



## A cross-sectional survey on the dengue situation in Rajshahi city, Bangladesh

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### Abstract

This study was performed to figure out the prevalence and pattern of the symptoms and diagnosis of patients during a dengue outbreak at Rajshahi metropolitan city in Bangladesh and to assess the significance of biochemical profiles and physiological complications of dengue patients. In this cross-sectional survey, a set of questionnaires was used for 150 randomly selected dengue patients in Rajshahi metropolitan city. An excess of male patients (80.66%) was found among reported dengue cases, comparing to females (19.33%). Thirty-five (23.33%) of infected patients were from the city of Rajshahi whereas 115 (76.67%) patients were from outside. Less than 7% patients had positive IgG or IgM values and only 6% had both. Out of 150, 94 patients (62.67%) had platelet counts lower than 150 k/ $\mu$ L. All patients had fever and over 90% patients had nausea, vomiting and pain in muscle and lower abdomen. Joint pain (74%), dark urine (64%) and bloody diarrhea (12.66%) were also reported but no patient experienced skin rash. Two patients (1.33%) suffered from acute pancreatitis as well as dementia and paralysis. Platelet count of patients displayed notable association with hypotension, bloody diarrhea and hydration status. Though Bangladesh is facing dengue outbreaks for over fifty years, the current situation is exacerbated by the rising number of deaths. Public health management needs to be enhanced and better organized to cope up with the dengue situation in Bangladesh.

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## Introduction

Dengue is a mosquito-borne viral disease that commonly occurs in tropical and sub-tropical regions. This arbovirus is a member of Flaviviridae family, transmitted to the host by two important vectors, female *Aedes aegypti* and *Aedes albopictus*, the latter is the secondary vector (CDC, 2020). These two types of mosquitoes mainly bite during daytime (CDPH, 2020). There are four serotypes of dengue virus which can cause dengue, DENV-One, DENV-Two, DENV-Three and DENV-Four. Three forms of dengue disease have been observed in dengue cases-dengue fever (DF), dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS).

Dengue infection is characterized by high fever, usually rising to 40°C or 104°F, severe headache along with pain behind the eyes, myalgia, arthralgia, nausea, vomiting, skin rash and swollen glands. DHF and DSS are collectively termed as 'severe dengue', and symptoms may include hemorrhage in the body, specially bleeding from nose and gums, blood in stool or vomit, frequent vomiting, abdominal pain, tiredness, restlessness, irritability (WHO, 2020; CDC, 2019). Dengue fever has three stages- the febrile phase, the critical phase and recovery phase. Severe dengue symptoms are observed in critical phase (Jain *et al.*, 2014). Clinical features of dengue infection manifests thrombocytopenia (platelets count <150 k/ $\mu$ L), electrolyte imbalance due to fluid loss leading to severe situations like pleural effusion, pericardial effusion, sudden rise in hematocrit (Rajapakse, 2011). Other rare physiological complications like neurological complications, acute kidney injury (AKI), hepatic and pancreatic involvement have also been reported in several cases (Jain *et al.*, 2014; Samanta, 2015; Vachvanichsanong *et al.*, 2015; Li *et al.*, 2017).

Previous statistical estimations show occurrence of 390 million dengue infections annually and three point nine billion people in 128 countries are at the risk of dengue infection (Brady *et al.*, 2012; Bhatt *et al.*, 2013). The estimation by WHO show an alarming increase in dengue occurrence from two point two

million in 2002 to over three point three four million in 2016 and another estimation of an increase from one point two million in 2008 to over three point three four million in 2016 in the Americas, South-East Asia and Western Pacific regions (WHO, 2019). Also, according to the WHO, 50–100 million cases are occurring annually.

