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Original Article

Clinical and Bio-Chemical Manifestation in Children with Dengue Fever

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ABSTRACT

Introduction: *Dengue fever, a mosquito-borne viral infection, poses a significant health threat, particularly in children. This study aims to explore the clinical and biochemical manifestations of dengue in pediatric patients to better understand the severity and associated risk factors in this vulnerable population.* ***Methods & Materials:*** *This descriptive cross-sectional study was conducted over one year in the Pediatric OPD & IPD of the Institute of Child and Mother Health (ICMH), involving 54 children aged 0-18 years diagnosed with dengue fever. Data were collected using a pre-tested semi-structured questionnaire, and the clinical and biochemical parameters were analyzed using SPSS version 21.* ***Results:*** *The majority of participants were under 5 years old (48.15%), with males constituting 55.56% of the sample. Over half of the participants (53.70%) were diagnosed with dengue fever, while 24.07% had dengue hemorrhagic fever, and 22.22% had dengue shock syndrome. Common symptoms included fever (100%) and vomiting (81.48%). Biochemical analysis revealed that 72.22% had platelet counts above 100,000, while 35.19% exhibited elevated SGPT levels. Cardiac involvement was noted in 25.93% of participants, with pericardial effusion observed.* ***Conclusion:*** *The study highlights the significant morbidity associated with dengue in children, particularly the severe forms of the disease. Early diagnosis, vigilant monitoring of biochemical markers, and comprehensive cardiac and renal assessments are crucial in managing severe cases. These findings underscore the need for targeted interventions to mitigate the impact of dengue in pediatric populations.*

Keywords: *Dengue Fever, Pediatric Dengue, Biochemical Markers, Cardiac Involvement, Dengue Hemorrhagic Fever*

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INTRODUCTION

Dengue fever, a mosquito-borne viral infection, has emerged as a significant global health concern, affecting millions of people annually across more than 100 countries. The World Health Organization estimates that dengue infections have increased 30-fold over the last 50 years, with approximately 50–100 million cases reported annually. Dengue is endemic in tropical and subtropical regions, with Asia,

South America, and the Caribbean being the most affected areas. The disease poses a considerable burden on public health systems, with substantial economic and social implications due to its high morbidity and potential mortality rates[1,2]. In Bangladesh, dengue fever has become a recurring public health challenge since the first major outbreak in 2000. The country's densely populated urban centers, particularly Dhaka, have been the epicenter of frequent outbreaks, primarily due to the ideal breeding conditions for Aedes mosquitoes. The cyclical nature of dengue outbreaks in Bangladesh, with significant spikes in cases observed in 2019 and 2022, underscores the persistent threat posed by this disease. The 2022 outbreak, in particular, was notable for its late resurgence and unusually high mortality rates, with 281 deaths reported—the highest annual figure since 2000. This resurgence was attributed to factors such as late-season rainfall, warmer temperatures, and the reintroduction of the DENV-4 serotype, which highlighted the evolving epidemiological landscape of dengue in the region[3,4]. While dengue fever affects individuals across all age groups, children are particularly vulnerable due to their unique physiological responses and the potential for more severe disease progression. Clinical manifestations in children often differ from those in adults, necessitating separate studies to better understand these differences and improve pediatric care. During the 2019 outbreak in Bangladesh, common symptoms in pediatric patients included high fever, vomiting, lethargy, and abdominal pain, with a significant proportion of cases progressing to severe forms of the disease such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS). The severity of these cases was often associated with younger age groups, emphasizing the need for age-specific clinical management strategies[5-7]. Biochemical markers play a crucial role in the diagnosis and management of dengue fever, particularly in pediatric cases where early identification of severe disease can significantly impact outcomes. Key markers such as platelet count, liver enzymes (AST and ALT), and hematocrit levels are closely monitored to assess disease progression. Thrombocytopenia, or a low platelet count, is one of the most consistent hematological findings in dengue patients and is often used as an indicator of disease severity. In children, a rapid decline in platelet count is commonly observed during the critical phase of the illness, with levels dropping below 100,000/cumm in severe cases. This drop is typically accompanied by a rise in hematocrit, signaling plasma leakage and increased risk of severe outcomes[7-9]. Liver enzyme levels, particularly AST and ALT, are also important biochemical markers in dengue fever. Studies have shown that these enzymes begin to rise early in the febrile phase and peak during the critical phase, with AST levels typically higher than ALT levels throughout the course of the disease. Elevated liver enzymes are indicative of hepatic involvement, which is more common in severe dengue cases and can lead to complications such as hepatitis and fulminant hepatic failure, particularly in children[7,8]. In addition to these traditional markers, other biochemical parameters such as albumin, cholesterol, and calcium levels have been studied for their potential role in predicting the critical phase of dengue fever. For instance, low levels of albumin and cholesterol have been associated with increased disease severity, while changes in calcium levels have been linked to disease progression. These findings underscore the importance of comprehensive biochemical monitoring in the management of dengue, especially in pediatric patients where early detection of severe disease can be lifesaving[7]. The persistent threat of dengue fever in Bangladesh, coupled with the unique clinical and biochemical challenges presented by pediatric cases, highlights the urgent need for continued research and tailored public health strategies. By focusing on the specific needs of children and leveraging key biochemical markers, healthcare providers can better manage dengue outbreaks and reduce the burden of this disease on the most vulnerable populations.

