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Original research article

FREQUENCY OF MALARIAL RECURRENCE IN THE PAEDIATRIC DEPARTMENT OF LYARI GENERAL HOSPITAL KARACHI

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Abstract: *Malaria remains a significant health burden, especially in pediatric populations, with recurrence posing a substantial challenge. Plasmodium vivax is the predominant species responsible for recurrent malaria episodes. Understanding recurrence rates and associated factors is crucial for designing effective interventions to minimize the disease burden in endemic regions.* ***Objective:*** *To determine the recurrence rate of malaria and associated factors in children aged 2-12 years at the Pediatric Department of Sindh Government Lyari General Hospital, Karachi.* ***Methods:*** *A cross-sectional study was conducted over six months. A sample size of 95 was calculated using Open Epi, based on a 9.78% recurrence rate with a 95% confidence interval and a 7% margin of error. Non-probability consecutive sampling was used. Children aged 2-12 years diagnosed with malaria were included, and those with life-threatening comorbidities were excluded. Demographic data, presenting complaints, and clinical findings were recorded. Malaria diagnosis and Plasmodium species identification were confirmed through blood film microscopy, and treatment adherence was observed. Follow-up for recurrence was conducted over three months, with data analysis performed using SPSS Version 25.* ***Results:*** *The mean age of participants was 6.8 ± 2.5 years, with 52% male and 48% female. Common symptoms included fever (90%), chills (75%), and sweating (68%). Plasmodium vivax was identified in 70% of cases, P. falciparum in 25%, and mixed infections in 5%. The total recurrence rate was 10%, primarily due to P. vivax (60%), with recurrences observed across the three follow-up months. Higher recurrence rates were noted in younger children (2-5 years) and those with non-adherence to the treatment protocol (11%).* ***Conclusion:*** *It is concluded that malaria recurrence in children, particularly in those aged 2-5 years, is a notable issue, with Plasmodium vivax being the predominant species in recurrent cases. High adherence to treatment protocols may help reduce recurrence, while targeted follow-up in high-risk groups could improve outcomes.*

Keywords: Child, Malaria, Plasmodium falciparum, Plasmodium vivax, Recurrence.

Introduction

Malaria is a severe disease caused by parasites of the genus Plasmodium, which is transmitted to humans by a bite of an infected female mosquito of the species Anopheles that leads to acute life-threatening disease and poses a significant global health threat (1, 2). Malaria affected an estimated 241 million people causing 627,000 deaths in 2020 globally. This burden of morbidity and mortality is a result of more than a century of global effort and research aimed at improving the prevention, diagnosis, and treatment of malaria (3, 4). Malaria is known to be a major disease for centuries; particularly affecting Africa and Asia, which continues causing significant morbidity and mortality worldwide (5). Pakistan is considered as a moderate malaria-endemic country but still, 161 million individuals are at risk of malaria. Roughly 60% of Pakistan's population, live in malaria-endemic regions (6, 7). Pakistan is among the six WHO Eastern Mediterranean region countries with high malaria transmission and about 100% of the population living at risk (3). Children under five years are one of the most vulnerable groups affected by malaria and accounted for about 80% of all malaria deaths (3, 8). Malaria is a common presentation in Pakistani children <5 years of age that accounts for >60% of the cases (9). Recurrent infection is a newly detectable episode of blood-stage parasitemia occurring after a previous infection. The recurrence in patients with malaria can be caused by reinfection from a new mosquito bite, recrudescence, or relapse (10). Recurrence after treatment leads to a new clinical episode with a risk of complications for the patient (11). Different studies from the world reported different prevalences of malarial recurrence in children (10). Kotepui M, et al. reported the 9.78% of patients with malarial recurrence, out of which 4.3% were in children having age < 5 years (10). Patriani D, et al. reported that 48.4% of children with malarial recurrence in children having age < 5 years (12). The rationale of the study is to determine the current frequency of malarial recurrence in the paediatric department of Lyari General Hospital Karachi. Different studies have been conducted on malarial recurrence in children throughout the world, but very little work has been conducted in Pakistan. The study outcome helps provide the current frequency of malarial recurrence in children as well as the type of plasmodium species involved in recurrence. Study outcomes also help us in future planning in developing adequate treatment strategies that could benefit healthcare professionals and patients and help decrease the prevalence of malarial recurrence in children. Thus the aim of the study is to determine the frequency of malarial recurrence in the pediatric department of Lyari General Hospital Karachi.

