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Caregiver Misconceptions and Delayed Hospital Presentation Associated With Severe Dengue Among Hospitalised Children in Bangladesh

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Abstract

Background: Dengue remains a major cause of hospitalisation and severe illness among children in Bangladesh. Caregivers' recognition of warning signs, decisions to seek healthcare, and use of traditional remedies can significantly affect disease progression. This study assessed gaps in caregivers' knowledge, the use of traditional remedies, and factors associated with severe dengue and delayed hospital presentation among hospitalised children.

Methodology: A hospital-based cross-sectional study was conducted among 390 children with laboratory-confirmed dengue admitted to two tertiary care centres in Dhaka between June and December 2025. Structured questionnaires were used to collect data on sociodemographic characteristics, healthcare-seeking pathways, traditional practices, and caregiver knowledge. The primary outcomes were severe dengue and delayed hospital presentation, defined as presentation >4 days after illness onset. Multivariable binary logistic regression models were fitted using 384 complete cases to identify independent predictors of severe disease and delayed presentation.

Results: Severe dengue was identified in 98 children (25.1%), while 142 children (36.4%) presented after the fourth day of illness. Substantial knowledge gaps were evident, including poor recognition of warning signs in 352 (90.3%), lack of recognition of shock signs in 289 (74.1%), and limited critical-phase awareness in 379 (97.2%). Traditional or non-medical remedies were used in 261 cases (66.9%). In the multivariable logistic regression analysis, delayed hospital presentation (>4 days) emerged as a strong independent risk factor for severe dengue (adjusted odds ratio (AOR) = 9.45, 95% confidence interval (CI): 5.12-17.44, $P < 0.001$), alongside travel-related delay (AOR = 4.68, 95% CI: 2.69-8.13, $P < 0.001$). Furthermore, the misconception that clinical recovery occurs after fever subsides (AOR = 3.71, 95% CI: 2.25-6.12, $P < 0.001$) and travel barriers (AOR = 4.52, 95% CI: 2.68-7.63, $P < 0.001$) were significant independent predictors of delayed hospital presentation.

Conclusions: Widespread cognitive misconceptions and structural barriers were significantly associated with delayed hospital presentation and severe dengue among children in Dhaka. Paediatric dengue management and community health strategies must prioritise targeted parental education, focusing on recognising clinical warning signs, understanding critical disease progression around defervescence, and seeking prompt medical care.

Categories: Pediatrics, Epidemiology/Public Health, Infectious Disease
Keywords: caregiver knowledge, children, dengue, devere dengue, healthcare-seeking behaviour, severe dengue

Introduction

Dengue is a mosquito-borne viral infection with a wide clinical spectrum. It ranges from a self-limiting febrile illness to severe dengue, characterised by plasma leakage, shock, severe bleeding and organ impairment. Deterioration typically occurs around defervescence, when fever falls and marks the start of the critical phase. Warning signs at this stage require urgent medical assessment [1]. Children are particularly affected. A Global Burden of Disease 2021 analysis found that dengue incidence and disability-adjusted life-years (DALYs) were consistently higher in children and adolescents than in the whole population between 1990 and 2021. Dengue-related DALYs in this age group rose by about 16% over that period, with the highest burden in middle- and low-middle-Socio-demographic Index (SDI) regions [2].

Bangladesh illustrates this changing burden. After sporadic transmission until 1999, dengue outbreaks have occurred with increasing frequency since 2000. The 2019 epidemic was the largest recorded at that time, and climate change, unplanned urbanisation, high population density, and a strained health system were proposed contributors, along with a need to train clinicians to manage severe dengue [3].

Hsan et al. reported that Bangladesh recorded its highest-ever number of dengue cases in 2023, with 321,179 cases and 1,705 deaths, of which approximately 10% occurred in children aged up to 10 years [4]. Data on children are more limited. A Bangladeshi paediatric study described clinical and haematological differences between dengue fever and dengue haemorrhagic fever. Its authors noted that paediatric clinical reports had been scarce and came mainly from Dhaka [5]. In our own study of 346 hospitalised children at Mugda Medical College Hospital in 2024, 15.3% had severe dengue. Raised haematocrit, pleural effusion, ascites, thrombocytopenia, hypoalbuminaemia and elevated transaminases were the strongest independent predictors, indicating that severe disease reflects plasma leakage and organ involvement [6]. That study examined only clinical, laboratory and radiological predictors, not caregiver or pre-hospital factors.

