ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 12, Iss 1, 2023

STUDY ON THE CLINICAL FEATURES OF MALARIA AND EVALUATION OF THE DISTRIBUTION OF MALARIAL VECTORS IN KOLKATA

Atreyee Choudhuri*
Research Scholar, Department of Bioscience, JIS University, Kolkata, India

*Address for Correspondence: Atreyee Choudhuri, Research Scholar, Department of Bioscience, JIS University, Kolkata, India E-mail: atreyee649@gmail.com

Abstract

Introduction: Malaria, caused by protozoa of the genus Plasmodium, remains a significant public health concern, especially in subtropical and tropical regions. Kolkata, in particular, has seen a high prevalence of malaria, with Plasmodium falciparum and Plasmodium vivax being the primary species. This study investigates the clinical features and vector distribution of malaria in the Kolkata region.
Aims and Objective: To evaluate the clinical features of malaria and corresponding vectors in Kolkata region.
Materials and Methods: This retrospective study, conducted from January to May 2024, analyzed data from patients diagnosed with malaria over the past three years in Kolkata. Data were collected from hospital records, including blood reports, microscopy results, and patient histories. Patients were surveyed using a structured questionnaire to gather socio-economic and anthropometric data. Statistical analysis was performed using SPSS 27, with significance set at $P<0.05$.
Results: The study included 103 falciparum and 97 vivax malaria patients. No significant differences were found in demographic and socio-economic characteristics between the groups. Severe disease was more common in falciparum malaria (82.5% vs. 33.0%, P=0.042). Hypoglycemia was significantly higher in falciparum patients (59.2% vs. 8.2%, P=0.044), while splenomegaly was more prevalent in vivax patients (43.3% vs. 15.5%, P=0.0455). No significant differences were observed for relapses, cerebral malaria, or renal failure.
Conclusion: The study concludes that falciparum malaria typically presents with continuous fever and greater severity, including higher incidences of hypoglycemia, whereas vivax malaria is associated with recurrent fever and splenomegaly. Thus, alongside standard regimens, symptomatic treatment tailored to the specific type of malaria is necessary.

Keywords: Malaria, Plasmodium falciparum, Plasmodium vivax, clinical features, Kolkata

Introduction

Malaria has been prevalent in human beings since time immemorial, with evidence of this even in the biblical scriptures and writings by Hippocrates. It is caused by protozoa of the genus Plasmodium. Only four species infect humans; P. falciparum, P. vivax, P. malariae, and P. ovale [1,2]. The disease is transmitted by the female Anopheles mosquito bites. Each of the species presents specific clinical features, but the most severe occur with P. falciparum infection, which includes cerebral malaria as a major complication [2].

Malaria prevails in the subtropical and tropical regions. An estimated 247 million cases occurred worldwide in 2006. Approximately 3.3 billion people were at risk, with almost a million deaths, 89% of these were in children under 5 years in sub-Saharan Africa. Probably, the Southeast Asian region's burden due to malaria is underestimated, yet it accounted for about 41% of the global cases [2,3]. This alone accounts for 77.2% of cases of malaria in the South-East Asia region in India, out of which over 95.5% of its population is at moderate to high risk [3].

Though P. vivax is considered benign, clinicians from endemic areas are increasingly recognizing its potential for recrudescence, which causes considerable illness, especially in young children [4,5]. The prevalence and distribution of the vectors of malaria play a major role in the transmission and incidence of the disease. In Kolkata, the principal vector of malaria is Anopheles stephensi, while Aedes aegypti is the vector for dengue. Malaria in Kolkata has improved quite a lot over the last decade due to tight vigil by KMC. While malaria is an important public health problem in India, contributing significantly to the malaria burden of Southeast Asia, the eastern and central regions of India contribute the greatest burden; 10 states contribute more than 80.2 percent to the country's cases. In the years 2014 and 2018, there were 26,000 and 25,000 reported cases of malaria in West Bengal, respectively; among them, the highest prevalence of the disease in the district was reported to be in Kolkata City [6].

The classic sign of malaria, and often the one that most frequently presents, is fever associated with chills, myalgias, headache, vomiting, and nausea. Diarrhea, abdominal pain, and cough are observed in some patients. As the illness evolves, some patients develop the classic malaria paroxysm: alternating periods of illness and symptom-free periods [7]. It consists of three stages, the first stage of 15-60 minutes characterized by shivering with a feeling of cold. This is followed by the 2-6 hour hot phase with fever possibly rising above 41°C with dry, flushed skin accompanied by other symptoms like vomiting, headache, and nausea. This is finally followed by the sweating phase, which lasts 2-4 hours with a rapid fall in fever accompanied by profuse sweating. The recurring fever in all malaria types results from the rupture of mature schizonts [8].