METHODS & MATERIALS

The study was designed as a descriptive cross-sectional study conducted over a period of one year in the Pediatric Outpatient Department (OPD) and Inpatient Department (IPD) of the Institute of Child and Mother Health (ICMH).

The study population included all children aged 0 to 18 years who were diagnosed with dengue fever during the study period. A total of 54 pediatric patients, diagnosed with dengue fever based on clinical and physical features, later confirmed by laboratory investigations, were enrolled in the study. The inclusion criteria for the study were children aged 0 to 18 years diagnosed with dengue fever. Children with pre-existing cardiac conditions were excluded from the study. The sampling technique employed was purposive sampling, ensuring that only relevant cases were included in the study. Data collection was carried out using a pre-tested semi-structured questionnaire, which was administered through face-to-face interviews. In addition, investigation reports, including laboratory tests, ECG, Echo, and chest X-ray (CXR) results, were collected from the investigators to corroborate the clinical findings. The weight of the children was measured using a bathroom scale, and their length was recorded using an infantometer. Data management and analysis were conducted using SPSS version 21. The collected data were analyzed and presented in the form of tables, graphs, and charts, providing a clear and concise depiction of the study findings. The data collection process took place during a dengue fever outbreak, ensuring the relevance and timeliness of the information gathered. Prior to the commencement of the study, ethical clearance was obtained from the Institutional Review Board (IRB) of the Institute of Child and Mother Health. Informed consent was obtained from the parents or guardians of the children after a thorough explanation of the study's nature and purpose. The right of the respondents to refuse participation or withdraw from the study at any point was respected. Additionally, confidentiality of the respondents' information was maintained throughout the study.

RESULTS

The study included 54 participants, with nearly half (48.15%) under the age of 5 years, 37.04% aged 5-10 years, and 14.81% over 10 years. Males made up 55.56% of the sample, with females at 44.44%. Only 1.85% of participants had a family history of dengue, but 22.22% reported having a family member affected by the disease. Most participants practiced preventive measures, with 90.74% using mosquito nets and 74.07% using mosquito repellents. However, 9.26% did not use mosquito nets, and 25.93% did not use repellents, indicating potential areas for improved public health interventions (**Table I**).

