ESTIMATION OF SERUM LACTATE DEHYDROGENASE LEVELS IN CHILDREN WITH DENGUE FEVER ADMITTED IN TERTIARY CARE CENTRE AT JAIPUR

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ABSTRACT

Background: Dengue fever is the most rapidly spreading arthropod-borne viral disease worldwide with children representing a particularly vulnerable population. Serum lactate dehydrogenase (LDH), a cytoplasmic enzyme released during cellular injury has been proposed as a potential prognostic biomarker in dengue. However, its systematic evaluation in the pediatric population in India remains limited. The present study aims to the Serum Lactate Dehydrogenase levels as a marker of severity in children with Dengue Fever and its association with Platelet count.

Methodology: A hospital-based observational study was conducted in the Department of Pediatrics, Mahatma Gandhi Hospital, Jaipur from April 2024 to March 2026. A total of 180 children aged 1-18 years, positive for dengue by IgM/NS1 antigen, were enrolled. Patients were classified as dengue without warning signs (n=130), dengue with warning signs (n=39) and severe dengue (n=11) using WHO criteria. Serum LDH was estimated at admission using the Siemens EXL-200 fully automated analyzer. Clinical, hematological and biochemical parameters were recorded and analyzed using descriptive statistics, Student's t-test, Chi-square test and Pearson's correlation coefficient.

Results: The overall mean age was 8.42 ± 4.73 years with male predominance (68.3%); demographic variables (age p=0.841, gender p=0.928, residence p=0.231) showed no significant association with severity. Fever was universal (100%). The mean serum LDH levels increased significantly with disease severity: 259.58 ± 116.46 U/L in dengue without warning signs, 564.72 ± 92.48 U/L in dengue with warning signs and 1009.91 ± 382.33 U/L in severe dengue (p=0.001). A significant negative correlation was observed between serum LDH and platelet count ($r = -0.607$, p=0.000). Thrombocytopenia (p=0.001), hemoconcentration (p=0.001) and elevated liver enzymes (p=0.001) were significantly associated with disease severity. Clinical warning signs including abdominal pain (p=0.001), vomiting (p=0.001), lethargy (p=0.001), tenderness (p=0.001) and bleeding (p=0.001) were significantly more prevalent in severe groups.

Conclusion: Serum LDH is a reliable, cost-effective biochemical marker for predicting the severity of dengue in children. Levels exceeding 500 U/L indicate significant disease activity, while levels approaching or exceeding 1000 U/L are strongly associated with severe dengue. Early estimation of serum LDH at admission, combined with clinical warning signs and hematological parameters, can facilitate timely risk stratification and management of pediatric dengue patients.

Keywords: Dengue Fever, Serum Lactate Dehydrogenase (Ldh), Pediatric Dengue, Disease Severity, Thrombocytopenia, Dengue Hemorrhagic Fever, Prognostic Biomarker, Tertiary Care, Jaipur.

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INTRODUCTION

Dengue fever is the most rapidly spreading arthropod-borne viral disease worldwide and a major public health concern in tropical and subtropical regions. It is transmitted primarily by

female Aedes aegypti and Aedes albopictus mosquitoes. Approximately 100 million cases occur annually with 250,000-500,000 severe cases requiring hospitalization. Children under 15 years are particularly vulnerable to severe disease manifestations. The clinical spectrum ranges from asymptomatic infection to severe dengue with hemorrhagic complications and shock, making early diagnosis and prognostic assessment essential.[1,2] Dengue infection progresses through three clinical phases: febrile, critical and recovery. The febrile phase lasts 3-7 days and is characterized by high fever, myalgia, arthralgia and constitutional symptoms. The critical phase follows defervescence and may be associated with plasma leakage, thrombocytopenia, hemorrhage and shock. Hepatic involvement is common due to direct viral infection and immune-mediated injury with nearly 65% of dengue hemorrhagic fever patients showing elevated liver enzymes.[3-5]

