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Original Research Article

Assessment of risk factors and early warning signs for mortality in children with severe dengue at tertiary care hospital, Dhaka, Bangladesh: a prospective observational study

Moshrefa Newaz[1]*, M. Mahbubul Hoque[2], Mashhura Huq[3], Sabrina Akter[4], Tahera Nasrin[5], Fahmida Hossain[3], Afsana Khanom[6]

[1]Department of Pediatrics, Islami Bank Central Hospital, Dhaka, Bangladesh
[2]Department of Pediatrics Medicine (Neonatal ICU), Bangladesh Institute of Child Health and Dhaka Shishu (Children) Hospital, Sher-e-Bangla Nagar, Dhaka, Bangladesh
[3]Department of Pediatrics, Ad-din Women's Medical College, Dhaka, Bangladesh
[4]Department of Pediatrics, Ad-din Sakina Women's Medical College, Jashore, Bangladesh
[5]Department of Pediatrics, Ibn Sina Hospital, Jashore, Bangladesh
[6]Department of Pediatrics, Sajida Hospital, Keranigonj, Dhaka Bangladesh

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***Correspondence:**
Dr. Moshrefa Newaz,
E-mail: kariul@hotmail.com

ABSTRACT

Background: Dengue remains a significant public health challenge, especially in pediatric populations. This study aims to analyze the demographic distribution, clinical presentation, and outcomes of severe dengue in children, with a focus on identifying key factors associated with recovery and mortality.
Methods: This cross-sectional analytical study was conducted on 300 children diagnosed with severe dengue at Dhaka Shishu (Children) hospital, Bangladesh, from January 2019 to December 2020. Participants were selected using convenient sampling, and data on demographic characteristics, clinical symptoms, and physical examination findings were collected and analyzed using SPSS V. 22.
Result: The study included a majority in the 6-10 years age group (56.67%), with a male predominance (59.33%). Major bleeding was observed in 27.33% of participants. The mortality rate was 4.67%. No significant differences in age and gender distribution were found between the recovery and mortality groups. Symptoms like cough, breathlessness, and abdominal pain, along with physical findings such as increased hematocrit, pleural effusion, and hepatomegaly, were significantly associated with mortality.
Conclusions: Severe dengue in children presents with a range of symptoms, with major bleeding being a critical indicator of disease severity. The study highlights the need for comprehensive clinical assessment and vigilant monitoring, emphasizing the importance of recognizing both common and severe symptoms in pediatric dengue for effective management and improved outcomes.

Keywords: Severe dengue, Pediatrics, Major bleeding, Mortality, Clinical presentation

INTRODUCTION

Dengue, a pervasive arboviral disease transmitted primarily by Aedes mosquitoes, stands as a significant global health concern. With its roots in tropical and subtropical regions, dengue has manifested as a public health challenge affecting millions worldwide.[1] The world health organization (WHO) estimates that approximately half of the world's population is at risk, with about 100-400 million infections occurring annually.[2] This staggering incidence underscores the disease's extensive impact on global public health,

