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# ASSESSMENT OF VARIATIONS IN HEMATOLOGICAL PARAMETERS DURING DENGUE INFECTION AT ANMCH ISLAMABAD

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**Keywords:**
*Dengue infection, Thrombocytopenia, Leukopenia, Hematocrit, Lymphocytosis, NS1 antigen, ELISA.*

**Abstract**

***Objective:***
*To evaluate alterations in key hematological parameters and determine their association with dengue infection severity among patients at ANMCH Islamabad.*

***Study Design:***
*Cross-sectional analytical study.*

***Place and Duration of Study:***
*The study was conducted at Al-Nafees Medical College & Hospital (ANMCH), Islamabad, from 1st September 2025 to 31st December 2025.*

***Methods:***
*A total of 250 serologically confirmed dengue patients (139 males, 111 females), aged 15–60 years, were enrolled through non-probability sampling. Diagnosis was confirmed using NS1 antigen and IgM/IgG ELISA assays. EDTA-anticoagulated blood samples were analyzed for platelet count, total leukocyte count (TLC), lymphocyte percentage, and hematocrit (HCT) using an automated hematology analyzer. Data were analyzed in SPSS version 27. Descriptive statistics were computed, and independent t-tests were applied to compare gender-based differences. A p-value ≤0.05 was considered statistically significant.*

***Results:***
*Marked thrombocytopenia was observed with a mean platelet count of 47.76 ± 19.43 × $10^3$/µL (p<0.001). Leukopenia was evident with a mean TLC of 3.13 ± 0.36 × $10^3$/µL (p<0.001). Lymphocyte percentage was elevated (52.30 ± 4.86%), indicating relative lymphocytosis (p<0.001). Hematocrit levels showed significant elevation consistent with hemoconcentration. Although females demonstrated slightly greater deviation in platelet and HCT values, gender-based differences were not statistically significant.*

***Conclusion:***
*Dengue infection is associated with distinct hematological changes, particularly significant platelet depletion, leukopenia, lymphocytosis, and elevated hematocrit. These parameters serve as practical indicators for early diagnosis, severity assessment, and clinical monitoring in dengue patients.*

**INTRODUCTION:**

Dengue fever is a rapidly expanding mosquito-borne viral disease that imposes a significant global health burden, particularly in tropical and subtropical regions.[1] Transmitted mainly by *Aedesaegypti*, dengue virus (DENV) represents a major arboviral threat, with millions of infections annually and recurrent outbreaks straining healthcare systems, especially in developing countries.[2,3] Despite advances in diagnostics and vector control, dengue continues to cause considerable morbidity and mortality, highlighting the need for improved clinical monitoring.

A hallmark of dengue infection is its impact on hematological parameters, which are vital indicators of disease progression and severity.[4] Common findings include thrombocytopenia, leukopenia, relative lymphocytosis, and altered hematocrit (HCT).[5] These changes result from bone marrow suppression, immune-mediated peripheral destruction of blood cells, endothelial dysfunction, and plasma leakage.[6]

Platelets, essential for vascular integrity and hemostasis, have a lifespan of 7–10 days under normal conditions.[7,8] Dengue-induced marrow suppression and immune-mediated destruction cause significant thrombocytopenia, often an early laboratory abnormality linked to bleeding risk and disease severity.[9,10] Leukopenia, arising from viral effects on hematopoietic progenitors and cytokine-mediated suppression, compromises host defense and may complicate illness.[11,12] Hemoconcentration, reflected by elevated hematocrit, signals plasma leakage, a feature of severe manifestations such as dengue hemorrhagic fever and dengue shock syndrome.[13,14]

The immunopathogenesis of dengue involves a strong cytokine response, including TNF-α and interleukins, contributing to endothelial injury, impaired hematopoiesis, and oxidative stress.[15–18]

These processes exacerbate cytopenias, potentially progressing to hemorrhage, shock, and multi-organ dysfunction if not recognized early.[19],[20]
Systematic evaluation of hematological parameters—platelet count, lymphocyte percentage, total leukocyte count (TLC), and hematocrit[21]–[23], is critical for early diagnosis, severity assessment, and clinical management[24],[25]. This study investigates these parameters among dengue patients in Islamabad, examining demographic influences such as age and gender.[26] Establishing local data may aid early recognition of severe cases, guide timely intervention, differentiate dengue from other febrile illnesses, and strengthen public health strategies.[27], [28]

## MATERIALS AND METHODS

### Study Design and Setting

A hospital-based cross-sectional analytical study was conducted to quantitatively assess hematological alterations among patients with confirmed dengue infection. The study was performed at Al-Nafees Medical College & Hospital (ANMCH), Islamabad, in collaboration with the Department of Medical Laboratory Technology, Isra University Islamabad Campus.

