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Original Article

Biochemical and Hematological Parameters among Patients of Mild and Severe Dengue: A Preliminary Study

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Abstract

Background: Dengue fever, a mosquito-borne viral disease caused by the Dengue virus (DENV), represents a diverse set of clinical manifestations that range from mild febrile illness to severe complications such as Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS). Severity caused by Dengue virus has been attributed to the occurrence of more than one DENV strain. However, there can be other pre-existing factors in the patients that may also add to the severity. This study focuses on analyzing and comparing the clinical observations as well as the biochemical assays of the dengue infected patients. **Methods:** The indoor patients (IPD) of Sharda Hospital who were confirmed cases of Dengue were taken for the study. The patients were divided into two categories: severe Dengue cases (ICU cases also included) and mild dengue cases. The Complete Blood Count (CBC), KFT (Kidney Function Test), LFT (Liver Function Test), etc. were analyzed. **Results:** It was observed that sodium level and total protein (liver) were low and chloride level and SGOT were high in some of the mild and severe patients. In a few cases the levels of monocytes were high, whereas TLC, lymphocytes, and neutrophils were observed to be low in the case of severe patients and high in a few cases of mild patients. These patients were mostly infected with a single strain; however, multiple DENV strains were also reported. **Conclusion:** The present study sensitizes the need to add these biochemical parameters and diagnose type-specific DENV infection to provide improvised and targeted clinical solutions.

Keywords: *Biochemical; Blood Parameters; Dengue Virus; DHF; DSS; Serotypes*

Introduction

Dengue fever is a rapidly emerging vector-borne viral disease that poses a significant public health challenge worldwide. According to the World Health Organization (WHO), 2025, Dengue is endemic in over 120 countries, with an estimated 390 million infections annually (https://www.who.int). The global incidence of Dengue has increased exponentially over the past five decades due to factors such as rapid urbanization, climate change, increased human mobility, and inadequate vector control measures (Brady *et al.*, 2012; Nakase *et al.*, 2024). Severe Dengue cases and outbreaks are happening more often. The disease is caused by the Dengue virus (DENV), a member of the Flaviviridae family, and is transmitted primarily by *Aedes aegypti* and *Aedes albopictus* mosquitoes (Raj *et al.,* 2025). The Dengue virus (DENV) is a single-stranded positive-sense RNA virus. The virus is classified into four antigenically distinct serotypes: DENV-1, DENV-2, DENV-3, and DENV-4, each of which can cause clinical manifestations ranging from mild febrile illness to severe Dengue hemorrhagic fever (DHF) and Dengue shock syndrome (DSS) (Guzman & Harris, 2015). Although primary infection with any serotype generally results in immunity against that specific strain, secondary infection with a heterologous serotype has been associated with an increased risk of severe disease due to antibody-dependent enhancement (ADE) (Wells *et al.,* 2025). Thus,

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understanding the virological and immunological interactions of these serotypes is crucial for the development of effective vaccines and therapeutic strategies.

Mild dengue fever is characterized by sudden-onset high fever, headache, retro-orbital pain, myalgia, arthralgia, rash, and leukopenia, while Dengue hemorrhagic fever (DHF) and Dengue shock syndrome (DSS) are associated with increased vascular permeability, plasma leakage, thrombocytopenia, and coagulopathy (Guzman & Harris, 2015). DHF is marked by hemorrhagic manifestations such as petechiae, epistaxis, and gastrointestinal bleeding, while DSS results from profound plasma leakage leading to circulatory failure and shock. The pathogenesis of severe dengue known to date is in terms of immune-mediated mechanisms, such as antibody-dependent enhancement (ADE) and cytokine storm (Ngono & Shresta, 2018; Kalimuddin *et al.,* 2025). Early recognition of severe Dengue symptoms is critical for clinical management and reducing mortality rates.

Different DENV serotypes have been associated with varying clinical outcomes; for instance, some studies suggest that DENV-2 is more frequently linked to severe disease, while DENV-1 is associated with milder presentations (Balmaseda *et al.,* 2006; Sankaradoss, 2026). There is still uncertainty regarding whether the clinical manifestations and disease severity of Dengue differ between patients with mono-infections and those with co-infections (Rathore & St. John, 2020; Tun *et al.,* 2025; Sufi *et al*., 2025); thus, understanding the impact of co-infections is crucial for improving disease prognosis, patient management, and public health interventions.