Severity is influenced by viral, immunological and host factors. However, the timing and appropriateness of care before admission may be modifiable determinants. In a multicentre study of 1,313 hospitalised patients during Bangladesh's 2023 epidemic, 19.3% had severe dengue. Low family income and lack of awareness contributed [7]. Delayed care-seeking is also a wider issue in childhood fever. In India, nearly one-third of caregivers sought treatment for children under five more than 24 hours after fever onset. Greater distance to a health facility was strongly associated with delay [8]. A mixed-methods study of parents of children with dengue in the Philippines found that financial constraints, previous dengue infection, transport, location and facility capacity contributed to delays. The study recommended public education about dengue symptoms and the importance of seeking care early [9]. However, the study was small, with only 24 respondents, and both dengue-specific studies were conducted outside Bangladesh.

A national survey of 1,010 adults in Bangladesh found that most had heard of dengue and had moderate knowledge of its vectors and symptoms. However, their preventive practices were poor [10]. These findings do not indicate whether caregivers recognise warning signs or the critical phase of dengue. Nor do they show how caregivers' beliefs affect decisions about seeking care for a sick child. Hospital studies conducted in Bangladesh during recent outbreaks have described clinical, laboratory, demographic and socioeconomic profiles [4-7]. They have not systematically examined caregivers' beliefs or the care pathway before hospital admission. Evidence on delayed presentation comes from studies of non-dengue febrile illness [8] or from small-scale or qualitative studies conducted elsewhere [9]. To our knowledge, no study in Bangladesh has used adjusted analysis to quantify the links between specific caregiver misconceptions, initial healthcare-seeking behaviour, access-related barriers, delayed hospital presentation and severe dengue among hospitalised children. To address these critical gaps, this study had two primary objectives: first, to systematically assess caregivers' baseline knowledge, awareness and traditional remedy practices; and second, to identify independent predictors and quantify their associations with the two primary outcomes of interest: delayed hospital presentation and progression to severe dengue among hospitalised children.

Materials And Methods

Study design and setting

This hospital-based, cross-sectional observational study included children with laboratory-confirmed dengue who were admitted to two tertiary care hospitals in Dhaka, Bangladesh: Mugda Medical College Hospital and Insaf Barakah Hospital. The study was conducted from June to December 2025. Mugda Medical College Hospital is a government tertiary hospital that primarily serves lower- and middle-income urban and peri-urban populations. Insaf Barakah Hospital is a private hospital that serves a more socioeconomically diverse population. Both hospitals receive patients from Dhaka and surrounding districts.

Participants were consecutively enrolled upon hospital admission. Severe dengue was diagnosed and classified daily in accordance with the World Health Organization (WHO) 2009 criteria, based on clinical signs, laboratory parameters and hospital tracking records. The date of symptom onset was established through standardised caregiver recall of the initial fever, and delayed presentation was prespecified as more than four days after symptom onset, reflecting the critical transition phase of dengue pathogenesis.

Study population and sampling

Children aged ≤18 years with laboratory-confirmed dengue were eligible. Dengue infection was confirmed by a positive NS1 antigen test and/or dengue-specific IgM according to hospital diagnostic protocols. We included primary caregivers who provided written informed consent and were available for interview during the hospital stay. Caregivers who declined participation or could not provide reliable information because of severe emotional distress, altered mental status or communication difficulties were excluded.

Consecutive sampling was used to enrol eligible participants. The minimum sample size (N = 384) was calculated using the standard formula for a cross-sectional study, assuming an anticipated prevalence of 50%, a 95% confidence level and a 5% margin of error. The target sample size was increased to 390 participants to account for potentially incomplete data. Furthermore, severe dengue was diagnosed and classified daily in accordance with the WHO 2009 criteria.

