Original Article

DENGUE FEVER IN BANGLADESH: CLINICAL, LABORATORY AND GENDER-BASED INSIGHTS FROM THE 2023 OUTBREAK

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Abstract

Background: Dengue fever, transmitted by Aedes mosquitoes, *is a major public health issue in Bangladesh. Urbanization, poor sanitation, and climate change have fueled its spread, with some cases progressing to severe forms like DHF and DSS.*

Objective: This study aimed to explore gender differences in socio-demographic, clinical and laboratory characteristics of dengue patients in Bangladesh and their correlation with disease severity.

Methods: This cross-sectional study included 135 dengue patients from a hospital in Dhaka, Bangladesh, diagnosed clinically and confirmed by laboratory tests between June and December 2023. Data on demographics, clinical symptoms, vital signs, and laboratory results (e.g., platelet count, RBC, hemoglobin, liver function tests) were collected. Statistical analyses were performed using SPSS software, with p-values calculated for gender-based comparisons.

Results: Of the 135 patients, 73% were male and 27% female. Fever (94%), muscle and joint pain (96%), headache (86%), and nausea (87%) were the most common symptoms. Females reported significantly more headaches (100%) than males (78.79%, p = 0.03). No gender differences were found in vital signs, but males had significantly higher red blood cell count (RBC), hemoglobin, and hematocrit levels (p < 0.01). Platelet count was higher in females (160,000/μL), but the difference was not significant (p = 0.68). Correlations showed that lower platelet counts were negatively correlated with higher dengue-specific antibodies (IgM and IgG), suggesting a potential early indicator of disease progression. Strong positive correlations were found between RBC count and hemoglobin (r = 0.84, p < 0.01), and liver enzymes (AST, ALT) with bilirubin (r = 0.49, p < 0.01).

Conclusion: This study underscores the importance of early detection, highlighting gender differences in symptoms and the potential of platelet counts, antibodies and liver markers in predicting dengue severity and guiding management.

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Introduction

Dengue fever, caused by the dengue virus (DENV) and transmitted primarily by *Aedes aegypti* mosquitoes, is one of the most rapidly spreading vector-borne diseases globally. It is a major public health concern, particularly in tropical and subtropical regions, where urbanization, population growth, inadequate sanitation and climatic changes have

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created favorable conditions for mosquito breeding[1]. The World Health Organization (WHO) estimates that annually, approximately 50-100 million people worldwide are infected with dengue, with over 2.5 billion people living in areas at risk[2]. Despite the development of a vaccine in certain countries, no specific antiviral treatment is widely available for dengue infection, making prevention and early detection crucial for managing outbreaks[3].

In Bangladesh, dengue has emerged as a major health threat, with outbreaks occurring annually since 2000. The country has experienced dramatic increases in cases, especially in urban centers like Dhaka, where rapid urbanization, population density and inadequate mosquito control measures exacerbate the risk[4]. The predominant serotypes of the dengue virus in Bangladesh are DENV-2 and DENV-3, with the latter being particularly associated with recent outbreaks. In 2019, over 100,000 cases of dengue were reported and 164 fatalities were recorded, highlighting the severity of the disease[5].The clinical presentation of dengue varies from mild febrile illness to severe forms, such as Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS), which can lead to multi-organ failure and death. The classic symptoms include high fever, retro-orbital pain, severe headache, rash, muscle and joint pain and nausea[6]. However, recent outbreaks in Bangladesh have shown shifts in the clinical manifestations, with a decrease in rash occurrences, an increase in gastrointestinal symptoms like diarrhea and ascites, and changes in hematological parameters such as leukopenia and elevated liver enzymes[7]. These evolving patterns suggest potential changes in the virus's behavior, co-infections or immune responses, which may affect the severity of the disease and its clinical outcomes.

