ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at:www.ijmacr.com

Volume – 9, Issue – 3, June – 2026, Page No.: 133 – 147

Changes in Serum Lipid Profile and Blood Gas Parameters and Their Significance as Prognostic Markers in Patients with Dengue with Warning Signs and Severe Dengue

[1]Dr. Chandrakala P, Professor and HOD, Kempegowda Institute of Medical Sciences Research Centre, Bangalore

[2]Dr. E. Siddarth Reddy, Junior Resident, Department of Paediatrics, Kempegowda Institute of Medical Sciences Research Centre, Bangalore

Corresponding Author: Dr. Chandrakala P, Professor and HOD, Kempegowda Institute of Medical Sciences Research Centre, Bangalore.

How to citation this article: Dr. Chandrakala P, Dr. E. Siddarth Reddy, "Changes in Serum Lipid Profile and Blood Gas Parameters and Their Significance as Prognostic Markers in Patients with Dengue with Warning Signs and Severe Dengue", IJMACR – June – 2026, Volume – 9, Issue – 3, P. No. 133 – 147.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Dengue continues to be a major pediatric health burden, and early prediction of progression from dengue with warning signs to severe dengue remains clinically important. Conventional markers such as platelet count and hematocrit are useful but do not always capture early metabolic deterioration. Serum lipid profile and blood gas parameters may provide additional prognostic value.

Aim: To assess changes in serum lipid profile and blood gas parameters and determine their significance as prognostic markers in patients with dengue with warning signs and severe dengue.

Methods: This prospective observational study included 90 children aged 1 month to 18 years admitted with dengue with warning signs or severe dengue at Kempegowda Institute of Medical Sciences, Bengaluru. Serum lipid parameters, including total cholesterol, HDL, LDL, VLDL, and triglycerides, were assessed along with blood gas parameters such as pH, PCO2, PO2, bicarbonate, and lactate. Clinical findings, laboratory results, and disease severity were correlated using appropriate statistical tests.

Results: Most patients were in the 6–10-year age group, and the majority had moderate disease severity. Abdominal pain was the most common presenting symptom. Acid-base derangement was frequent, with compensated metabolic acidosis and metabolic acidosis being common findings. Total cholesterol showed a significant decline with increasing severity, while ABG pH demonstrated a strong association with disease severity. VBG category showed a highly significant correlation with severity, with severe metabolic acidosis predominantly seen in severe dengue. ABG pH also

showed excellent diagnostic performance in predicting mild dengue.

Conclusion: Serum lipid alterations, particularly reduced total cholesterol, and blood gas abnormalities, especially declining pH and metabolic acidosis, appear to be useful prognostic markers in dengue. Their incorporation into routine assessment may support earlier recognition of high-risk patients and improve clinical triage.

Keywords: Dengue, Severe Dengue, Dengue with Warning Signs, Serum Lipid Profile

Introduction

Dengue is one of the most rapidly spreading mosquito-borne viral infections worldwide and represents a major public health challenge, particularly in tropical and subtropical regions. The disease is caused by four distinct serotypes of dengue virus (DENV 1–4) transmitted primarily by *Aedes aegypti*. [1]. India remains among the countries bearing the highest dengue burden, with seasonal outbreaks contributing to considerable pediatric morbidity and mortality[2].

Clinically, dengue infection demonstrates a wide spectrum ranging from asymptomatic illness to severe life-threatening disease characterized by plasma leakage, hemorrhage, organ dysfunction, and shock. The World Health Organization (WHO) classifies dengue into dengue without warning signs, dengue with warning signs (DWWS), and severe dengue. Warning signs such as persistent vomiting, abdominal pain, mucosal bleeding, lethargy, hepatomegaly, and rising hematocrit with rapid platelet decline indicate impending deterioration[3]. Severe dengue is defined by severe plasma leakage leading to shock or respiratory distress, severe bleeding, or severe organ impairment including hepatic, neurological, or cardiac involvement[4]. Early identification of patients likely to progress from DWWS to severe dengue remains critical for timely intervention and improved outcomes.

The pathophysiology of severe dengue is complex and multifactorial. It involves viral replication, immune activation, cytokine storm, endothelial dysfunction, and alterations in vascular permeability. The hallmark of severe disease is plasma leakage resulting from increased capillary permeability, leading to hemoconcentration, hypovolemia, and tissue hypoxia[5]. Inflammatory mediators such as tumor necrosis factor-alpha, interleukins, and chemokines play a central role in endothelial injury and vascular instability[6]. These systemic inflammatory changes not only influence hemodynamic parameters but also affect metabolic pathways, including lipid metabolism and acid-base balance.

Materials And Methods

The prospective observational hospital-based was conducted in the Department of Pediatrics, including Pediatric wards and the Pediatric Intensive Care Unit (PICU), at KIMS Hospital, Bangalore, over a period of 18 months. 90 subjects fulfilling inclusion and exclusion criteria were selected for study.

Inclusion Criteria

Children aged 1 month to 18 years, admitted with a confirmed diagnosis of dengue with warning signs or severe dengue based on WHO classification, positive dengue serology (NS1 antigen and/or IgM antibody).