Materials and Method

This study was conducted on Dengue positive serum samples collected from patients who referred to Sharda Hospital, Greater Noida, during the period from June to November 2024. These hospitalized patients had been confirmed for positivity using the Dengue Non-Structural Protein (NS1) assay in the hospital. A total of 180 Dengue fever cases were recorded across various age groups. Blood samples were collected after taking prior consent and then stored in the repository of the Centre of Excellence for Virology and Immunology, Sharda University. Here the serum was separated and then tested for DENV serotyping using the Indirect Fluorescent Antibody (IFAT) test as per protocol referred to by Kuberski and Rosen (Kuberski & Rosen, 1977).

Clinical data, including symptoms, laboratory findings, and severity classifications (as per W.H.O.), of a total of 165 patients were recorded. Patients were categorized based on the presence of specific symptoms into groups such as high-grade fever, headache, vomiting, rash, body ache, abdominal pain, bleeding manifestation, thrombocytopenia, loose motion, etc. The Complete Blood Count (CBC), KFT (Kidney Function Test), LFT (Liver Function Test), etc. were also recorded. Of these, 19 patients were admitted to the ICU due to severe conditions and one patient did not survive (Code: DENV/IFAT/87). The cause of mortality reported was Dengue Shock Syndrome with Septic Shock (Severe Metabolic Acidosis with MODS with Dengue Shock Syndrome with Septic Shock with Sepsis).

Ethical Consideration

This study was approved by the “Institutional Ethics Committee of the School of Medical Sciences and Research & Sharda Hospital,” with reference number SU/SMS&R/76-A/2024/68 dated 01.04.2024.

Results

The patients were divided into two categories: severe Dengue cases (ICU cases also included) and mild dengue cases. This was based on the categorization of symptoms. Patients with fever, headache, bleeding, rash, and thrombocytopenia and ICU admitted were kept in the category of ‘Severe’ cases (as per W.H.O. classification and based on the treating clinician’s report), while the rest having mild fever, vomiting, rash, and body pain were kept under the “Mild” category.

In patients with severe Dengue fever, it was observed that all had fever (100%), headache (100%), and thrombocytopenia (100%), while 94.1% had rashes (Figure 01). Among these patients, 3 were

found to be infected by all 4 DENV strains, 5 cases had infections with three DENV strains, 13 had infections with two DENV strains, and the remaining 13 were infected by a single DENV strain. The viral strain found more prevalent was the DENV-2 type, followed by DENV-1 and DENV-4 and lastly the DENV-3 type (Figure 02).