In Bangladesh the dengue situation first occurred in 1964. It was named 'Dacca fever' back at that time (Ordoñez *et al.*, 1966). First epidemic of dengue occurred in 2000 followed by the dengue cases between 1964 and 1999. The cases were not officially reported until 2000 (Yunus *et al.*, 2001). According to the World Health Organization, 970 cases arose in 1999. In 2000, 5551 cases were reported and in 2002, 6232 cases were reported. DHF was first detected in Bangladesh during this outbreak of 2000 followed by a massive epidemic in 2002 (Rahman *et al.*, 2002). In 2000, 5551 cases were reported and in 2002, 6132 cases were reported (Hasan, 2019). Between 2000 and 2009, 24 of 64 districts in Bangladesh were submerged in dengue situations whereas in 2019 alone dengue has spread to 50 districts. From the reports dated August 31, 2023, there were a total of 123,808 dengue patients and 593 confirmed deaths recorded within the time frame from January 1, 2023, to August 31, 2023. This represents the highest number of patients and deaths in the last five years (DGHS, 2023).

## Materials and methods

### Study design

This study is a cross-sectional survey carried out in Rajshahi city, Bangladesh on one hundred and fifty patients with dengue fever with the help of a set of questionnaires. Data were collected for over a period of one month. The survey included patients aged from five to seventy-five years, who were affected by dengue infection. The study protocol was approved by Ethical clearance of the experiments using Swiss albino mice was provided by the Institutional Animal, Medical Ethics, Bio-safety and Bio-security Committee (IAMEBBC) for Experimentations on Animals, Human, Microbes and Living Natural

Sources, Institute of Biological Sciences (IBSc), University of Rajshahi, Bangladesh (Memo No. 102(6)/320/IAMEBBC/IBSc).

#### Question format

Twenty-nine questions were organized in four sections. Seven questions were in a statement format, other 22 questions were multiple choice questions with “yes” and “no” options. We investigated four main areas-

I. The patient’s demographic information (four questions): sex, age, present address, if anyone is infected from the family.

II. Symptoms of the disease (eight questions): nature of fever, abdominal pain, nausea and vomiting, bloody diarrhea and vomiting, dark urine (Hydration status), blood pressure, skin rash, muscle or joint pain.

III. How the patients became infected (five questions): this section was divided into two sub-sections, if the patient was infected within Rajshahi city or from outside of Rajshahi city. Both the sub-sections had five common questions about- living area, water clogged domestic containers and if they were cleaned regularly, cleanliness of the bathroom/washroom, if the patient visited any infected person before he himself was infected, if the patient traveled too frequently.

IV. Diagnosis (seven questions): which medical tests were performed, test results for NS1, IgM, and IgG, platelet counts, how the patient reacted after

diagnosis, when the patient was admitted into the hospital/clinic after diagnosis.

#### Statistical analysis

Analysis of data was done using IBM SPSS statistics version 25.0 and 107 Microsoft Excel 2016. In this study, two variables were continuous- age and platelet count. Age was found to be skewed hence median (IQR) was used to measure the average value of age. Chi-squared test was used to quantify the categorical variables (sex, locations where infected).

All clinical signs and symptoms were presented as categorical variables as well. Correlation between platelet counts and clinical symptoms was measured using the Spearman’s correlation coefficient test. Thrombocytopenia was defined as platelet count <150 k/ $\mu$ L (Izak and Bussel, 2014). The odds ratios (ORs) with 95% confidence intervals (CI) were measured by applying binary logistic regression analysis for estimating the occurrence for clinical symptoms as outcomes and thrombocytopenia as a predictor. Age and sex were considered as confounders.

#### Results

One hundred and fifty dengue patients from Rajshahi city participated in this survey study. Among them 121 (80.66%) participants were male and 29 (19.33%) were female. Majority of patients (76.67%) became infected in the city of Rajshahi whereas 23.33% were infected outside of the city (Fig. 1).

And most of the patients belonged to the age group of 18 to 30, and their median age (IQR) was 28 (23.00, 45.00) (Table 1).

**Table 1.** Baseline characteristics of patients.

Parameters	Median (IQR)/No. of %
Age	28 (23.00, 45.00)
Sex	
Male	121 (80.66)
Female	29 (19.33)
Locations where infected	
Dhaka	115 (76.7)
Outside of Dhaka	35 (23.3)

Continuous variable (age) is represented as median (IQR). Categorical variables (sex and locations where infected) are presented as no. of %.

