

HEMATOLOGICAL AND BIOLOGICAL PROFILING OF DENGUE INFECTION: A
COMPARATIVE EVALUATION OF COMPLETE BLOOD COUNT, ALANINE
TRANSAMINASE AND CREATINE PHOSPHOKINASE IN PATIENTS AT
TERTIARY CARE HOSPITAL PESHAWAR

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Abstract

Dengue fever, which is carried by Aedes mosquitos, poses considerable public health risks globally, particularly in endemic areas such as Pakistan. The purpose of this study is to analyze the hematological and biochemical alterations in dengue-infected individuals, with an emphasis on complete blood count (CBC), serum glutamate pyruvate transaminase (SGPT), and creatinine phosphokinase (CPK) levels. The current study is done to assess the correlation between blood parameters and the severity of dengue infection and

to analyze gender differences in disease outcomes. An observational cross-sectional study was done at tertiary care institutions in Peshawar, including 68 confirmed dengue cases. Blood samples were tested for CBC, SGPT, and CPK levels. Data were acquired from patient records and processed with IBM SPSS 27, which used descriptive and inferential

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statistics. The research group was 57% female, with an average age of 31.47 years. Notable results included thrombocytopenia (mean platelet count: 170,452.75 cells/ μ L), leukopenia (mean WBC count: 6394.54 cells/ μ L), and high SGPT levels (mean: 69.12 IU/L), whereas most patients had normal CPK levels (mean: 94.5 IU/L). Chi-square analysis found a significant relationship between gender and illness severity, with females being more likely to present with moderate to severe dengue. The study identifies substantial hematological and biochemical changes in dengue patients, stressing their usefulness as prognostic indicators. Early diagnosis and care of dengue infections can lead to better patient outcomes.

Keywords: Dengue fever, full blood count, SGPT, Creatine phosphokinase.

Introduction:

Dengue is a viral infection, which is caused by the bite of a female Aedes mosquito, specifically, Aedes aegypti however, other species of the genus Aedes, such as Aedes albopictus also a vector of the dengue virus. Remember that Aedes Albopictus is also known as the Asian tiger mosquito (1). Dengue fever also known as break bone fever is the most common arboviral disease in the world. Dengue belongs to the Flaviviridae family of viruses, including many of the vector-borne and tick-borne diseases caused by the virus. Dengue fever is commonly found in the geographic area where malaria is also present both diseases show a high incidence of cases during rainy and post-rainy periods (2). Dengue virus is present in four distinct antigenically serotypes namely DENV 1, DENV 2, DENV 3, and DENV 4. The virus infects approximately 100 million of people each year. The WHO (World Health Organization) reports approximately 100 million people worldwide are potentially affected by this virus. In Pakistan the first confirmed outbreak of dengue hemorrhagic fever was reported in 1994, the serotype reported was DENV 2. (3). The book's study shows that In 2005 and 2006 there were exceptional and prominent cases of dengue hemorrhagic fever reported, mainly in epidemic-affected areas, with a significant number of cases reported from Karachi. The book studies show that dengue fever is spread globally affecting up to 129 countries worldwide, and remember that only 70% of all dengue cases are found in Asia. Between January and September 2022, Pakistan reported 25,932 dengue cases, and 74% of these patients were reported in September alone (4). The provincial breakdown was; Sindh 32% 6,888 cases, Punjab 29% 6,855 cases, KPK 25% 5,506 cases, and Baluchistan 14% 3,128 cases (5). Dengue fever, a viral infection transmitted by mosquitos, is a serious public health concern worldwide, especially in tropical and subtropical areas. Dengue diagnosis and therapy necessitate an awareness of changes in biomarkers such as SGPT (serum glutamate pyruvate transaminase), hemoglobin (HB), CRP, white blood cells (WBCs), and