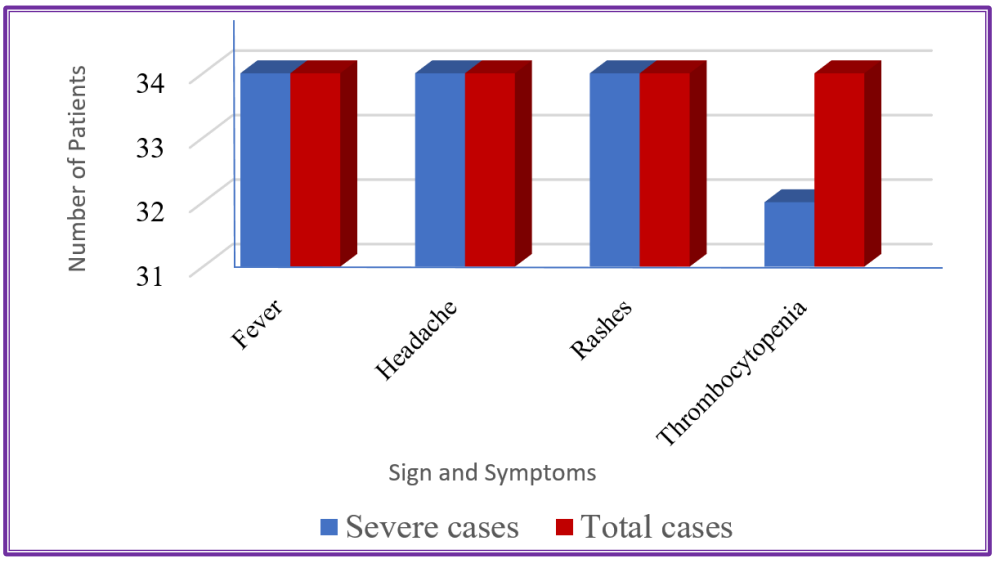


Figure 1: *Graphical Representation of The Severe Cases of Dengue Patients*

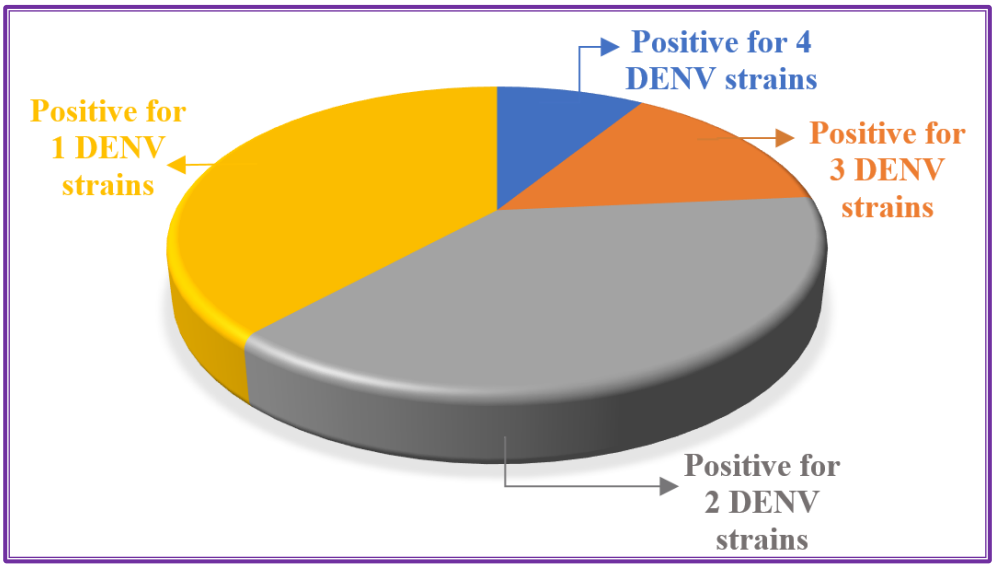


Figure 2: *Pie Diagram Indicating Number of DENV Strains Present in Severe Cases*

Of these 34 cases, 19 patients were admitted to the ICU. They had various symptoms other than the one described above (Figure 03). Almost all the patients reported fever (100%), headache (100%), vomiting (100%), thrombocytopenia (100%), bleeding (100%), and body ache (100%). Other symptoms reported were rashes (89%), loose motion (84%), and abdominal pain (79%). Among these patients, 3 were found to be infected by all 4 DENV strains, 5 cases had infections with three DENV strains, 7 had infections with two DENV strains, and the remaining 5 were infected by a single DENV strain.

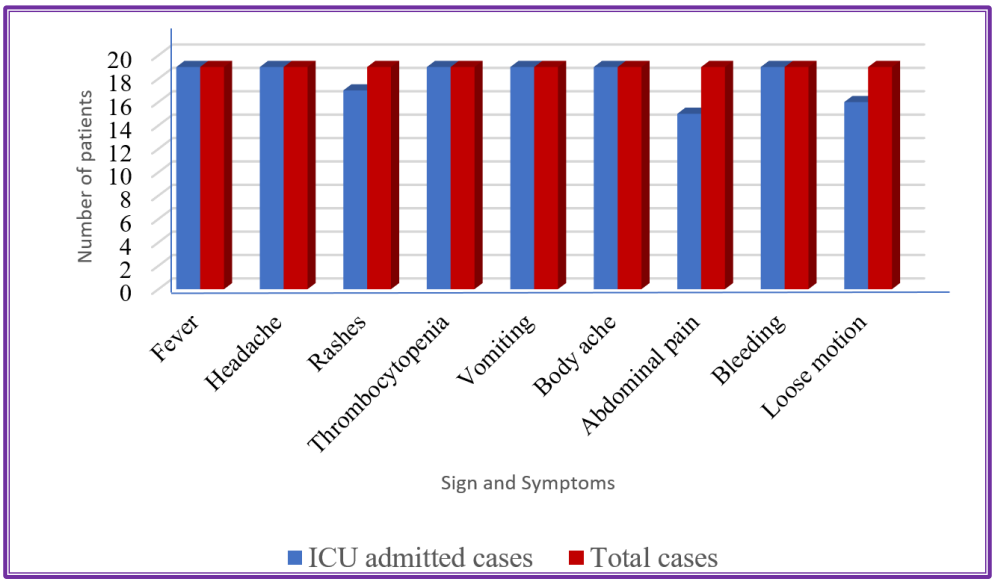


Figure 3: *Graphical Representation of the ICU Admitted Cases of Dengue Patients*

In patients with mild dengue fever, it was observed that all the patients had fever (98.4%), followed by headache (72.5%). Thrombocytopenia was seen in only 61.0%, and rashes in only 5.3%. The other symptoms observed were body ache (35.11%), loose motion (32.06%), abdominal pain (29.0%), vomiting (15.2%), and bleeding (6.8%) (Figure 04). Of these patients, there were 5 who were found to be infected by all 4 DENV strains, 24 cases had three DENV strains, 36 had infection by two DENV strains, and 58 had infection with a single strain, while the rest (8) were not found to be positive for any of the DENV strains. The viral strain found more prevalent was the DENV-4 type, followed by DENV-2 and DENV-3 and lastly the DENV-1 type (Figure 05).