### Study Population

The study population consisted of patients presenting with clinically suspected dengue infection at ANMCH Islamabad. To ensure population uniformity and minimize confounding, only laboratory-confirmed dengue cases aged 15–60 years were included. Both male and female patients were enrolled to facilitate gender-based comparative analysis of hematological parameters.

### Sample Size and Sampling Technique

The required sample size was calculated using the single population proportion formula:
[N = Z^2 \times p (1-p) / d^2]
Assuming a 95% confidence interval (Z = 1.96), estimated prevalence (p = 0.5) due to absence of precise local estimates, and acceptable margin of error (d), the calculated sample size was 250 participants.

### Inclusion Criteria

1. Laboratory-confirmed dengue infection through NS1 antigen and/or IgM/IgG ELISA assays.
2. Age between 15–60 years.
3. Presentation within five days of symptom onset.
4. Provision of written informed consent.

### Exclusion Criteria

1. Documented co-infections (malaria, typhoid fever, hepatitis).
2. Known hematological disorders (e.g., leukemia, aplastic anemia).
3. Pregnant or lactating women.

**Data Collection and Laboratory Procedures**

After obtaining informed consent, demographic and clinical data were recorded using a structured data collection form. Dengue infection was confirmed by ELISA-based detection of NS1 antigen and/or IgM/IgG antibodies according to manufacturer instructions.

Approximately 2–3 mL of venous blood was collected under aseptic conditions into EDTA-anticoagulatedvacutainer tubes. Complete blood count (CBC) parameters including platelet count, total leukocyte count (TLC), hematocrit (HCT), and lymphocyte percentage were measured using the Mindray BC-5150 automated hematology analyzer.

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**Statistical Analysis**

Data were entered and analyzed using IBM SPSS version 27. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Independent sample t-tests were applied to evaluate gender-based differences in hematological parameters. Statistical significance was set at $p \leq 0.05$.

**RESULTS**

This cross-sectional analytical study included 250 ELISA-confirmed dengue patients evaluated between September and December 2025. Of these, 139 (55.6%) were males and 111 (44.4%) were females, yielding a male-to-female ratio of 1.25:1. The overall mean age was 39.27 ± 13.68 years, with comparable mean ages in males (39.49 ± 13.35 years) and females (38.99 ± 14.15 years) (Table 1; Graph 1–.2).

**Serological Distribution**

Based on NS1 antigen and antibody profiling, 97 patients (38.8%) were categorized as current infection (NS1 positive), 76 (30.4%) as primary dengue infection (IgM positive, IgG negative), and 77 (30.8%) as secondary dengue infection (IgG positive with or without IgM). The distribution of serological categories was similar between genders (Table 1; Graph 3–4). Statistically significant deviation from normal reference ranges ($p < 0.001$) (Table 3).

**Platelet Count**

The mean platelet count for the overall cohort was 47.76 ± 19.43 × $10^3$/µL, substantially lower than the normal reference range (150–450 × $10^3$/µL) (Table IV.4). This marked reduction confirms severe thrombocytopenia as the most pronounced hematological abnormality in dengue patients.

Gender-wise analysis showed mean platelet counts of 48.03 ± 20.04 × $10^3$/µL in males and 47.41 ± 18.73 × $10^3$/µL in females. Although females demonstrated a slightly greater deviation from reference values, the difference was not statistically significant ($p = 0.803$) (Table 2; Graph 3–4).