particularly in countries with limited healthcare resources. In Bangladesh, dengue presents a critical public health issue, with the prevalence and impact of the disease being profoundly felt. The country, characterized by its dense population and tropical climate, provides an ideal breeding ground for Aedes mosquitoes, facilitating the widespread transmission of dengue. Recent studies have highlighted the increasing trend of dengue cases in Bangladesh, with significant outbreaks recorded in recent years.[3] These outbreaks pose substantial healthcare challenges, straining the already burdened healthcare system and highlighting the need for effective disease management strategies. The epidemiological trends in Bangladesh reveal a concerning pattern, particularly in pediatric populations. Children in this region are disproportionately affected by dengue, experiencing higher rates of infection and severe outcomes compared to adults. This disparity is attributed to several factors, including children's underdeveloped immune systems and higher exposure risks.[4] Managing dengue in children presents unique challenges, necessitating a tailored approach that considers the distinct clinical presentation and progression of the disease in this demographic. Severe dengue, as classified by the WHO, is particularly concerning due to its high risk of morbidity and mortality. This classification includes dengue hemorrhagic fever and dengue shock syndrome, conditions that can lead to significant complications and, in severe cases, death. Globally, severe dengue has been associated with an increased mortality rate, especially among children. In regions like Bangladesh, where healthcare resources are limited, the mortality rates associated with severe dengue in children are alarmingly high.[5] The literature on risk factors and early warning signs for severe dengue and mortality in children is extensive. Studies have identified various clinical and demographic factors associated with an increased risk of severe outcomes.[6,7] These include but are not limited to, underlying health conditions, delayed hospital admission, and specific ethnic backgrounds.[5,8] Early warning signs such as abdominal pain, persistent vomiting, and clinical fluid accumulation are critical indicators of disease progression and warrant immediate medical attention.[9] However, gaps remain in our understanding, particularly in the context of the Bangladeshi demographic. The unique epidemiological and healthcare landscape of Bangladesh necessitates a localized understanding of risk factors and early warning signs specific to this region. This knowledge gap underscores the need for further research tailored to the Bangladeshi context, which can inform more effective disease management and intervention strategies. The importance of early identification of risk factors and warning signs cannot be overstated. Early detection and timely intervention are crucial in reducing mortality associated with severe dengue, especially in pediatric populations. By identifying patients at higher risk of severe outcomes, healthcare providers can prioritize resources and provide targeted care, potentially averting fatal complications.[10] This study aims to analyze the demographic distribution, clinical presentation, and outcomes of Severe Dengue in children, with a focus on identifying key factors associated with recovery and mortality.

METHODS

This cross-sectional analytical study was conducted at the department of pediatrics, Dhaka Shishu hospital in Bangladesh over a 2-year period from January 2019 to December 2020. The study population comprised children admitted to the inpatient department with a diagnosis of severe dengue. Using a convenient sampling technique, 300 pediatric severe dengue cases were enrolled during the study period. The inclusion criteria were children up to 15 years of age, irrespective of gender; and serologically-confirmed severe dengue cases testing positive for either NS1 antigen, both NS1 antigen and IgM, or both IgM and IgG antibodies. The exclusion criteria eliminated: NS1 antigen-negative dengue-like illness cases, children only testing positive for IgG antibodies; and children with pre-existing liver, renal or lung comorbidities.

Data on clinical and laboratory parameters were collected at the time of hospitalization using predesigned data collection sheets. Parameters examined included vital signs, fluid status, bleeding manifestations, liver function, hematological indices, and dengue serological test results. All collected data were edited, cleaned, compiled and processed using SPSS version 22.0 software. Quantitative variables were expressed as frequency, percentage, mean and standard deviation. Appropriate statistical tests of comparison and significance were applied during data analysis, including chi-square tests, independent t-tests, logistic regression models and receiver operating characteristic (ROC) curves. Statistical significance was defined by a $p<0.05$.

Ethical approval was obtained from the ethical review committee of the Bangladesh institute of child health prior to study commencement. Furthermore, written informed consent was taken from the parents or guardians of all enrolled patients following a detailed briefing about the study purpose, risks and benefits. Reassurances were provided about the lack of associated harm or economic burden. Patient photographs were only taken after obtaining additional consent. Any developing adverse events would be promptly and adequately managed.

RESULTS

The study's participant distribution showed that out of 300 children with severe dengue, 27% (n=81) were aged 5 or below, 56.67% (n=170) were between 6-10 years, and 16.33% (n=49) were aged 11-15. In terms of gender, 59.33% (n=178) were male and 40.67% (n=122) were female. Regarding bleeding severity, 27.33% (n=82) experienced major bleeding, 50% (n=150) had minor bleeding, and 22.67% (n=68) showed no bleeding (Table 1).

Table 1: Distribution of baseline characteristics among the total participants, (n=300).

Variables	N	Percentage (%)
Age (in years)		
≤5	81	27.00
6-10	170	56.67
11-15	49	16.33
Gender		
Male	178	59.33
Female	122	40.67
Bleeding severity		
Major bleeding	82	27.33
Minor bleeding	150	50.00
No bleeding	68	22.67

In the study, out of the 300 participants, the majority, 95.33% (n=286), recovered from severe dengue, while 4.67% (n=14) resulted in mortality (Figure 1).