As the burden of dengue continues to rise in Bangladesh, understanding the socio-demographic and clinical factors that influence disease severity becomes essential for optimizing diagnosis and management. This study aims to explore these factors by investigating the clinical presentations and laboratory findings of dengue patients during the 2023 outbreak. By identifying trends and shifts in the disease's clinical profile, the study seeks to contribute to better disease management strategies, early detection, and prevention in future outbreaks. The findings of this study will be pivotal in refining diagnostic protocols, guiding therapeutic interventions, and

improving patient outcomes in dengue-endemic regions.

Methodology

Study Design
This study was a cross-sectional observational study conducted at a tertiary care hospital in Bangladesh to examine the demographic, clinical and laboratory characteristics of dengue patients. The study was designed to explore gender differences in dengue's clinical manifestations and laboratory findings, as well as to assess correlations between laboratory parameters and disease severity. All participants (or their guardians) provided written informed consent. The study was carried out between June 2023 and December 2023, capturing data from dengue patients admitted to the hospital.

Study Population
The study included a total of 135 dengue patients, consisting of 99 males (73%) and 36 females (27%), all of whom were diagnosed based on clinical symptoms and confirmed through laboratory tests, including NS1 antigen, IgM and IgG. The inclusion criteria for the study were: a confirmed diagnosis of dengue based on serological tests, patients aged e" 1 year, and the inclusion of both male and female patients. Exclusion criteria consisted of patients with coexisting chronic conditions such as diabetes, hypertension, or liver disease, pregnant women, patients diagnosed with other febrile illnesses (e.g., malaria or typhoid), and patients who either refused to participate or could not provide proper consent. This inclusive approach ensured the representation of a diverse demographic and clinical spectrum of dengue patients, reflecting the Bangladeshi population during the study period.

Data Collection

Demographic Information
Demographic data for the study included the age and gender of all 135 dengue patients. Age was categorized into seven distinct groups: <10 years, 11-20 years, 21-30 years, 31-40 years, 41-50 years, 51-60 years, and >60 years. The gender distribution was recorded, with 99 males (73%) and 36 females (27%). Age and gender information were crucial for understanding the demographic distribution of dengue patients in the study, and the mean age and standard deviation (SD) for each gender group were calculated to assess any

potential differences in age between male and female patients. This detailed demographic analysis allowed the study to capture variations in dengue infection patterns based on age and gender.

Clinical Information

Clinical symptoms were systematically collected through patient interviews and physical examinations upon hospital admission. The primary symptoms tracked included fever, headache, muscle and joint pain, nausea, vomiting, pain behind the eyes, rash, abdominal pain, lethargy, restlessness, general weakness, persisting vomiting, and sleepiness. Each symptom was documented for both male and female patients and the frequency of symptom occurrence was recorded. This information was critical for comparing gender-based symptom prevalence. The significance of gender differences in symptom presentation was evaluated by calculating p-values for each symptom, which provided insights into the variation of clinical manifestations across genders in dengue patients.

Vital Signs

Vital signs were monitored at the time of admission and periodically throughout the hospital stay to assess the severity of the dengue infection. Key parameters measured included systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse rate (PR), and respiratory rate (RR). Systolic and diastolic blood pressures were recorded in mmHg, pulse rate in beats per minute (bpm), and respiratory rate in breaths per minute (bpm). These vital signs were measured using standard clinical instruments, and the data were used to compare vital sign variations between male and female patients. The analysis of vital signs aimed to evaluate any gender-based differences in the clinical response to dengue infection and to monitor for potential complications.

Laboratory Parameters

Upon admission, patients underwent several laboratory tests to assess various hematological and biochemical parameters indicative of dengue infection and its impact on the body. These tests included a Complete Blood Count (CBC) to measure RBC count, hemoglobin (Hb), hematocrit (HCT), platelet count, and white blood cell (WBC) count. Liver function tests (LFTs), including AST, ALT and total bilirubin, were performed to evaluate liver involvement. Renal function tests (RFTs), such as creatinine levels, were measured to assess kidney function, while albumin levels were also recorded. For confirming dengue infection, serological tests (NS1 antigen, IgM and IgG levels)

were conducted. These laboratory parameters were analyzed to identify any abnormalities and to explore potential correlations between various biomarkers in dengue patients. Standard techniques in the hospital's pathology department were used to ensure accuracy and consistency in all laboratory measurements.