Clinical signs and symptoms observed in dengue patients were hypotension (83.3%), bloody diarrhea (12.7%), nausea and vomiting (94.0%), abdominal pain (93.3%), joint pain (74.0%), muscle pain (89.3%), dehydration (64.0%) and the laboratory

diagnostic results showed that NS1 was positive in all cases (100%), IgG positive (10.7%), IgG negative (89.3%), IgM positive (12.0%), IgM negative (88.0%) (Table 2).

**Table 2.** Frequency of clinical signs and symptoms.

Clinical signs and symptoms	No. of %
Thrombocytopenia	56.7
Hypotension	83.3
Bloody diarrhea	12.7
Nausea and Vomiting	94.0
Abdominal pain	93.3
Joint pain	74.0
Muscle pain	89.3
Hydration status (dehydrated)	64.0
IgG positive	10.7
IgG negative	89.3
IgM Positive	12.0
IgM negative	88.0

Our data showed that 14 (9.33%) patients had the lowest range of platelets count, which was 11-24 k/ $\mu$ L and 56 (37.33%) patients had the highest range of platelets count, which was above 150 k/ $\mu$ L. A total of 94 (62.67%) patients had platelets count below 150 k/ $\mu$ L (Fig. 2).

Platelet count showed significant correlation with Age

( $r_s = -0.298$ ), Hypotension ( $r_s = 0.508$ ), Bloody diarrhea ( $r_s = 0.427$ ), Nausea and vomiting ( $r_s = 0.188$ ), Joint pain ( $r_s = 0.265$ ), hydration status ( $r_s = 0.437$ ), IgG ( $r_s = 0.209$ ), IgM ( $r_s = 0.163$ ).

On the other hand, Sex ( $r_s = -0.038$ ), Abdominal pain ( $r_s = 0.070$ ), Muscle pain ( $r_s = 0.122$ ) exhibited weak correlation. Table 3.

**Table 3.** Correlations of platelet count with demographics, clinical symptoms and seroprevalence.

Clinical symptoms	Platelet count (K/ $\mu$ L)	
	$r_s$ value	$p$ -value
Age	-0.298	<0.001
Sex	-0.038	0.641
Hypotension	0.508	<0.001
Bloody diarrhea	0.427	<0.001
Nausea and vomiting	0.188	<0.05
Abdominal pain	0.070	0.392
Joint pain	0.265	<0.01
Muscle pain	0.122	0.136
Hydration status	0.437	<0.001
IgG	0.209	<0.05
IgM	0.163	<0.05

The  $r_s$  value and  $p$ -values were obtained from the Spearman's Correlation Coefficient test.

Progression of severe dengue was associated with concurrent decrease in platelet count compared to normal values. Hypertension (OR = 21.78, 95% CI: 4.82, 98.42), Bloody diarrhea (OR = 19.44, 95% CI: 2.46, 153.40), Nausea & Vomiting (OR = 7.75, 95% CI: 1.42, 42.41) were significantly associated with thrombocytopenia. Hydration status (OR = 4.90, 95%

CI: 2.33, 10.30) and Joint pain (OR = 2.53, 95% CI: 1.6, 5.52) showed a positively association, while Abdominal pain OR = 2.12, 95% CI: 0.55, 8.26), Muscle pain OR = 2.04, 95% CI: 0.68, 6.13) were not significantly associated with thrombocytopenia (Table 4).

**Table 4.** Associations between thrombocytopenia and the odds ratio of dengue clinical symptoms.

Variable	Dengue clinical symptoms						
	Hypotension	Bloody diarrhea	Nausea and vomiting	Abdominal pain	Joint pain	Muscle pain	Hydration status
	$\beta$ (95% CI)	$\beta$ (95% CI)	$\beta$ (95%CI)	$\beta$ (95% CI)	$\beta$ (95% CI)	$\beta$ (95% CI)	$\beta$ (95% CI)
Thrombocytopenia	21.78 (4.82, 98.42)***	19.44 (2.46, 153.40)**	7.75 (1.42, 42.41)*	2.12 (0.55, 8.26)	2.53 (1.6, 5.52)*	2.04 (0.68, 6.13)	4.90 (2.33, 10.30)***

Results were derived from binary logistic regression analysis.