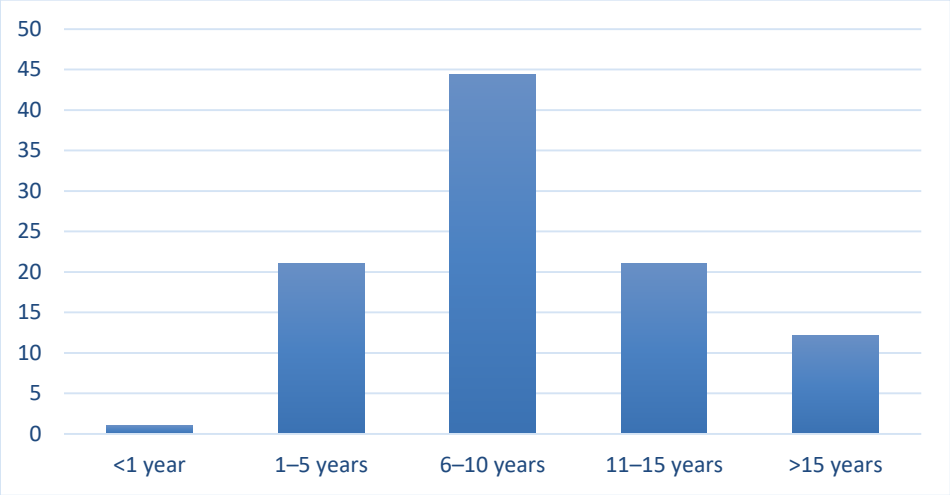
Exclusion Criteria

Presence of comorbid conditions known to affect lipid metabolism (such as obesity, nephrotic syndrome, diabetes mellitus), Severe protein-energy malnutrition, known metabolic disorders, Pre-existing hepatic encephalopathy or chronic liver disease, patients who

left against medical advice (LAMA), any condition that could independently influence lipid profile or acid-base status.

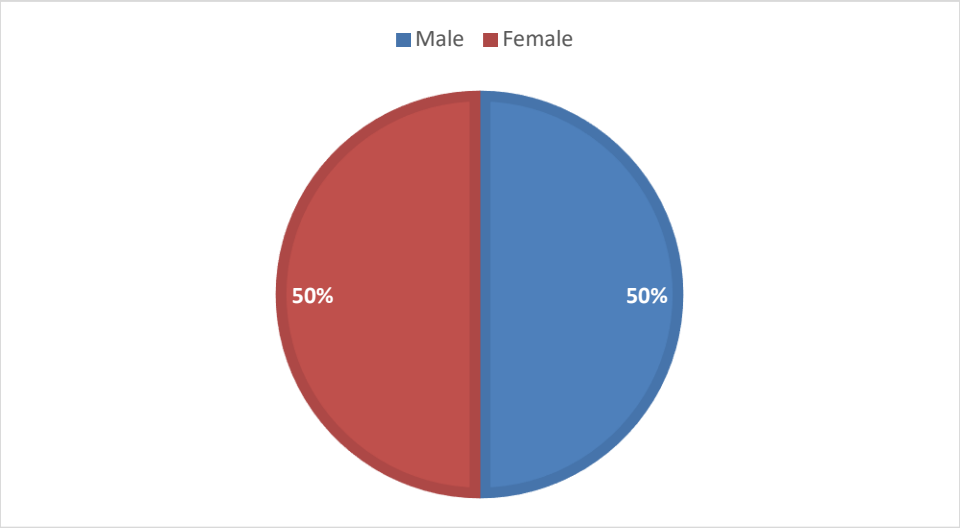
Result

Fig 1: Age Distribution among study population



The majority of patients belonged to the 6–10 year's age group (44.4%), followed by 1–5 years and 11–15 years (21.1% each). Children above 15 years constituted a smaller proportion (12.2%), while infants were least affected (1.1%). This indicates that dengue was more prevalent among school-aged children in the study population.

Fig 2: Gender Distribution among Study Population



The study population showed an equal gender distribution, with both males and females constituting 50% each, indicating no gender predominance among the study participants.

Table 1: Distribution of Signs and Symptoms among Study Population (n = 90)

Signs & Symptoms	n	%
Fever (F)	4	4.4

Fever + Pain abdomen (F,Pab)	53	58.9
Fever + Vomiting (F,V)	12	13.3
Fever + Vomiting + Pain abdomen (F,V,Pab)	6	6.7
Fever + Vomiting + Bleeding diathesis (F,V,Bdp)	5	5.6
Fever + Pain abdomen + Vomiting + Bleeding (F,Pab,V,Bdp)	2	2.2
Fever + Pain abdomen + Body ache (F,Pab,Bap)	2	2.2
Fever + Body ache + Pain abdomen (F,Bap,Pab)	2	2.2
Others	4	4.4
Total	90	100

Fever with abdominal pain (58.9%) was the most common presenting symptom, followed by fever with vomiting (13.3%). A smaller proportion presented with combined symptoms including bleeding manifestations and body ache, indicating variability in clinical presentation, with abdominal involvement being predominant.

Fig 3: Signs and Symptoms

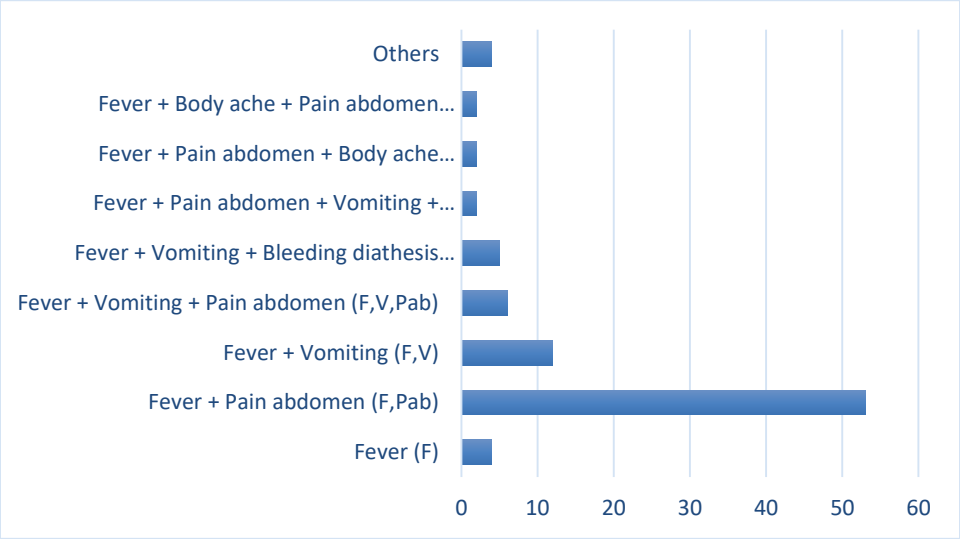


Table 2: Distribution of Head to Toe Findings among Study Population (n = 90)