Statistical Analysis

Data were analyzed using SPSS (version 25). Descriptive statistics, including frequencies, percentages, means, and standard deviations, summarized the data. The Chi-square test compared categorical variables, while the Independent t-test compared continuous variables between males and females. Pearson's correlation coefficient assessed the relationships between laboratory parameters. A p-value of <0.05 was considered statistically significant. Gender differences in clinical and laboratory presentations were specifically analyzed.

Results

Out of 135 patients 99 were male and 36 were female. Males constitute 73% of the sample, and females make up 27%. The data suggests a higher prevalence of dengue in males compared to females. The average age for males is 30.17 years and for females, it is 27.03 years. The total average age is 29.57 years. The p-value (0.315) indicates no significant age difference between male and female groups. Maximum numbers of cases were observed in <10 years and the age range belong to 31-40 years both in male and female patients. The age and gender distribution of dengue patients showed in table I.

Table-I
Demographic characteristics of dengue patients

Age Group	Male (n = 99)	Female (n = 36)	Total (n = 135)
<10	20 (20.2%)	8 (22.2%)	28 (20.7%)
11-20	15 (15.2%)	7 (19.4%)	23 (17.0%)
21-30	17 (17.2%)	4 (11.1%)	21 (15.6%)
31-40	19 (19.2%)	9 (25.0%)	28 (20.7%)
41-50	9 (9.1%)	5 (13.9%)	14 (10.4%)
51-60	10 (10.1%)	2 (5.6%)	12 (8.9%)
>60	9 (9.1%)	1 (2.8%)	10 (7.4%)

In this study, fever was the most common symptom, affecting 94% of patients, with 100% of females and 91% of males reporting it. Headache occurred more frequently in females (100%) compared to males (80%, p = 0.03). Muscle and joint pain was seen in 96% of patients, with no significant gender difference (p = 0.25). Nausea (87%) and vomiting (82%) were more

common in females (94% and 89%, respectively), though not significantly so (p = 0.07 and p = 0.12). Pain behind the eyes was reported by 73% of patients, with no significant gender difference (p = 0.15). Rash, abdominal pain, lethargy, and restlessness were less common overall and showed no significant gender differences. These findings suggest that while headache and nausea were more prevalent in females, symptoms like fever and muscle pain were similarly common across genders (Table II).

Table-II
Clinical Symptoms in Dengue Patients

Symptoms	Male (n=99)	Female (n=36)	Total (n=135)	P-value
Fever	91%	100%	94%	0.05
Headache	80%	100%	86%	0.03
Muscle and Joint Pain	95%	97%	96%	0.25
Nausea	82%	94%	87%	0.07
Vomiting	78%	89%	82%	0.12
Pain Behind the Eyes	70%	80%	73%	0.15
Rash	25%	22%	24%	0.75
Abdominal Pain	22%	30%	25%	0.18
Lethargy	18%	24%	20%	0.32
Restlessness	14%	18%	16%	0.50
General Weakness	17%	23%	19%	0.35
Persisting Vomiting	10%	12%	11%	0.65
Sleepiness	8%	10%	9%	0.60

There were no significant differences in systolic blood pressure (118.29 ± 10.42 vs. 117.47 ± 9.84), diastolic blood pressure (78.24 ± 7.85 vs. 76.64 ± 8.32), pulse rate (92.14 ± 8.83 vs. 93.16 ± 8.83), or respiratory rate (17.75 ± 2.08 vs. 17.81 ± 1.90) between male and female dengue patients (p > 0.05 for all parameters). These findings suggest that dengue affects vital signs similarly in both genders, with no significant gender-based differences. Monitoring these parameters remains important for detecting severe complications, such as severe dengue or organ dysfunction (Table III).