platelet count. These indicators are crucial in determining illness severity, prognosis, and possible complications such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) (6). Numerous studies have produced conflicting findings about the function of various biomarkers, depending on factors such as patient demographics, the timing of laboratory testing, and the course of the disease. An indicator of liver involvement and a gauge of the degree of hepatic damage, SGPT is a liver enzyme that is frequently raised levels are frequently seen in severe cases, especially those with DHF, indicating liver damage (2). The severity of the illness is correlated with the degree of SGPT elevation; greater levels indicate worse outcomes. A comprehensive biomarker study is necessary, nevertheless, as research has shown that higher SGPT alone is not usually a sign of severe dengue. (5) For improved illness treatment, researchers have underlined the significance of SGPT in conjunction with other clinical and laboratory indicators (6). Monitoring HB is critical for spotting possible problems, such as hemorrhage and shock. A large drop in HB may demand blood transfusions, especially in individuals with active bleeding. Previous research has looked at HB levels as part of a multiparameter strategy for early diagnosis of severe dengue patients, emphasizing the necessity of prompt management and monitoring (7). Elevated CRP levels have been found in dengue patients, especially those with secondary infection or severe symptoms such as DHF or DSS. CRP levels are associated with systemic inflammation and can help identify people at risk for severe disease development. While CRP is a useful inflammatory measure, its specificity for dengue is debatable because it is elevated in a variety of other illnesses (8). Comparative research on the function of CRP in the early detection of severe dengue is essential for enhancing clinical results and diagnostic precision. WBCs, or white blood cells, are a vital part of the immune response. Leukopenia is a condition in which WBC numbers usually fall in the early stages of dengue illness.

Immune suppression and viral invasion of bone marrow have been connected to this decline in WBCs, especially neutrophils, which can exacerbate illness outcomes in certain individuals. WBC monitoring aids in tracking the course of dengue since recovery may be indicated by a rise in WBC counts following the initial decline, but persistently low levels may suggest problems (3). WBC counts have been studied for their prognostic significance, highlighting their importance in clinical decision-making. Given that thrombocytopenia is a defining feature of dengue, particularly in severe instances, platelet count is arguably the most important indicator of the illness. During a dengue infection, the bone marrow produces fewer platelets and destroys more of them, which lowers platelet counts. In addition to being linked to poor clinical outcomes, such as

shock and hemorrhagic consequences, low platelet counts can cause spontaneous bleeding. Predicting the severity of the illness requires routine platelet monitoring; readings below $100,000/\text{mm}^3$ necessitate closer monitoring (9). Some studies indicate that platelet count can be used as an early warning indication for serious illness, and in extreme situations, platelet transfusions may be required. Improving the clinical care of dengue patients requires a thorough grasp of the relationships between SGPT, HB, CRP, WBCs, and platelet counts. Prior research emphasizes how crucial it is to combine these indicators to diagnose severe dengue early and avoid consequences (10). The study of statistical data on patients with dengue fever, particularly regarding liver enzymes, kidney function, and blood parameters, offers insights into the disease's impact. In America and Europe, dengue has traditionally been less prevalent compared to tropical regions, but cases have risen due to increased travel and climate changes. In countries like the U.S., studies have shown that dengue patients present with elevated liver enzymes, such as alanine aminotransferase (ALT). According to the Centers for Disease Control and Prevention (CDC), over 60% of dengue patients in Puerto Rico exhibited ALT levels significantly higher than the normal range, indicating liver inflammation or damage. White blood cells (WBCs) and platelet counts, key indicators of immune response and blood clotting, are also monitored closely in these patients (8)-11). Creatinine phosphate levels, an indicator of kidney function, have been a focus of concern among dengue patients in Europe. In regions like Spain and Portugal, where dengue cases have emerged due to increased mosquito activity, creatinine phosphate elevation has been noted in severe cases, particularly those progressing to dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS). Research published by the European Journal of Public Health indicates that over 10% of dengue patients in southern Europe experience acute kidney injury, marked by elevated creatinine levels.