HTT Findings	n	%
No abnormality (N)	66	73.3
Microcephaly with tonsillar enlargement	2	2.2
Hyperpigmented lesions/marks	4	4.4
Eye/Eyes congestion	2	2.2
Tonsillar enlargement (Grade 3 ± follicles)	2	2.2
Extremity changes (cold/clumsy/flushing)	2	2.2
Flushing	1	1.1
Oral/throat congestion	2	2.2

Abdominal findings (distension/tenderness)	1	1.1
Lymph node enlargement	1	1.1
Posterior pharyngeal wall congestion	1	1.1
Rashes (B/L lower limbs)	1	1.1
Dental findings	1	1.1
Hypopigmented patch	1	1.1
AF open	1	1.1
Surgical scar (appendectomy)	1	1.1
Total	90	100

The majority of patients (73.3%) had no abnormal HTT findings. Among the abnormal findings, hyperpigmented lesions were the most frequently observed (4.4%). Overall, HTT abnormalities were infrequent and heterogeneously distributed, with no single predominant clinical feature.

Table 3: Distribution of Per Abdomen (PA) Findings among Study Population (n = 90)

PA Findings	n	%
No abnormality (N)	69	76.7
Tenderness (any region)	5	5.6
TA (tender abdomen)	4	4.4
Distension (± tenderness)	5	5.6
Hepatomegaly (liver palpable/span increased)	5	5.6
Others	2	2.2
Total	90	100

The majority of patients (76.7%) had no abnormal per abdomen findings. Among abnormal findings, tenderness, distension, and hepatomegaly were the most commonly observed features, each present in a small proportion of patients.

Fig 4: PA Findings

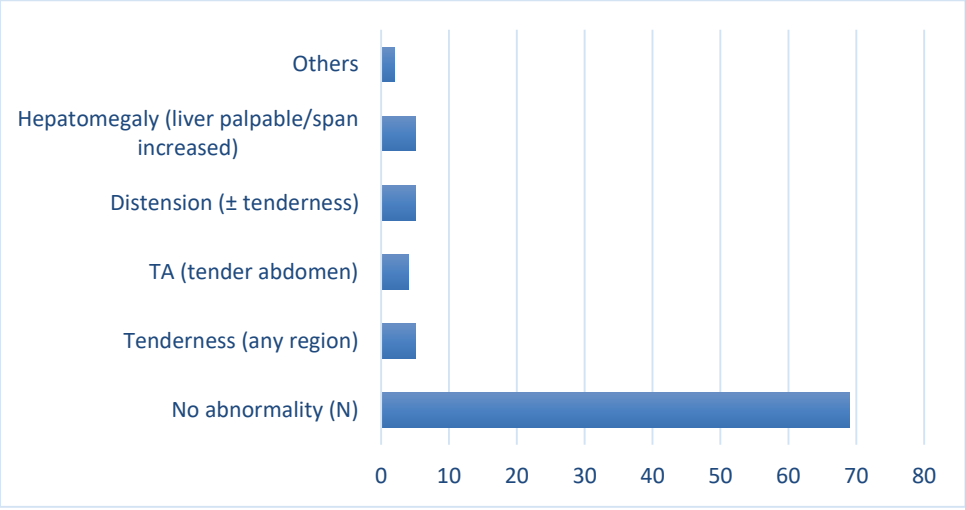


Table 4: Distribution of Severity among Study Population (n = 90)

Severity	n	%
Mild	20	22.2
Moderate	50	55.6
Severe	20	22.2
Total	90	100

The majority of patients belonged to the moderate severity group (55.6%), while mild and severe cases constituted equal proportions (22.2% each).

Fig 5: Severity

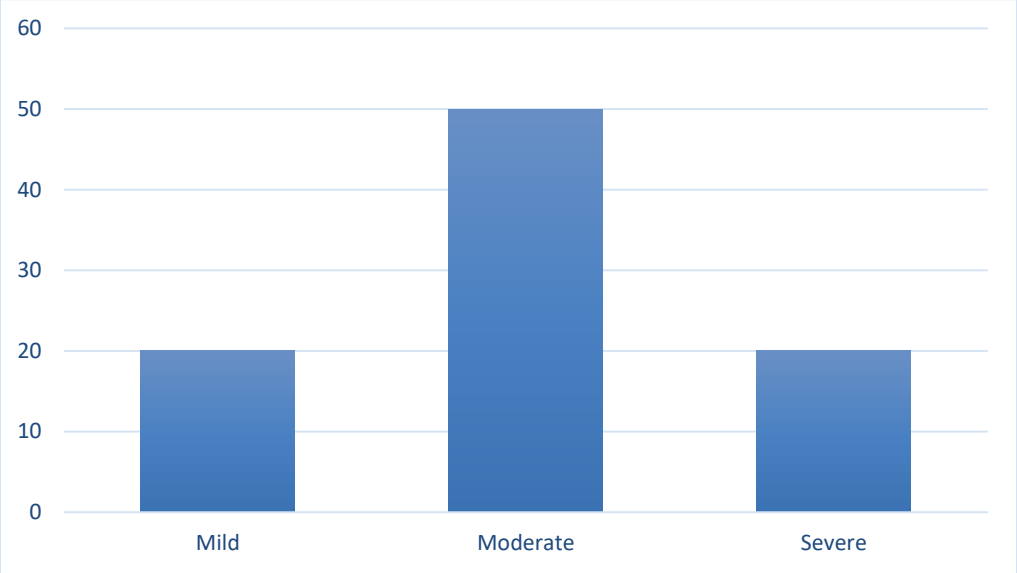


Table 5: Distribution of VBG Findings among Study Population (n = 90)

