria deaths outside the African region. A disease that was relatively unknown in Mangaluru till 1990, has shown consistent rise till 2015 killing nearly 300 people. Though, declining trends are being observed since 2015, yet its incidence continues to be high. Present study was undertaken to study clinical as well as epidemiological factors associated with malaria transmission in Mangaluru.
Methods: A record based retrospective study was conducted in A J Institute of Medical Sciences and Research Centre Mangaluru tertiary care hospital. The data was retrieved from the Medical Record Department of the hospital for three years i.e. 2015 to 2017 and analysed.
Results: A total of 1779 confirmed cases of malaria were admitted during the study period. Out of these 1309 (73.58%) cases were due *P. vivax*, 73 (04.10%) cases due to *P. falciparum* 306 (17.20%) cases had mixed infections while species of remaining 91 (05.11%) cases remained unspecified. A peak in the number of inpatients was seen in June while mean duration of hospital stay was 5.17±3.31 days. A total of 252 (14.16%) patients had one or more severe manifestations of malaria as per WHO guidelines.
Conclusions: The present study reveals that majority of admitted malaria cases were young adult males belonged to urban area. Majority of the cases were infected by *Plasmodium vivax* or had mixed infections.

Keywords: Tertiary care hospital, Malaria cases, *Plasmodium falciparum*, Epidemiological factors, Severe malaria

INTRODUCTION

Malaria is a global health problem. In 2017, an estimated 219 million cases of malaria occurred worldwide, compared with 239 million cases in 2010 and 217 million cases in 2016. Further, there were an estimated 435 000 deaths in 2017 from malaria globally, as compared to 451 000 estimated deaths in 2016, and 607 000 in 2010. Children aged under 5 years are the most vulnerable group accounting for 61% (266 000) of all malaria deaths worldwide.[1] Although there were an estimated 20 million fewer malaria cases in 2017 than in 2010, data for the period 2015–2017 highlights that no significant progress in reducing global malaria cases was made in this time frame.[2] The WHO African region carries a disproportionately high share of the global malaria burden and in 2017, this region was home to 92% of malaria cases and 93% of malaria deaths. Total funding for malaria control and elimination reached an estimated US$ 3.1 billion in 2017. Contributions from governments of endemic countries amounted to US$ 900 million, representing 28% of total funding.[3]

With about 9.5 million malaria cases in 2017, down 3 million cases since 2016, India is no longer among the top three countries with the highest malaria burden.

Among the 11 nations with 70% of the world's burden of malaria, only India has managed to reduce its disease burden, registering a 24% decrease between 2016 and 2017. It currently accounts for 4% of global malaria cases and 52% of malaria deaths outside the African region and has set 2030 as the target year for eliminating malaria. The state of Odisha, with a population of 36.7 million (3.5%), contributes about 25% of the total annual malaria cases, more than 40% of *P. falciparum* malaria cases and nearly 20–30% of deaths caused by malaria in India.[4]

Unbridled urbanization, drought, migration of workers, and lax control efforts are all contributing to the resurgence of malaria in India and the problem is expected to exacerbate in the years to come. With increasing global warming, it is projected that in 2050s, malaria is likely to persist in Odisha, West Bengal and southern parts of Assam, bordering north of West Bengal, but may shift from the central Indian region to the south western coastal states of Maharashtra, Karnataka and Kerala. Also the northern states, including Himachal Pradesh and Arunachal Pradesh, Nagaland, Manipur and Mizoram in the northeast may become malaria prone.[5]

Mangaluru, is a picturesque city in southern India, on the shore of the Arabian Sea, is the headquarters of Dakshina Kannada district. The population of Mangaluru City Corporation is estimated to be 602,184 in the 2018. Since early 1990s, the district has been witnessing a great spurt in construction activities and this has brought the dreaded disease, malaria, to this peaceful land. A disease that was rare in Mangaluru until 1990 has already killed more than 300 people in the district since 1995. Whereas the incidence of malaria is showing a downward trend in Karnataka, it is continues to remain high in Mangaluru, and in 2017, of the 11312 cases reported from Karnataka, 8075 (71.4%) were from Mangaluru (Figure 1).[6]

While there are very limited studies in Karnataka on epidemiological factors which contribute to morbidity and mortality of malaria, there are very few studies in Mangaluru on this important dimension. With this background, the present study was undertaken among inpatients admitted to a tertiary care teaching hospital with the following objectives:

- To study the socio-demographic profile of study subjects.
- To study epidemiological factors associated with transmission of malaria.