Hemoglobin (Hb) levels, however, tend to remain stable in most patients, unless there is severe bleeding, which is rare in milder Cases of dengue in Europe (10) In contrast, Southeast Asia has been a dengue hotspot for decades, with countries like Thailand, Indonesia, and Vietnam experiencing millions of cases annually. Studies from the World Health Organization (WHO) show that ALT and creatinine phosphate levels tend to be significantly higher in severe dengue cases across this region. In Thailand, for example, approximately 45% of severe dengue patients exhibit abnormal ALT levels, indicating significant liver damage. Meanwhile, low platelet counts (thrombocytopenia) and decreased WBCs are hallmark signs of dengue in Southeast Asia. Platelet counts often drop below $100,000 \text{ cells}/\text{mm}^3$, with a severe drop being an indicator of potential progression to developmental heart failure (6) - When we focus on South Asia, including

India and Bangladesh, dengue remains a major public health concern. In these regions, statistical data show that ALT levels in dengue patients are elevated in nearly 40% of cases, reflecting liver strain. Creatinine phosphate levels, while generally stable, spike in around 8-12% of patients, especially in those with severe dengue or underlying health conditions. Hemoglobin levels remain mostly unaffected, but WBC counts tend to decrease sharply during the acute phase of the illness. In India, studies have shown that around 50% of hospitalized dengue patients present with thrombocytopenia, with platelet counts dropping dangerously low, necessitating careful monitoring (13)-(29). Pakistan has experienced significant dengue outbreaks, particularly in urban areas like Karachi and Lahore. In Pakistani dengue patients, ALT levels tend to rise moderately, with approximately 35% of patients showing elevated levels. Creatinine phosphate levels, while not typically alarming, can become elevated in cases of severe dengue, particularly in older patients or those with pre-existing conditions. Hemoglobin levels generally remain within normal ranges, but a significant drop in platelet count is observed, similar to other Asian countries. Pakistani hospitals have reported that about 55% of dengue patients experience thrombocytopenia, with platelet counts frequently falling below 150,000 cells/mm³, making close monitoring of blood parameters essential for effective management (14). Across the regions examined, a clear trend emerges in how dengue impacts various blood parameters, particularly ALT, creatinine phosphate, hemoglobin, WBCs, and platelets. In both America and Europe, dengue is still emerging, but it already shows significant effects on liver function, as evidenced by elevated ALT levels. Creatinine phosphate levels, especially in European patients, point to potential kidney strain in severe cases. Moving to Southeast Asia, where dengue is endemic, the disease's impact on ALT, WBCs, and platelet counts is even more pronounced, with many patients exhibiting thrombocytopenia. In South Asia and Pakistan, dengue follows similar patterns with ALT and platelet abnormalities being prevalent, but kidney function remains relatively stable in most patients. This statistical data highlights the importance of monitoring liver function and blood parameters for early detection of complications in dengue patients across different regions (15).

Material Methods:

This observational cross-sectional study was conducted at three tertiary care hospitals in Peshawar, Khyber Pakhtunkhwa, Pakistan, including Kuwait Teaching Hospital (KTH), Afridi Medical Complex (AMC), and Lady Reading Hospital (LRH). A total of 68 patients with laboratory-confirmed dengue infection were included in the study. The sample size was determined using Rao Soft sample size calculator based on an estimated population proportion of 10%, a 90% confidence level, and a 10% margin of error, resulting in a

calculated sample size of 68 participants. Patients were selected using a non-probability convenience sampling technique. Participants were eligible if they had a confirmed diagnosis of dengue infection based on positive dengue IgM or, in selected cases, IgG serology. In accordance with World Health Organization (WHO) criteria, patients presenting with an acute febrile illness of more than two days accompanied by at least two clinical manifestations, including headache, retro-orbital pain, myalgia, skin rash, bleeding manifestations, or leucopenia, were also considered eligible. Patients with congenital or acquired heart disease, a history of drug use that could affect cardiac rhythm, alcoholic liver disease, viral hepatitis, breast cancer, current use of anticoagulant or antiplatelet medications, or viral hemorrhagic fever other than dengue were excluded from the study. Data were collected through a structured data extraction form incorporating demographic, clinical, and laboratory information. Demographic variables included age and sex, while clinical information comprised confirmed dengue diagnosis, presenting symptoms, disease severity, complications, and treatment outcomes. Laboratory data included complete blood count (CBC), serum glutamate pyruvate transaminase (SGPT), and creatine phosphokinase (CPK) levels, along with other relevant hematological and biochemical parameters. Where applicable, additional clinical information regarding complications occurring during the course of dengue infection was also documented. Laboratory and clinical records were reviewed systematically to ensure complete and consistent data collection. All collected data were entered and analyzed using IBM SPSS Statistics version 27. Continuous variables, including hematological parameters, SGPT, and CPK levels, were assessed for normality and summarized as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. The Chi-square test was used to assess associations between categorical variables, particularly the presence of abnormal CBC, SGPT, and CPK findings among patients with dengue infection.

