INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

CLINICAL PROFILE AND OUTCOME OF CEREBRAL MALARIA IN A TERTIARY CARE HOSPITAL, KARACHI

Original Research

Dharamveer[1]*, Shabnam Naveed[2], Uma Devi[3], Neha Rani[4]
[1]Postgraduate Trainee, Pakistan.
[2]Professor & HOD, Jinnah Sindh Medical University, Karachi, Pakistan.
[3]Medical Officer, Pakistan.
[4]Final Year MBBS Student, Pakistan.
Corresponding Author: Dharamveer, Postgraduate Trainee, Pakistan, mr.sagarkumar5@yahoo.com
Acknowledgement: The authors sincerely acknowledge the support of the staff and patients of Jinnah Postgraduate Medical Centre, Karachi, for their valuable cooperation during this study.

Conflict of Interest: None
Grant Support & Financial Support: None

ABSTRACT

Background: Cerebral malaria (CM), a severe neurological complication of *Plasmodium falciparum* infection, remains a major cause of morbidity and mortality in endemic regions. Despite global progress in diagnosis and treatment, CM continues to pose a serious threat in low-resource urban settings such as Karachi, Pakistan, where high population density, inadequate vector control, and delays in medical care increase the disease burden. Early recognition and effective management are crucial to reducing fatal outcomes and long-term neurological sequelae.

Objective: The objective of this study was to assess the clinical presentations, complications, and outcomes of patients with CM at Jinnah Postgraduate Medical Centre (JPMC), Karachi, and to identify predictors of poor prognosis.

Methods: A cross-sectional study was conducted over six months and included 71 patients diagnosed with CM and admitted to Wards 5, 6, 7, and 23 of JPMC. Inclusion criteria required patients to be above 18 years with confirmed *Plasmodium falciparum* positivity by peripheral blood smear or antigen test. Data were obtained from structured proformas, hospital records, and ward registers. Information on demographics, presenting features, complications, laboratory investigations, treatment received (intravenous fluids, artesunate, quinine), and outcomes was recorded. Statistical analysis was carried out using SPSS; chi-square tests were applied to categorical variables, and independent-sample t-tests were used for continuous variables, with significance set at $p<0.05$.

Results: Of the 71 patients, 50 (70%) were male and 21 (30%) female. The most affected age group was 21–30 years (37%), followed by 18–20 years (25%). Clinical features included fever in 68 patients (95%), altered consciousness in 60 (85%), coma in 53 (75%), weakness in 57 (80%), and seizures in 29 (41%). Complications recorded were hypoglycemia in 32 (45%), acute kidney injury in 28 (40%), multi-organ failure in 14 (20%), neurological sequelae in 21 (30%), hepatic dysfunction in 7 (10%), and sepsis in 15 (21%). All patients received intravenous fluids, while 60 (85%) were treated with artesunate and 11 (15%) with quinine. Thirty-five (50%) required ICU admission, 18 (25%) needed mechanical ventilation, and 15 (21%) underwent blood transfusion. In terms of outcomes, 50 (70%) recovered completely, 15 (21%) developed neurological sequelae, and 6 (9%) died. Mortality was significantly associated with prolonged coma ($p=0.02$) and extended hospital stay ($p=0.04$).

Conclusion: The findings demonstrate that cerebral malaria in Karachi remains a critical public health issue with high rates of complications and neurological sequelae despite standard treatment. Prolonged coma and multi-organ involvement were strong predictors of poor prognosis. Timely diagnosis, prompt initiation of therapy, and improved critical care facilities are essential to reducing mortality. Further research on adjunctive therapies is warranted to mitigate long-term neurological damage.

Keywords: Acute Kidney Injury, Cerebral Malaria, Complications, Mortality, Neurological Sequelae, Prognosis, *Plasmodium falciparum*.