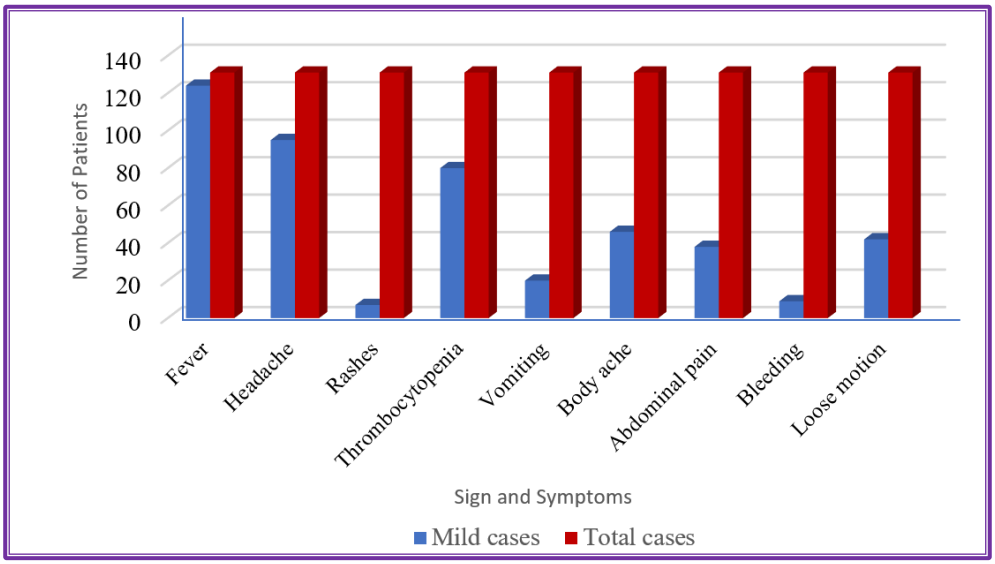


Figure 4: *Graphical Representation of the Mild Cases of Dengue Fever*

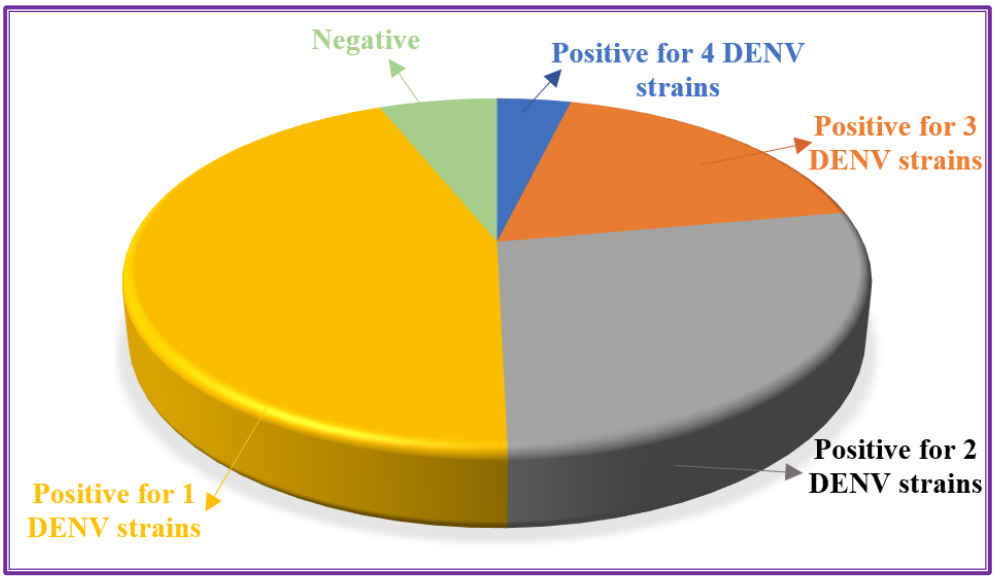


Figure 5: *Pie Diagram Indicating Number of DENV Strains Present in Mild Cases*

The Kidney Function Test was observed. In the patients with severe dengue, out of 34 patients, 32 had undergone the test. The normal values of each parameter were as follows: Urea 20-43 mg/dl; Creatinine 0.66-1.25 mg/dl; Uric Acid 3.50-8.50 mg/dl; Sodium 137-145 mEq/L; Potassium 3.50-5.10 mEq/L; and Chloride 98-107 mEq/L. Though normal ranges were found in many, comparatively low Sodium levels were the ones that were found to be low in 15 patients (46.8%), followed by Urea in 12 (37.5%), Uric acid in 11 (34.3%), and Creatinine in 6 (18.7%). Comparatively Chloride was found to be high in 8 patients (25.0%) (Table 01, Figure 06). Overall, one patient (DENV/IFAT/117) had high levels of all the parameters except Potassium**.** The patient was positive for all the 4 DENV strains.