A p-value of less than 0.05 was considered statistically significant. The findings were presented using appropriate tables and graphical representations. Ethical approval for the study was obtained from the relevant Ethical Review Board of Khyber Medical University prior to commencement of the research. Administrative permission was subsequently obtained from the concerned hospital authorities. Written informed consent was obtained from all participants before inclusion in the study, and confidentiality and privacy of participants' information were maintained throughout the research process.

Results

Demographic and Clinical Characteristics of Study Participants

A total of 68 participants were included in the study. The demographic and clinical characteristics of the participants are summarized in Table 4.1. Of the total participants, 38 (55.9%) were female and 30 (44.1%) were male, indicating a slightly higher representation of females. The mean age of the participants was 31.47 ± 14.39 years, with an age range of 10–76 years. Regarding disease severity, participants were categorized into mild, moderate, and severe groups. The mean severity score was 2.31 ± 0.65 , indicating that moderate disease was the predominant category. The mean hemoglobin concentration was 13.34 ± 2.05 g/dL. The mean WBC count was 6394.54 ± 2662.74 cells/ μ L, while the mean platelet count was $170,452.75 \pm 99,932.14$ cells/ μ L. The mean CPK concentration was 94.50 ± 78.06 IU/L, whereas the mean SGPT level was 69.12 ± 69.59 IU/L.

Variable	Mean / Frequency (%)
Age (years)	31.47 ± 14.39
Gender	
Male	30 (44.1%)
Female	38 (55.9%)
Disease severity	
Mild	25 (36.8%)
Moderate	28 (41.2%)
Severe	15 (22.1%)
Hemoglobin (g/dL)	13.34 ± 2.05
WBC count (cells/ μ L)	6394.54 ± 2662.74
Platelet count (cells/ μ L)	$170,452.75 \pm 99,932.14$
CPK (IU/L)	94.50 ± 78.06
SGPT (IU/L)	69.12 ± 69.59

Association Between Gender and Disease Severity

A chi-square test was performed to assess the association between gender and disease severity. Among male participants, 15 (50.0%) had mild disease, 10 (33.3%) had moderate disease, and 5 (16.7%) had severe disease. Among female participants, 10 (26.3%) had mild disease, 18 (47.4%) had moderate disease, and 10 (26.3%) had severe

disease. The proportion of moderate and severe disease was therefore higher among females than males.

Table 4.2. *Association Between Gender and Disease Severity*

Disease severity	Male n (%)	Female n (%)	Total n (%)
Mild	15 (50.0)	10 (26.3)	25 (36.8)
Moderate	10 (33.3)	18 (47.4)	28 (41.2)
Severe	5 (16.7)	10 (26.3)	15 (22.1)
Total	30 (100)	38 (100)	68 (100)

Hematological and Biochemical Profile of Study Participants

The hematological and biochemical parameters of the participants were evaluated to characterize the laboratory profile associated with dengue infection. The mean hemoglobin concentration was 13.34 ± 2.05 g/dL. The mean WBC count was 6394.54 ± 2662.74 cells/μL, with considerable variation among participants. The mean platelet count was 170,452.75 ± 99,932.14 cells/μL, reflecting substantial variability in platelet levels. The mean CPK level was 94.50 ± 78.06 IU/L, while the mean SGPT level was 69.12 ± 69.59 IU/L. The elevated mean SGPT level suggests that biochemical evidence of hepatic involvement was present in a proportion of participants.