METHODS

A record-based observational study was undertaken to determine the socio-demographic and epidemiological factors related to the transmission of malaria. A total of 1779 patients, who were admitted from 1 January 2015 to 31 December 2017 to the tertiary hospital of AJIMS&RC, Mangaluru, Karnataka were included in the study. Details of the patient pertaining their demographic characters, clinical features, complications and disease outcome etc. were retrieved from the medical records department (MRD) of the hospital. The study was carried out over a period of six months i.e. from 1 March 2018 to 31 August 2018.

Selection criteria

The study included all positive cases of malaria confirmed by any of the methods available in the hospital i.e. microscopic examination of blood smear, immune chromatographic test (MP-ICT) or malaria parasite quantitative buffy coat test (MP-QBC).

Suspected malaria cases found negative by laboratory tests as well as all clinical cases, even if they received treatment for malaria were excluded from the study.

Statistical analysis

Data was entered into Microsoft Excel and analysed using the statistical package of social sciences (SPSS) version 22.0. The results have been presented with the help of tables/figures bar/ line diagrams.

Limitations

The study had the limitations which are inherent to any hospital record based studies as the sample drawn was from the admitted patients in the hospital and this may not be a true representative of the community. Besides there could also be some missing data due to lack of systematic filing of medical records. Therefore the findings of the study may not be the true reflection of the community and hence may not be generalised.

RESULTS

A total of 1779 confirmed cases of malaria were included in the study, who was admitted in the hospital during the period from 1 January 2015 to 31 December 2017. Among these cases, 715 (40.19%) were in the age group of 20-30 years, 335 (18. 83%) in 31-40 years, followed by 232 (13.04%) in 11-20 years, 132 (07.41%) in 51-60 years, 49 (9%) in 51-60 years, 99 (05.56%) were above 60 years of age while remaining 71 (03.99%) cases belonged to <10 years age group. Gender distribution of study subjects brings out that 1137 (63.91%) of them were male, while 642 (36.08%) of them were female. Rural - urban breakdown of cases brings out that majority of them i.e. 1342 (75.43%) were from urban back ground while remaining 437 (24.56%) cases belonged to rural area. Further, majority 903 (50.75%) of the admitted cases were unskilled workers and house wives 474 (26.64%). Skilled workers and professionals accounted for a small percentage of cases i.e. 106 (5.95% and 29 (1.63%) respectively (Table 1).

Table 1: Distribution of cases according to age, gender, occupation and place of residence (n=1779).

Variable	Frequency	Percentage (%)
Age (in years)		
<10	71	3.99
11 to 20	232	13.04
21 to 30	715	40.19
31 to 40	335	18.83
41 to 50	195	10.96
51 to 60	132	07.41
>60	99	05.56
Gender		
Male	1137	63.91
Female	642	36.08
Residence		
Rural	437	24.56
Urban	1342	75.43
Occupation		
Unskilled	903	50.75
Semi-skilled	267	15.00
Skilled	106	05.95
Professional	29	01.63
House wives	474	26.64
Total	1779	100

Year wise distribution of malaria cases during the study period reveals a declining trend in number of admissions, as out of 1779 cases, highest number of admissions i.e. 738 (41.48%) were seen in 2015 while, in the year 2016 and 2017 these declined to 593 (33.33%) and 448 (25.18%) respectively. Month wise breakdown of cases under study brings out that during the year 2015, maximum number of admissions took place in the months May (94; 12.7%), while during the year 2016, maximum number of cases (81; 13.65%) were admitted during the month of July. However, during the year 2017, maximum cases (69; 15.40%) were admitted during the month of June. The lowest admission during 2015 happened in the month of February (28; 3.79%) while during 2016 and 2017, lowest admissions took place during the months of March (26; 4.38%) and February (21; 04.68%); respectively (Table 2).