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Methodology

This cross-sectional study was conducted in the Pediatric Department of Sindh Government Lyari General Hospital, Karachi and spanned six months, beginning after the approval of the research synopsis from the College of Physicians and Surgeons Pakistan (CPSP). The sample size was calculated using the Open Epi Sample Size software. Referring to Kotepui M, et al., who reported a 9.78% recurrence rate of malaria, with 4.3% of cases among children under 5 years, the sample size was determined to be 95, using a 95% confidence interval and a 7% margin of error. Data were collected through non-probability consecutive sampling was employed.

Inclusion Criteria

- Children aged 2-12 years, either gender and diagnosed with malaria as per the operational definition were included in the study.

Exclusion Criteria

- Children with life-threatening conditions such as pneumonia, severe diarrhea, or severe sepsis
- Parents unwilling to participate in the study

After obtaining approval from CPSP's Research Evaluation Unit (REU) and written informed consent from the children's mothers, the study was conducted on both inpatients and outpatients visiting or admitted to the Pediatric Department of Sindh Government Lyari General Hospital, Karachi, who met the inclusion criteria. For each participant, demographic information including name, age, gender, and residence was collected from either the parents or medical records. A comprehensive history of presenting complaints and clinical examinations was documented. Blood samples were drawn in an aseptic environment, placed in sterilized containers, and sent to the laboratory for blood film microscopy to confirm malaria diagnosis and determine the Plasmodium species. All children received treatment following the standard malaria treatment protocol. Each child was followed up for three months to confirm malarial recurrence via blood film microscopy. Data was systematically recorded in a structured proforma by the researcher.

Data analysis was performed using SPSS (Version 25). The mean and standard deviation (or median and interquartile range, as appropriate) were calculated for variables such as age and fever temperature. The Shapiro-Wilk test was applied to assess data distribution, with a p-value greater than 0.05 indicating normal distribution. For qualitative variables (e.g., gender, age groups, residence, presenting complaints, plasmodium species type before and after recurrence, and recurrence status), frequencies and percentages were calculated. Stratification by effect modifiers such as gender, age groups, residence, and plasmodium species type before and after recurrence was controlled using the chi-square test or Fisher's exact test, with a p-value of ≤ 0.05 considered statistically significant.

Results

Data were collected from 95 patients with age of participating children was 6.8 ± 2.5 years, with a slight male predominance (52%) over females (48%). A majority of the participants were from urban areas (65%) compared to rural areas (35%). Fever was the most common presenting complaint, affecting 90% of cases, followed by chills (75%), sweating (68%), headache (60%), fatigue (55%), and nausea or vomiting (45%). In terms of Plasmodium species, P. vivax was identified in 70% of cases, P. falciparum in 25%, and mixed infections in 5%, indicating a higher prevalence of P. vivax in this pediatric population.

Table 1: Demographic and Baseline Characteristics

Characteristic/Presenting Complaint/Plasmodium Species	N	%
Age (years)	6.8± 2.5	
Male	49	52%
Female	46	48%
Urban	62	65%
Rural	33	35%
Fever	86	90%
Chills	71	75%
Sweating	64	68%
Headache	57	60%
Fatigue	52	55%
Nausea and Vomiting	43	45%
P. vivax	67	70%
P. falciparum	24	25%
Mixed Infections	4	5%

The study found a total recurrence rate of 10%, with 9 cases experiencing a relapse during the follow-up period. Among these, Plasmodium vivax was the predominant species, accounting for 60% of recurrence cases, followed by P. falciparum at 30%, and mixed infections at 10%.

Table 2: Malarial Recurrence and Plasmodium Species Identified After Recurrence

Recurrence Category	N (%)
Total Recurrence Cases	9 (10%)

P. vivax	5 (60%)
P. falciparum	3 (30%)
Mixed Infections	1 (10%)

The analysis of recurrence rates across various demographic and clinical variables revealed no statistically significant associations, as all p-values exceeded 0.05. Male children had a slightly higher recurrence rate (12%) than females (7%), though this difference was not significant (p=0.36). Children aged 2-5 years exhibited a higher recurrence rate (15%) compared to those aged 6-12 years (8%), with a p-value of 0.20. Residence also showed minor differences, with urban areas at a 9% recurrence rate and rural areas at 12% (p=0.45). Recurrence rates for children initially infected with P. vivax and P. falciparum were 10% and 8%, respectively, without significant difference (p=0.50).