Table 4.3. *Mean Hematological and Biochemical Parameters*

Laboratory parameter	Mean	Standard deviation
Hemoglobin (g/dL)	13.34	2.05
WBC count (cells/μL)	6394.54	2662.74
Platelet count (cells/μL)	170,452.75	99,932.14
CPK (IU/L)	94.50	78.06
SGPT (IU/L)	69.12	69.59

Dengue Diagnosis in Relation to Hemoglobin Level

The relationship between dengue diagnosis and hemoglobin category was assessed. Among the 55 participants classified as confirmed dengue cases, 15 (27.3%) had low hemoglobin levels (<12 g/dL), 35 (63.6%) had normal hemoglobin levels (12–16 g/dL), and 5 (9.1%) had high hemoglobin levels (>16 g/dL). Among the 13 participants who were not classified as confirmed cases, 5 (38.5%) had low hemoglobin, 5 (38.5%) had normal hemoglobin, and 3 (23.1%) had high hemoglobin.

Table 4.4. *Distribution of Dengue Diagnosis According to Hemoglobin Level*

Dengue diagnosis	Low Hb <12 g/dL	Normal Hb 12–16 g/dL	High Hb >16 g/dL	Total
Confirmed	15 (27.3%)	35 (63.6%)	5 (9.1%)	55
Not confirmed	5 (38.5%)	5 (38.5%)	3 (23.1%)	13
Total	20	40	8	68

Dengue Diagnosis in Relation to White Blood Cell Count

The distribution of WBC counts according to dengue diagnosis is presented in Table 4.5. Among confirmed dengue cases, 28 (50.9%) had a low WBC count (<4,000 cells/ μ L), 25 (45.5%) had a normal WBC count (4,000–11,000 cells/ μ L), and only 2 (3.6%) had an elevated WBC count (>11,000 cells/ μ L). Among non-confirmed participants, 2 (15.4%) had low WBC counts, 10 (76.9%) had normal counts, and 1 (7.7%) had an elevated WBC count.

Table 4.5. *Distribution of Dengue Diagnosis According to WBC Count*

Dengue diagnosis	Low WBC <4,000	Normal WBC 4,000–11,000	High WBC >11,000	Total
Confirmed	28 (50.9%)	25 (45.5%)	2 (3.6%)	55
Not confirmed	2 (15.4%)	10 (76.9%)	1 (7.7%)	13
Total	30	35	3	68

Dengue Diagnosis in Relation to Platelet Count

Platelet counts were categorized as low (<150,000 cells/ μ L), normal (150,000–400,000 cells/ μ L), and high (>400,000 cells/ μ L). Among the 55 confirmed dengue cases, 40 (72.7%) had thrombocytopenia, 13 (23.6%) had normal platelet counts, and 2 (3.6%) had high platelet counts. In comparison, 5 (38.5%) of the non-confirmed participants had low platelet counts.

Table 4.6. *Distribution of Dengue Diagnosis according to Platelet Count*

Dengue diagnosis	Low <150,000	Normal 150,000–400,000	High >400,000	Total
Confirmed	40 (72.7%)	13 (23.6%)	2 (3.6%)	55
Not confirmed	5 (38.5%)	7 (53.8%)	1 (7.7%)	13
Total	45	20	3	68

Dengue Diagnosis in Relation to CPK Levels

CPK levels were categorized as normal (<200 IU/L) and elevated (>200 IU/L). Among confirmed dengue cases, 50 (90.9%) had normal CPK levels, whereas 5 (9.1%) had elevated CPK levels. Among participants who were not classified as confirmed dengue cases, 10 (76.9%) had normal CPK levels and 3 (23.1%) had elevated levels.

Table 4.7. *Distribution of Dengue Diagnosis According to CPK Level*

Dengue diagnosis	Normal CPK <200 IU/L	Elevated CPK >200 IU/L	Total
Confirmed	50 (90.9%)	5 (9.1%)	55
Not confirmed	10 (76.9%)	3 (23.1%)	13
Total	60	8	68

Dengue Diagnosis in Relation to SGPT Levels

SGPT levels were categorized as normal (<40 IU/L) and elevated (>40 IU/L). Among the 55 confirmed dengue cases, 25 (45.5%) had normal SGPT levels, whereas 30 (54.5%) had elevated SGPT levels. Among the 13 non-confirmed participants, 5 (38.5%) had normal SGPT levels and 8 (61.5%) had elevated SGPT levels.