The cumulative trend of admissions over the three year study period from 2015 -2017 saw highest admissions in the month of June (207; 11.63%) while lowest admissions 86 (4.83%) were seen in the month of February (86; 4.83%) (Table 2).

Table 2: Year and month wise distribution of malaria cases (n=1779).

Month	Years						Total	
	2015		2016		2017			
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
January	62	08.40	55	09.27	17	03.79	134	07.53
February	28	03.79	35	05.90	23	05.13	86	04.83
March	46	06.23	26	04.38	21	04.68	93	05.22
April	59	07.99	55	09.27	35	07.81	149	08.37
May	94	12.73	42	07.08	24	05.35	160	08.99
June	80	10.84	76	12.81	51	11.38	207	11.63
July	56	07.58	81	13.65	69	15.40	206	11.57
August	48	06.50	71	11.97	48	10.71	167	09.38
September	64	08.67	44	07.41	51	11.38	159	08.93
October	42	05.69	35	05.90	32	07.14	109	06.12
November	75	10.16	38	06.40	40	08.92	153	08.60
December	84	11.38	35	05.90	37	08.25	156	08.76
Total	738	100	593	100	448	100	1779	100

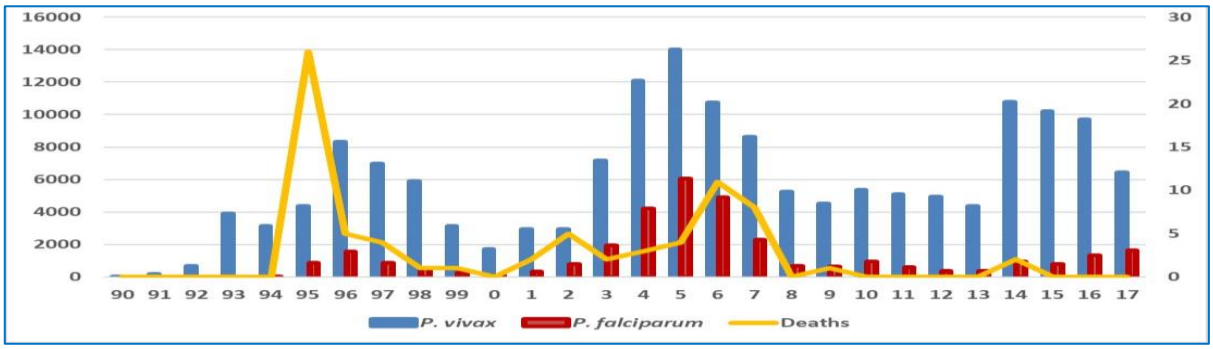

Figure 1: Incidence of malaria in Mangaluru from 1990-2017.[6]

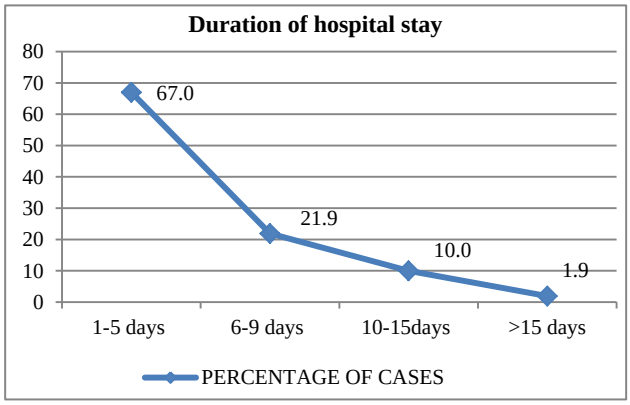

Figure 2: Line diagram showing duration of hospital stay (n=1779).

Regarding the duration of stay in the hospital, majority of the patients i.e. 1192 (67.0%) stayed for 1-5 days, followed by 391 (21.97%) for 6-9 days, 179 (10.0%) for 10-15 days and rest 17 (1.9%) of the patients stayed for more than 15 days. The mean duration of stay for the cases was 5.17±3.31 days (Figure 2).