VBG Category	n	%
Normal	28	31.1
Compensated metabolic acidosis	24	26.7
Metabolic acidosis	22	24.4
Severe metabolic acidosis	16	17.8
Total	90	100

A majority of patients (68.9%) exhibited acid-base disturbances, with compensated metabolic acidosis being the most common, followed by metabolic acidosis and severe metabolic acidosis. Normal acid-base status was observed in 31.1% of patients, indicating a substantial burden of metabolic derangement in the study population.

Fig 6: Distribution of VBG Findings

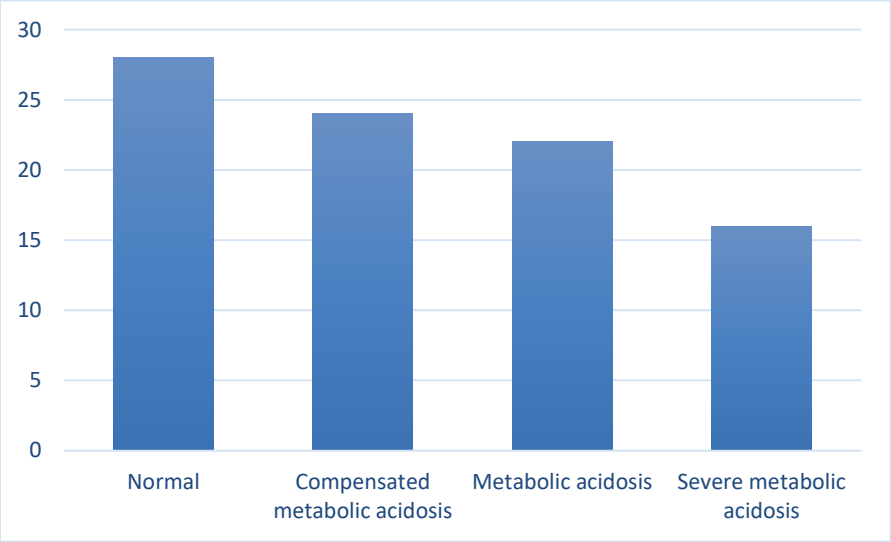


Table 6: Descriptive Statistics of Clinical and Biochemical Parameters (n = 90)

Parameter	Mean ± SD	Minimum	Maximum
Temperature (°F)	100.98 ± 0.58	100.0	102.1
Hemoglobin (g/dL)	12.38 ± 1.80	8.3	18.5
PCV (%)	38.44 ± 6.87	29.2	80.6
Platelet count	5568.00 ± 20614.92	0.25	92000
Total Count (TC)	6301.59 ± 3258.71	2150	21230
OT	237.22 ± 709.64	18.0	4881.0
PT	128.60 ± 439.73	14.0	3002.0
Albumin (AB)	3.44 ± 0.43	2.7	4.8
Total Cholesterol (TCL)	94.08 ± 18.30	61	160
Triglycerides (TG)	137.10 ± 45.61	60	302
HDL	24.16 ± 9.08	10	48
LDL	46.52 ± 21.34	16	142
VLDL	25.59 ± 9.17	13	65
ABG (pH)	7.31 ± 0.05	7.20	7.40

The descriptive analysis shows that the study population had a mean temperature of 100.98°F, indicating febrile illness. Hematological parameters were within expected ranges, while platelet counts showed wide variability. Lipid profile revealed reduced cholesterol levels with moderate variability. The mean ABG value (7.31 ± 0.05) indicates a tendency towards metabolic acidosis in the study population.

Table 7: Comparison of Serum Lipid Profile across Severity Groups (n = 90)

Parameter	Mild (n=20) Mean ± SD	Moderate (n=50) Mean ± SD	Severe (n=20) Mean ± SD	p-value
Total Cholesterol (TCL)	97.80 ± 21.91	96.10 ± 17.73	85.30 ± 13.07	0.047
Triglycerides (TG)	137.85 ± 46.82	136.82 ± 44.66	137.05 ± 49.07	0.996
HDL	21.35 ± 7.30	25.20 ± 9.23	24.35 ± 10.08	0.278
LDL	44.10 ± 15.76	49.48 ± 24.21	41.55 ± 17.85	0.320
VLDL	24.05 ± 7.46	24.60 ± 8.01	29.60 ± 12.25	0.082

A statistically significant difference was observed in total cholesterol levels across severity groups (p = 0.047), with lower values noted in severe cases, indicating its potential role as a prognostic marker. However, no statistically significant differences were observed for triglycerides, HDL, LDL, and VLDL levels, although a trend towards altered lipid profile with increasing severity was noted.