The liver serves as an important site for dengue virus replication with hepatocytes and Kupffer cells being primary targets. Viral replication and the resulting inflammatory response contribute to hepatocellular damage and release of biochemical markers such as AST, ALT and LDH. Among these, lactate dehydrogenase (LDH) is an important indicator of cellular injury and tissue necrosis. Elevated serum LDH levels have been shown to reflect the degree of hepatic involvement and may predict progression to severe dengue.[2,4,5] LDH is a cytoplasmic enzyme present in almost all tissues and is released into circulation following cellular injury. In dengue fever, elevated LDH levels indicate hepatocellular damage and metabolic dysfunction. Studies have demonstrated that LDH levels above 500 IU/L during the early febrile phase may help differentiate dengue from other febrile illnesses, while levels approaching or exceeding 1,000 IU/L during the critical phase may predict severe dengue, dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS).[6,7] The distinction between uncomplicated dengue and severe forms such as DHF and DSS is crucial for patient management. DHF is characterized by thrombocytopenia, hemorrhagic manifestations, hepatomegaly and plasma leakage, whereas DSS is associated with profound plasma leakage leading to hypovolemic shock. Studies have shown significantly higher serum LDH levels in severe dengue with values exceeding 600 IU/L demonstrating high sensitivity for identifying patients at risk of severe disease.[2,4,8]

Children constitute a high-risk group for severe dengue due to unique epidemiological and immunological factors. Secondary infection with a heterotypic dengue serotype increases the risk of DHF and DSS through antibody-dependent enhancement, while even primary infections in infants may result in severe disease. Therefore, biochemical markers such as LDH may be particularly useful for early identification of pediatric patients at risk of disease progression.[9,10] An inverse relationship between serum LDH levels and platelet count has also been reported. Elevated LDH is associated with thrombocytopenia, reflecting increased tissue injury, systemic inflammation and disease severity. This relationship has been observed in severe infections and may provide additional prognostic value in dengue patients.[8,10] The present study aims to assess serum LDH levels in children with dengue fever, determine their association with disease severity and evaluate the usefulness of LDH as a prognostic marker in pediatric dengue infection.

METHODOLOGY

A hospital-based observational study was carried out in the Department of Pediatrics at Mahatma Gandhi Hospital, Jaipur, from April 2024 to March 2026. The study was designed to evaluate the role of serum lactate dehydrogenase (LDH) levels in children diagnosed with dengue infection and to assess its association with disease severity and platelet count. Children aged between 1 and 18 years who were admitted to the pediatric department and tested positive for dengue infection by IgM antibody or NS1 antigen were included in the study. Patients fulfilling the World Health Organization (WHO) criteria for dengue fever with or without warning signs, dengue hemorrhagic fever and dengue shock syndrome were eligible for enrollment. The sample included all dengue-positive patients whose parents or legal guardians provided written informed consent during the study period. Only those cases in which serum LDH estimation was performed at the time of admission were included for final analysis. Patients initially admitted to the pediatric ward who subsequently deteriorated and required transfer to the Pediatric Intensive Care Unit (PICU) for advanced management were considered as new cases for analytical purposes.

In inclusion criteria, children aged 1-18 years who were IgM/NS1 dengue positive and whose parents consented for participation. In exclusion criteria, Patients who refused consent; those who received platelet transfusion during the illness; patients on anti-platelet medications; those with chronic diseases (chronic liver disease, chronic kidney disease); patients who received steroid therapy in the last 6 months; patients on anti-cancer drug therapy or with immunodeficiency; and dengue cases with co-infections such as scrub typhus, malaria, or leptospira.

Clinical Evaluation and Data Collection

A detailed clinical history was obtained for each enrolled patient with particular emphasis on symptoms such as fever, rash, headache, retro-orbital pain, vomiting and bleeding manifestations.

A comprehensive physical examination was performed and all clinical findings were recorded systematically on a structured proforma designed specifically for the study. Relevant laboratory investigations and clinical parameters including complete blood count, liver function tests, renal function tests, serum electrolytes and serum LDH were documented at admission.