Among the 286 children who recovered, 26.92% (n=77) were aged 5 or below, 57.34% (n=164) were between 6-10 years, and 15.73% (n=45) were aged 11-15. The mean age in the recovery group was 7.02 years (SD±3.13), with an age range of 1-14 years. In contrast, of the 14 children who did not survive, 28.57% (n=4) were aged 5 or below, 42.86% (n=6) were between 6-10 years, and another 28.57% (n=4) were aged 11-15, with a mean age of 7.18 years (SD±2.70) and an age range of 4-14 years. P value for age comparison was greater than 0.05, indicating no statistically significant difference in age distribution between the recovery and mortality groups. Regarding gender, in the recover group, 59.79% (n=171) were male and 40.21% (n=115) were female. In the mortality group, the distribution was 50% (n=7) for both males and females. The p value for gender comparison was also greater than 0.05, suggesting no significant difference in gender distribution between the two groups (Table 2).

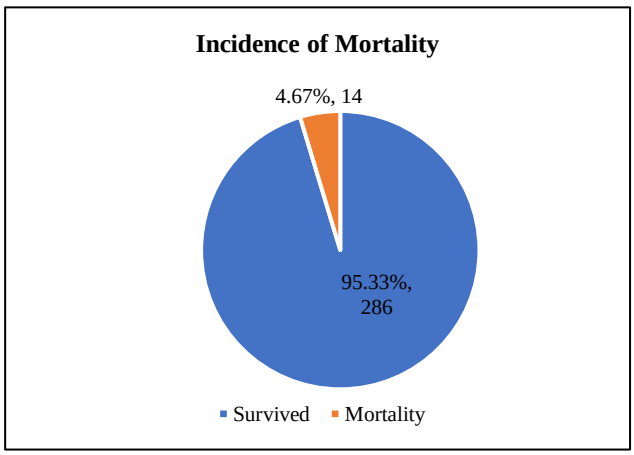

Figure 1: Distribution of participants by incidence of mortality, (n=300).

All participants, both in the recovery (n=286) and mortality (n=14) groups, exhibited fever (100%). Prevalence of headache was 59.09% (n=169) in the recovery group and 78.57% (n=11) in the mortality group, with a p>0.05, indicating no significant difference. Retro orbital pain was reported in 47.55% (n=136) of recovery group and 64.29% (n=9) of the mortality group, also showing no significant difference (p>0.05). Myalgia was observed in 24.13% (n=69) of the recovery group and 42.86% (n=6) of the mortality group, with arthralgia at 19.58% (n=56) and 7.14% (n=1), respectively, both with p>0.05. A notable difference was seen in cough and breathlessness; cough was present in 75.87% (n=217) of the recovery group and 100% (n=14) of the mortality group (p<0.05), while breathlessness was reported in 26.22% (n=75) of the recovery group and 78.57% (n=11) of the mortality group (p<0.001), indicating a significant difference. Vomiting was observed in 89.86% (n=257) of the recovery group and 78.57% (n=11) of the mortality group (p>0.05). Abdominal pain was reported in 58.04% (n=166) of the recovery group and 92.86% (n=13) of the mortality group, showing a significant difference (p<0.01). Diarrhea and convulsion were present in 27.62% (n=79) and 8.39% (n=24) of the recovery group, and 14.29% (n=2) and 7.14% (n=1) of the mortality group, respectively, both with p>0.05. Rash was reported in 80.07% (n=229) of the recovery group and 85.71% (n=12) of the mortality group, with no significant difference (p>0.05) (Table 3).

In recovery group (n=286), 25.17% (n=72) experienced major bleeding, while in the mortality group (n=14), a significantly higher proportion of 71.43% (n=10) experienced major bleeding, with a p value of less than 0.001, indicating a significant association between major bleeding and mortality. For minor bleeding, 51.05% (n=146) of the recovery group experienced this symptom compared to 28.57% (n=4) in the mortality group. The proportion of participants with no bleeding was 23.78% (n=68) in the recovery group, whereas none (0%) in the mortality group reported no bleeding. P values for both minor bleeding and no bleeding were greater than 0.05, suggesting no significant difference in these categories between recovery and mortality groups (Figure 2).