Fig 7: Comparison of Serum Lipid Profile Across Severity Groups

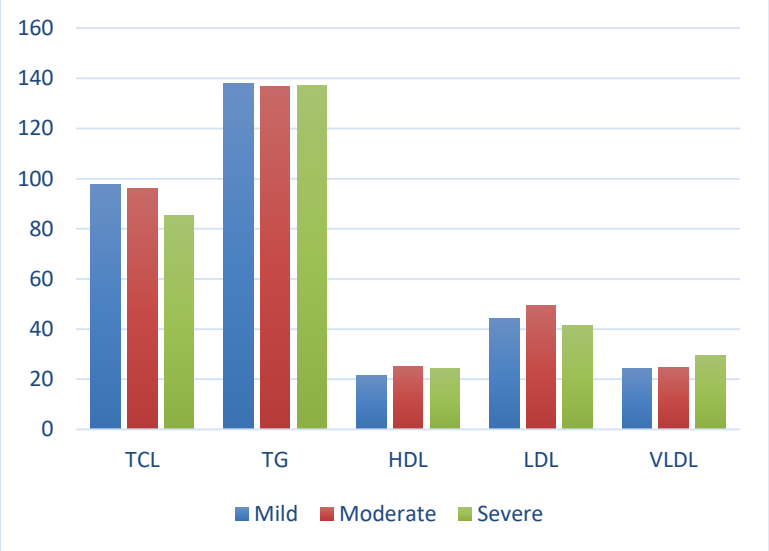


Table 8a: Comparison of ABG (pH) across Severity Groups (n = 90)

Severity	Mean ± SD	p-value
Mild (n=20)	7.37 ± 0.01	<0.001
Moderate (n=50)	7.31 ± 0.04	
Severe (n=20)	7.25 ± 0.05	
Total (n=90)	7.31 ± 0.05	

A highly statistically significant difference was observed in ABG (pH) values across severity groups (p < 0.001). The mean pH decreased progressively from mild to severe cases, indicating worsening metabolic acidosis with increasing disease severity, highlighting its strong prognostic significance.

Table 8b: Post Hoc Analysis (Bonferroni Test) for ABG Across Severity Groups

Comparison	Mean Difference	Std. Error	p-value	95% CI (Lower–Upper)
Mild vs Moderate	0.0636	0.00977	<0.001	0.0397 – 0.0875
Mild vs Severe	0.1190	0.01168	<0.001	0.0905 – 0.1475
Moderate vs Severe	0.0554	0.00977	<0.001	0.0315 – 0.0793

Post hoc analysis using Bonferroni correction showed that all pairwise comparisons between severity groups were statistically significant ($p < 0.001$ for all comparisons). This indicates that the differences in mean ABG values between mild, moderate, and severe groups are statistically significant.

Fig 8: Comparison of ABG pH Across Severity Groups

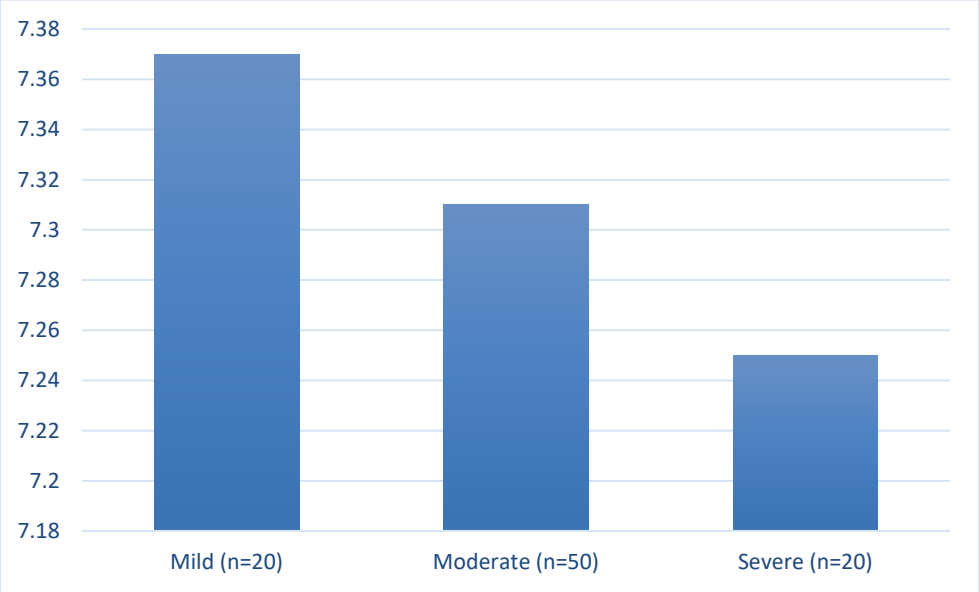


Table 9: Association between VBG Findings and Dengue Severity (n = 90)

VBG Category	Mild	Moderate	Severe	Total
Normal	20	5	3	28
Compensated metabolic acidosis	0	24	0	24
Metabolic acidosis	0	21	1	22
Severe metabolic acidosis	0	0	16	16
Total	20	50	20	90

Fisher-Freeman-Halton Exact Test: $p < 0.001$

A statistically significant association was observed between VBG findings and dengue severity ($p < 0.001$, Fisher-Freeman-Halton exact test). Mild cases predominantly had normal acid-base status, whereas moderate cases showed compensated and metabolic acidosis. Severe dengue cases were strongly associated with severe metabolic acidosis, indicating progressive metabolic derangement with increasing disease severity.

Fig 9: Association Between VBG Findings and Dengue Severity

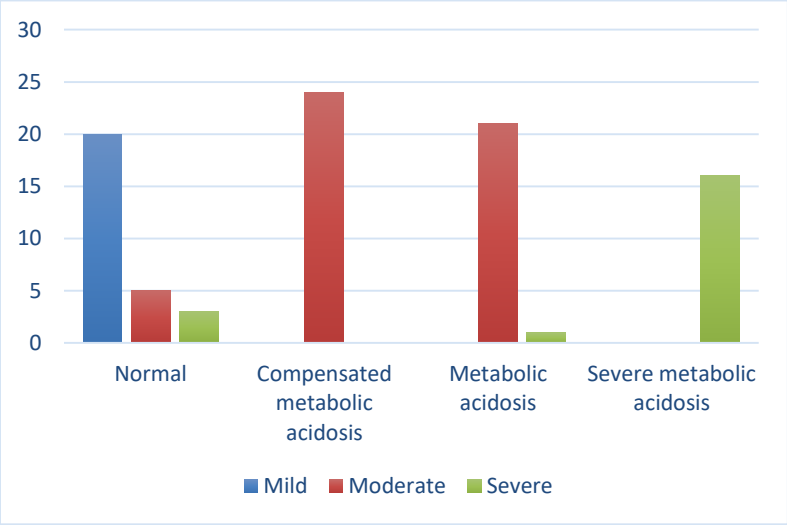


Table 10: Correlation of ABG (pH) with Hematological and Lipid Parameters (n = 90)