Assessment of Serum LDH Levels and Sample Collection

Venous blood samples were collected using standard aseptic venipuncture techniques. A total of 5 mL of blood was drawn into a plain vial from each patient. The samples were allowed to clot and serum was separated by centrifugation for biochemical analysis. Serum LDH levels were estimated at admission using the Siemens EXL-200 fully automated analyzer. The assay was based on the enzymatic conversion of L-lactate to pyruvate with simultaneous reduction of nicotinamide adenine dinucleotide (NAD) to NADH; the rate of increase in absorbance at 340 nm, corresponding to the formation of NADH was directly proportional to LDH activity in the sample, measured using a bichromatic rate technique at wavelengths of 340 and 383 nm. LDH levels greater than 500 IU/L were considered useful in differentiating dengue infection from non-dengue cases during the early febrile phase, while levels approaching or exceeding 1,000 IU/L on day 0 of admission were considered suggestive of severe dengue with plasma leakage. The normal reference range for LDH was considered as 143-370 U/L for children aged 1-15 years and 105-233 U/L for those aged above 16 years.

Statistical Analysis

All clinical, laboratory and demographic data were entered into a master chart and subjected to appropriate statistical analysis. Descriptive statistics included mean with standard deviation, median with interquartile range (IQR) and frequency with percentages, as appropriate. Categorical variables were analyzed using the Chi-square test, while continuous variables were compared using Student's ttest. Correlations between quantitative variables were assessed using Pearson's correlation coefficient (r). A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 180 children with confirmed dengue infection were enrolled during the study period. They were classified into three groups: dengue without warning signs (n=130; 72.2%), dengue with warning signs (n=39; 21.7%) and severe dengue (n=11; 6.1%). The consolidated demographic and clinical characteristics of all enrolled patients are presented below.

Table 1: Demographic and Patient Characteristics of Children with Dengue Fever according to Severity Groups

Characteristic	Dengue without Warning Signs (n=130)	Dengue with Warning Signs (n=39)	Severe Dengue (n=11)	Total (n=180)	p-value
Age (years), Mean ± SD	8.53 ± 4.83	8.22 ± 4.73	7.77 ± 3.80	8.42 ± 4.73	0.841
Gender					
Male	89 (68.5%)	26 (66.7%)	8 (72.7%)	123 (68.3%)	0.928
Female	41 (31.5%)	13 (33.3%)	3 (27.3%)	57 (31.7%)	
Residence					
Urban	100 (76.9%)	25 (64.1%)	9 (81.8%)	134 (74.4%)	0.231
Rural	30 (23.1%)	14 (35.9%)	2 (18.2%)	46 (25.6%)	
Duration of Illness (days), Mean ± SD	4.68 ± 1.62	5.03 ± 1.73	4.55 ± 1.29	4.74 ± 1.63	0.463

The demographic analysis revealed that age (mean 8.42 ± 4.73 years), gender distribution (males 68.3%), place of residence (urban 74.4%) and duration of illness (mean 4.74 ± 1.63 days) did not differ significantly across severity groups (all p>0.05).

Table 2: Distribution of Presenting Symptoms among Children with Dengue Fever according to severity groups

Symptoms	Dengue without Warning Signs (n=130)	Dengue with Warning Signs (n=39)	Severe Dengue (n=11)	Total (n=180)	p-value
Fever	130 (100%)	39 (100%)	11 (100%)	180 (100%)	-
Cough	10 (7.7%)	4 (10%)	1 (0.9%)	15 (8.3%)	0.875
Headache	15 (11.5%)	3 (7.6%)	2 (18.1%)	20 (11.1%)	0.594

Loose Stools	15 (11.5%)	0 (0.0%)	1 (9.1%)	16 (8.9%)	0.085
Rash	35 (26.9%)	11 (28.2%)	5 (45.5%)	51 (28.3%)	0.424
Excessive Crying	15 (11.5%)	4 (10.3%)	3 (27.3%)	22 (12.2%)	0.284
Poor Oral Intake	78 (60.0%)	26 (66.6%)	10 (90.9%)	114 (63.3%)	0.110
Myalgia	49 (37.7%)	16 (41.0%)	8 (72.7%)	73 (40.6%)	0.075
Tenderness	4 (3.1%)	12 (30.8%)	6 (54.5%)	22 (12.2%)	0.001*
Lethargy	2 (1.5%)	19 (48.7%)	7 (63.6%)	28 (15.6%)	0.001*
Abdominal Pain	2 (1.5%)	23 (59.0%)	8 (72.7%)	33 (18.3%)	0.001*
Vomiting	8 (6.2%)	28 (71.8%)	6 (54.5%)	42 (23.3%)	0.001*
Bleeding	0 (0%)	10 (25.6%)	4 (36.4%)	14 (7.8%)	0.001*