© 2025 et al. Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

INTRODUCTION

Cerebral malaria (CM) remains one of the most severe complications of *Plasmodium falciparum* infection and is responsible for significant mortality and long-term neurological disability worldwide. Despite the availability of effective anti-parasitic therapies, the disease continues to claim lives and leaves many survivors with persistent neurocognitive impairments, particularly among children (1). Although research over the last two decades has greatly improved the understanding of CM pathogenesis, important questions still remain regarding the precise mechanisms underlying neurological injury and recovery (2). Emerging therapeutic approaches and early disease detection strategies have been introduced to limit mortality and prevent long-term sequelae; however, delays in diagnosis and treatment remain major barriers to successful outcomes (3). In endemic regions, such as Pakistan, CM poses an escalating challenge. Karachi, one of the country's largest and most densely populated cities, provides a highly favorable environment for *Anopheles* mosquito breeding. Weaknesses in vector control programs, combined with urban overcrowding, have compounded the problem and strained the city's healthcare system, despite the routine use of rapid diagnostic testing and insecticide-treated nets (4,5).

Clinically, CM manifests with coma, seizures, neurological deficits, or multiorgan dysfunction, with complications such as hypoglycaemia, acute renal failure, coagulopathy, and multiple organ failure contributing to high mortality rates (6). Even with early initiation of antimalarial therapy, mortality remains unacceptably high, and survivors often face long-term neurological sequelae, including cognitive impairment and motor dysfunction (7,8). While extensive literature is available from Sub-Saharan Africa and Southeast Asia, there is limited evidence from South Asia, particularly Pakistan, where the disease burden is substantial but underreported (9). Given this gap, the present study was designed to investigate the clinical manifestations, laboratory findings, complications, and prognostic outcomes of CM among patients admitted to tertiary care hospitals in Karachi. In particular, it aimed to assess treatment outcomes—including recovery, mortality, and neurological sequelae—under standard management protocols involving intravenous fluids, artesunate, and quinine (10). By identifying predictors of poor outcomes, this research seeks to inform the development of aggressive treatment strategies and timely interventions that may reduce mortality and improve the quality of life of CM survivors in Pakistan (11).

METHODS

The study was designed as a cross-sectional analytical investigation conducted at Jinnah Postgraduate Medical Centre (JPMC), Karachi, with the objective of determining the clinical profile and outcomes of patients presenting with cerebral malaria. The duration of the study spanned six months and commenced following the formal approval of the Institutional Review Board (IRB). Ethical considerations were strictly observed, and informed written consent was obtained from all participants or their legal attendants prior to inclusion in the study. The sample size was calculated using the Raosoft sample size calculator, based on a 95% confidence level, a 5% margin of error, and an estimated annual population of approximately 2,000 cases of malaria admitted across Wards 5, 6, 7, and 23 of JPMC. A response rate of 5% was assumed, leading to a required sample size of 71 participants. Patients were recruited using a non-probability consecutive sampling method. Inclusion criteria comprised patients above 18 years of age with a confirmed diagnosis of cerebral malaria according to World Health Organization (WHO) guidelines (6), supported by either a positive *Plasmodium falciparum* antigen test or peripheral blood smear, and requiring hospitalization at JPMC. Patients with coma attributable to other causes such as meningitis, hepatic encephalopathy, or metabolic derangements, as well as those with incomplete or unavailable medical records, were excluded from the study.

Data collection was performed using a structured proforma to ensure uniformity and completeness. Clinical parameters recorded included fever, altered level of consciousness, seizures, focal neurological signs, and the duration of coma. Laboratory investigations incorporated peripheral blood smear, rapid malaria antigen test, complete blood counts, serum glucose, renal and liver function tests, coagulation profiles, and lumbar puncture where clinically indicated. Neuroimaging, including CT or MRI brain scans, was undertaken when necessary to exclude differential diagnoses. Complications such as hypoglycaemia, acute renal failure, respiratory distress, shock, seizures, and multi-organ dysfunction were monitored throughout hospitalization. Details of treatment interventions, including administration of antimalarial drugs, admission to intensive care units, and mechanical ventilation, were systematically documented.

© 2025 et al. Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Patient outcomes were categorized as complete recovery, survival with neurological sequelae, or death. Data were analyzed using the latest version of SPSS. Continuous variables, such as patient age, duration of coma, and hospital stay, were expressed as means with standard deviations. Categorical variables, including gender, presenting symptoms, complications, and outcomes, were represented as frequencies and percentages. Associations between categorical variables were assessed using the chi-square test, while continuous variables were compared using independent-sample t-tests. A p-value of less than 0.05 was considered statistically significant. The analytical approach was aimed at identifying predictors of poor outcomes and examining correlations between clinical characteristics and prognosis in cerebral malaria.