Table – I: Distribution of baseline characteristics among the participants (*n*=54)

Baseline Characteristics	Frequency	Percentage
Age		
<5yr	26	48.15
5-10yr	20	37.04
>10yrs	8	14.81
Sex		
Male	30	55.56
Female	24	44.44
Family history of dengue		
Yes	1	1.85
No	53	98.15
Affected family member		
Yes	12	22.22
No	42	77.78
Use of Mosquito net		
Yes	49	90.74
No	5	9.26
Use of mosquito repellant		
Yes	40	74.07
No	14	25.93

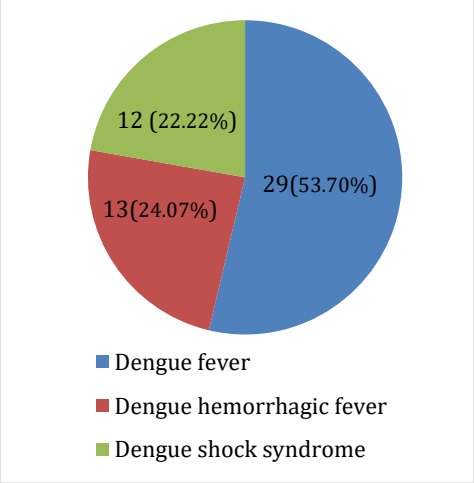

Figure 1: Distribution of Participants by types of Dengue (*n*=54)

Among the 54 participants, 53.70% were diagnosed with dengue fever, 24.07% with dengue hemorrhagic fever, and 22.22% with dengue shock syndrome (**Figure 1**).

All participants in the study (100%) presented with fever, with the vast majority (98.15%) experiencing temperatures between 101-105ºF. Vomiting was another common symptom, reported by 81.48% of participants, while 35.19% experienced abdominal pain. Other clinical features included headache (20.37%), rash (20.37%), and bleeding manifestations, such as bleeding from the skin (18.52%), gum bleeding (14.81%), and epistaxis (11.11%). Less common symptoms were retro-orbital pain (12.96%), nausea (11.11%), and hematochezia (7.41%). Only 1.85% of participants reported myalgia/arthralgia/back pain or hematuria. The duration of fever was less than 5 days in 98.15% of the participants. The majority of the patients had a hospital stay of 3-6 days (51.85%), with fewer patients staying for 7-10 days (31.48%) or 11-14 days (14.81%). Additionally, 24.07% of participants tested positive in the tourniquet test, indicating capillary fragility and a tendency for bleeding (**Table II**).

Table – II: Distribution of Participants by types of Clinical Characteristics (*n*=54)

Clinical Characteristics	Frequency	Percentage
Clinical Features		
Fever	54	100.00
Headache	11	20.37
Retro-orbital Pain	7	12.96
Mayalgia/Arthralgia/Back Pain	1	1.85
Nausea	6	11.11
Vomiting	44	81.48
Abdominal Pain	19	35.19
Rash	11	20.37
Bleeding from Skin	10	18.52
Epistaxis	6	11.11
Gum Bleeding	8	14.81
Hematuria	1	1.85
Hematochezia	4	7.41
Duration of Fever		
<5 days	53	98.15
>5 days	1	1.85
Duration of the Hospital Stay		
3-6 days	28	51.85
7-10 days	17	31.48
11-14 days	8	14.81
Temperature of patients		
99-101º f	1	1.85
101-105 º f	53	98.15
Tourniquet test		
Positive	13	24.07
Negative	41	75.93

The biochemical characteristics of the participants showed that 68.52% had hemoglobin (HB) levels above 11 grams/dl, while 22.22% had levels below 9.9 grams/dl.

Hematocrit levels were between 30-40% in 72.22% of the participants, with 22.22% below 30%. Platelet counts were over 100,000 in 72.22% of cases, but 9.26% had counts between 20,000-50,000, indicating a significant variation in severity. SGPT levels were elevated (>40 IU) in 35.19% of participants, suggesting liver involvement. Most participants (75.93%) had normal serum creatinine levels (<1 mg/dl), though 24.07% had elevated levels, hinting at potential renal issues. Regarding electrolytes, 68.52% had normal serum sodium (135-145 mEq/L) and potassium levels (3.5-5.5 mEq/L). However, 24.07% had hyponatremia (<135 mEq/L), and 22.22% had hypokalemia (<3.5 mEq/L). Serum chloride levels were normal (96-106 mEq/L) in 53.70% of participants, but 40.74% had elevated levels. The mean serum sodium, potassium, and chloride levels were 138.6 ± 0.65 mEq/L, 4.3 ± 0.1 mEq/L, and 104.73 ± 0.67 mEq/L, respectively (**Table III**).