**Lymphocyte Percentage**

The overall mean lymphocyte percentage was 52.30 ± 4.86%, exceeding the normal physiological range (20–40%) (Table 3). This finding indicates relative lymphocytosis during dengue infection.
Mean lymphocyte values were comparable between males (52.30 ± 4.76%) and females (52.31 ± 5.02%), with no statistically significant difference (p = 0.995) (Table 2).

**Total Leukocyte Count (TLC)**

The mean TLC was 3.13 ± 0.36 × $10^3$/µL, which is below the normal range (4.0–11.0 × $10^3$/µL), indicating leukopenia (Table 3).
Gender-specific analysis revealed similar reductions in males (3.12 ± 0.37 × $10^3$/µL) and females (3.14 ± 0.36 × $10^3$/µL), with no statistically significant difference (p = 0.708) (Table 2).

**Hematocrit (HCT)**

The overall mean hematocrit value was 53.48 ± 3.59%, which exceeds standard reference values and indicates hemoconcentration (Table 3).
Males exhibited a mean HCT of 55.65 ± 2.50%, while females showed 50.77 ± 2.82%. The difference between genders was statistically significant (p < 0.001) (Table 2). Although males had higher absolute HCT values, females demonstrated relatively greater deviation from their respective normal reference range.

**List of Tables**

**Table 1: Demographic data of dengue patients showing age, gender proportion and serostatus of dengue.**

| Variable (N = 250) | | | Frequency (%) / Mean ± SD |
|---|---|---|---|
| Age | Male (n=139) | | 39.489±13.353 |
| | Female (n=111) | | 38.991±14.146 |
| | Overall(N=250) | | 39.268±13.685 |
| Gender | Male | | 139(55.6) |
| | Female | | 111(44.4) |
| Condition of Antigen/Antibody on Dengue | Current Infection | Male (n=139) | 52(37.4) |
| | | Female (n=111) | 45(40.5) |
| | | Overall(N=250) | 97(38.8) |
| | Primary dengue infection | Male (n=139) | 43(30.9) |
| | | Female (n=111) | 33(29.7) |
| | | Overall(N=250) | 76(30.4) |
| | Secondary dengue infection | Male (n=139) | 44(31.7) |
| | | Female (n=111) | 33(29.7) |
| | | Overall(N=250) | 77(30.8) |

**Table 2: Gender wise Statistical comparison of Hematological Parameter of dengue patients.**

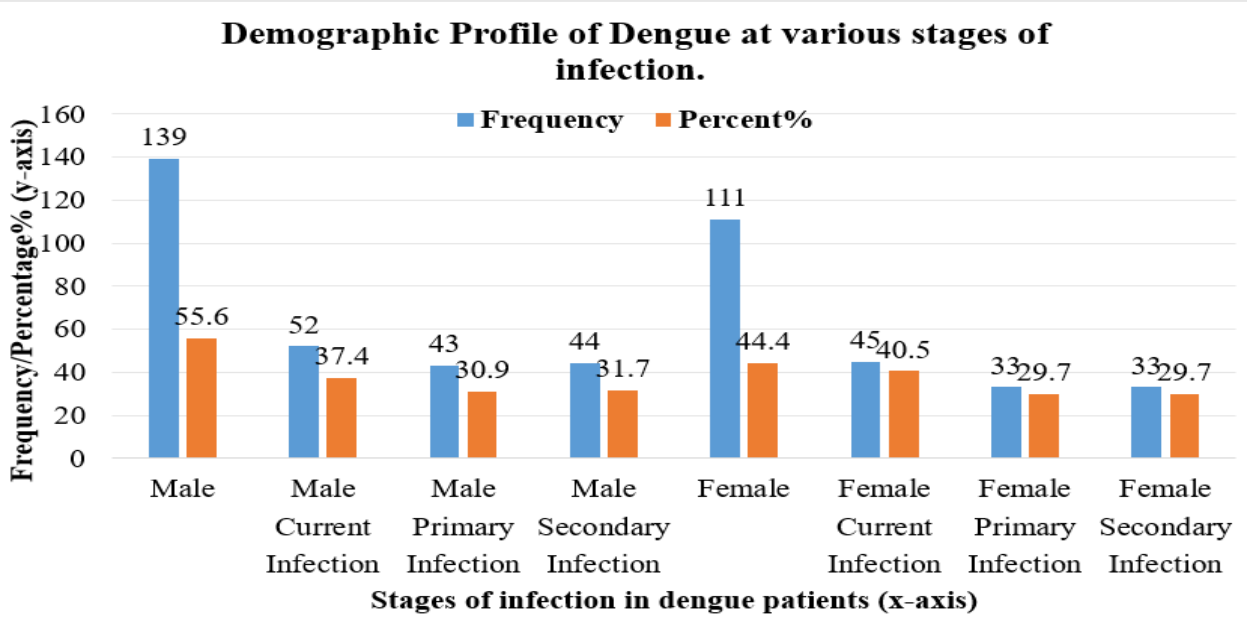
| Variable (N=250) | | Mean± SD | P-value |
|---|---|---|---|
| Platelets (10^3/µl) | Male (n=139) | 48.03±20.04 | 0.803 |
| | Female (n=111) | 47.41±18.73 | |
| Lymphocytes (%) | Male (n=139) | 52.30±4.76 | 0.995 |
| | Female (n=111) | 52.31±5.02 | |
| Total Leukocyte Count (10^3/µl) | Male (n=139) | 3.13±0.37 | 0.708 |
| | Female (n=111) | 3.14±0.36 | |
| Hematocrit (%) | Male (n=139) | 55.65±2.50 | < .001 |
| | Female (n=111) | 50.77±2.82 | |