*Significant ($p<0.05$)

Fever was present in 100% of patients across all severity groups, making it the most consistent presenting symptom. Other symptoms such as cough, headache, loose stools, rash, excessive crying, poor oral intake and myalgia were observed in varying proportions but did not show statistically significant differences ($p>0.05$). However, symptoms like tenderness (3.1%, 30.8%, 54.5%), lethargy (1.5%, 48.7%, 63.6%), abdominal pain (1.5%, 59.0%, 72.7%), vomiting (6.2%, 71.8%, 54.5%) and bleeding (0%, 25.6%, 36.4%) showed a significant increase with disease severity ($p<0.05$). These findings indicate that certain clinical features, particularly gastrointestinal symptoms, bleeding manifestations and systemic signs like lethargy, are significantly associated with more severe forms of dengue.

Table 3: Comparison of Hematological Parameters among Children with Dengue Fever According to Severity Groups

Symptoms	**Dengue without WarningSigns (n=130)**	**Dengue with Warning Signs (n=39)**	**Severe Dengue (n=11)**	**Total (n=180)**	**p-value**
Hb (g/dL)	12.33 ± 1.92	13.50 ± 2.23	15.20 ± 2.94	12.76 ± 2.19	0.001*
Hematocrit (%)	37.58 ± 5.40	41.70 ± 6.78	46.36 ± 11.26	39.01 ± 6.65	0.001*
Total WBC (/mm³)	5843.28 ± 4557.27	4261.26 ± 3706.13	3385.27 ± 6476.44	5460.29 ± 4544.33	0.159
Platelet Count (/mm³)	124922.29 ± 30788.62	66830.90 ± 16054.10	25655.27 ± 11764.29	106269.51 ± 41671.66	0.001*

*Significant ($p<0.05$)

The mean hemoglobin (Hb) levels showed a significant increasing trend with disease severity. Patients with dengue without warning signs had a mean Hb of 12.33 ± 1.92 g/dL, those with warning signs had 13.50 ± 2.23 g/dL and severe dengue patients had 15.20 ± 2.94 g/dL. This difference was statistically significant ($p=0.001$), suggesting hemoconcentration in severe cases. Similarly, hematocrit levels increased significantly with severity with mean values of 37.58 ± 5.40%, 41.70 ± 6.78% and
46.36 ± 11.26% respectively in the three groups ($p=0.001$). This suggests hemoconcentration due to plasma leakage in severe dengue cases. The total WBC count showed a decreasing trend with increasing severity (5843.28, 4261.26 and 3385.27 /mm³ respectively), but this difference was not statistically significant ($p=0.159$). These findings suggest that total WBC levels are not significantly associated with dengue severity. Patients with dengue without warning signs had a mean platelet count of 124922.29 ± 30788.62/mm³, those with warning signs had 66830.90 ± 16054.10/mm³ and severe dengue patients had markedly lower counts of 25655.27 ± 11764.29/mm³. This difference was statistically significant ($p=0.001$), indicating a strong association between thrombocytopenia and disease severity.

Table 4: Comparison of Serum LDH Level among Children with Dengue Fever according to Severity Groups

Severity Group	**Mean (U/L)**	**SD**	**95% confidence interval**		**p-value**
			Lower	**Upper**	
Dengue without warning signs	259.58	116.46	239.37	279.79	0.001*
Dengue with warning signs	564.72	92.48	534.74	594.70	

Severe Dengue	1009.91	382.33	753.05	1266.77
Total	**371.54**	**249.07**	**334.91**	**408.18**

*Significant (p<0.05)

The mean serum lactate dehydrogenase (LDH) levels increased markedly with the severity of dengue. Patients with dengue without warning signs had a mean LDH level of 259.58 ± 116.46 U/L, those with warning signs had 564.72 ± 92.48 U/L and severe dengue patients had very high levels of 1009.91 ± 382.33 U/L. This difference was statistically highly significant (p=0.001). These findings indicate that serum LDH levels are strongly associated with disease severity and may serve as an important biochemical marker reflecting tissue damage and disease progression in dengue.