Variable	r-value	p-value
Hemoglobin (HB)	-0.244	0.021
PCV	-0.019	0.859
Platelet count (PLT)	0.006	0.954
Total Cholesterol (TCL)	0.025	0.812
Triglycerides (TG)	-0.007	0.946
HDL	-0.163	0.125
LDL	-0.092	0.387
VLDL	-0.105	0.324

A statistically significant negative correlation was observed between hemoglobin levels and ABG (pH) ($r = -0.244$, $p = 0.021$), indicating a slight decrease in pH with increasing hemoglobin levels. However, no significant correlation was found between ABG and platelet count or lipid parameters ($p > 0.05$), suggesting that ABG changes may be independent of lipid profile alterations in this study.

Table 11: Diagnostic Performance of ABG (pH) in Predicting Mild Dengue (n = 90)

Parameter	Value
Area Under Curve (AUC)	0.944
Standard Error	0.024
95% Confidence Interval	0.898 – 0.990
p-value	< 0.001

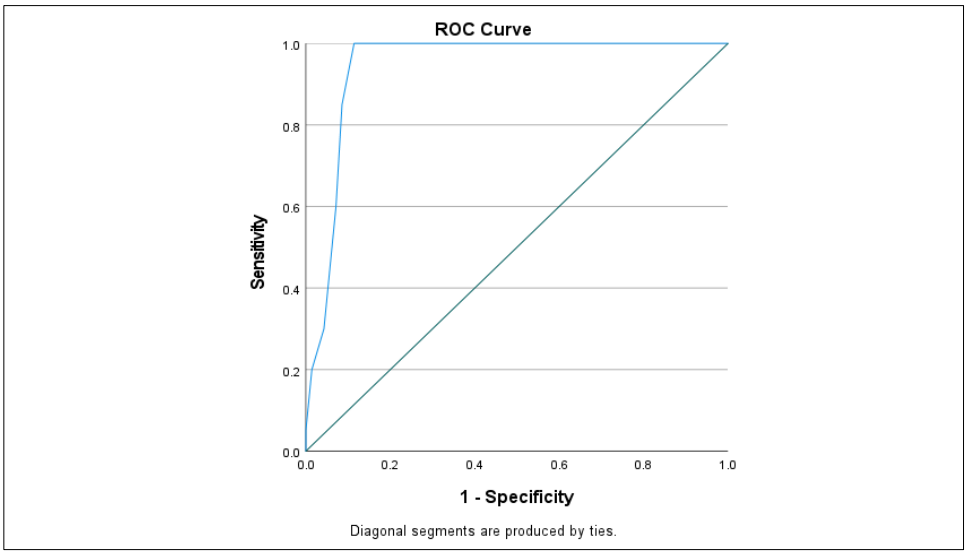
ABG (pH) demonstrated excellent diagnostic accuracy in predicting mild dengue (AUC = 0.944, $p < 0.001$). Higher pH values were strongly associated with mild disease, indicating that preservation of normal acid-base status correlates with less severe illness.

Table 12a: Optimal Cut-off of ABG (pH) for Identifying Mild Dengue

Cut-off (pH)	Sensitivity	Specificity
≥ 7.35	85%	91.4%
≥ 7.36	60%	92.9%
≥ 7.34	100%	80.0%

A pH cut-off around 7.35 provided a good balance between sensitivity and specificity for identifying mild dengue cases. Higher cut-off values increased specificity at the cost of sensitivity.

Fig 10: Optimal Cut-off of ABG (pH) for Identifying Mild Dengue



Discussion

Age The present study showed that the largest proportion of patients belonged to the 6–10 year's age group (44.4%), followed by 1–5 years and 11–15 year's groups (21.1% each), while 12.2% were older than 15 years and only 1.1% were below 1 year. These findings indicate that dengue with warning signs and severe dengue in the present cohort was concentrated predominantly in school-aged children. This finding is strongly corroborated by Biswas HH et al. (2015), who conducted a large prospective study in a pediatric population (N=1,236) and demonstrated that lipid alterations, particularly reduced LDL-C, were significantly associated with severe dengue outcomes in children.[56]

Gender The present study demonstrated an exactly equal gender distribution, with 45 males (50.0%) and 45 females (50.0%), indicating that no sex predominance was observed among the study participants. This suggests that, within the current cohort, both boys and girls were equally affected by dengue with warning signs and severe dengue. This finding is consistent with van Gorp EC et al. (2002), whose study of 90 participants (50 severe DHF/DSS, 20 mild DHF, 20 controls) did not report gender as a significant predisposing factor for lipid alterations or severity.

Signs and Symptoms The most common clinical presentation in the present study was fever with abdominal pain, seen in 58.9% of patients, followed by fever with vomiting in 13.3%, while smaller groups had

combinations of vomiting, pain abdomen, bleeding manifestations, and body ache. This pattern indicates that gastrointestinal warning symptoms formed the dominant mode of presentation. These clinical findings align with the biochemical observations of Suvarna JC et al. (2009), who reported that severe bleeding showed significant correlation with cholesterol levels and hepatic dysfunction. The high prevalence of abdominal pain in our study correlates with their finding that patients with capillary leakage and severe outcomes had significantly lower cholesterol levels.