Confounders: Age and Sex

Abbreviation: OR, Odds ratio; CI, class interval.

\*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ .

## Discussion

In 2019, Bangladesh experienced its most severe outbreak, originating in Dhaka city and later spreading to all regions of the country (Hasan *et al.*, 2021). In our study, out of the one hundred and fifty patients, 35 (23.33%) patients were infected from Rajshahi city and 115 (76.67%) patients were infected from outside of Rajshahi city. Majority of the infected individuals were male which constitutes 80.66% of

the total patients, a reasonable explanation is that males change their locations more frequently than females and also stay at hotels, inns, rest-houses for professional purposes. In most cases, these places are handled by non-professional employees and are not maintained by proper hygienic practices.

For males, these situations may enhance the opportunities of being more exposed to mosquitoes.

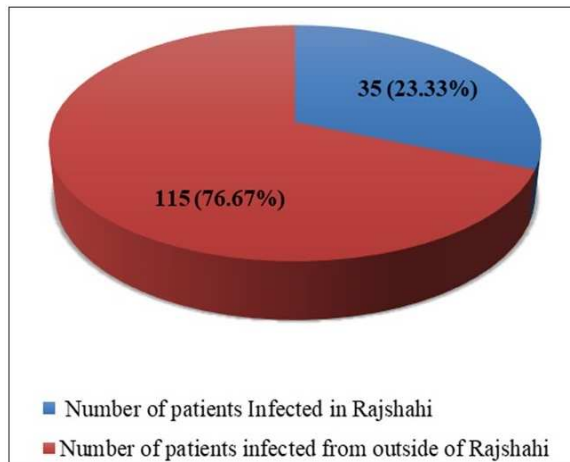
**Table 5.** Estimation of infection status.

No. of patients	Test result for IgM	Test result for IgG	Infection status
10 (6.67%)	+	-	Recent primary infection
6 (4%)	-	+	Recent secondary infection
9 (6%)	+	+	Recent secondary infection
125 (83.33%)	-	-	No recent infection

Negative IgM or IgG within three to five days of viremia indicates primary infection, and, positive IgM or negative IgG within three days of viremia indicates a secondary infection (Changal *et al.*, 2016; WHO, 2009). If the antibody measurement is done after three to five days of the disease onset, we barely conclude them as active infections rather than recent infections. All the patients were diagnosed between 5<sup>th</sup> to 9<sup>th</sup> days of the onset of dengue symptoms.

83.33% had negative test results both for IgM and IgG measurement indicating the infection status as non-recent infections. 6.67% patients had recent primary infections and 4% had recent secondary infections. 6% had recent secondary infections (Table 5) (Lima *et al.*, 2012). At the onset of the disease, IgM starts to appear in the serum and it is more easily detectable as the days passed but after two to three months, their appearance in serum was undetectable. IgG is

generally detectable on the 7<sup>th</sup> day of disease onset. 94% had negative result for the IgG test, thereby interpreting the fact of being diagnosed around that time.