Table 5: Comparison of Liver Function Tests and Serum Albumin among Children with Dengue Fever according to Severity Groups

Symptoms	Dengue without Warning Signs (n=130)	Dengue with Warning Signs (n=39)	Severe Dengue (n=11)	Total (n=180)	p-value
Serum Albumin (g/dL)	3.44 ± 0.67	3.21 ± 0.64	2.87 ± 0.66	3.35 ± 0.67	0.008*
AST (IU/L)	89.16 ± 42.34	190.36 ± 147.67	974.76 ± 800.34	214.34 ± 142.29	0.001*
ALT (IU/L)	42.47 ± 9.24	102.93 ± 57.74	567.06 ± 421.08	116.45 ± 98.54	0.001*

*Significant (p<0.05)

The mean serum albumin levels showed a decreasing trend with increasing severity of dengue. Patients with dengue without warning signs had a mean albumin level of 3.44 ± 0.67 g/dL, those with warning signs had 3.21 ± 0.64 g/dL and severe dengue patients had the lowest levels at 2.87 ± 0.66 g/dL. This difference was statistically significant (p=0.008). The reduction in albumin levels reflects increased capillary permeability and plasma leakage, which are characteristic features of severe dengue infection. The mean AST levels were 89.16 ± 42.34 IU/L in dengue without warning signs, 190.36 ± 147.67 IU/L in dengue with warning signs and markedly elevated to 974.76 ± 800.34 IU/L in severe dengue cases. Similarly, ALT levels increased from 42.47 ± 9.24 IU/L to 102.93 ± 57.74 IU/L and further to 567.06 ± 421.08 IU/L across the three groups. These differences were statistically significant (p=0.001). This indicates that hepatic involvement becomes more severe with increasing dengue severity, reflecting liver cell injury and dysfunction in severe cases.

Table 6: Comparison of Serum Electrolytes and creatinine among Children with Dengue Fever according to Severity Groups

Symptoms	Dengue without Warning Signs (n=130)	Dengue with Warning Signs (n=39)	Severe Dengue (n=11)	Total (n=180)	p-value
Sr. Sodium (mEq/L)	137.08 ± 3.99	135.34 ± 3.47	130.66 ± 5.57	134.47 ± 3.99	0.707
Sr. Potassium (mEq/L)	3.63 ± 0.17	3.62 ± 0.31	3.99 ± 0.37	3.85 ± 0.33	0.021*
Sr. Creatinine (mg/dL)	0.50 ± 0.19	0.56 ± 0.17	0.65 ± 0.19	0.53 ± 0.12	0.001*

*Significant (p<0.05)

The serum sodium levels showed a decreasing trend with increasing severity (137.08 ± 3.99, 135.34 ± 3.47 and 130.66 ± 5.57 mEq/L respectively), but this difference was not statistically significant (p=0.707). In contrast, serum potassium levels showed a slight decrease with severity (3.63 ± 0.17, 3.62 ± 0.31 and 3.99 ± 0.37 mEq/L) and this difference was statistically significant (p=0.021). These findings indicate that while sodium levels may not significantly vary, potassium imbalance may be associated with disease severity in dengue patients. Patients with dengue without warning signs had a mean creatinine level of 0.50 ± 0.19 mg/dL, those with warning signs had 0.56 ± 0.17 mg/dL and severe dengue patients had higher levels of 0.65 ± 0.19 mg/dL. This difference was statistically significant (p=0.001). These findings suggest worsening renal function with increasing severity of dengue, possibly due to hypoperfusion, shock or direct renal involvement.