PV (Pulse Volume) In the present study, reduced pulse volume was present in 18.9% of cases and normal in 81.1%, indicating that this feature was relatively uncommon in the overall study population. This suggests that peripheral hypoperfusion, while clinically identifiable in a subset of cases, was not a dominant manifestation in dengue with warning signs and severe dengue. However, the literature strongly links perfusion abnormalities to metabolic acidosis. Tat TN et al. (2024) studied 492 children with dengue shock syndrome (DSS) and found that elevated lactate and lactate-to-bicarbonate ratio were strong predictors of mortality (AUC 0.876 and 0.867 respectively), with an optimal lactate cutoff of 4.2 mmol/L. The fact that only 18.9% of our patients had reduced PV, yet 68.9% had VBG abnormalities, suggests that metabolic acidosis precedes overt clinical signs of poor perfusion.

HTT Findings (Head-to-Toe) The present study showed that 73.3% of patients had no abnormal HTT findings, while the remaining cases demonstrated scattered abnormalities such as hyperpigmented lesions (4.4%), eye congestion, tonsillar enlargement, extremity changes, and rashes, each occurring in 1.1% to 2.2% of cases. These observations indicate that HTT abnormalities were infrequent, heterogeneous, and lacked a single dominant clinical pattern. In contrast, the literature emphasizes that biochemical markers are far more consistent. Marin-Palma D et al. (2019) demonstrated that dengue patients exhibit altered inflammatory profiles, including increased IL-10 and reduced expression of inflammasome-related genes (NLRP1, NLRC4, caspase-1), with significant correlations between LDL levels and inflammatory mediators.

Per Abdomen Findings Per abdomen examination in the present study was normal in 76.7% of patients, while abnormal findings included tenderness (5.6%), distension (5.6%), hepatomegaly (5.6%), and tender abdomen (4.4%). These data show that although abdominal pain was the leading presenting symptom (58.9%), objective abdominal findings were seen only in a minority of patients. This dissociation between subjective symptoms and objective signs is explained by the biochemical literature. Suvarna JC et al. (2009) reported that severe bleeding and capillary leakage correlated significantly with cholesterol levels and hepatic dysfunction. The hepatomegaly observed in 5.6% of our patients likely corresponds to the elevated liver enzymes (OT 237.22 ± 709.64) seen in our descriptive data.

Severity The present study classified patients into mild (22.2%), moderate (55.6%), and severe (22.2%) dengue, showing that the majority belonged to the moderate category. This distribution is ideal for evaluating prognostic markers because it allows comparison across a clinical spectrum. van Gorp EC et al. (2002) used a similar distribution (50 severe DHF/DSS, 20 mild DHF, 20 controls) and found significant decreases in total cholesterol, HDL, and LDL in severe cases. Our finding

of significant total cholesterol decline (p=0.047) directly replicates their work.

VBG Findings The venous blood gas profile in the present study revealed that only 31.1% of patients had normal acid-base status, whereas 26.7% had compensated metabolic acidosis, 24.4% had metabolic acidosis, and 17.8% had severe metabolic acidosis, indicating that 68.9% of the cohort had some degree of acid-base derangement. These findings show a substantial burden of metabolic compromise. Tat TN et al. (2024) directly supports this, demonstrating that lactate and lactate-to-bicarbonate ratio are powerful predictors of mortality in DSS (AUC 0.867-0.876).

Descriptive Clinical and Biochemical Parameters The descriptive analysis showed mean temperature 100.98°F, hemoglobin 12.38 g/dL, PCV 38.44%, and platelet count 5568.00/mm³. The wide variability in platelet count (0.25 to 92,000) reflects the thrombocytopenia typical of severe dengue. Durán A et al. (2015) reported a significant positive correlation between LDL levels and platelet counts (p=0.019) and a negative correlation between VLDL and platelets (p=0.0162), which aligns with our lipid findings

Total Cholesterol The present study found that total cholesterol differed significantly across severity groups, declining from 97.80 ± 21.91 mg/dL in mild dengue to 96.10 ± 17.73 mg/dL in moderate dengue and further to 85.30 ± 13.07 mg/dL in severe dengue (p = 0.047). This finding is remarkably consistent with the literature. van Gorp EC et al. (2002) first demonstrated that total cholesterol, HDL, and LDL are significantly decreased in severe DHF (p<0.05). Triglycerides The present study showed that triglyceride values were remarkably similar across severity groups, with 137.85 ± 46.82 mg/dL in mild cases, 136.82 ± 44.66 mg/dL in moderate cases, and 137.05 ± 49.07 mg/dL in severe cases (p = 0.996). This indicates that triglycerides did not vary with severity. This finding is directly supported by Lima WG et al. (2019), HDL In the present study, HDL levels were 21.35 ± 7.30 mg/dL in mild cases, 25.20 ± 9.23 mg/dL in moderate cases, and 24.35 ± 10.08 mg/dL in severe cases (p = 0.278). While not statistically significant, the trend of higher HDL in moderate/severe cases is interesting. van Gorp EC et al. (2002) found significantly decreased HDL in severe DHF. Marin-Palma D et al. (2019) reported marked reduction in HDL, particularly in patients with warning signs.

LDL The present study found LDL values of 44.10 ± 15.76 mg/dL in mild dengue, 49.48 ± 24.21 mg/dL in moderate dengue, and 41.55 ± 17.85 mg/dL in severe dengue (p = 0.320). Although not statistically significant, the lowest LDL was observed in severe cases. van Gorp EC et al. (2002) and Biswas HH et al. (2015) both reported significantly decreased LDL in severe dengue. VLDL The present study recorded VLDL values of 24.05 ± 7.46 mg/dL in mild cases, 24.60 ± 8.01 mg/dL in moderate cases, and 29.60 ± 12.25 mg/dL in severe cases (p = 0.082). The upward trend in severe disease is consistent with Durán A et al. (2015), who reported significantly increased VLDL in severe dengue and a negative correlation with platelet counts (p=0.0162).