Table 1: *Details of Level of Kidney Function Parameters in Patients with Dengue Fever*

	Severe cases (n=32)						Mild cases (n-92)					
	High levels	**%**	**Low levels**	**%**	**Normal**	**%**	**High levels**	**%**	**Low levels**	**%**	**Normal**	**%**
Urea (mg/dl)	6	18.7	12	37.5	14	43.7	10	10.8	32	34.7	50	54.3
Creatinine (mg/dl)	5	15.6	6	18.7	21	65.6	11	11.9	17	18.4	64	70.6
Uric acid (mg/dl)	2	6.25	11	34.3	19	59.3	5	5.43	39	42.3	48	52.1
Sodium (mmol/L)	1	3.12	15	46.8	16	56.2	5	5.43	57	61.9	30	32.6
Potassium (mmol/L)	1	3.12	1	3.12	30	93.7	3	3.26	3	3.26	86	93.4
Chloride (mmol/L)	8	25.0	1	3.12	23	71.8	15	16.3	5	5.43	72	78.2

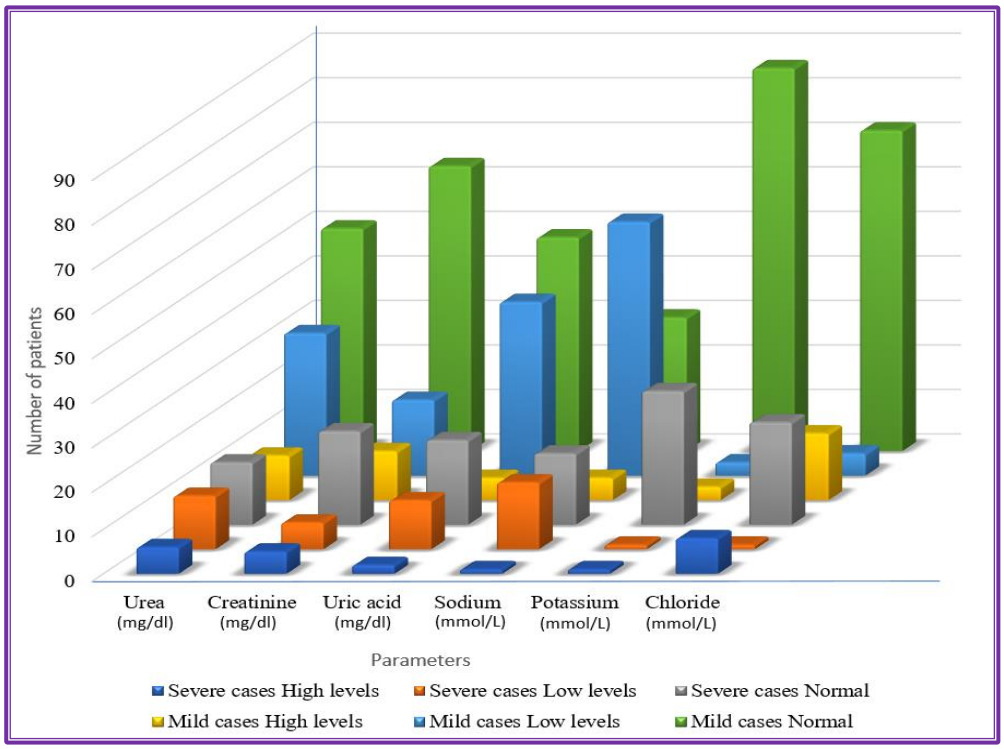


Figure 6: *Graphical Representation of The Various KFT Parameters in Both Severe and Mild Cases of Dengue Fever*

In the patients with mild dengue, it was observed that most of the parameters were lower (except Chloride) than the reference range, viz., Sodium levels were the ones that were found to be low in 57 patients (61.9%), followed by Uric acid in 39 (42.3%), Urea in 32 (34.7%), and Creatinine in 17 (18.4%). Comparatively Chloride was found to be high in 15 patients (16.3%). (Table 01, Figure 06).