**Table 3: Deviation in Mean of Hematological parameter from normal reference values.**

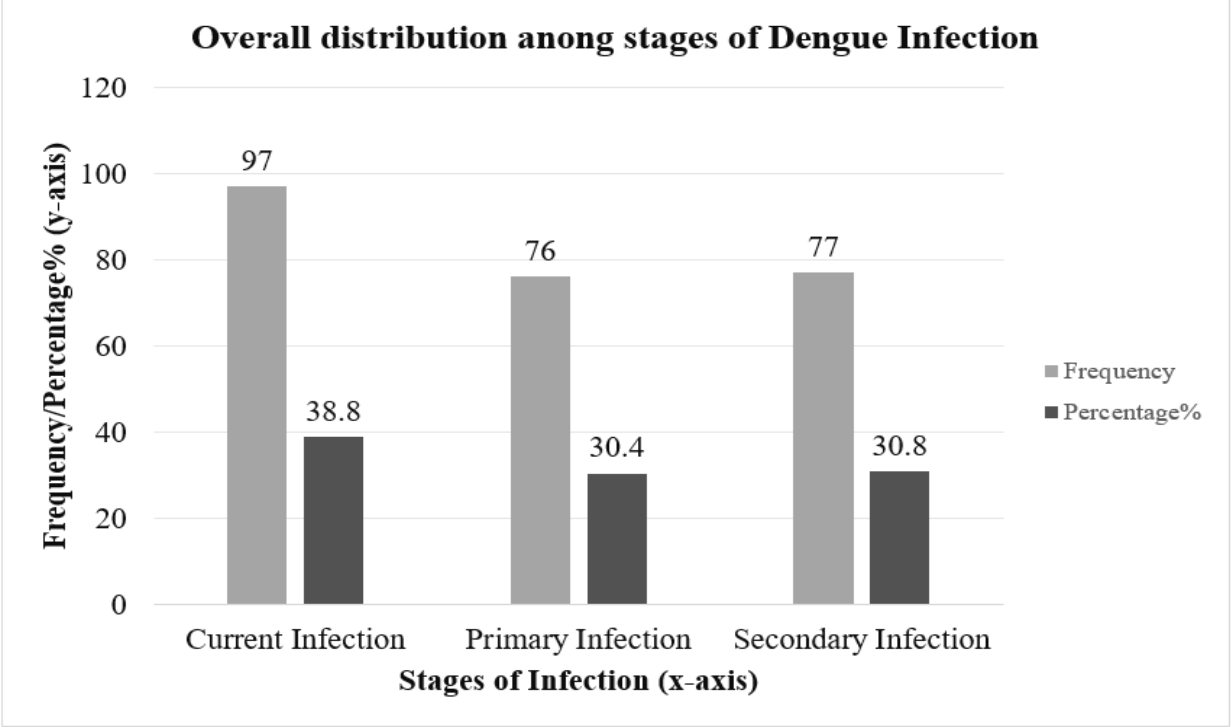
| Variable (N=250) | | Mean±SD (Affected Parameters) | Normal Reference Range | Differences |
|---|---|---|---|---|
| Platelets (10^3/µl) | Male (n=139) | 48.028±20.039 | 150-450 | 81 |
| | Female (n=111) | 47.414±18.732 | | 84 |
| | Overall(N=250) | 47.756±19.433 | | 83 |
| Lymphocytes (%) | Male (n=139) | 52.302±4.757 | 20-40 | 8 |
| | Female (n=111) | 52.306±5.019 | | 7 |
| | Overall(N=250) | 52.304±4.865 | | 7 |
| Total Leukocyte Count (10^3/µl) | Male (n=139) | 3.125±0.371 | 4.0-11.0 | 0.504 |
| | Female (n=111) | 3.143±0.356 | | 0.501 |
| | Overall(N=250) | 3.133±0.364 | | 0.503 |
| Hematocrit (%) | Male (n=139) | 55.647±2.501 | 40-50 | 3 |
| | Female (n=111) | 50.765±2.821 | 36-44 | 4 |
| | Overall(N=250) | 53,480±3.591 | M(40-50) F(36-44) | 7 |