Table 7: Duration of Hospital Stay (days) among children with dengue fever according to severity groups

Severity Group	n	Mean	SD	Min	Max	F-value	p-value

Dengue without warning signs	130	4.869	1.4488	2.0	9.0	80.106	0.001*
Dengue with warning signs	39	6.821	1.9449	3.0	10.0		
Severe Dengue	11	12.909	6.0738	7.0	24.0		
Total	**180**	5.783	2.8876	2.0	24.0		

* Significant (p<0.05)

The duration of hospital stay increased significantly with the severity of dengue. Patients with dengue without warning signs had a mean hospital stay of 4.87 ± 1.45 days, those with warning signs stayed for 6.82 ± 1.94 days and severe dengue patients required a much longer hospitalization of 12.91 ± 6.07 days. The F-value of 80.106 with a p-value of 0.001 indicates that this difference is highly statistically significant. This suggests that disease severity has a direct impact on the length of hospitalization with severe cases requiring prolonged medical care.

Table 8: Postoperative Complications among children with dengue fever according to severity groups

Postoperative Complications	Dengue with Warning Signs	Severe Dengue
CNS (Seizures, Encephalitis, Encephalopathy)	0	4
GIT (Hepatitis, Bleeding)	10	6
Renal (Acute Kidney Injury)	0	7
CVS (Shock, Myocarditis)	16	11
Respiratory (ARDS, Pulmonary Bleed)	7	8
Others (Secondary HLH, Conjunctival Hemorrhage)	0	4

□2=35.647; p=0.001 (Significant p<0.05)

Complications were more frequent and severe in severe dengue than in dengue with warning signs. CNS complications (4 cases), renal complications (7 cases) and other complications including secondary HLH and conjunctival hemorrhage (4 cases) were observed only in severe dengue. Gastrointestinal complications were noted in 10 cases of dengue with warning signs and 6 cases of severe dengue, while cardiovascular (16 vs. 11 cases) and respiratory complications (7 vs. 8 cases) were present in both groups. The association was statistically significant (χ^2 = 35.647, p = 0.001), indicating greater complication severity in advanced dengue.

Table 9: Pearson's Correlation Between Serum LDH Levels and Platelet Count

		Platelet Count (/mm³)	Serum LDH (U/L)
Platelet Count (/mm³)	Pearson Correlation	1	-.607**
	Sig. (2-tailed)		.000
	N	180	180
Serum LDH (U/L)	Pearson Correlation	-.607**	1
	Sig. (2-tailed)	.000	
	N	180	180
**. Correlation is significant at the 0.01 level (2-tailed).			

The correlation analysis between serum LDH levels and platelet count shows a significant negative correlation (Pearson correlation coefficient r = -0.607, p = 0.000). This indicates that as serum LDH levels increase, platelet counts tend to decrease. The correlation is statistically significant at the 0.01 level (2-tailed), suggesting a strong inverse relationship between these two parameters. This finding supports the role of LDH as a marker of disease severity, as higher LDH levels are associated with increased cellular damage and more severe thrombocytopenia in dengue patients.

DISCUSSION

Dengue fever is a major public health problem in tropical and subtropical regions, particularly affecting the pediatric population with a wide spectrum of clinical manifestations ranging from mild febrile illness to severe life-threatening complications. Early identification of factors

associated with disease severity is essential for timely intervention, appropriate management and reduction of morbidity and mortality. The present study was undertaken to evaluate the clinical profile and assess the role of hematological and biochemical parameters, especially serum lactate dehydrogenase (LDH), in predicting the severity and outcome of dengue infection in children. In the present study, the mean age of children was comparable across all severity groups with an overall mean age of 8.42 ± 4.73 years and the difference was not statistically significant (p=0.841), indicating that age was not significantly associated with dengue severity. Similar findings were reported by Equebal et al. (2022)[11], who observed a mean age of 9.6 ± 5.06 years, while Patel et al. (2024)[12] reported that pediatric dengue cases were distributed across a broad age range of 2-16 years with the highest proportion in the 6-9 years age group. Nguyen et al. (2024)[13] documented a median age of 7.7 years among children with dengue-induced severe hepatitis and Sirikutt et al. (2014)[2] also reported no significant age-related distinction in dengue severity. Males constituted 68.3% of the study population with a consistent male predominance across all severity groups; however, the difference in gender distribution was not statistically significant (p=0.928). Comparable male predominance was reported by Patel et al. (2024)[12] (57.77% males), Ladani et al. (2022)[14] (62.34% males) and Perveen et al. (2017)[15] (66.1% males), supporting the trend of higher dengue incidence among male children. In contrast, Equebal et al. (2022)[11] reported an equal male-to-female ratio, which may be attributable to regional variations and differences in healthcare-seeking behavior.