Table 2: *Details of Level of Liver Function Parameters in Patients with Dengue Fever*

	Severe cases (n=29)						Mild cases (n=95)					
	High levels	**%**	**Low levels**	**%**	**Normal**	**%**	**High levels**	**%**	**Low levels**	**%**	**Normal**	**%**
Bilirubin total (mg/dl)	8	27.5	0	0	21	72.4	13	13.6	1	1.05	81	85.2
Bilirubin direct (mg/dl)	15	51.7	0	0	14	48.2	46	48.2	1	1.05	48	50.5
Bilirubin indirect (mg/dl)	5	17.2	2	6.89	22	75.8	9	9.47	5	5.26	81	85.2
SGOT (U/L)	22	75.8	0	0	7	24.1	67	70.5	2	2.10	26	27.3
SGPT (U/L)	19	65.5	0	0	10	34.4	64	67.3	0	0	31	32.6
Alk phosphatase (U/L)	14	48.2	0	0	15	51.7	55	57.8	0	0	40	42.1
Protein total (gm/dl)	2	6.89	13	44.8	14	48.2	6	6.31	29	30.5	60	63.1
Albumin (gm/dl)	0	0	5	17.2	24	82.7	4	4.21	10	10.5	81	85.2
Globulin (g/dl)	2	6.89	0	0	27	93.1	8	8.42	0	0	87	91.5
A/G ratio	0	0	7	24.1	22	75.8	1	1.05	11	11.5	83	87.3

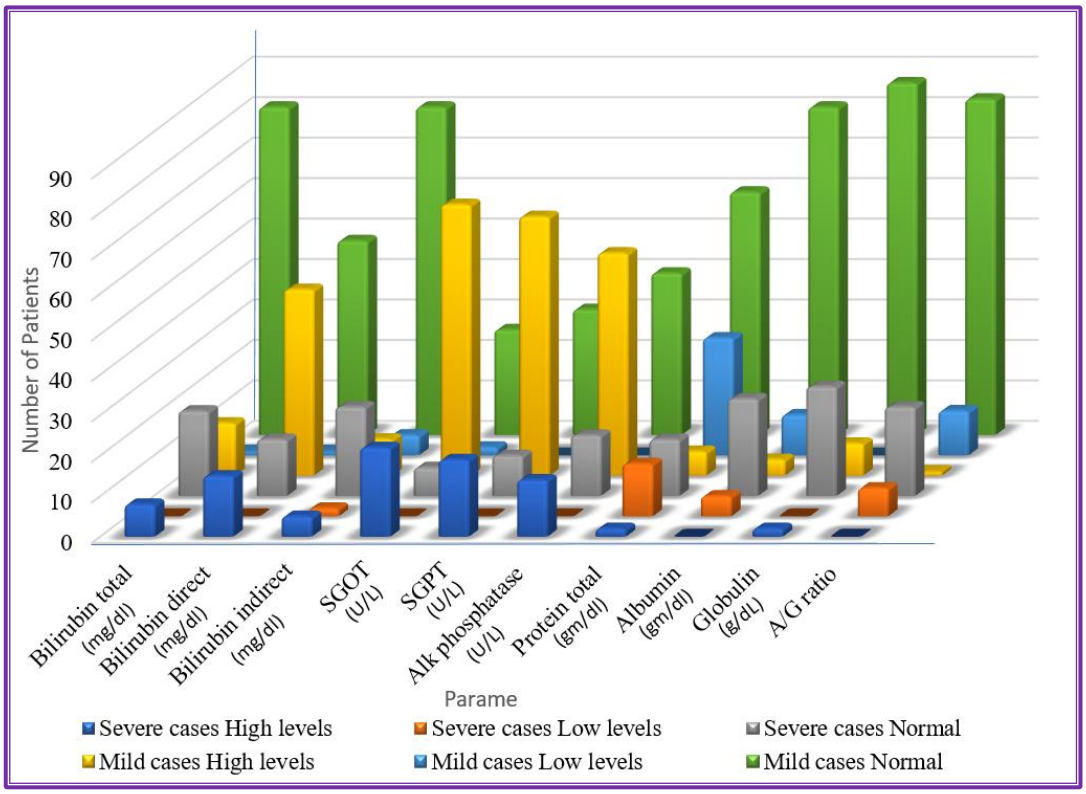


Figure 7: *Graphical Representation of the Various LFT Parameters in Both Severe and Mild Cases of Dengue Fever*