Table IV presents a comparison of laboratory parameters between male and female dengue patients. Males showed significantly higher values in red blood cell count (RBC), hemoglobin, and hematocrit compared to females (p-values: RBC = < 0.05, Hemoglobin = < 0.01, Hematocrit = < 0.01), indicating a gender-based difference in these parameters. However, no significant differences were observed between males and females for platelet count, creatinine levels, white blood cell count, liver function tests (AST, ALT, bilirubin), or albumin levels (p-values > 0.05). The platelet count, despite being higher in females (160 ± 99.86), did not show statistical significance (p = 0.68), nor did other markers such as WBC differential or liver enzymes. Overall, while certain hematological differences (RBC, hemoglobin, hematocrit) were observed, gender did not substantially affect other laboratory parameters in dengue patients.

Table 5 highlights significant correlations between selected laboratory parameters in dengue patients. A negative correlation was found between platelet count and both Dengue IgM (r = -0.26533, p = 0.00641) and Dengue IgG (r = -0.45, p < 0.01), indicating that as platelet count decreases, IgM and IgG levels increase. A strong positive correlation was observed between RBC count and Hemoglobin (r = 0.83756, p < 0.01), and also between RBC count and Hematocrit (r = 0.71948, p < 0.01), suggesting a linear relationship between these hematological parameters. Additionally, AST and ALT levels showed a positive correlation with Bilirubin (r = 0.49267, p < 0.01), while Albumin had a negative correlation with Bilirubin (r = -0.26891, p = 0.00625).

Table-III
Vital Signs of Dengue Patients (n= 135)

Parameter	Male (n = 99)	Female (n = 36)	P-value
Systolic Blood Pressure (mm/Hg)	118.29 ± 10.42	117.47 ± 9.84	0.65
Diastolic Blood Pressure (mm/Hg)	78.24 ± 7.85	76.64 ± 8.32	0.29
Pulse Rate (bpm)	92.14 ± 8.83	93.16 ± 8.83	0.72
Respiratory Rate (b/m)	17.75 ± 2.08	17.81 ± 1.90	0.87

Table-IV
Laboratory Parameters in Dengue Patients

Parameter	Male (Mean ± SD)	Female (Mean ± SD)	P-value
RBC Count (x10^6/µl)	4.927 ± 0.71	4.41 ± 0.77	< 0.05
Hemoglobin (g/dl)	13.62 ± 1.75	11.62 ± 2.104	< 0.01
Hematocrit (HCT) (%)	40.77 ± 6.18	35.61 ± 6.05	< 0.01
Platelet Count (x10³/µl)	139.101 ± 82.58	160 ± 99.86	0.68
Creatinine (mg/dl)	0.947 ± 0.310	0.818 ± 0.314	0.21
WBC Count (x10^3/µl)	7.12 ± 2.10	6.85 ± 2.33	0.47
Neutrophils (%)	64.51 ± 11.5	61.85 ± 12.09	0.45
Lymphocytes (%)	27.52 ± 9.22	30.38 ± 9.98	0.32
Monocytes (%)	5.56 ± 2.09	4.92 ± 2.03	0.34
Eosinophils (%)	2.10 ± 0.83	2.55 ± 1.13	0.62
Bilirubin Total (mg/dl)	0.56 ± 0.31	0.58 ± 0.32	0.78
AST (U/L)	95.5 ± 56.27	105.62 ± 62.91	0.38
ALT (U/L)	85.9 ± 51.12	92.35 ± 57.12	0.45
Albumin (g/dl)	3.8 ± 0.5	3.6 ± 0.5	0.35