The majority of children in the present study belonged to urban areas (74.4%) with urban predominance observed across all severity groups, although the difference was not statistically significant (p=0.231). Similar observations were reported by Kasarabada et al. (2023)[16], Sirikutt et al. (2014)[2] and Choudhary et al. (2025)[17], who highlighted the higher prevalence of dengue in densely populated urban and endemic regions where environmental conditions favor mosquito breeding and transmission. The mean duration of illness at admission was 4.74 ± 1.63 days with no significant variation among severity groups (p=0.463), which is comparable to the findings of Equebal et al. (2022)[11] and other studies reporting a typical febrile phase of 2-7 days irrespective of disease severity. However, clinical symptoms such as tenderness, lethargy, abdominal pain, vomiting and bleeding showed a significant association with dengue severity (p<0.001) with their frequency increasing markedly from dengue without warning signs to severe dengue. Similar findings were reported by Ravishankar et al. (2015)[18] and Sachdev et al. (2021)[19], who emphasized that early recognition of clinical warning signs and deterioration during the critical phase is crucial for predicting severe dengue and improving patient outcomes.

Hemoglobin and hematocrit levels showed a statistically significant increasing trend with disease severity (p=0.001), reflecting hemoconcentration secondary to plasma leakage in severe dengue. Mean hematocrit of 46.36 ± 11.26% in severe dengue patients indicates significant plasma extravasation consistent with criteria for DHF. These findings are supported by Vijayakumar et al. (2025)[20], who demonstrated that rising packed cell volume (PCV) was one of the key biochemical and hematological parameters clearly associated with the severity of illness and clinical recovery in pediatric dengue. The mean platelet count declined significantly with increasing severity: from 124922.29 /mm³ in dengue without warning signs to 25655.27 /mm³ in severe dengue (p=0.001). Equebal et al. (2022)[11] also documented that the mean platelet count was markedly reduced in severe dengue (56,405.00 ± 49,918.74) compared to dengue with warning signs (92,257.50 ± 71,235.44; p=0.028). The inverse relationship between thrombocytopenia and disease severity has been consistently observed across studies, reflecting bone marrow suppression, peripheral platelet destruction and consumption in the coagulopathy of severe dengue.

The most significant finding of the present study was the progressive and statistically significant elevation of serum LDH with increasing dengue severity. Mean LDH levels increased from 259.58 ± 116.46 U/L in dengue without warning signs to 564.72 ± 92.48 U/L in dengue with warning signs and 1009.91 ± 382.33 U/L in severe dengue (p=0.001). These findings are consistent with Choudhary et al. (2025)[17], who reported mean LDH values of 237.59 ± 58.31 U/L, 576.47 ± 285.22 U/L and 764.58 ± 178.39 U/L across the respective severity groups. Similar observations were made by Ladani et al. (2022)[14], who demonstrated significantly higher LDH levels in severe dengue compared to non-severe dengue (388.23 ± 99.47 U/L vs. 148.45 ± 11.81 U/L; p=0.001). Perveen et al. (2017)[15] also reported markedly elevated LDH levels in patients with DHF compared to uncomplicated dengue (618.38 ± 219 U/L vs. 316.45 ± 104 U/L; p<0.001). Shankar P et al. (2017)[21] found that 92.7% of severe dengue patients had LDH levels >600 IU, while Equebal et al. (2022)[11] observed LDH levels >1000 IU in nearly 70% of severe dengue cases, which were associated with increased complications and prolonged hospitalization. Kasarabada et al. (2023)[16] further reported a strong positive correlation between LDH levels and disease severity (r=0.778, p<0.01) and Sirikutt et al. (2014)[2] suggested that LDH values approaching 1000 IU may indicate severe dengue with plasma leakage. Patel et al.