Overall, two patients (DENV/IFAT/67 and 118) had high levels of most of the parameters**.** The patient DENV/IFAT/118 was positive for all 4 DENV strains. The liver function test in patients with severe dengue showed high levels of most of the parameters inversely to what was observed in the KFT. The normal values of each parameter were as follows: Bilirubin Total 0.20-1.30 mg/dl; Bilirubin Direct 0-0.40 mg/dl; Bilirubin Indirect 0-1.10 mg/dl; SGOT 17.00-59.00 U/L; SGPT 0-50 U/L; Alkaline Phosphatase 38-126 U/L; Protein Total 6.30-8.20 gm/dl; Albumin 3.50-5.00 gm/dl; and Globulin 2.00-3.50 gm/dl. The SGOT was high in 22 patients (75.8%), followed by SGPT in 19 (65.5%), Bilirubin direct (51.7%), Alkaline Phosphatase in 14 (48.2%), Bilirubin indirect (17.2%), etc. Low levels of total protein (44.8%), A/G ratio (24.1%) and albumin (17.2%) were observed (Table 02, Figure 07). Overall, two patients (DENV/IFAT/32 and 103) had high levels of most of the parameters.

Patients with mild dengue exhibited high levels of most parameters in the LFT, contrary to the findings in the KFT. The SGOT levels were the ones that were found to be highest amongst all. The SGOT was high in 67 patients (70.5%), followed by SGPT in 64 (67.3%), Alkaline Phosphatase in 55 (57.8%), Bilirubin direct (48.2%) etc. Low levels were seen in protein total (30.5%), A/G ratio (11.5%) and albumin (10.5%) (Table 02, Figure 07). Overall, two patients (DENV/IFAT/32 and 103) had high levels of most of the parameters.

The Complete Blood Count (CBC) test was also seen. The normal values of each parameter were as follows: Haemoglobin 11-14 (female) 13-17 (male) g/dL; Total Leucocyte Count 4.0-11.010^3/Cmm; Neutrophils 40-70%; Lymphocytes 20-45%; Eosinophils 0.00-6.00%; Monocytes 0.00-10.00%; and Basophils 0.00-2.00%. In the patients with severe dengue, it was observed that all had high levels of Monocytes (100%). Low levels were observed mostly, i.e. TLC was low in 57.5% while Neutrophils was low in 21.2%. Lymphocytes were high in 27.2% (Table 03, Figure 08).

Table 3: *Details of Level of CBC Parameters in Patients with Dengue Fever*

	Severe Cases (n=33)						Mild cases (n-124)					
	High levels	**%**	**Low levels**	**%**	**Normal**	**%**	**High levels**	**%**	**Low levels**	**%**	**Normal**	**%**
TLC (10^3/cmm)	0	0	19	57.5	14	42.4	56	45.1	2	1.61	66	53.2
Neutrophils (10^3/µL)	6	18.1	7	21.2	20	60.6	22	17.7	21	16.9	81	65.3
Lymphocytes (10^3/µL)	9	27.2	5	15.1	19	57.5	21	16.9	25	20.1	78	62.9
Eosinophils (10^3/µL)	1	3.03	0	0	32	96.9	3	2.41	0	0	121	97.5
Monocytes (10^3/µL)	33	100	0	0	0	0	124	100	0	0	0	0
Basophils (10^3/µL)	0	0	0	0	33	100	0	0	3	2.41	120	96.7