Table-V
Correlation of Selected Parameters in Dengue Patients

Parameter 1	Parameter 2	Correlation Coefficient (r)	P-value
Platelet count	Dengue IgM Level	r = -0.26533	0.00641
Platelet count	Dengue IgG Level	r = -0.45	< 0.01
RBC Count	Hemoglobin (HB)	r = 0.83756	< 0.01
Hematocrit (HCT)	Hemoglobin (HB)	r = 0.76825	< 0.01
RBC Count	Hematocrit (HCT)	r = 0.71948	< 0.01
AST (SGOT)	ALT (SGPT)	r = 0.65341	< 0.01
AST (SGOT)	Bilirubin (Total)	r = 0.49267	< 0.01
Albumin	Bilirubin (Total)	r = -0.26891	0.00625
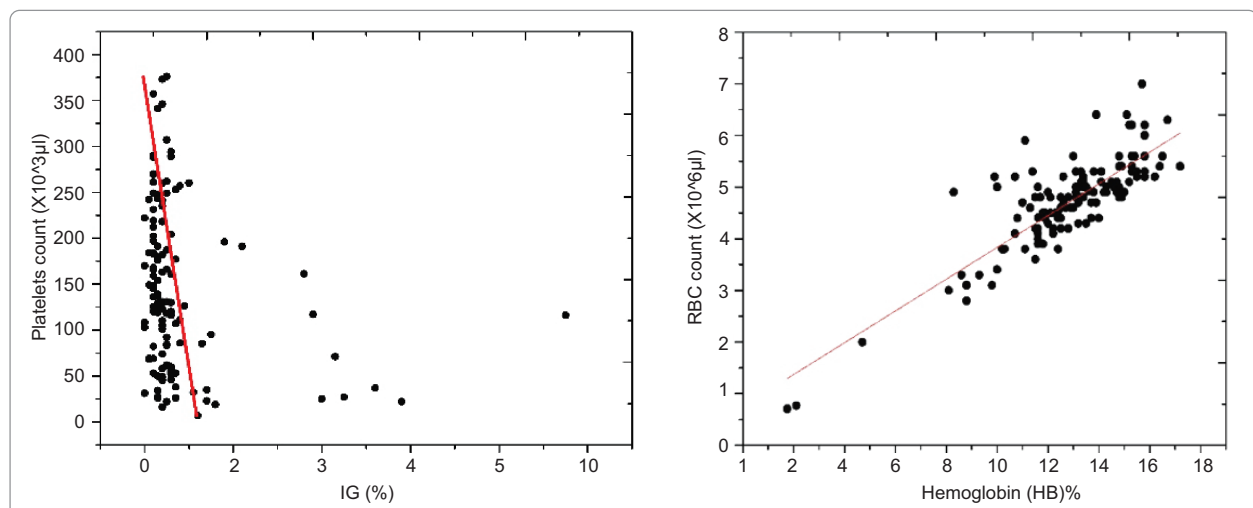
Figure 1: *Photograph showing correlation plots (a) correlations between platelet count and dengue IgM, (b) correlation between RBC Count and Hemoglobin*

Discussion

Dengue fever is a growing public health concern in Bangladesh. This study aimed to assess the demographic, clinical, and laboratory characteristics of dengue patients, focusing on gender differences. Our findings highlight key patterns in dengue's epidemiology and clinical presentation, showing both similarities and differences between male and female patients. The study revealed a significantly higher prevalence of dengue among males (73%) compared to females (27%), which is consistent with several studies from dengue-endemic regions[8,9]. The male preponderance observed in this cohort may be attributed to occupational and environmental factors, as males are more likely to engage in outdoor work or activities that increase exposure to Aedes mosquitoes. However, some regional studies found a more balanced gender distribution. The mean age of patients in this study was 29.57 years, with no significant difference between males (30.17 ± 20.5) and females (27.03 ± 16.18), indicating that age did not significantly vary between genders. These findings are similar to those from other studies in South Asia, where the age distribution of dengue patients largely involves young adults, although there is a notable peak in incidence among children under 10 years. The distribution in our cohort further suggests that the highest number of cases were observed in both younger and middle-aged groups (<10 years and 31-40 years). This may reflect an increased risk of infection due to school attendance in children and outdoor occupational exposure in adults.