Table – III: Distribution of Participants by Biochemical Characteristics (*n*=54)

Biochemical characteristics	Frequency	Percentage
HB%		
<9.9 gram/dl	12	22.22
10- 10.9gram/dl	5	9.26
>11 gram/dl	37	68.52
Hematocrit (%)		
<30	12	22.22
30-40	39	72.22
>40	3	5.56
Platelet Count		
20,000-50,000	5	9.26
50,000-100,000	10	18.52
>100,000	39	72.22
SGPT Levels		
≤40 IU	35	64.81
>40 IU	19	35.19
Serum creatinine		
<1	41	75.93
≥1	13	24.07
Serum Electrolyte		
Serum Na+ Level (mEq/L)		
<135mEq/L	13	24.07
135-145 mEq/L	37	68.52
>145 mEq/L	4	7.41
Mean±SD	138.6 ± 0.65 mEq/L	
Serum K+ Level (mEq/L)		
<3.5 mEq/L	12	22.22
3.5-5.5 mEq/L	37	68.52
>5.5 mEq/L	5	9.26
Mean±SD	4.3± 0.1 mEq/L	
Serum Cl- level		
<96 mEq/L	3	5.56
96-106 mEq/L	29	53.70
>106 mEq/L	22	40.74
Mean±SD	104.73 ± 0.67mEq/L	

The cardiac characteristics of the participants revealed that 98.15% had normal chest X-ray findings, with only 1.85% showing cardiomegaly. ECG results were normal for 90.74% of participants, while 9.26% exhibited bradycardia. Echocardiographic evaluations indicated that 74.07% had normal findings, but 25.93% of participants had pericardial effusion, highlighting a notable incidence of cardiac involvement among the children with dengue (**Table IV**).

Table – IV: Distribution of Participants by Cardiac Characteristics (*n*=54)

Cardiac Characteristics	Frequency	Percentage
Chest x-ray		
Cardiomegaly	1	1.85
Normal	53	98.15
ECG		
Bradycardia	5	9.26
Normal	49	90.74
Echo Finding		
Normal	40	74.07
Pericardial Effusion	14	25.93

DISCUSSION

The findings of this study on the clinical and biochemical manifestations of dengue fever in children align with and extend the current understanding of the disease, particularly in pediatric populations. The age distribution of participants, with nearly half being under five years of age, underscores the heightened vulnerability of younger children to severe dengue manifestations. This observation is consistent with global trends where younger age groups are disproportionately affected by severe forms of dengue, as highlighted in studies from Sri Lanka and Indonesia, where children below five years were more likely to experience severe symptoms and complications[10,11]. The slight male predominance observed in our study (55.56%) is also in line with previous research indicating a marginally higher incidence of severe dengue in males, possibly due to gender-related physiological differences in immune response[12,13]. These demographic patterns suggest that age and gender are significant factors in the epidemiology of dengue fever, reinforcing the need for targeted interventions for these vulnerable groups. The distribution of dengue types in our study, where dengue fever accounted for 53.70% of cases, with dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) comprising 24.07% and 22.22%, respectively, reflects the diverse clinical presentations of dengue observed globally. Similar distributions have been documented in other regions, including Indonesia, where all four dengue virus serotypes circulate, leading to a wide range of clinical outcomes[10]. The significant proportion of severe cases in our study highlights the critical need for early diagnosis and intervention to prevent the progression to DHF and DSS, which are associated with higher morbidity and mortality rates. Clinically, fever and vomiting were the most common symptoms in our cohort, with all participants presenting with fever and 81.48% reporting vomiting. These findings are consistent with the typical clinical presentation of dengue fever, as reported in multiple studies, where fever is universally present, and gastrointestinal symptoms like vomiting are prevalent, particularly in pediatric populations[10,14]. The high incidence of abdominal pain (35.19%) and bleeding manifestations, such as skin bleeding (18.52%) and gum bleeding (14.81%), further underscores the multisystem involvement in severe dengue, which has been documented in various studies across different regions[15,16]. The biochemical analysis in our study revealed that 72.22% of participants had platelet counts above 100,000, while 35.19% had elevated SGPT levels, indicating liver involvement. These findings are in line with studies from Sri Lanka and other regions that have identified thrombocytopenia and elevated liver enzymes as critical markers of severe dengue and predictors of disease progression[16,17]. The correlation between low platelet counts and high hematocrit levels, observed in our study, mirrors the hematological patterns seen in severe dengue cases elsewhere, emphasizing the importance of these markers in monitoring disease severity and guiding clinical