On analysis of 1382 cases of malaria which were, either due to *P. vivax* or *P. falciparum*, *P.vivax* was responsible for 1309 (94.71%) of the cases while P falciparum accounted for remaining 73 (05.28%) of the cases. Analysis of all the 1779 cases admitted during the period of study brings out that *P. vivax* alone accounted for 1309 (73.58%) cases while *P. falciparum* accounted for 73 (04.10%) cases. The remaining 397 (22.31%) cases were due to mixed infections 306 (17.20%), while 91 (05.11%) of the cases remained unspecified (Table 3-5).

Table 3: Month and year-wise distribution of *P. vivax* and *P. falciparum* cases (n=1382).*

Month	Year 2015		Year 2016		Year 2017		Total		
	P. vivax	***P. falciparum***	***P. vivax***	***P. falciparum***	***P. vivax***	***P. falciparum***	***P. vivax***	***P. falciparum***	**% of *falciparum* cases**
January	44	3	43	1	13	0	100	04	03.84
February	29	0	23	0	17	1	69	01	01.42
March	38	0	23	0	17	1	78	01	01.26
April	45	1	44	2	22	7	111	10	08.26
May	85	1	39	1	15	1	139	03	02.11
June	58	3	68	0	36	2	162	05	02.99
July	40	0	53	3	47	3	140	06	04.10
August	35	1	47	1	27	10	109	12	09.91
September	47	0	32	2	35	3	114	05	04.20
October	34	0	25	2	14	8	73	10	12.04
November	54	2	21	1	28	9	103	12	10.43
December	57	3	30	0	24	1	111	04	03.47
Total	566	14	448	13	295	46	1309	73	05.28

*excluding data on mixed and unspecified cases.

Table 4: Month and year-wise distribution of mixed plasmodium parasites (n=306).

Month	Year 2015		Year 2016		Year 2017		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
January	14	10.07	1	01.26	3	03.40	18	05.88
February	6	04.31	8	10.12	4	04.54	18	05.88
March	4	02.87	2	02.52	3	03.40	9	02.94
April	13	09.35	6	07.59	5	05.68	24	07.84
May	8	05.75	1	01.26	7	07.95	16	05.22
June	19	13.66	3	03.79	13	14.77	35	11.43
July	14	10.07	15	18.98	19	21.59	48	15.68
August	9	06.47	17	21.51	9	10.22	35	11.43
September	15	10.79	7	08.86	6	06.81	28	09.15
October	7	05.03	6	07.59	7	07.95	20	06.53
November	13	09.35	11	13.92	3	03.40	27	08.82
December	17	12.23	2	02.52	9	10.22	28	09.15
Total	139	100	79	100	88	100	306	100

Table 5: Month and year-wise distribution of cases with unspecified plasmodium parasite (n=91).

	Year 2015		Year 2016		Year 2017		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
January	1	03.44	2	04.44	1	05.88	4	04.39
February	3	10.34	4	08.88	1	05.88	8	08.79
March	4	13.79	1	02.22	0	-	5	05.47
April	0	-	3	06.66	1	05.88	4	04.39
May	0	-	1	02.22	1	05.88	2	02.19
June	0	-	5	11.11	0	-	5	05.47
July	2	06.88	10	22.22	0	-	12	13.18
August	3	10.34	6	13.33	2	11.76	11	12.08
September	2	06.88	3	06.66	7	41.17	12	13.18
October	6	20.68	2	04.44	3	17.64	11	12.08
November	1	03.44	5	11.11	0	-	6	06.59
December	7	24.13	3	06.66	1	05.88	11	12.08
Total	29	100	45	100	17	100	91	100

Table 6: Symptoms and signs among admitted case cases (n=1779).