**List of Graphs**

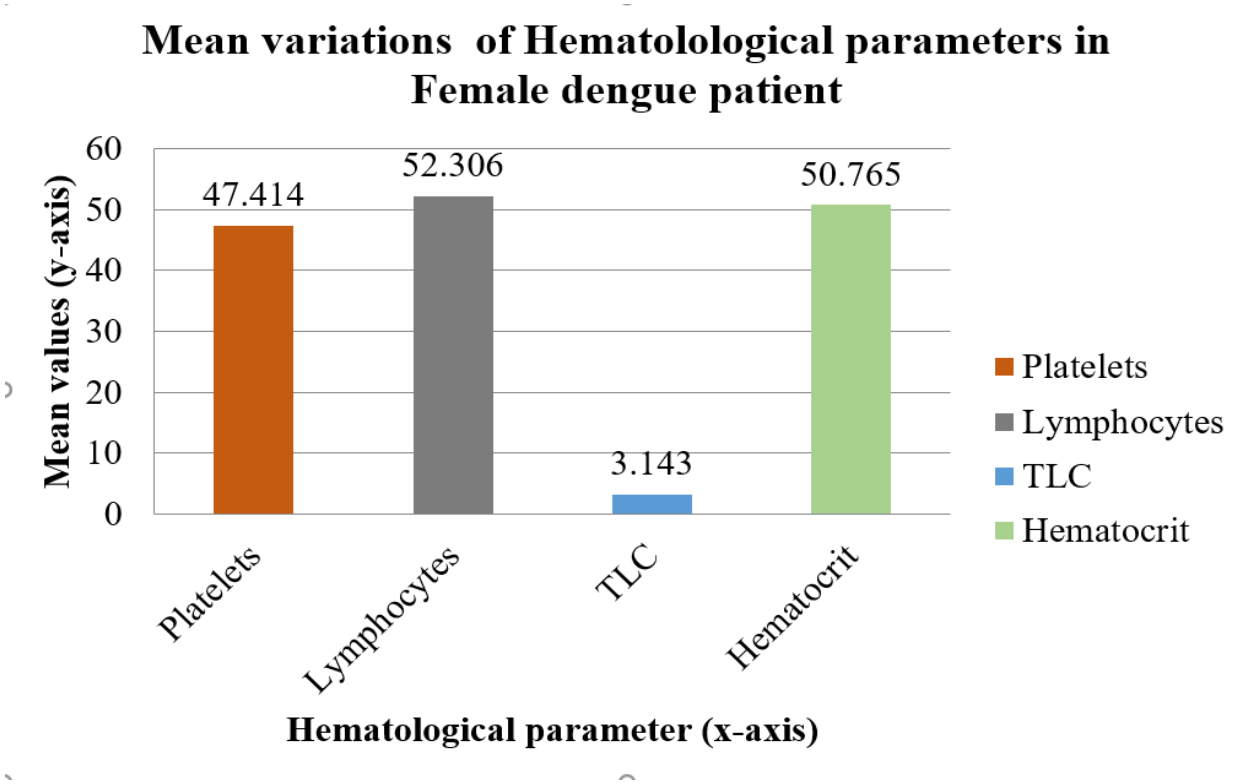
**Graph 1:** Demonstrating a demographic Profile of Dengue Infection at various stages.