P. ovale and P. vivax malaria have a cycle of 48 hours, as schizonts mature and fever recurs in two days. Infection caused by P. malariae has a cycle of 72-hour duration and is called quartan malaria, with the fever recurring every three days. The fever increases in falciparum malaria every 48 hours but often does not appear to follow any periodically distinct pattern. The typical fever patterns of the malaria early stages might not be manifested and the lack of fever regularity and synchrony does not exclude the presence of malaria [9]. Physical manifestations of malaria are nonspecific and of little help for diagnosis; they often appear only as fever. Splenomegaly is frequent but may not be present in the early stage of the disease. The disease may also cause jaundice, hepatomegaly, hypotension and abdominal pain, but a rash and lymphadenopathy are usually absent. Complications result from haemolytic anaemia and microvascular obstruction leading to tissue ischaemia. Severe

malaria consists of acidosis, respiratory distress, raised aminotransferases, hypoglycaemia, high parasitaemia, and severe anaemia [10,11].

Methods

The current study is a retrospective analysis based on November 2023 to March 2024 clinical data for the assessment of malaria symptoms prevalence and vector distribution in Kolkata. The population under the study consisted of a pool of patients who were diagnosed as malaria cases in Kolkata in major hospitals within a period of the last three years. The data collection in this regard consisted of a review of the hospital records for confirmed malaria cases, taking into consideration the blood reports, microscopy results, physical examinations, and personal, family, and travel histories obtained from patients.The identified patients were contacted and interviewed by a structured questionnaire survey, which gathered information on socio-economic data, anthropometric data, malaria awareness, prevention knowledge, and hygiene attitude. In particular, demographic features, socio-economic parameters, and clinical features including fever patterns of vivax and falciparum malaria were compared in this study.

Inclusion Criteria:

- The patient is of any age and has a confirmed diagnosis of malaria, whether it be P. vivax or P. falciparum, within the last three years.
- Availability of complete medical records on blood reports, microscopy results, and physical examination records
- Patients or guardians of patients in case of minors who give informed consent to participate in the questionnaire survey.

Exclusion Criteria:

- Patients diagnosed with malaria outside this period of three years.
- Incomplete medical records that lack the necessary data to proceed with the analysis.
- Those patients or guardians refusing to participate in the questionnaire survey.
- Patients with malaria but with some other chronic disease that would confuse the outcome, such as HIV/AIDS or tuberculosis.

Statistical analysis

Data analysis was carried out using SPSS 27. Descriptive statistics described continuous variables as means with standard deviations and categorical data as frequencies with percentages. The clinical characteristics among P. vivax and P. falciparum malaria were compared using ANOVA. The categorical data was tested between the groups of the chi-square tests and the demographic characteristics by ANOVA. For comparisons, the level of significance was fixed at $p<0.05$. The Ethics Committee of the hospital has approved the study.

Results

The demographic and socio-economic characteristics of patients infected with either falciparum or vivax malaria are summarized in Table 1.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 12, Iss 1, 2023

For gender distribution, there were 49 males and 54 females in the falciparum group, compared to 51 males and 46 females in the vivax group. The P-values for males (0.65) and females (0.85) indicate no significant difference in gender distribution between the two groups. The average age of patients was 31.16 ± 15.03 years in the falciparum group and 31.8 ± 15.9 years in the vivax group, with a P-value of 0.77, suggesting no significant age difference between the groups. Family demographics were similar between the two groups. The average number of family members was 7.68 ± 2.25 for the falciparum group and 7.77 ± 2.26 for the vivax group (P-value = 0.75). Similarly, the average number of children per family was 5.68 ± 2.25 for falciparum patients and 5.77 ± 2.26 for vivax patients, with a P-value of 0.94, indicating no significant difference.

The socio-economic status, measured by annual family income on a scale of 1 to 5, was 2.93 ± 0.83 for the falciparum group and 3.17 ± 0.77 for the vivax group, with a P-value of 0.74, showing no significant difference in income levels. The study found that there were self-employed (38 falciparum, 34 vivax), salaried laborers (28 falciparum, 14 vivax), laborers (15 falciparum, 18 vivax), salaried service (11 falciparum, 17 vivax), and farmers (11 falciparum, 14 vivax). The P-value of 0.69 indicates no significant difference in the occupation distribution between the groups.