management[7]. Cardiac involvement, indicated by the presence of pericardial effusion in 25.93% of participants, is another significant finding of this study. This aligns with growing evidence from studies on dengue, which have increasingly recognized cardiac complications, including myocardial impairment and pericardial effusion, as critical but often underreported aspects of severe dengue[17,18]. The presence of these cardiac manifestations further complicates the clinical management of dengue and highlights the need for comprehensive cardiovascular monitoring in severe cases. Renal function, as assessed by serum creatinine levels, was compromised in 24.07% of participants, reflecting potential renal involvement. This finding is consistent with studies on dengue hemorrhagic fever in patients with pre-existing renal conditions, where renal impairment significantly increases the risk of severe outcomes, including shock and multi-organ failure[16,18]. The interplay between cardiac, renal, and hepatic dysfunction in severe dengue cases underscores the complexity of the disease and the need for a multidisciplinary approach to management. In conclusion, the findings of this study corroborate the patterns observed in global and regional studies on dengue fever, particularly in pediatric populations. The consistent observation of severe clinical and biochemical manifestations across different settings highlights the universal challenges posed by dengue fever and underscores the importance of early diagnosis, comprehensive monitoring, and targeted interventions to mitigate the severe outcomes associated with this disease. This study adds to the growing body of evidence on the multisystem impact of dengue and emphasizes the need for ongoing research and improved clinical practices to better manage this pervasive public health threat.

Limitations of the Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion

This study provides a comprehensive analysis of the clinical and biochemical manifestations of dengue fever in children, highlighting the significant morbidity associated with severe cases such as dengue hemorrhagic fever and dengue shock syndrome. The findings underscore the importance of early diagnosis and targeted intervention, particularly for younger children who are more susceptible to severe outcomes. The observed correlations between biochemical markers, such as platelet counts and liver enzyme levels, with disease severity reinforce the need for vigilant monitoring to prevent complications. The study also emphasizes the critical role of cardiac and renal assessments in managing severe dengue cases. These insights contribute to the broader understanding of dengue in pediatric populations and underscore the necessity for continued research and improved clinical practices to reduce the burden of this disease.

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Conflict of Interest

The authors declare no conflict of interest.

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. *Guo C, Zhou Z, Wen Z, Liu Y, Zeng C, Xiao D, Ou M, Han Y, Huang S, Liu D, Ye X. Global epidemiology of dengue outbreaks in 1990–2015: a systematic review and meta-analysis. Frontiers in cellular and infection microbiology. 2017 Jul 12;7:317.*
2. *Our World in Data [Internet]. [cited 2024 Aug 28]. Dengue fever infections. Available from: https://ourworldindata.org/grapher/dengue-incidence*
3. *Hossain MS, Noman AA, Mamun SM, Mosabbir AA. Twenty-two years of dengue outbreaks in Bangladesh: epidemiology, clinical spectrum, serotypes, and future disease risks. Tropical Medicine and Health. 2023 Dec;51(1):1-4.*
4. *Haider N, Hasan MN, Khalil I, Tonge D, Hegde S, Chowdhury MA, Rahman M, Khan MH, Ansumana R, Zumla A, Uddin MJ. The 2022*

dengue outbreak in Bangladesh: hypotheses for the late resurgence of cases and fatalities. Journal of Medical Entomology. 2023 Jul 1;60(4):847-52.