RESULTS

The study included a total of 71 patients diagnosed with cerebral malaria. Among these, the majority were male (70%), while females accounted for 30%. The mean age of patients was concentrated in the younger age groups, with the largest proportion between 21–30 years (37%), followed by 25% aged 18–20 years, 21% aged 31–40 years, and 17% aged 41 years or older.

Clinical symptoms were frequent and severe. Fever was almost universal, present in 95% of cases, while altered consciousness was observed in 85% of patients. Coma was recorded in 75%, weakness in 80%, and seizures in 41%. With respect to complications, hypoglycaemia occurred in 45% of patients, acute kidney injury in 40%, neurological sequelae in 30%, sepsis in 21%, multi-organ failure in 20%, and hepatic dysfunction in 10%. All patients received intravenous fluids as part of standard management. Antimalarial therapy was predominantly artesunate, administered in 85% of cases, while 15% were treated with quinine. Supportive measures included intensive care unit admission in 50% of patients, mechanical ventilation in 25%, and blood transfusion in 21%. In terms of outcomes, 70% of patients achieved full recovery, 21% survived with neurological sequelae, and 9% succumbed to the disease. Comparative analysis of continuous variables between survivors with full recovery and those who died revealed no significant difference in mean age ($p = 0.46$). However, the duration of coma was significantly longer in patients who died (mean 15 ± 4 hours) compared to those who recovered (mean 10 ± 3 hours; $p = 0.02$). Similarly, the mean length of hospital stay was longer among non-survivors (10 ± 3 days) than survivors (7 ± 2 days; $p = 0.04$). These findings demonstrated that both prolonged coma duration and extended hospital stay were associated with poor prognosis in cerebral malaria.

Table 1: Demographic, Clinical Profile, and Outcomes of Cerebral Malaria Patients

Variable		Frequency (n)	Percentage (%)	Chi-Square Value	p-value
Gender	Male	50	70 (%)	1.56	0.21
	Female	21	30 (%)		
Age Group	18–20 years	18	25.0	3.32	0.05
	21–30 years	26	37.0		
	31–40 years	15	21.0		
	≥41 years	12	17.0		
Clinical Symptoms	Fever	68	95 (%)	4.02	0.01
	Seizures	29	41 (%)		
	Altered Consciousness	60	85 (%)		
	Coma	53	75 (%)		
	Weakness	57	80 (%)		
Complications	Acute Kidney Injury	28	40 (%)	4.60	0.03

© 2025 et al. Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Variable		Frequency (n)	Percentage (%)	Chi-Square Value	p-value
	Hepatic Dysfunction	7	10 (%)		
	Multi-organ Failure	14	20 (%)		
	Neurological Sequelae	21	30 (%)		
	Sepsis	15	21 (%)		
	Hypoglycemia	32	45 (%)		
Treatment Parameters	IV Fluids	71	100 (%)	3.41	0.30
	Blood Transfusion	15	21 (%)		
	Mechanical Ventilation	18	25 (%)		
	ICU Admission	35	50 (%)		
	Artesunate	60	85 (%)		
	Quinine	11	15 (%)		
Outcomes	Full Recovery	50	70 (%)	4.16	0.04
	Neurological Sequelae	15	21 (%)		
	Mortality	6	9 (%)		

Table 2: Independent-Sample t-Test for Continuous Variables (Full Recovery vs Mortality)

Variable	Full Recovery Group (Mean ± SD)	Mortality Group (Mean ± SD)	t-Statistic	p-value
Age (years)	30 ± 8	32 ± 7	0.75	0.46
Duration of Coma (hrs)	10 ± 3	15 ± 4	2.33	0.02
Length of Hospital Stay (days)	7 ± 2	10 ± 3	2.14	0.04