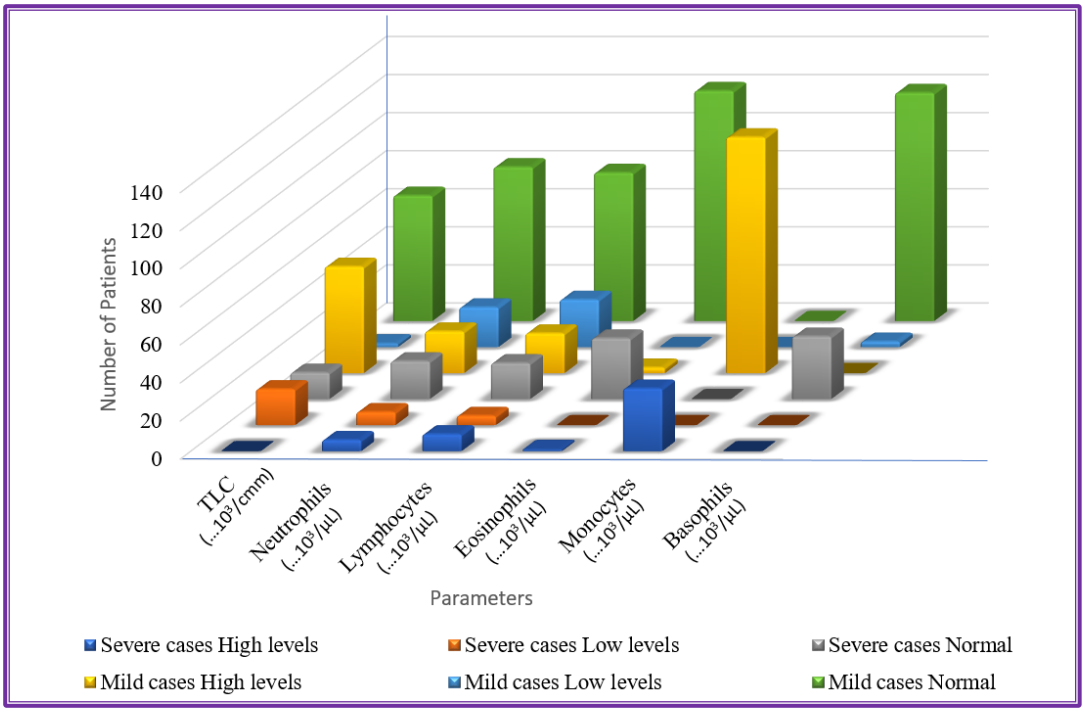


Figure 8: *Graphical Representation of the Various CBC Parameters in Both Severe and Mild Cases of Dengue Fever*

In the patients with mild dengue, high levels of Monocytes were observed in all. Comparative, high levels were observed i.e. TLC was high in 45.1%, Neutrophils was also high in 17.7% and Lymphocytes was low (20.1%) (Table 03, Figure 08). This was seen opposite in cases of severe v/s mild cases.

Discussion

Dengue fever and its severe forms continue to be a cause of concern worldwide. Being transmitted by *Aedes* mosquitoes, the virus enters into the bloodstream. Leukopenia has been observed in the cases of Dengue Fever while Thrombocytopenia in cases of DHF. Lymphocytosis has also been reported in the past (Azin *et al.,* 2012; Rao *et al.,* 2020). Besides Lymphocytes and Thrombocytes, Monocytes are also considered as one of the main targets of DENV infection. These are responsible for activating IL-10. There are changes in the number and subsets of monocyte during dengue (Adikari *et al.,* 2016; Chaloemwong *et al.,* 2018; Castillo *et al.,* 2019; Lertjuthaporn *et al.,* 2021; Dash *et al.,*

2024).Recently, its use as an indicator for dengue severity has been highlighted by Poottasane and co-workers (Poottasane *et al.,* 2023; Roy *et al.,* 2025; Hakami *et al.,* 2025).

It has also been reported that DENV presence can lead to hepatic injury, elevation of transaminases, resulting in jaundice (Munasinghe & Rajasuriya, 1967; Swamy *et al.,* 2021). Kidney complications have also been observed in dengue infection, especially in severe cases (Neto *et al*., 2025). Proteinuria, haematuria, tubular necrosis etc are some of the renal associated complications found associated with dengue infection (Wiwanitkit & Wiwanitkit, 2017; Rajpal *et al.,* 2026).

Since the above reports indicate that the virus can utilize receptors on the host cell surface, it will create a disturbance in the number of essential pathways and hence severe or complicated symptoms will be developed. In the present study, we found an interesting observation that Sodium level was found to be lower than normal in some of the mild and the severe forms whereas Chloride was found to be high in some of the mild and the severe forms. Similarly, in case of liver parameters, the SGOT was found to be high in both the cases while protein content (protein total) was found to be low.

The blood parameters observed varied in some severe and mild cases. In case of patients with severe and mild dengue, the levels of Monocytes were high, however TLC (total leucocyte count), Lymphocytes and Neutrophils was observed to be low in case of severe patients, while high in case of mild patients.

The presence of multiple serotypes within the same population poses additional challenges, as co-infections can trigger heightened immune responses, leading to complications such as plasma leakage and organ dysfunction (Priyadarshi *et al.,* 2024). Additionally, co-infections with multiple Dengue serotypes may further exacerbate disease severity, yet their clinical impact remains inadequately explored (Sabrina *et al.,* 2025).

Limitations

The present study has been conducted in a hospital-based setting of Uttar Pradesh, India. More studies are needed on a yearly basis such that the trend of haematological parameters can be confirmed using a greater number of patient data.

Future Scope

As a furtherance to this work, we wish to expand this study in other states too, such that stronger associations and predictors can be deduced.

Conclusion

Through the present study we aim to highlight the importance and need of carefully looking into the various body parameters that might get disturbed during dengue infection or any other viral infection. Since the virus replicates inside the cytoplasm, there is quite a possibility that it might interfere or hamper any of the ongoing pathways inside the cell. Hence, the clinical parameters may not just be viewed from a biochemical point of view but also from a multiple serotype infection point of view, as it may lead to a long-term impact on the cells involved in the pathogenicity of dengue.

Conflict of Interest

The authors declare no conflicts of interest in this work.

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