Data collection

Data were collected through face-to-face interviews using a structured, pre-tested questionnaire

(Appendices A-B). The questionnaire was developed with reference to WHO dengue guidelines [1] and previous literature on dengue knowledge and healthcare-seeking behaviour [8,9]. It was pre-tested with 20 caregivers and showed good internal consistency (Cronbach's α = 0.82). The questionnaire covered child characteristics, caregivers' sociodemographic factors, healthcare-seeking behaviour, barriers to accessing care, traditional and other non-medical practices, and caregivers' knowledge and beliefs about dengue. Child-level clinical information was obtained from caregivers and, where available, hospital records.

Questionnaires assessing caregiver knowledge were adapted from validated tools in prior regional studies, with internal reliability confirmed via pilot testing (α > 0.80). The questionnaire and its structural components were formally reviewed, validated, and approved by the Institutional Ethics Review Board prior to study commencement as part of the formal ethical clearance process. Caregiver warning-sign recognition was classified as 'good' if respondents correctly identified ⩾3 WHO-defined warning signs and 'poor' if fewer than three were identified. Critical-phase awareness was defined as recognising the high-risk window occurring around defervescence (days 3-5).

Variables and operational definitions

The primary outcome was severe dengue, defined according to WHO 2009 criteria [1]. Children who did not have severe dengue were classified as having non-severe dengue, regardless of whether they had warning signs. The date of symptom onset was established through standardised caregiver recall of the initial fever. Delayed presentation was prespecified as >4 days after onset, reflecting the critical transition phase of dengue pathogenesis.

Child-level variables included hospital, sex, age, comorbidity and day of illness at presentation. Age was categorised as <5, 5-10 and >10 years. Comorbidity included clinically significant conditions such as asthma, congenital heart disease, diabetes, neurological disorders and malnutrition; malnutrition was assessed according to WHO child growth standards [11]. Caregiver education was categorised as ⩽primary or ⩾secondary education, and residence as urban Dhaka, Dhaka slum or outside Dhaka.

Monthly household income was categorised as <15,000, 15,000-25,000 or >25,000 BDT. These categories follow the classification used in the Bangladesh Bureau of Statistics Household Income and Expenditure Survey (HIES) 2022 [12].

Delayed presentation was defined as arrival at the study hospital more than 4 days after illness onset. Presentation by day 4 was classified as non-delayed. Referral to a tertiary hospital after day 4 did not, by itself, constitute delayed presentation if appropriate medical assessment had taken place earlier.

Initial healthcare-seeking behaviour was classified as doctor or hospital, pharmacy, social media or the internet, or a traditional healer. Access- and travel-related delays included reported barriers involving distance, transport, financial constraints or difficulties with referral or access.

Traditional and non-medical remedy use was analysed using the composite variable recorded in the dataset. Individual practices, including papaya leaf juice, papaya fruit extract, and the use of traditional healers and homoeopathy, were recorded separately. These practices were not mutually exclusive.

Caregiver knowledge and beliefs covered recognition of dengue warning signs and signs of shock, awareness of the critical phase, and beliefs that a high fever indicates severe dengue and that recovery follows the subsidence of fever. Caregiver misconceptions were defined as incorrect or misleading beliefs about dengue progression or severity.

Statistical analysis

Data were analysed using IBM SPSS Statistics version 29 (IBM Corp., Armonk, NY). Categorical variables were reported as frequencies and percentages and compared using the chi-squared test or Fisher's exact test, as appropriate. Continuous variables were reported as medians and interquartile ranges and compared using appropriate non-parametric tests. A two-sided *P*-value of <0.05 was considered statistically significant.