The main sources of drinking water were government supplies (35 falciparum, 24 vivax), ponds (27 falciparum, 25 vivax), self-owned pumps (21 falciparum, 26 vivax), and tube wells (20 falciparum, 22 vivax). The P-value of 0.655 shows no significant difference in the primary drinking water sources between the two groups.

Table 1: Demographic and Socio-economic characteristics of the patients in each group

Characteristics	**Falciparum (n=103)**	**Vivax (n=97)**	**P-value**
Sex			
Male	49	51	0.65
Female	54	46	0.85
Age	31.16±15.03	31.8±15.9	0.77
Family			
Number of Family Members	7.68±2.25	7.77±2.26	0.75

Number of children in the family	5.68±2.25	5.77±2.26	0.94
Social Class (Annual Family Income)	2.93±0.83	3.17±0.77	0.74
Occupation of the family head			
Self Employed	38	34	0.69
Salaried Labours	28	14	
Labour	15	18	
Salaried Service	11	17	
Farmer	11	14	
Main source of drinking water			
Government Supplies	35	24	0.655
Pond	27	25	
Self owned pump	21	26	
Tube well	20	22	

The study found that there are significant patients of falciparum malaria with continuous fever (P=0.0322) while recurrent fever was significant among patient with vivax malaria (P=0.0211). Figure 1 shows the detailed data on the number of patients with continuous fever and recurring fever in each group.

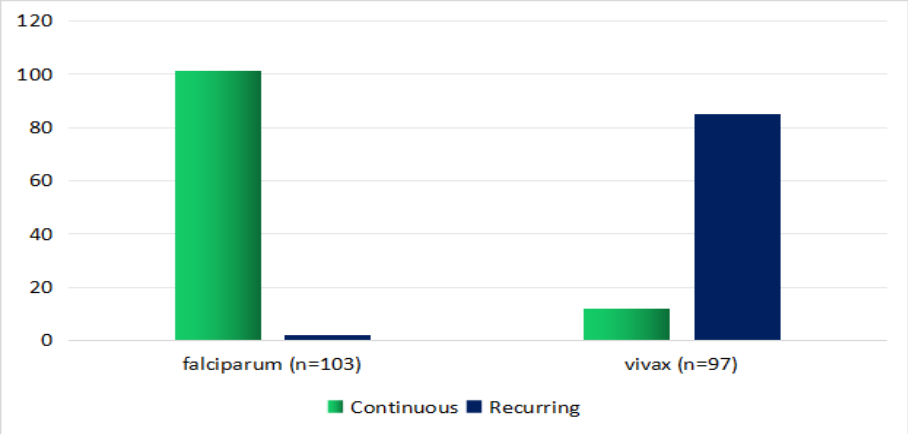

Figure 1: Fever Pattern of the patients in each group

Table 2 outlines the clinical features observed in patients infected with either falciparum or vivax malaria. The statistical analysis includes P-values to determine the significance of differences between the two groups for each clinical feature. Among the 103 patients with falciparum malaria, 85 (82.5%) exhibited severe disease, whereas only 32 (33.0%) of the 97 patients with vivax malaria showed severe symptoms. This difference is statistically significant with a P-value of 0.042, indicating that severe disease is more common in falciparum malaria compared to vivax malaria. None of the falciparum patients experienced relapses within a year, while 5 (5.2%) of the vivax patients did. However, the difference is not statistically significant (P-value = 0.095), suggesting that relapses are relatively uncommon in both groups but slightly more in vivax malaria. Cerebral malaria was rare, occurring in 2 (1.9%) of the falciparum patients and none of the vivax patients, with a P-value of 0.75, indicating no significant difference between the two groups. Renal failure was also uncommon, seen in just 1 (1.0%) of the falciparum cases and not at all in the vivax cases. The P-value of 0.99 shows no significant difference between the groups for this clinical feature.

Hypoglycemia was significantly more frequent in the falciparum group, affecting 61 (59.2%) patients compared to 8 (8.2%) in the vivax group, with a P-value of 0.044. This indicates a significant difference, suggesting hypoglycemia is much more common in falciparum malaria. In contrast, splenomegaly was more prevalent in the vivax patients, with 42 (43.3%) cases, compared to 16 (15.5%) in the falciparum patients. The P-value of 0.0455 indicates a statistically significant difference, showing splenomegaly is more commonly associated with vivax malaria.