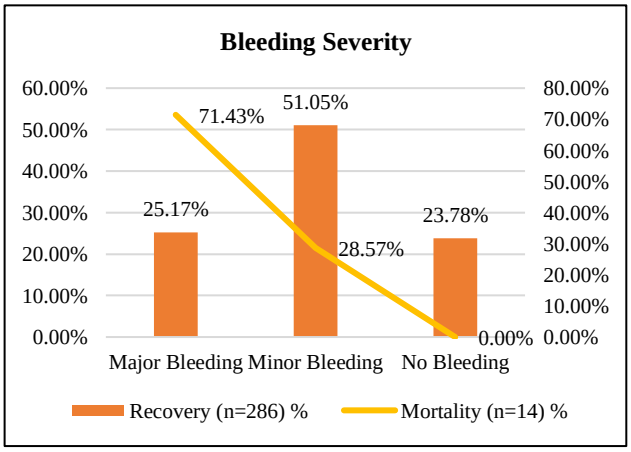

Figure 2: Comparison of bleeding type among participants by survival, (n=300).

Table 2: Comparison of demographic characteristics among participants by survival, (n=300).

Variables	Recovery, (n=286)		Mortality, (n=14)		P value
	N	%	N	%	
Age (in years)					
≤5	77	26.92	4	28.57	>0.05
6-10	164	57.34	6	42.86	
11-15	45	15.73	4	28.57	
Mean±SD	7.02±3.13		7.18±2.70		>0.05
Range	1-14		4-14		-
Gender					
Male	171	59.79	7	50.00	>0.05
Female	115	40.21	7	50.00	

Table 3: Comparison of symptoms among participants by survival, (n=300).

Symptoms	Recovery, (n=286)		Mortality, (n=14)		P value
	N	%	N	%	
Fever	286	100	14	100	-
Headache	169	59.09	11	78.57	>0.05
Retro orbital pain	136	47.55	9	64.29	>0.05
Myalgia	69	24.13	6	42.86	>0.05
Arthralgia	56	19.58	1	7.14	>0.05
Cough	217	75.87	14	100	<0.05
Breathlessness	75	26.22	11	78.57	<0.001
Vomiting	257	89.86	11	78.57	>0.05
Abdominal pain	166	58.04	13	92.86	<0.01
Diarrhea	79	27.62	2	14.29	>0.05
Convulsion	24	8.39	1	7.14	>0.05
Rash	229	80.07	12	85.71	>0.05

Table 4: Comparison of physical examination findings among participants by survival, (n=300).

Physical findings	Recovery (n=286)		Mortality (n=14)		P value
	N	%	N	%	
>20% rise of HCT	143	50	13	92.86	<0.05
Signs of pleural effusion	200	69.93	14	100	<0.05
Signs of ascites	138	48.25	14	100	<0.001
Hepatomegaly	192	67.13	13	92.86	<0.05
Refractory shock	54	18.88	11	78.57	<0.001

In the recovery group (n=286), a >20% rise in hematocrit (HCT) was observed in 50.00% (n=143) of the cases, while a notably higher percentage of 92.86% (n=13) was seen in the mortality group (n=14), with a $p<0.05$, indicating a significant association. Signs of pleural effusion were present in 69.93% (n=200) of the recovery group and in all (100%) of the mortality group, showing a significant difference ($p<0.05$). Similarly, signs of ascites were found in 48.25% (n=138) of the recovery group and in all (100%) of the mortality group, with a $p<0.001$, further highlighting significant difference. Hepatomegaly was observed in 67.13% (n=192) of the recovery group and in a higher proportion of 92.86% (n=13) in the mortality group, with the p value indicating a significant difference ($p<0.05$). Refractory shock was noted in 18.88% (n=54) of the recovery group, compared to a much higher 78.57% (n=11) in the mortality group, with $p<0.001$, underscoring a strong association between refractory shock and mortality in pediatric dengue cases (Table 4).