Two separate multivariable binary logistic regression models were performed. The first model examined factors associated with severe dengue, including age, comorbidity, delayed presentation, household income, use of traditional or non-medical remedies, recognition of warning signs and signs of shock, awareness of the critical phase, the misconception that high fever indicates severe illness, the belief that recovery occurs after fever subsides, and access- or travel-related delays. Day of illness was not included as a separate variable because delayed presentation was derived from it. The second model assessed factors associated with delayed hospital presentation, including hospital, residence, household income, caregiver education, use of traditional or non-medical remedies, initial healthcare-seeking behaviour, access- or travel-related delay, high-fever misconception, belief that recovery occurs after fever subsides, and warning-sign recognition. Candidate variables for multivariable modelling were selected based on biological plausibility, clinical relevance and bivariate screening ($P < 0.20$), with known confounders forced into the models to

ensure simultaneous adjustment.

A complete-case analysis was performed for the multivariable logistic regression models (*N* = 384), excluding six participants (1.5%) who declined to disclose their monthly household income. All six participants had delayed hospital presentation (>4 days); among them, three had severe dengue and three had non-severe dengue. These six participants were excluded from the multivariable regression analyses because of missing household income data.

Ethical considerations

The Institutional Ethics Review Board approved the study before it began. Written informed consent was obtained from all participating caregivers before data collection. Confidentiality was maintained throughout the study.

Results

This hospital-based cross-sectional study included 390 children who were admitted with dengue fever to two tertiary care centres in Dhaka, Bangladesh. Figure *1* shows the participant flow. The study assessed 460 eligible caregivers for inclusion. Seventy caregivers were excluded: 31 (44.3%) declined to participate, 22 (31.4%) faced communication barriers and 17 (24.3%) experienced emotional distress. The study enrolled the remaining 390 caregivers, who were included in the final analysis.

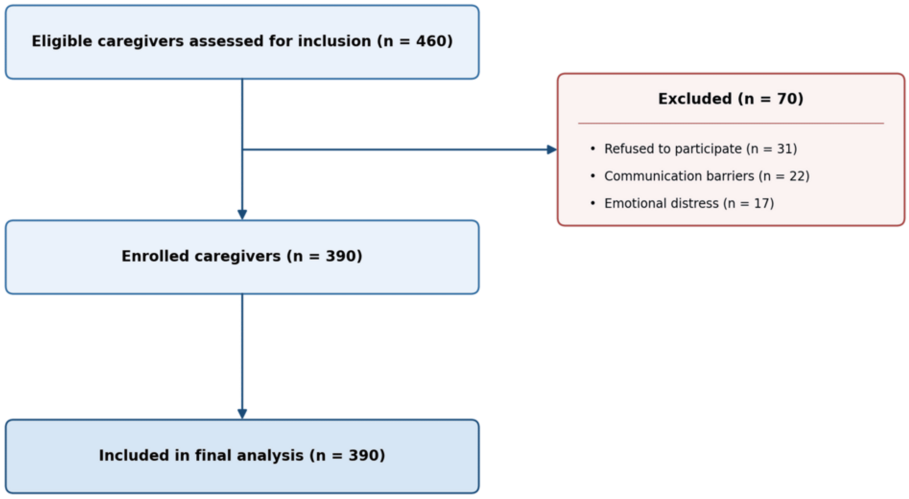


FIGURE 1: Flow diagram of caregiver recruitment and study inclusion.

The flow diagram shows participant selection from eligibility assessment through enrolment and inclusion in the final analysis. Of 460 eligible caregivers assessed, 70 were excluded because of refusal to participate, communication barriers or emotional distress, leaving 390 caregivers enrolled and included in the final analysis.

Of the 390 participants, most presented with non-severe dengue (*n* = 292, 74.9%), while 98 (25.1%) developed severe dengue. The analysis examined sociodemographic and clinical characteristics, access and travel barriers, caregiver knowledge and misconceptions, and independent predictors of delayed hospital presentation and disease severity. Multivariable logistic regression was conducted using complete cases (*N* = 384).