	Frequency	Percentage (%)
Clinical manifestations and complication		
Fever	1669	93.81
Headache	1573	88.42
Chills/rigor	1449	81.45
Sweating	1336	75.09
Vomiting/nausea	1187	66.72
Pain abdomen	773	43.45
Chest Pain/Myalgia /Body ache/Prostration	1132	63.63
Puffiness /selling around the eyes	79	04.44
Cough/sore throat	662	37.21
Loss of Appetite	1449	81.45
Diarrhoea	873	49.07
Convulsions	27	01.51
Bleeding manifestations	14	0.78
Clinical Signs		
Disorientation	17	0.95
Severe anemia (<7.0 g/dl.)	252	14.1
Icterus	79	04.44
Hepatomegaly	537	30.18
Splenomegaly	1152	64.75

The month wise cumulative analysis of malaria cases during the study period, brings out that highest admissions of *P. falciparum* cases was seen during the months of October (12.04%), followed by November (10.43%), August (09.91%) and April (08.26%), while lowest admissions were seen in months of February and March. Further, the highest number of *P. vivax* cases were admitted during the month of June (162; 12.37%) while lowest admissions were in the month of February (69; 5.27%) (Table 3).

The study reveals that there were a total of 306 cases of mixed infection among admitted patients during the study period. Out of these nearly half of them i.e. 139 (45.42%) were admitted in 2015 itself, while 88 (28.75%) cases were admitted in 2016 and remaining 79 (25.81%) cases were admitted in 2017 (Table 4).

The study also brought out that out of a total of 1779 admitted cases of malaria, diagnosis of 91 cases remained unspecified and these could not be assigned to any particular species. Nearly half of these unspecified cases were reported in the year 2016 i.e. 45 (49.45%), while 29 (31.86%) and 17 (18.68%) cases were reported in the year 2015 and 2017 respectively (Table 5).

The study brings out fever as the most common 1669 (93.81%) presenting symptom reported by of the patients,

followed by headache 1573 (88.42%), loss of appetite 1449 (81.45%), sweating 1336 (75.09%) vomiting1187 (66.72%), body-ache/myalgia 1132 (66.66%), chills/rigor 1116 (62.73%), loose stools 873 (49.07%), pain abdomen 773 (43.45%) and sore throat/cough 662 (37.21%). Hepatomegaly was present in 537 (30.18%) of the patients, while splenomegaly was present in 1152 (64.75%) patients.

A small percentage of patients also presented with severe symptoms (in accordance with WHO criteria) i.e. disorientation 17 (0.95%), icterus 79 (4.44%) convulsions 27 (1.51%) and bleeding manifestations 14 (0.78%). However, all cases were managed well and there were no fatalities.

DISCUSSION

Historically, malaria in India was predominantly caused by *Plasmodium vivax*, accounting for 53% of the estimated cases. After the spread of drug-resistant *Plasmodium falciparum* in the 1990s, the prevalence of the two species remained equivalent at the national level for a decade. By 2014, the proportion of *P. vivax* decreased to 34% nationally, but with high regional variation. In 2014, *P. vivax* accounted for around 380,000 malaria cases in India; almost a sixth of all *P. vivax* cases reported globally. *P. vivax* has remained resistant to control measures, particularly in urban areas.[7-9]

In the present study there was more number of male patients (63.91%) as compared to the females (36.08%). Most of the cases (40.19%) belonged to 21-30 years age group. Children under 10 years age and elderly patients above 60 years accounted for a small percentage i.e. 03.99% and 05.56 respectively.

Kar and Bhatta in a similar hospital bases study conducted at Odisha reported 15% of the admitted patients to be in the age group of <20 years, 36% in 21-30 years 20% in 31-40 years, 15% in 41-50 years, 9% in 51-60 years while 5% of them were above 60 years.[10] Wasnik, et al in another hospital based study in central India, also found that, males outnumbered the females and accounted for (75%) and (25%) of the total cases respectively.[11] Similar results were also reported by Muddaiah and Prakash in their study at a tertiary care hospital in South Canara, who observed that percentage of males was much greater (81%) than the females (19%) and most of them were in the age group of 21-30 yr.[12]

In present study, three fourth (75.43%) of the admitted cases belonged to urban areas while one fourth (24.56%) of them belonged to rural areas. Further, majority (50.75%) of them were unskilled labourers. The leading newspaper reports also confirm high incidence among urban population and with high incidence among un-skilled migrant workers.[13-15]

Present study brings out a declining trend in the admission of malaria cases in the hospital during the period of study i.e. from 738 cases in 2015 to 448 in 2017. Our findings are comparable with official statistics on malaria in Mangaluru and other researchers, which also confirm a declining trend during these years i.e. from 11021 cases in 2015 to 8075 cases in 2017.[6,16]

Cumulative data on month wise distribution of malaria cases in present study brings out highest admissions during the months of June and July i.e. 207(11.63%) and 206 (11.57%) cases respectively while lowest admissions were seen during the months of February and March i.e. 86 (04.83%) and 93 (05.22%) respectively.