Table 2: Clinical Features of the patients in each group

Clinical Features	**falciparum (n=103)**	**vivax (n=97)**	**P-value**
Severity	85 (82.5%)	32 (33.0%)	0.042

Relapses within a year	0 (0.0%)	5 (5.2%)	0.095
Cerebral Malaria	2 (1.9%)	0 (0.0%)	0.75
Renal Failure	1 (1.0%)	0 (0.0%)	0.99
Hypoglycemia	61 (59.2%)	8 (8.2%)	0.044
Splenomegaly	16 (15.5%)	42 (43.3%)	0.0455

Discussion

Vector-borne malaria presents an important socio-economic burden, directly and indirectly, on the poor communities. Though it is one of the major public health problems in India, where about 23% of the population is below the poverty line, very few studies have estimated the potential influence of socio-economic factors in the KMC Area with high prevalence of malaria in West Bengal [5,9]. The economic burden of malaria is more significant in the poor population than among the higher socioeconomic group of people. Socioeconomic improvement and public health development in the disenfranchised community may decrease the burden of the disease and eventually reduce economic burden [11-13].

Previous studies by Bag et al. (2024) and Nag et al. (2020) assessed the cases of malaria in Mangaluru, on India's southern coast, for its clinical manifestations, severity, and mortality. In addition, the present study also evaluated hematological and biochemical markers and the sequelae of the disease [14,15]. The serious complications of severe malaria include jaundice, acute renal failure, hematuria, thrombocytopenia, metabolic acidosis, hepatic failure, severe anemia, acute respiratory distress syndrome, hypotension, and cerebral malaria [16]. Most patients presented with mild clinical manifestations of malaria, probably as a result of prompt treatment and/or pre-existing host immune responses [11,16].

A study by Acharya et al. (2024) was undertaken to assess the present status and trends of malaria in the KMC area with a view to analyzing the temporal, spatial, and demographic distribution of malaria, identifying high-risk areas for future outbreaks, and recommending management strategies [17]. The findings indicated that there is a need to increase the Annual Blood Examination Rate in Kolkata. The study also promoted Insecticide-Treated Nets and Long-Lasting Insecticidal Nets along with conventional vector control measures and Behavior Change Communication strategies for dealing with the malaria problem [18].

Malaria remains one of the pressing national and global health concerns. Recent research highlights environmental and demographic factors that impact local patterns of transmission by vectors. In a different comparative study, Bag et al. investigated malaria prevalence in

urban and rural communities in which the infection rates were 6.1% and 18.8%, respectively. Relative risk of malaria prevalence at the household level is 1.8% in urban and 6.7% in rural [19,20].

A previous study by Sinha et al. (2021) assessed the effect of socioeconomic status on the prevalence of disease in the KMC Area of West Bengal, where malaria is the most common disease and has a prevalence of 5%. A higher prevalence was found to exist in males than in females, with more significant effects among working-age people. The economic burden of the disease is much worse among lower socioeconomic individuals [21].

Conclusion

The study has concluded that falciparum malaria is more likely to have continuous fever and its severity is also more than vivax malaria. Falciparum malaria is also found to have higher incidences of hypoglycaemia while vivax malaria is associated with recurrent fever and splenomegaly. Therefore, along with the standard regimens, there is a need to carry out symptomatic treatment for a specific type of malaria. The study has obtained data from hospital records which may limit the comprehensiveness and accuracy, as it depends on quality of existing records. Additionally, the study has considered last 3 years data which may have bias due to a specific timeframe (timeframe bias). More over, the study was conducted in confined region (Kolkata), which may limit the generalizability of the findings to other geographic areas with different environmental and socio-economic conditions. Similar studies should be conducted in prospective manner and longitudinal studies to monitor patients in real-time, providing a more varied and accurate assessment of clinical features and outcomes. Expanding the study to include a larger sample size and extending the duration to cover multiple years and seasons can take seasonal patterns into account and long-term trends of malaria incidence.