Sociodemographic and clinical characteristics by disease severity

Table *1* outlines the distribution of sociodemographic and clinical characteristics by disease severity. The sample comprised 390 children: 292 (74.9%) had non-severe dengue and 98 (25.1%) had severe dengue. Children aged 5-10 years and those aged over 10 years accounted for substantial proportions in both groups. Overall, males slightly outnumbered females. Delayed hospital presentation, defined as seeking care more than four days after illness onset, was much more common among children with severe dengue. Overall, delayed presentation occurred in 142 patients (36.4%). It occurred in 74 of 98 patients (75.5%), compared with 68 of 292 patients (23.3%) with non-severe dengue. This difference showed that delayed clinical assessment was concentrated among children who developed severe complications.

Variable	Category	Non-severe dengue, *n* (%)	Severe dengue, *n* (%)	Total, *n* (%)	Statistical test	Test statistic (df)	*P*-value	Effect size
Hospital	Mugda Medical College Hospital	155 (53.1%)	50 (51.0%)	205 (52.6%)	Chi-square test	0.125 (1)	0.724	Phi = 0.018
	Insaf Barakah Hospital	137 (46.9%)	48 (49.0%)	185 (47.4%)	Chi-square test	0.125 (1)	0.724	Phi = 0.018
Sex	Male	162 (55.5%)	52 (53.1%)	214 (54.9%)	Chi-square test	0.173 (1)	0.677	Phi = 0.021
	Female	130 (44.5%)	46 (46.9%)	176 (45.1%)	Chi-square test	0.173 (1)	0.677	Phi = 0.021
Age group	<5 years	112 (38.4%)	40 (40.8%)	152 (39.0%)	Chi-square test	0.358 (2)	0.836	Cramer's V = 0.030
	5-10 years	108 (37.0%)	33 (33.7%)	141 (36.2%)	Chi-square test	0.358 (2)	0.836	Cramer's V = 0.030
	>10 years	72 (24.7%)	25 (25.5%)	97 (24.9%)	Chi-square test	0.358 (2)	0.836	Cramer's V = 0.030
Comorbidity	No	231 (79.1%)	83 (84.7%)	314 (80.5%)	Chi-square test	1.458 (1)	0.227	Phi = 0.061
	Yes	61 (20.9%)	15 (15.3%)	76 (19.5%)	Chi-square test	1.458 (1)	0.227	Phi = 0.061
Delayed presentation	No (≤ 4 days)	224 (76.7%)	24 (24.5%)	248 (63.6%)	Chi-square test	76.542 (1)	<0.001	Phi = 0.443
	Yes (>4 days)	68 (23.3%)	74 (75.5%)	142 (36.4%)	Chi-square test	76.542 (1)	<0.001	Phi = 0.443
Day of illness at presentation	Median (IQR)	3 (2-4)	6 (5-7)	4 (2-6)	Mann-Whitney U test	*U* = 3,420	<0.001	Rank-biserial *r* = 0.762

TABLE 1: Clinical and participant characteristics by dengue severity.

Data are presented as *n* (%) except for day of illness at presentation, which is presented as median (IQR). Percentages in the non-severe and severe dengue columns are calculated within the respective severity groups, whereas percentages in the total column are calculated for the overall study population. The chi-squared test was used for categorical variables and the Mann-Whitney U test for day of illness at presentation.

Caregiver characteristics and socioeconomic status

Table 2 presents the socioeconomic backgrounds and caregiver characteristics of the study participants (N = 390), including six participants who did not disclose their monthly income. Most caregivers were mothers. Families fell into lower, middle and higher monthly household income brackets. However, a notable proportion of severe dengue cases came from lower-income households. Caregivers' educational attainment varied. Lower educational attainment was positively correlated, in bivariate analysis, with delayed health-seeking behaviour and subsequent disease severity.