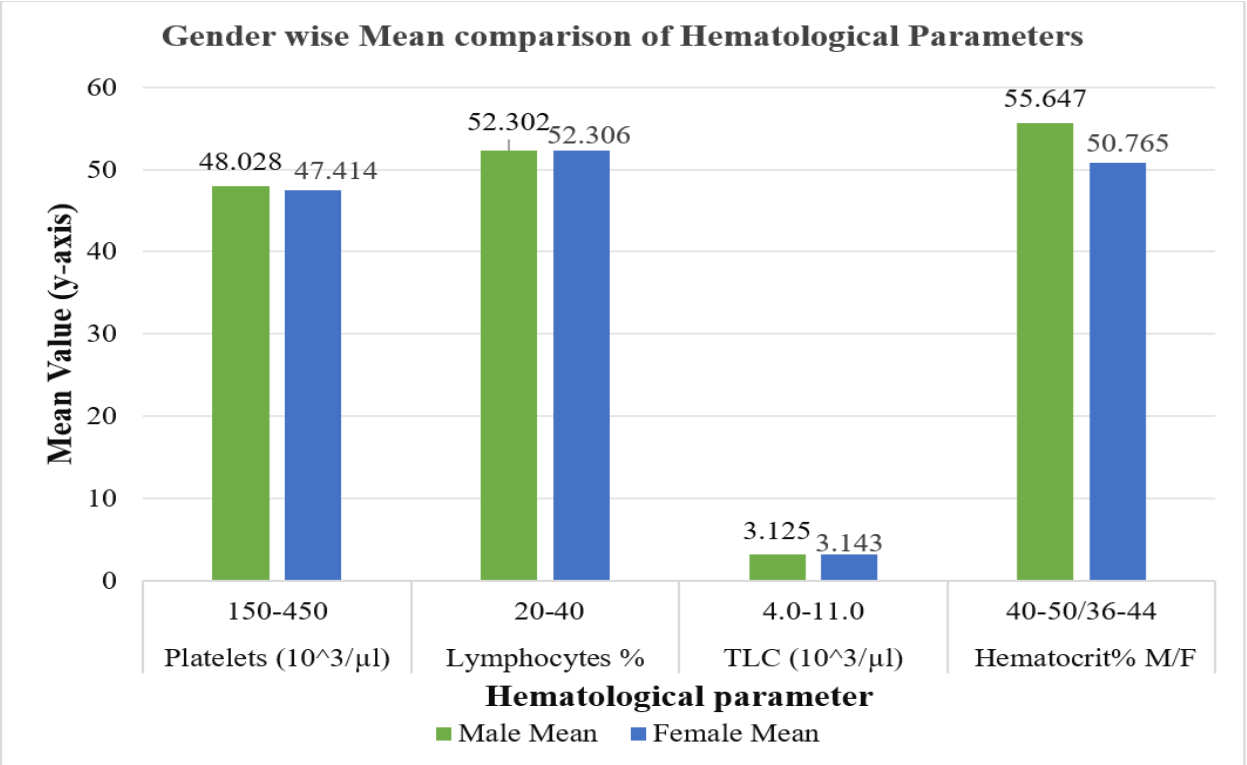

**Graph 2:** Showing overall Frequency/% of current, primary, secondary dengue infection.




**Graph 3:** Showing Variations in Mean Hematological Parameters among Female dengue patients.




**Graph 4:** Showing gender wise mean comparison of variations in Hematological Parameters of dengue patients.




**DISCUSSION**

The present study evaluated variations in platelet count, lymphocyte percentage, total leukocyte count (TLC), and hematocrit (HCT) among 250 confirmed dengue patients at ANMCH Islamabad to determine their diagnostic and prognostic significance.