References

1. 1. Cohee LM, Laufer MK. Malaria in Children. Pediatr Clin N Am., 2017; 64(4): 851–66.
2. Schumacher RF, Spinelli E. Malaria in Children. Mediterr J Hematol Infect Dis., 2012; 4(1): 66-98.
3. Sengupta DAM, Chatterjee D, Ghosh R. A Brief Study on the Prevalence of Malaria in Kolkata, West Bengal, India. Glob J Med Res., 2022; 22(4): 25–28.
4. Murray CJL, Rosenfeld LC, Lim SS, Andrews KG, Foreman KJ, et al. Global malaria mortality: a systematic analysis. Lancet, 2012; 379: 413–31. doi: 10.1016/S0140-6736(12)60034-8.
5. O'Meara WP, Mwangi TW, Williams TN, McKenzie FE, et al. Relationship between exposure, clinical malaria, and age in an area of changing transmission intensity. Am J Trop Med Hyg., 2008; 79: 185–91.
6. Crowley J, Chu C, Love GM, Nosten F. Malaria in children. Lancet., 2010; 375: 1468–81.

7. Price RN, Douglas NM, Anstey NM. New developments in Plasmodium vivax malaria: severe disease and the rise of chloroquine resistance. Curr Opin Infect Dis., 2009; 22: 430–35.
8. Bostrom S, Giusti P, Arama C, Persson JO, Dara V, et al. Changes in the levels of cytokines, chemokines and malaria-specific antibodies in response to Plasmodium falciparum infection in children living in sympatry in Mali. Malar J., 2012; 11(1): 109-28. doi: 10.1186/1475-2875-11-109
9. Kochar DK, Das A, Garg S, Kochar SK, Sengar GS, et al. Clinical Features of Children Hospitalized with Malaria-A Study from Bikaner, Northwest India. Am J Trop Med Hyg., 2010; 83(5): 981–89.
10. Bria YP, Yeh CH, Bedingfield's. Significant symptoms and nonsymptom-related factors for malaria diagnosis in endemic regions of Indonesia. Int J Infect Dis., 2021; 82: 194-200. doi: 10.1016/j.ijid.2020.11.177.
11. Punnath K, Dayanand KK, Chandrashekar VN, Achur RN, et al. Clinical features and haematological parameters among malaria patients in Mangaluru city area in the southwestern coastal region of India. Parasitol Res., 2019; 119(3): 1043–56.
12. Sen S, Mukhopadhyay B. Situation of malaria in Kolkata Municipal Corporation area: A secondary data analysis report. Indian J Community Med., 2014; 39(2): 114-39
13. Khatoon S, Khan MMA. Socio-Economic Status and Burden of Malaria in Kolkata Municipal Corporation (KMC) Area, West Bengal. J Infect Dis., 2020; 52(1): 72–77.
14. Bag NI, Paul B, Bhattacharyya M, Sarkar S. Malaria infection and associated household level risks in an urban and rural areas of West Bengal. J Vector Borne Dis., 2024; 4(2): 101-20.
15. Nag S, Basu N, Bandyopadhyay SK. Application of machine intelligence in digital pathology: Identification of falciparum malaria in thin blood smear image. Adv. Mach. Intell. Interact. Med Image Anal., 2020; 82(6): 543-67
16. Foko LP, Arya A, Sharma A, Singh V. Epidemiology and clinical outcomes of severe Plasmodium vivax malaria in India. J. Infect., 2021; 82(6): 231-46. doi: 10.1016/j.jinf.2021.03.028
17. Acharya A, Naskar A, Chaudhury A, Sardar AA, Samanta A, et al. Prevalence of polymorphisms in marker genes associated with antimalarial drug resistance in Plasmodium falciparum following 10 years of artemisinin-based combination therapy implementation in urban Kolkata. Trop. Parasitol., 2024; 14(1): 23-29
18. Gupta S, Bandyopadhayay MK, Saha A, Chowdhury AR, Bandyopadhyay M. Correlation between parasitemia and different complications of malaria– The clinical outlook. Natl. J. Physiol. Pharm. Pharmacol., 2023; 13(5): 1011-26
19. Narang G, Jakhan J, Tamang S, Yadav K, Singh V. Characterization of drug resistance genes in Indian Plasmodium falciparum and Plasmodium vivax field isolates. Acta Trop., 2024; 255(32): 107-32. doi: 10.1016/j.actatropica.2024.107218.
20. Iqbal A, Chakraborty J, Choudhuri S, Naik A, Bhattacharyya M. CML-004: Imatinib is Protective Against Falciparum Malaria: A Case Control Study from a Tertiary Care Centre in West Bengal. Clin Lymphoma Myeloma Leuk., 2020; 20(62): 77-89.
21. Sinha SK, Pal D, Garg M. Profile of hematological parameters in Plasmodium falciparum malaria: A study from West Bengal. J. Hematol. Allied Sci., 2021; 1(1): 28-32.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 12, Iss 1, 2023