5. *Khan MA, Al Mosabbir A, Raheem E, Ahmed A, Rouf RR, Hasan M, Alam FB, Hannan N, Yesmin S, Amin R, Ahsan N. Clinical spectrum and predictors of severity of dengue among children in 2019 outbreak: a multicenter hospital-based study in Bangladesh. BMC pediatrics. 2021 Dec;21:1-0.*
6. *Pothapregada S, Kamalakannan B, Thulasingam M. Clinical profile of atypical manifestations of dengue fever. The Indian Journal of Pediatrics. 2016 Jun;83:493-9.*
7. *Kularatnam GA, Jasinge E, Gunasena S, Samaranayake D, Senanayake MP, Wickramasinghe VP. Evaluation of biochemical and haematological changes in dengue fever and dengue hemorrhagic fever in Sri Lankan children: a prospective follow up study. BMC pediatrics. 2019 Dec;19:1-9.*
8. *Ferede G, Tiruneh M, Abate E, Wondimeneh Y, Gadisa E, Howe R, Aseffa A, Tessema B. A study of clinical, hematological, and biochemical profiles of patients with dengue viral infections in Northwest Ethiopia: implications for patient management. BMC infectious diseases. 2018 Dec;18:1-6.*
9. *Chatterjee AB, Matti M, Kulkarni V. Role of platelet parameters in dengue fever in children. Pediatric Oncall Journal. 2019 Nov 22;17(1).*
10. *Sasmono RT, Santoso MS, Pamai YW, Yohan B, Afida AM, Denis D, Hutagalung IA, Johar E, Hayati RF, Yudhaputri FA, Haryanto S. Distinct dengue disease epidemiology, clinical, and diagnosis features in Western, Central, and Eastern Regions of Indonesia, 2017–2019. Frontiers in Medicine. 2020 Nov 20;7:582235.*
11. *Annan E, Treviño J, Zhao B, Rodriguez-Morales AJ, Haque U. Direct and indirect effects of age on dengue severity: The mediating role of secondary infection. PLoS neglected tropical diseases. 2023 Aug 9;17(8):e0011537.*
12. *Sharif N, Sharif N, Khan A, Dey SK. The epidemiologic and clinical characteristics of the 2023 dengue outbreak in Bangladesh. InOpen Forum Infectious Diseases 2024 Feb (Vol. 11, No. 2, p. ofae066). US: Oxford University Press.*
13. *Khan MB, Yang ZS, Lin CY, Hsu MC, Urbina AN, Assavalapsakul W, et al. Dengue overview: An updated systemic review. J Infect Public Health. 2023 Oct;16(10):1625–42.*
14. *Wong JM, Adams LE, Durbin AP, Muñoz-Jordán JL, Poehling KA, Sánchez-González LM, Volkman HR, Paz-Bailey G. Dengue: a growing problem with new interventions. Pediatrics. 2022 Jun 1;149(6).*
15. *Thadchanamoorthy V, Dayasiri K. Expanded dengue syndrome presenting with acute liver failure, acute kidney injury, pancreatic involvement, coagulopathy, and multiple intracranial hemorrhages in a young child: a case report. Journal of Medical Case Reports. 2022 Mar 29;16(1):123.*
16. *Vidanapathirana M. Dengue haemorrhagic fever in chronic kidney disease and heart failure: challenges in fluid management. Tropical Medicine and Health. 2024 Apr 24;52(1):33.*
17. *Yacoub S, Trung TH, Lam PK, Thien VH, Hai DH, Phan TQ, Nguyet OP, Quyen NT, Simmons CP, Broyd C, Screaton GR. Cardio-haemodynamic assessment and venous lactate in severe dengue: relationship with recurrent shock and respiratory distress. PLoS neglected tropical diseases. 2017 Jul 10;11(7):e0005740.*
18. *Vachvanichsanong P, Thisyakorn U, Thisyakorn C. Dengue hemorrhagic fever and the kidney. Archives of virology. 2016 Apr;161:771-8.*