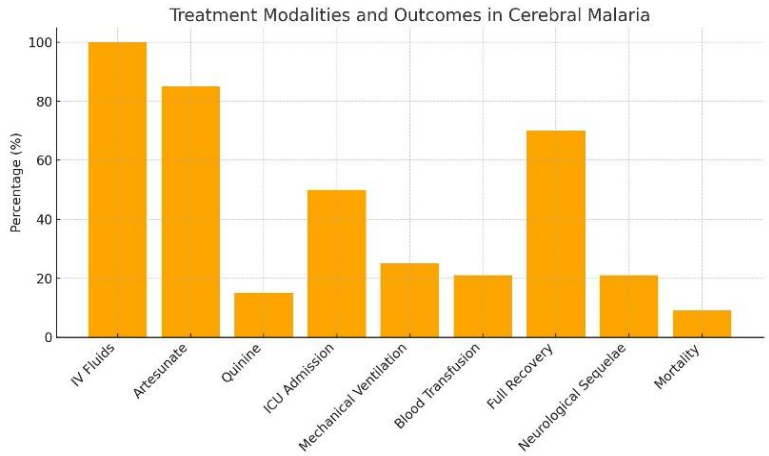

Figure 1 Treatment Modalities and Outcomes in Cerebral Malaria

© 2025 et al. Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

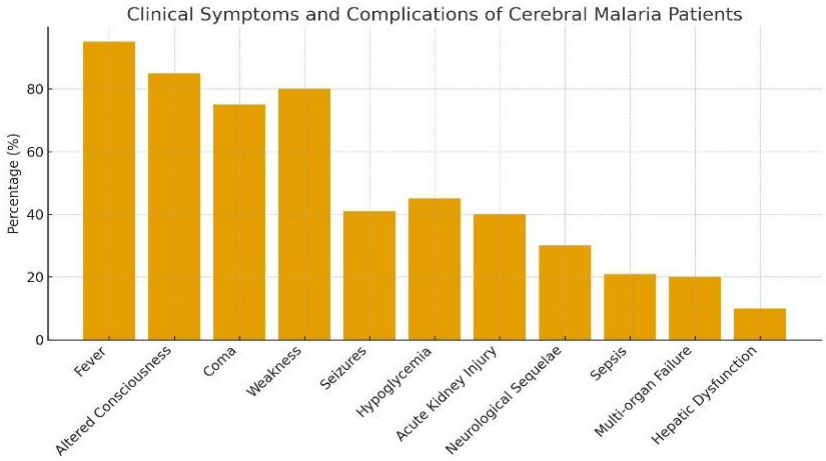

Figure 2 Clinical Symptoms and Complications of Cerebral Malaria Patients

DISCUSSION

This study expanded the understanding of the clinical spectrum of cerebral malaria and highlighted the diversity of its presentations, complications, and outcomes in an urban tertiary care setting. The findings demonstrated that the burden of cerebral malaria remains considerably high in densely populated areas such as Karachi, where inadequate vector control measures and delayed healthcare access continue to exacerbate morbidity and mortality. The predominance of cases among younger adults, particularly in the 21–30 and 31–40 age groups, reinforced observations from earlier research that cerebral malaria tends to affect non-immune or partially immune individuals living in endemic regions with high transmission rates (12). Although cerebral malaria in children has been extensively documented in tropical countries, the results from this study indicated that adults, particularly the immunocompromised, are also at significant risk, which underlines the vulnerability of wider age groups in endemic populations (13). The clinical manifestations observed, including fever, altered consciousness, coma, and seizures, aligned with patterns commonly reported in the literature (14). The relatively high frequency of seizures observed in this study underscored their significance as a critical complication, as seizures have been consistently associated with adverse neurological outcomes and delayed cognitive recovery in cerebral malaria (15). Complications such as acute kidney injury, multi-organ failure, and hypoglycaemia were prominent and strongly linked to poorer prognoses, supporting previous findings that prolonged coma duration is a predictor of organ dysfunction and mortality (16). Notably, hypoglycaemia affected nearly half of the patients, reaffirming its role as a critical determinant of outcome in severe malaria, influenced both by the disease process and by certain treatment regimens (17).