A slight male predominance (55.6%) was observed, which is consistent with previously reported epidemiological trends. Murphy et al., 2020[29] and Bhugra et al., 2020[30], similarly documented higher dengue incidence among males, attributing this to increased outdoor exposure and occupational risk. The mean age (39.27 ± 13.68 years) indicates that dengue predominantly affects adults in the productive age group, aligning with Du et al., 2021[31].

Serological profiling demonstrated 38.8% current infection (NS1 positive), 30.4% primary infection, and 30.8% secondary infection. Comparable seropositivity distributions were reported by Tabassum et al., 2024[32], confirming the consistency of infection patterns within regional populations.

Among hematological parameters, platelet count showed the most profound alteration (47.76 ± 19.43 $\times 10^3$/µL; $p < 0.001$), confirming marked thrombocytopenia. This finding strongly correlates with Rai et al., 2020[33], who identified thrombocytopenia as the most significant laboratory abnormality and a predictor of disease severity. Chaloemwong et al., 2018[34] further reported significant platelet decline between days 3–10 of illness ($p < 0.001$), suggesting comparable platelet suppression across both sexes.

Lymphocyte percentage was moderately elevated (52.30 ± 4.865%; $p < 0.001$), indicating reactive lymphocytosis. Similar immune-mediated lymphocytic responses were documented by Anwar et al., 2022[35], who observed elevated lymphocyte counts in NS1 and IgM positive patients.

TLC demonstrated significant leukopenia (3.13 ± 0.36 $\times 10^3/\mu L$; $p < 0.001$), supporting findings by Nandi, 2025[36] and Sagar et al., 2024[37], who reported leukopenia in a majority of confirmed dengue cases. Bone marrow suppression and immune-mediated destruction likely explain this reduction.

Hematocrit levels were significantly elevated (53.48 ± 3.59%; $p < 0.001$), indicating hemoconcentration secondary to plasma leakage. Akhtar et al., 2025[38] similarly reported raised hematocrit levels among dengue patients. Notably, hematocrit variation between genders was statistically significant ($p < 0.001$).

## CONCLUSION

This study demonstrates that dengue infection produces distinct and quantifiable alterations in hematological parameters. Significant thrombocytopenia was observed as the most prominent laboratory abnormality, indicating marked platelet depletion as a central feature of dengue pathophysiology. In addition, total leukocyte count showed a significant reduction consistent with leukopenia, while lymphocyte percentage.

### RECOMMENDATIONS

1. Multicenter studies involving larger and more diverse populations should be conducted to enhance the generalizability of findings.
2. Longitudinal follow-up studies are recommended to evaluate the dynamic recovery pattern of hematological parameters during convalescence.
3. Future research should explore additional hematological indices such as platelet indices and lymphocyte-to-platelet ratio for improved prognostic accuracy.

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## DECLARATIONS:

### Statements and Declarations:

Data Transparency: The authors are committed to ensuring transparency in the presentation of data throughout this research endeavor.

### Ethical Approval

The study protocol was approved by the Institutional Review Board Committee (IRBC) of Al-Nafees Medical College & Hospital, Islamabad. The study adhered to ethical principles of biomedical research

**Author Contribution:** The first 4 author has contributed equally while 5th author have helped in statically analysis, 5th author is corresponding author have done critical review of paper

**Funding**

No external funding was received for this study. The research was conducted using institutional laboratory facilities at Al-Nafees Medical College & Hospital (ANMCH), Islamabad.

**Data Availability:** All datasets generated or analyzed during this study are comprehensively documented and available within the published article.

**Conflict of Interest**

The authors declare that there is no conflict of interest regarding the publication of this thesis. None of the authors has any financial, personal, or professional relationship that could have influenced the study outcomes.

**Disclosure**

This research work is part of an undergraduate thesis submitted in partial fulfillment of the requirements for the degree of Bachelor of Science in Medical Laboratory Technology at Isra University Islamabad Campus. The study was conducted as an academic research project and does not represent an ongoing funded trial or commercial investigation.

**Consent to Publication:** Publication consent is not applicable to this research project.

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