ABG (pH) The present study demonstrated a highly significant decline in ABG pH across severity groups, with mean values of 7.37 ± 0.01 in mild dengue, 7.31 ± 0.04 in moderate dengue, and 7.25 ± 0.05 in severe dengue (p < 0.001). This is one of the strongest findings of our study. Hassan N et al. (2017) directly supports this, showing that decreasing base excess (which directly correlates with pH) had 84.62% sensitivity and 90.56%

specificity for predicting mortality. Post Hoc ABG Analysis Post hoc Bonferroni analysis in the present study showed that all pairwise differences in ABG pH between severity groups were statistically significant. The mean difference between mild and moderate cases was 0.0636 ($p < 0.001$), between mild and severe cases 0.1190 ($p < 0.001$), and between moderate and severe cases 0.0554 ($p < 0.001$). These findings confirm that ABG pH differentiates not only the extremes of disease but also adjacent severity categories. No other study in the provided literature performed such detailed pairwise analysis, but Thanh NT et al. (2024) came closest by showing that the lactate-to-bicarbonate ratio had a stronger prognostic association (OR=8.66) than lactate alone (OR=1.35). Association between VBG Findings and Severity

The present study demonstrated a strong association between VBG category and dengue severity ($p < 0.001$). Mild cases were predominantly associated with normal acid-base status (20/20), moderate cases clustered in compensated metabolic acidosis (24/50) and metabolic acidosis (21/50), while severe dengue was strongly associated with severe metabolic acidosis (16/20). This near-perfect gradient is clinically invaluable. Hassan N et al. (2017) reported that elevated lactate was 100% sensitive for mortality, and Tat TN et al. (2024) found that severe bleeding, higher fluid infusion, and elevated vasoactive-inotropic score were significant predictors of mortality. Our VBG gradient directly reflects the physiological impact of circulatory failure and makes VBG assessment highly relevant for bedside triage. Correlation of ABG with Hematological and Lipid Parameters The correlation analysis showed that hemoglobin had a weak but statistically significant negative correlation with ABG pH ($r = -0.244$, $p = 0.021$), while PCV, platelet count, total cholesterol, triglycerides, HDL, LDL, and VLDL did not show significant correlation. The hemoglobin finding likely reflects hemoconcentration due to plasma leakage, leading to impaired perfusion and acidosis. The lack of correlation between pH and lipids suggests that acid-base deterioration and hypocholesterolemia are independent pathophysiological processes. This is supported by Durán A et al. (2015), who found correlations between lipids and platelets but not specifically with pH, Diagnostic Performance of ABG (pH).

The present study showed that ABG pH had excellent diagnostic performance for predicting mild dengue, with an AUC of 0.944, 95% CI 0.898–0.990, and $p < 0.001$. A cut-off of ≥7.35 gave 85% sensitivity and 91.4% specificity, while ≥7.34 increased sensitivity to 100% (specificity 80.0%). This performance is comparable to or better than established biomarkers. Rao R et al. (2021) reported CRP AUC 0.929, Suresh SC et al. (2021) reported ferritin AUC 0.947.

Conclusion

The present study establishes that blood gas parameters, especially ABG pH and VBG-based metabolic acidosis, are strong and clinically meaningful prognostic markers in patients with dengue with warning signs and severe dengue. Among lipid parameters, total cholesterol showed significant association with severity, but the prognostic value of the lipid profile was clearly less consistent than that of blood gas analysis. The findings indicate that worsening acidosis parallels increasing clinical severity and can serve as an effective indicator of disease progression. Therefore, incorporation of blood gas assessment into routine evaluation of dengue patients may improve early recognition of severe illness,

guide monitoring intensity, and support timely intervention. The study also suggests that serum total cholesterol may be used as an adjunctive supportive marker, but acid-base assessment remains the more reliable prognostic tool. Overall, the results highlight the importance of combining clinical warning signs with targeted biochemical and blood gas evaluation to improve severity assessment and clinical outcomes in dengue.

References

1. Rathore AP, Farouk FS, John AL. Risk factors and biomarkers of severe dengue. Current Opinion in Virology. 2020 Aug 1;43:1-8.
2. Silva MM, Gil LH, Marques ET, Calzavara-Silva CE. Potential biomarkers for the clinical prognosis of severe dengue. Memórias do Instituto Oswaldo Cruz. 2013 Sep;108(6):755-62.
3. Patil R, Bajpai S, Ghosh K, Shetty S. Microparticles as prognostic biomarkers in dengue virus infection. Acta Tropica. 2018 May 1;181:21-4.
4. Huy BV, Toàn NV. Prognostic indicators associated with progresses of severe dengue. PloS one. 2022 Jan 5;17(1):e0262096.
5. Chua AJ, Lin F, Min HH, Ding Y, Thein TL, Guo L, Zhu Y, Ng ML, Shi L, Oon JE, Salada B. Dengue prognostic biomarkers predict dengue haemorrhagic fever with high sensitivity and specificity. International Journal of Infectious Diseases. 2023 May 1;130:S76.
6. Sivasubramanian S, Mohandas S, Gopalan V, Raj VV, Govindan K, Varadarajan P, Kaveri K, Ramkumar KM. The utility of inflammatory and endothelial factors in the prognosis of severe dengue. Immunobiology. 2022 Nov 1;227(6): 152289.
7. Parag AR, Kulkarni SV. A study of prognostic markers for dengue infection.