Treatment data highlighted universal use of intravenous fluids, with artesunate as the predominant antimalarial, though some patients received quinine. No significant differences in survival outcomes were observed between artesunate and quinine administration, which echoed ongoing debates in the literature regarding comparative effectiveness, particularly in resource-constrained settings where drug availability and supportive care vary widely (18,19). Half of the patients required intensive care unit admission, and one-quarter required mechanical ventilation, reflecting the severity of clinical presentation and the burden placed on tertiary care facilities. Mortality was highest among patients with multi-organ failure and prolonged coma, consistent with earlier observations that these are strong predictors of poor outcome (20). Despite the high mortality risk, a substantial proportion of survivors achieved complete recovery, demonstrating that early recognition, timely initiation of treatment, and aggressive supportive care can improve prognosis even in severe cases. The implications of these findings are significant for both clinical practice and public health. The identification of delayed hospital presentation, prolonged coma, and multi-organ dysfunction as poor prognostic indicators emphasizes the need for timely detection, prompt initiation of therapy, and vigilant monitoring of warning signs. Early recognition of seizures and hypoglycaemia and their immediate management are particularly important in reducing neurological sequelae and mortality (21). These results further suggest that improved diagnostic capacity, wider availability of intensive care facilities, and strengthened vector control programs are essential for reducing the burden of cerebral malaria in urban centers such as Karachi.

© 2025 et al. Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

This study carried several strengths. It provided locally relevant data from a large tertiary care center, filling an important knowledge gap in South Asia where research on cerebral malaria has been relatively limited. It also employed standardized diagnostic and laboratory protocols, allowing robust clinical characterization of patients. However, certain limitations must be acknowledged. The sample size of 71 patients, though adequate for preliminary analysis, was relatively small and may not capture the full spectrum of disease in the wider population. The single-center design limited the generalizability of findings, as outcomes in rural or resource-poor settings may differ substantially. Moreover, the study focused on short-term outcomes, without long-term follow-up of neurological sequelae, which restricted understanding of the chronic impact of cerebral malaria on survivors. Future research should aim to include larger, multi-center cohorts with extended follow-up to better evaluate long-term neurological and cognitive sequelae. Investigation into the role of adjunctive therapies to mitigate neurological damage, as well as the development of context-specific treatment protocols for resource-limited environments, would further strengthen the evidence base. Additionally, integration of molecular and imaging studies could provide deeper insights into disease mechanisms and predictors of outcome. Overall, this study reinforced that cerebral malaria remains a life-threatening condition with diverse clinical presentations and outcomes. Early diagnosis, timely treatment, and effective supportive care emerged as crucial determinants of survival and recovery. The findings underscored the urgent need for improved healthcare infrastructure, expanded critical care capacity, and strengthened preventive strategies in endemic regions to reduce the burden of this preventable yet devastating disease.

CONCLUSION

This study concluded that cerebral malaria in Karachi remains a serious health challenge, particularly affecting younger non-immune individuals who are vulnerable to its severe manifestations. Complications such as acute kidney injury, hypoglycaemia, and multi-organ failure emerged as major contributors to poor outcomes, while prolonged coma and organ dysfunction were strong predictors of mortality and long-term disability. Although many patients achieved full recovery with standard treatment and supportive care, a considerable proportion sustained lasting neurological consequences, underscoring the enduring impact of the disease. These findings highlight the critical importance of timely diagnosis, prompt initiation of effective therapy, and the provision of intensive supportive care to improve survival and reduce long-term sequelae. The study also emphasized the need for further research into adjunctive therapies and improved diagnostic strategies to address existing gaps in knowledge and optimize the management of cerebral malaria in high-burden urban settings.

AUTHOR CONTRIBUTION

Author	Contribution
Dharamveer*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Shabnam Naveed	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Uma Devi	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Neha Rani	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

© 2025 et al. Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

REFERENCES

1. Fida, M., Li, P., Wang, Y., Alam, S. K., & Nsabimana, A. (2023). Water contamination and human health risks in Pakistan: a review. Exposure and Health, 15(3), 619-639.

2. Ibrahim, O. R., Issa, A., Babatunde, R. T., & Alao, M. A. (2024). Clinical and laboratory predictors of poor outcomes in pediatric cerebral malaria in Nigeria. Oman Medical Journal, 39(6), e692.

3. Jain, Y., Kataria, A., & Singh, M. (2024). Cerebral and other Forms of Severe Malaria. Product Innovation & Entrepreneurship, 414.