In a similar study on the pattern of monthly distribution of malaria cases admitted in a hospital, Muddaiah and Prakash, reported an increase in number of cases from the month of June onwards reaching its peak during monsoon months. Kar and Bhatta also brought out more admission in the months of April (13%), July and August (12% each), November (11%) and December (12%). The lowest admission happened in the month of March (0.4%) followed by February (1.8%) and January (5.2%).[10,12] Similar findings have been depicted by Saya, et al, and Naz, et al, in their studies.[17,18] The reason for high incidence of malaria cases during monsoon months in Mangaluru may be attributed to increase in breeding sites due to water collection at construction sites.

In our study, mean duration of stay in the hospital was found to be 5.17±3.31 days, which is comparable to a study by Yadav, et al, in Delhi who observed median duration of hospital stay to be 4 days, and 3.6 days as reported by Zubairi in Pakistan.[19,20]

Present study, after excluding the data on mixed and unspecified cases, clearly brings out dominance of *P vivax* species among study subjects, accounting for 94.71% of the malaria cases while *P. falciparum* accounted only for 5.28% of the patients. However, the findings of our study are at variance with the official data which shows a relatively higher prevalence of *P. falciparum* in Mangaluru i.e. 7.31%, 12.15% and 20.09% during 2015, 2016 and 2017 respectively.[6] Dayanand, et al, in their study in 2014 in Mangaluru also reported a rather high prevalence of *P. falciparum* of 14.9%,while the prevalence of mixed infection in their study was found to be only 03.4%.[15] In another study in Mangaluru, Gai, et al, reported prevalence of *Vivax* malaria to be (69.6%) mixed *Plasmodium vivax–Plasmodium falciparum* infection to be (21.3%) and *P. falciparum* to be (9.0%). [14]

In present study almost all patients had fever (93.81%) while headache (88.42%), chills (81.45%), loss of appetite (81.45%), sweating (75.09%) vomiting 36 (66.72%), were some of the other common symptoms. Further, a small percentage of cases also reported with one or more severe manifestations of malaria, which

included convulsions (01.51%), bleeding manifestations (0.78%), disorientation (0.95%), icterus (04.44%) and severe anaemia (14.10%). Hepatomegaly and splenomegaly was found in 30.18% and 64.75% of the admitted cases, respectively. In a study by Yadav, et al, at Delhi, fever was found to be the most common symptom (87; 97%) followed by vomiting (36; 40%), bleeding (27; 30%) and pain in abdomen (24; 27%). Hepatomegaly was present in (53; 62% patients), splenomegaly in (55; 60%) and oedema in (11; 12%) patients. The most common severe manifestations were bleeding (30%) followed by impaired consciousness (20%). Severe anaemia was present in 17.4% while raised S. Bilirubin >3 mg was found in 14% patients. Similar findings have been reported by by Suruvu, et al, Limaye, et al, Zubairi, et al and Kochar, et al, in their studies.[19-23]

CONCLUSION

The present study brings out a high incidence of malaria in 20-40 years age group, which accounted for 50.02% of the cases, while 75.43 of them were from urban areas. *Plasmodium vivax* was the dominant species accounting for 94.71% of the cases (excluding mixed, unspecified infections), while *P. falciparum* was responsible for 5.28% of the cases. An increase in number of cases during monsoon months was observed. Fever, headache, loss of appetite were common presenting symptoms, while severe manifestations included icterus, bleeding, disorientation and severe anaemia.

In spite of intensive interventions, there are increased numbers of cases every year in Mangaluru resulting in high socio-economic burden on the families and communities. Needless to say that, there is a need to create public awareness about the disease by conducting regular health awareness programs, which in turn will lead to adoption of good personal protective and environmental sanitation practices among the people and communities, which perhaps is the key to malaria prevention and control.

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