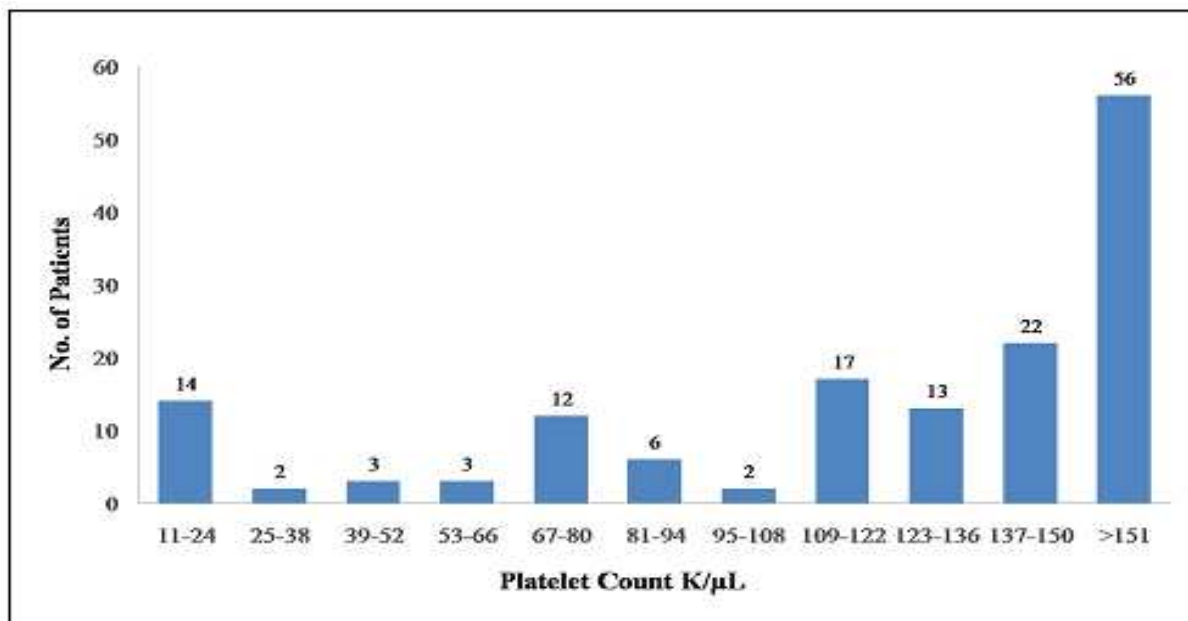


**Fig. 1.** Percentages of patients infected in and outside of Rajshahi city.

Normal platelet count of the human body is 150-400 K/ $\mu$ L of total blood volume (Izak and Bussel, 2014). In dengue fever, the total number of platelets drops

below 150 K/ $\mu$ L per microliter causing thrombocytopenia which is the most unique clinical feature of dengue disease. Majority of patients (56.7%) had thrombocytopenia with platelet count ranging from 11-150 K/ $\mu$ L. 9.33% had severe thrombocytopenia having a platelet count range of 11-24 K/ $\mu$ L. In case of 43.33%, platelet count was in normal range, above 150 K/ $\mu$ L. A wide range of symptoms were observed including four rare cases of pancreatic and neurological complications.

The most common symptom of dengue disease is high fever which was observed in all of these patients. Another common symptom is skin rash which was completely absent in all patients. Also 64% had dark urine (Hydration status) and none had acute kidney injury. 1.33% had acute pancreatitis. Pancreatic damage and enlarged pancreas have also been reported in several cases. Pancreatitis is characterized by abdominal pain which can be confused with traditional dengue symptom.



**Fig. 2.** Distribution of patients by validating the platelet Counts (K/ $\mu$ L).

Encephalopathy and encephalitis are characterized by fever, headache, nuchal rigidity, seizures delusion, dementia, depression, lethargy, reduced sensitivity, and paralysis observed in rare dengue cases (Ramos *et al.*, 1998; Li *et al.*, 2017). Neurological complications characterized by dementia and

paralysis below the waist had been observed in 1.33% of patients. 2% patients had undergone ALT and AST tests with normal test results.

## Conclusion

Bangladesh has been encountering dengue for more than 50 years. Public health managements should be more enriched and organized to cope up with the ongoing dengue season. Keen observation should be developed in order to monitor renal, pancreatic and neurological defects along with other organ dysfunctions. The biochemical profile of the patients should be more exaggerated- complete blood count test, pancreatic amylase and lipase test, liver ALT and AST test, kidney function test should be included in order to avoid severe complications. Raising public awareness is also important for creating proper knowledge of health and attitude towards a clinical situation and for creating the habit of taking necessary steps as soon as possible.

## Conflict of interest statement

Authors declare that they have no competing interest.

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The study received no funding.

## Author Contributions

IH wrote the main study protocol and designed the study. HMH, KNIR and MMHJ performed the survey and collected the data. SK, HMH and MPH did data analysis. SK and HMH wrote the initial draft of the manuscript, which was edited and revised by IH. IH provided administrative support and supervised the project. All authors read and approved the final manuscript.

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