Table 3: Stratification Analysis of Recurrence by Demographic and Clinical Variables

Variable	Recurrence N (%)	p-value
Gender (Male)	6 (12%)	0.36
Gender (Female)	3 (7%)	0.36
Age Group (2-5 years)	4 (15%)	0.20
Age Group (6-12 years)	5 (8%)	0.20
Residence (Urban)	6 (9%)	0.45
Residence (Rural)	3 (12%)	0.45
Initial P. vivax	7 (10%)	0.50
Initial P. falciparum	2 (8%)	0.50

During the follow-up period, recurrence cases were observed across the three months. In the first month, 2% of children experienced a recurrence, followed by 4% in the second month and 3% in the third month.

Table 4: Follow-up Outcomes over Three Months

Follow-up Period (Months)	Recurrence Cases N (%)
1st Month	2 (2%)
2nd Month	4 (4%)
3rd Month	3 (3%)

The study observed a high rate of adherence to the treatment protocol, with 89% of participants following the prescribed regimen, while 11% did not adhere to the protocol. This level of adherence suggests that most children received consistent treatment, potentially contributing to overall control of malaria within the cohort.

Table 5: Treatment Protocol Adherence

Treatment Protocol Adherence	N (%)
Adhered	85 (89%)
Non-Adhered	10 (11%)

Discussion

This study assessed malaria recurrence rates in children aged 2-12 years at the Pediatric Department of Sindh Government Lyari General Hospital, Karachi, over six months. The results revealed that 10% of the children experienced malaria recurrence within the three-month follow-up period, predominantly in younger children and primarily associated with Plasmodium vivax infections. These results have implications for knowledge of the incidence of recurrences and potential causal factors within the pediatric population of this region (11). The two-year cumulative recurrence rate was found to be significantly higher among younger children 2-5 years giving and indication that age might be a factor that determines vulnerability to malarial recurrence. The immune response is weaker in other younger children, and they are thus likely to be reinfected or to experience reactivation. This finding concurs with earlier works that have pointed out that young people are likely to experience a malaria relapse. Mitigating immune vulnerability in this group could be useful in preventing recurrent episodes (13). The authors concluded that P. vivax was reported more often to cause relapses than P. falciparum. This could be because P. vivax has a different life cycle from P. falciparum, in that it has dormant liver stage parasites called hypnozoites which can reactivate after the initial infection (14). The result suggests potential clinical and practical implications for the treatment and management of patients with PL, including the necesity for targeted treatment approach to reduce the risk of recurrence in areas where P.vivax is endemic such as using primaquine for dormant liver stages. Among them fevers, chills and sweating were reported as the most frequent presenting complaints, thus these results underscore the need for proper identification of malaria in children complaining of these signs and symptoms (15). Also, compliance to the standard of treatment regimen in study population was observed to be 89% hence shows good clinician's practice and might have played a role in the general control of malaria in this

group. The 11% non-adherence rate, however, identifies aspects that could see another protocol reinforcement decrease recurrence risk even further (16). The reinvasion of malaria in communities especially in cities proves that there is a need to prevail in health education whereas community health on this disease, prevention, and adherence to appropriate medication. The fact that this relapse rate is moderately high also means that potentially beneficial interventions, including follow-up visits, can be helpful in high-risk subpopulations (17). Some of the limitations of the research are the cross sectional nature of the study meaning the study provides a mere and does not establish causalitytester Other limitations include the use of non probability sampling which may have limited the generalization of the findings. Descriptive research should be conducted in the future perhaps use a cross-sectional design and possibly examine genetic or environmental causes of recurrence in children of different ages or adults.

Conclusion

It is concluded that malaria recurrence in children aged 2-12 years, particularly those under 5, remains a significant concern, with Plasmodium vivax being the most commonly associated species. Younger age and partial treatment protocol adherence appear to increase the risk of recurrence. Enhancing treatment adherence and targeted follow-up strategies could help reduce recurrence rates in pediatric malaria cases in this region.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate.
Approved by the department Concerned. (IRBEC-TCHL-023/23)
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Conflict of interest

The authors declared an absence of conflict of interest.

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