(2024)[12] also demonstrated a strong positive correlation between serum LDH and ferritin levels in children with dengue shock (r=0.97, p<0.001), supporting the role of LDH as a sensitive predictor of severe outcomes in pediatric dengue.

Liver enzymes (AST and ALT) showed a dramatic, statistically significant increase with disease severity in the present study. Mean AST rose from 89.16 IU/L (dengue without warning signs) to 974.76 IU/L (severe dengue) and ALT from 42.47 IU/L to 567.06 IU/L (p=0.001). These findings are consistent with Sirikutt et al. (2014)[2], who reported that a majority of dengue patients showed elevated AST (94.9%) and ALT (68.6%) with highest levels in DHF and DSS. Ravishankar et al. (2015)[18] found significant elevations of AST, ALT and LDH in children with warning signs compared to uncomplicated dengue fever. Sachdev et al. (2021)[19] identified elevated liver transaminases as predictors of mortality in severe pediatric dengue. Nguyen et al. (2024)[13] described that severe dengue-induced hepatitis is associated with marked elevation of transaminases (>350-400 IU/L) and increased mortality risk, comparable to the AST levels of ~975 IU/L observed in severe dengue in the present study.

Renal function parameters and electrolytes also showed significant trends with severity. Mean serum creatinine increased from 0.50 ± 0.19 mg/dL in dengue without warning signs to 0.65 ± 0.19 mg/dL in severe dengue (p=0.001), indicating progressive renal involvement. Serum potassium declined significantly with severity (p=0.010), consistent with hypokalemia related to plasma leakage and multi-organ dysfunction. Sachdev et al. (2021)[19] similarly identified elevated creatinine as an independent predictor of mortality in severe pediatric dengue.

The mean hospital stay was 4.87 ± 1.45 days in dengue without warning signs, 6.82 ± 1.94 days in dengue with warning signs and 12.91 ± 6.07 days in severe dengue (p=0.001). Equebal et al. (2022)[11] reported significantly longer hospital stays in patients with LDH >1000 IU (14.685 days vs. 8.732 days, p=0.000). Sachdev et al. (2021)[19] and Nguyen et al. (2024)[13] both confirmed high PICU utilization and intensive care requirements in severe dengue, in agreement with the present study. The strong negative correlation between serum LDH and platelet count (r = −0.607, p=0.000) in the present study is a key finding linking two important prognostic parameters. Kasarabada et al. (2023)[16] reported an inverse Pearson's correlation coefficient of −0.326 between LDH levels and platelet count, while Equebal et al. (2022)[11] observed a weak and non-significant inverse correlation (r = −0.055; p=0.676). The stronger correlation observed in the present study (r = −0.607) may be attributed to the inclusion of a broader spectrum of disease severity and the larger sample size, making the correlation more statistically robust.

CONCLUSION

The present study demonstrates that dengue fever in children presents with varying severity, from mild illness to life-threatening complications. While demographic factors such as age, gender and place of residence were not significantly associated with disease severity, clinical warning signs including abdominal pain, vomiting, lethargy, tenderness and bleeding were strongly linked to severe dengue. Significant hematological and biochemical alterations were observed with increasing severity, including hemoconcentration, thrombocytopenia, elevated serum LDH, deranged liver and renal function tests, hypoalbuminemia and electrolyte imbalance, indicating plasma leakage and multi-organ involvement. Severe dengue was also associated with longer hospital stay, increased PICU/HDU requirement and a higher incidence of systemic complications. The significant negative correlation between LDH and platelet count further highlights the value of LDH as a reliable marker of disease severity. Overall, the study establishes that early recognition of warning signs and close monitoring of hematological and biochemical parameters, particularly serum LDH, can help predict disease severity, facilitate timely management and improve outcomes in pediatric dengue patients.

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