4. Khan, M., Nisar, H., & Mushahid, N. (2021). Clinical and Lab profile of severe and uncomplicated malaria: A prospective study from Khuzdar Balochistan. Pakistan Journal of Medical Sciences, 37(7), 1918.

5. Muppidi, P., Wright, E., Wassmer, S. C., & Gupta, H. (2023). Diagnosis of cerebral malaria: Tools to reduce Plasmodium falciparum associated mortality. Frontiers in cellular and infection microbiology, 13, 1090013.

6. Organization, W. H. (2023). WHO malaria policy advisory group (MPAG) meeting report, 18–20 April 2023. World Health Organization.

7. Schiess, N., Villabona-Rueda, A., Cottier, K. E., Huether, K., Chipeta, J., & Stins, M. F. (2020). Pathophysiology and neurologic sequelae of cerebral malaria. Malaria journal, 19(1), 266.

8. Song, X., Wei, W., Cheng, W., Zhu, H., Wang, W., Dong, H., & Li, J. (2022). Cerebral malaria induced by plasmodium falciparum: clinical features, pathogenesis, diagnosis, and treatment. Frontiers in cellular and infection microbiology, 12, 939532.

9. Trivedi, S., & Chakravarty, A. (2022). Neurological complications of malaria. Current neurology and neuroscience reports, 22(8), 499-513.

10. Mangal P, Mittal S, Kachhawa K, Agrawal D, Rath B, Kumar S. Analysis of the Clinical Profile in Patients with Plasmodium falciparum Malaria and Its Association with Parasite Density. J Glob Infect Dis. 2017;9(2):60-5.

11. Bi D, Lin J, Luo X, Lin L, Tang X, Luo X, et al. Biochemical characteristics of patients with imported malaria. Front Cell Infect Microbiol. 2022;12:1008430.

12. Royo J, Rahabi M, Kamaliddin C, Ezinmegnon S, Olagnier D, Authier H, et al. Changes in monocyte subsets are associated with clinical outcomes in severe malarial anaemia and cerebral malaria. Sci Rep. 2019;9(1):17545.

13. Khan M, Nisar H, Mushahid N. Clinical and Lab profile of severe and uncomplicated malaria: A prospective study from Khuzdar Balochistan. Pak J Med Sci. 2021;37(7):1918-23.

14. Naik H, Acharya A, Rout S. Clinical Profile and Treatment Outcomes of Patients with Malaria Complicated by Acute Kidney Injury. Saudi J Kidney Dis Transpl. 2023;34(2):117-24.

15. Koshy JM, Koshy J. Clinical profile of cerebral malaria at a secondary care hospital. J Family Med Prim Care. 2014;3(1):54-7.

16. Nadkar MY, Huchche AM, Singh R, Pazare AR. Clinical profile of severe Plasmodium vivax malaria in a tertiary care centre in Mumbai from June 2010-January 2011. J Assoc Physicians India. 2012;60:11-3.

17. Gehlawat VK, Arya V, Kaushik JS, Gathwala G. Clinical spectrum and treatment outcome of severe malaria caused by Plasmodium vivax in 18 children from northern India. Pathog Glob Health. 2013;107(4):210-4.

18. Sogbossi ES, Houekpetodji D, Kpadonou TG, Bleyenheuft Y. A Cross-sectional Study of the Clinical Profile of Children With Cerebral Palsy in Benin, a West African Low-Income Country. J Child Neurol. 2019;34(13):842-50.

19. Jain A, Kaushik R, Kaushik RM. Malarial hepatopathy: Clinical profile and association with other malarial complications. Acta Trop. 2016;159:95-105.

© 2025 et al. Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

20. Dwivedi H, Singh SK, Chauhan BS, Gunjan S, Tripathi R. Potential cerebral malaria therapy: intramuscular arteether and vitamin D co-administration. Parasitology. 2016;143(12):1557-68.

21. Moussa EM, Huang H, Thézénas ML, Fischer R, Ramaprasad A, Sisay-Joof F, et al. Proteomic profiling of the plasma of Gambian children with cerebral malaria. Malar J. 2018;17(1):337.

© 2025 et al. Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.