Fever was the most common symptom in our cohort, consistent with the literature that reports fever in over 90% of dengue patients globally. A particularly noteworthy finding in this study is the significantly higher frequency of headache in females (100%) compared to males (78.79%, p = 0.03). These results align with the findings of other studies, who noted that females with dengue tend to experience more pronounced headache and other central nervous system-related symptoms[10]. The overall distribution of symptoms was similar between genders for most other clinical features, such as muscle and joint pain (96%), nausea (87%), and vomiting (82%), with only slight differences in prevalence. However, these differences were not statistically significant, which is consistent with previous studies, where the clinical manifestation of dengue was found to be similar across genders. Symptoms like rash, abdominal pain, and

lethargy were less common overall, and no significant gender differences were found, suggesting that they may be more closely linked to the severity of the infection rather than gender itself.

In terms of vital signs, no significant differences between males and females were observed for systolic and diastolic blood pressure, pulse rate, or respiratory rate. These results support the findings from other studies, which have shown that dengue affects vital signs similarly in both genders[11]. Monitoring these parameters is critical for identifying severe dengue and preventing complications such as organ failure or shock. Although gender did not influence vital signs in our study, continuous surveillance of these parameters remains important in managing the progression of the disease, especially in severe cases.

Laboratory tests revealed several significant genders-based differences in hematological parameters. Males exhibited higher levels of red blood cell count (RBC), hemoglobin, and hematocrit, with p-values of < 0.05 for RBC and < 0.01 for hemoglobin and hematocrit. These differences are in line with the general physiological understanding that males typically have higher hematocrit and hemoglobin levels due to factors such as greater muscle mass and higher levels of testosterone, which stimulate erythropoiesis[12]. Interestingly, platelet count, while higher in females, did not show a statistically significant difference (p = 0.68), suggesting that gender does not significantly impact platelet dynamics in dengue, which may be influenced more by the severity of the infection and immune response rather than gender itself. Our results regarding liver function tests, creatinine levels, and white blood cell counts showed no significant gender differences (p > 0.05), suggesting that dengue-induced changes in these parameters are similar across genders. This finding aligns with those from previous studies, indicating that gender does not influence the systemic effects of dengue on renal or liver function in a significant way[13].

One of the key findings of this study was the identification of significant correlations between various laboratory parameters. Specifically, we observed a negative correlation between platelet count and dengue IgM (r = -0.26533, p = 0.00641) and dengue IgG (r = -0.45, p < 0.01). This indicates that as platelet count decreases, the levels of dengue-specific antibodies (IgM and IgG) increase, which may be a reflection of the immune response in the acute phase of infection.

Such correlations suggest that platelet reduction could serve as an early indicator of disease progression. Additionally, we found strong positive correlations between RBC count and hemoglobin (r = 0.83756, p < 0.01) and between RBC count and hematocrit (r = 0.71948, p < 0.01), confirming the expected relationship between these hematological parameters. Furthermore, liver enzymes (AST and ALT) showed positive correlations with bilirubin (r = 0.49267, p < 0.01), while albumin levels had a negative correlation with bilirubin (r = -0.26891, p = 0.00625), highlighting the involvement of hepatic dysfunction in dengue and the potential for these parameters to serve as markers of disease severity[14].

Our findings align with studies from other dengue-endemic countries reporting gender differences in clinical and laboratory parameters. However, unlike some studies, we did not observe significant differences in platelet count and liver enzymes, suggesting that factors like sample size, study setting, and disease severity may influence results. Regional studies in Bangladesh show similar trends, highlighting the need for further research on how these factors affect dengue progression and outcomes[15].

Conclusion

This study highlights key demographic, clinical, and laboratory features of dengue patients in Bangladesh, revealing significant gender-based differences in certain parameters. Males were found to have a higher prevalence of dengue, with elevated red blood cell count, hemoglobin, and hematocrit compared to females. Fever was the most common symptom, with headache and nausea being more frequent in females. No significant gender differences were observed in vital signs or platelet counts, suggesting similar disease impact across genders in these aspects. Correlations between laboratory parameters, including platelet count and dengue IgM/IgG levels, further offer insight into disease progression. These findings underscore the importance of tailored clinical management and continuous monitoring of hematological and vital parameters, particularly in the context of dengue's growing burden in Bangladesh. Further research is needed to explore the underlying causes of gender differences in clinical and laboratory manifestations of dengue.

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