DISCUSSION

The participant distribution in this study, which included 300 children with severe dengue, revealed that the majority were in the 6-10 years age group (56.67%, n=170), followed by those aged ≤5 years (27%, n=81) and 11-15 years (16.33%, n=49). This age distribution is consistent with findings from other similar studies, which reported a majority of dengue cases in the 1-5 years age group.[11,12] The gender distribution in our study, with 59.33% (n=178) males and 40.67% (n=122) females, aligns with the equal sex distribution observed in a Kolkata study, indicating that dengue affects both genders similarly in pediatric populations.[11] Regarding

the severity of symptoms, our study found that 27.33% of the total study population experienced major bleeding, a significant clinical feature in severe dengue cases. This is in line with the findings of Rosenberger et al study, who highlighted severe bleeding as a critical aspect of severe dengue.[13] The mortality rate in our study was 4.67% (n=14), which is comparable to the 4% mortality reported in the Kolkata study.[11] However, it is lower than the 15% mortality associated with severe dengue fever in children reported in a study by Sudhakar et al.[14] This difference could be attributed to variations in healthcare facilities, demographic factors, or the severity of the dengue strains in different regions. The lack of significant difference in age and gender distribution between the recovery and mortality groups in our study ($p>0.05$) suggests that these demographic factors alone may not be strong predictors of dengue outcomes in children. This observation is crucial for healthcare providers to understand that severe dengue can affect any child regardless of age or gender, emphasizing the need for vigilance in all pediatric cases. Fever was universally present in our study, a characteristic feature of dengue observed in both recovery and mortality groups. This aligns with the general understanding of dengue's clinical presentation, where fever is a primary symptom.[2] The prevalence of headache and retro orbital pain, though higher in the mortality group, did not show a statistically significant difference, suggesting these symptoms alone may not be strong predictors of dengue outcomes. This observation is consistent with findings from other studies, which also report these symptoms as common but not necessarily indicative of disease severity.[13] However, our study found a significant association between cough, breathlessness, and mortality. This is particularly noteworthy as respiratory symptoms in dengue are often less emphasized compared to classical symptoms like fever and rash.[15,16] The high incidence of breathlessness in the mortality group (78.57%) compared to the recovery group (26.22%) suggests that respiratory distress may be an important indicator of severe dengue, warranting closer monitoring and possibly more aggressive management in these cases. Abdominal pain was another symptom significantly associated with mortality (92.86% in the mortality group vs. 58.04% in the recovery group), echoing the findings of studies that highlight gastrointestinal symptoms as markers of severe dengue.[14,17,18] The presence of major bleeding in a significantly higher proportion of the mortality group (71.43%) compared to the recovery group (25.17%) underscores the critical nature of bleeding in dengue prognosis. This is in line with the literature that identifies severe bleeding as a key determinant of dengue severity and a predictor of poor outcomes.[13] Physical examination findings further reinforce these observations. A greater than 20% rise in hematocrit, indicative of hemoconcentration, was significantly more common in the mortality group. This finding is supported by studies that associate hemoconcentration with severe dengue and higher mortality risk.[2,19,20] The presence of pleural effusion and ascites in all patients in the mortality group compared to a lower percentage in the recovery group highlights the importance of these signs in predicting severe dengue outcomes. Hepatomegaly and refractory shock, more prevalent in the mortality group, are also recognized as indicators of severe dengue in pediatric patients.[14]

Limitations

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

In conclusion, this study on 300 children with severe dengue highlights that the disease affects a broad age range and both genders equally. Major bleeding, a significant clinical feature, was strongly associated with mortality, emphasizing its role in severe dengue prognosis. The mortality rate aligns with regional studies, suggesting that outcomes may vary based on healthcare infrastructure and demographic factors. Key findings indicate that severe dengue can impact any child, regardless of age or gender. Symptoms such as cough, breathlessness, and abdominal pain, along with physical findings like increased hematocrit, pleural effusion, and hepatomegaly, were more prevalent in cases resulting in mortality. These findings underscore the need for comprehensive assessment and vigilant management in pediatric dengue, highlighting the importance of recognizing both common and severe symptoms for effective treatment and improved outcomes.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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