Table 4.8. *Distribution of Dengue Diagnosis According to SGPT Level*

Dengue diagnosis	Normal SGPT <40 IU/L	Elevated SGPT >40 IU/L	Total
Confirmed	25 (45.5%)	30 (54.5%)	55
Not confirmed	5 (38.5%)	8 (61.5%)	13
Total	30	38	68

Overall Laboratory Abnormalities Among Confirmed Dengue Cases

The frequency of laboratory abnormalities among confirmed dengue cases is summarized in Figure no.1 Thrombocytopenia was the most frequently observed abnormality, followed by leukopenia and elevated SGPT. Elevated CPK was observed in a relatively small proportion of confirmed cases.

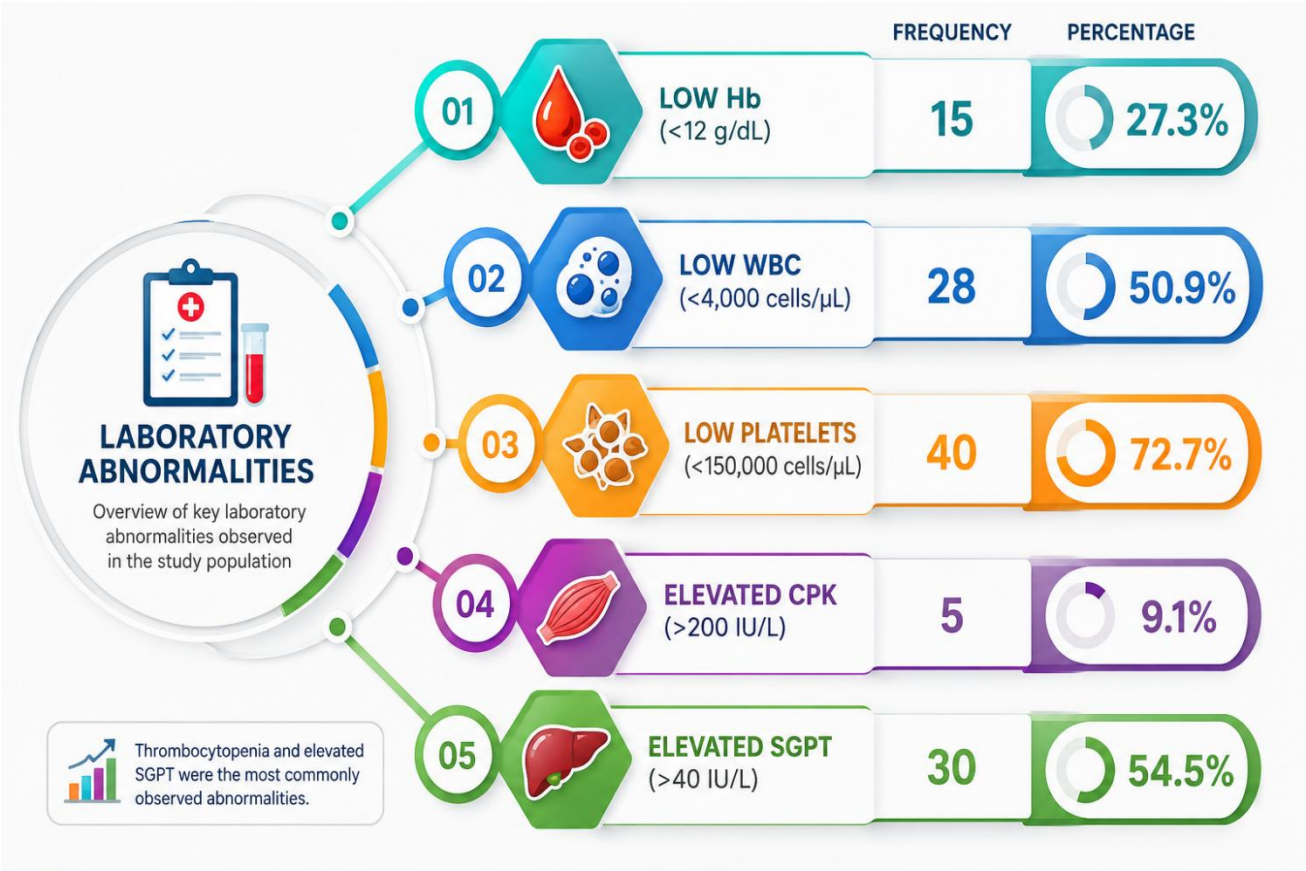


Figure no.1 Frequency of Major Laboratory Abnormalities Among Confirmed Dengue Cases

Discussion:

This study provides valuable insights into the demographic and clinical characteristics of dengue-infected patients in Pakistan, corroborating several findings from previous literature while offering unique observations. The gender distribution in this study showed a modest prevalence of female patients (57%), which is consistent with earlier studies that found varying gender vulnerability to dengue infection. The literature does not clearly indicate that females are more vulnerable to dengue, however reasons such as healthcare-seeking behavior or hormonal impacts have been postulated as plausible causes for this trend (1). Females are more likely to encounter moderate to severe versions of the condition, as demonstrated by the chi-square analysis. This conclusion is consistent with research demonstrating that females may have more severe clinical presentations (2). This cohort's mean age of 31.47 years is comparable to data from earlier research, where dengue illness has been documented to afflict persons of diverse age

groups, while younger populations and adults appear to be more often affected (3). Children in endemic regions have a higher risk of serious illness due to inadequate immunity and limited preventative information (8). Our findings indicate that, while dengue affects all age groups, young people and children are most vulnerable. This study found a mean platelet count of 170,452.75 cells/ μ L, which is consistent with the thrombocytopenia seen in most dengue patients (4). This is comparable to prior data that finds platelet counts decreasing considerably during dengue illness (5). In addition, leukopenia (low white blood cell count) was reported, with a mean WBC count of 6394.54 cells/ μ L, which aligns with typical results in dengue patients where WBC reduction is common. Most patients' hemoglobin levels were within normal limits, but several cases of anemia were found, presumably connected to dengue hemorrhagic fever, as shown by earlier investigations (6). This study discovered that most patients had normal CPK levels, with a mean of 94.5 IU/L, suggesting that, while muscle injury is a possible consequence of dengue, it may not be the predominant characteristic in the majority of cases. This complements research demonstrating that high CPK levels, while present, are infrequent and generally linked with more severe manifestations of the disease, such as dengue shock syndrome or dengue hemorrhagic fever (1)- (9). Elevated SGPT levels in 30 confirmed dengue patients suggest liver involvement, aligning with a previous study indicating hepatic dysfunction in dengue (10). The majority of participants in this research had moderate to severe illness. This conclusion is consistent with recent research demonstrating that secondary infections, particularly by different serotypes, might aggravate illness severity, leading to complications such as dengue hemorrhagic fever or dengue shock syndrome (2) -(3).

The World Health Organization's categorization system categorizes dengue into classic dengue, dengue hemorrhagic fever, and dengue shock syndrome remains a solid foundation for predicting illness outcomes (4)- (6). The correlation study of verified dengue cases and blood indicators indicated the predicted tendencies. Thrombocytopenia and leukopenia were substantially linked with confirmed dengue infections, matching the findings of past investigations (5) - (6). Elevated liver enzymes (SGPT) were also connected with dengue, validating the hypothesis that liver involvement is a common consequence of dengue infection (7) - (8). The regional data supplied by Pakistani health officials, which showed an alarming increase in dengue incidence in 2022, helps to frame the study's conclusions. (9) - (11). The bulk of cases in our research, like the wider national data, were seen in September, which correlates with the post monsoon season—a period known for heightened mosquito activity (12) - (13). These findings are consistent with the wider literature, which repeatedly correlates

dengue epidemics with climatic and environmental conditions, particularly in tropical and subtropical countries (14) - (15).

Conclusion:

This study identifies significant hematological and biochemical alterations in dengue infected individuals, emphasizing the importance of these markers in determining illness severity. The prevalence of female patients with moderate to severe dengue underscores the importance of gender-specific methods in clinical care. Early detection and monitoring of hematological abnormalities allows for prompt therapies, potentially improving patient outcomes.

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