Variable	Category	Non-severe dengue, *n* (%)	Severe dengue, *n* (%)	Total, *n* (%)	Statistical test	Test statistic (df)	*P*-value	Effect size
Caregiver education	Lower (below or equal to primary)	115 (39.4%)	37 (37.8%)	152 (39.0%)	Chi-square test	0.082 (1)	0.775	Phi = 0.014
	Higher (higher or equal to secondary)	177 (60.6%)	61 (62.2%)	238 (61.0%)	Chi-square test	0.082 (1)	0.775	Phi = 0.014
Residence	Urban (Dhaka city)	188 (64.4%)	61 (62.2%)	249 (63.8%)	Chi-square test	3.258 (2)	0.196	Cramer's V = 0.091
	Slum area	48 (16.4%)	11 (11.2%)	59 (15.1%)	Chi-square test	3.258 (2)	0.196	Cramer's V = 0.091
	Outside Dhaka	56 (19.2%)	26 (26.5%)	82 (21.0%)	Chi-square test	3.258 (2)	0.196	Cramer's V = 0.091
Monthly household income	<15,000 BDT	102 (34.9%)	30 (30.6%)	132 (33.8%)	Fisher-Freeman-Halton exact test	2.640 (3)	0.554	Cramer's V = 0.082
	15,000-25,000 BDT	115 (39.4%)	42 (42.9%)	157 (40.3%)	Fisher-Freeman-Halton exact test	2.640 (3)	0.554	Cramer's V = 0.082
	>25,000 BDT	72 (24.7%)	23 (23.5%)	95 (24.4%)	Fisher-Freeman-Halton exact test	2.640 (3)	0.554	Cramer's V = 0.082
	Not disclosed	3 (1.0%)	3 (3.1%)	6 (1.5%)	Fisher-Freeman-Halton exact test	2.640 (3)	0.554	Cramer's V = 0.082

TABLE 2: Caregiver sociodemographic characteristics by dengue severity.

Data are presented as *n* (%). The chi-squared test was used for caregiver education and residence. The Fisher-Freeman-Halton exact test was used for monthly household income.

Healthcare access, travel barriers and initial medical contact

Table *3* presents the structural and travel-related factors that influenced hospital admission across disease severity levels (*N* = 390). Overall, 111 participants (28.5%) reported travel-related delays caused by long distances, heavy urban traffic and inadequate transport. These delays affected 54 of 98 children with severe dengue (55.1%), compared with 57 of 292 children with non-severe dengue (19.5%). Physical and logistical barriers to healthcare access were associated with delayed hospital presentation and were more frequently reported among children with severe dengue.

Variable	Category	Non-severe dengue, *n* (%)	Severe dengue, *n* (%)	Total, *n* (%)	Statistical test	Test statistic (df)	*P*-value	Effect size
Initial healthcare seeking	Doctor/Hospital	207 (70.9%)	64 (65.3%)	271 (69.5%)	Fisher-Freeman-Halton exact test	2.782 (3)	0.312	Cramer's V = 0.084
	Pharmacy	48 (16.4%)	23 (23.5%)	71 (18.2%)	Fisher-Freeman-Halton exact test	2.782 (3)	0.312	Cramer's V = 0.084
	Social media/Internet	27 (9.2%)	7 (7.1%)	34 (8.7%)	Fisher-Freeman-Halton exact test	2.782 (3)	0.312	Cramer's V = 0.084
	Traditional healer	10 (3.4%)	4 (4.1%)	14 (3.6%)	Fisher-Freeman-Halton exact test	2.782 (3)	0.312	Cramer's V = 0.084
Access/travel-related delay	No	235 (80.5%)	44 (44.9%)	279 (71.5%)	Chi-square test	39.412 (1)	<0.001	Phi = 0.318
	Yes	57 (19.5%)	54 (55.1%)	111 (28.5%)	Chi-square test	39.412 (1)	<0.001	Phi = 0.318

TABLE 3: Healthcare-seeking and access-related factors by dengue severity.

Data are presented as *n* (%). Travel-related delay was significantly higher among severe dengue cases, supporting its role as a major contributing factor.

Traditional practices and home remedies before hospitalisation

Table *4* summarises the use of traditional remedies and non-medical practices at home before formal hospital admission (*N* = 390). Some caregivers reported using herbal extracts, imposing specific dietary restrictions or preparing alternative remedies, such as papaya leaf juice. Traditional remedies were common in both groups. However, multivariable analyses showed that these practices were mainly concurrent habits rather than direct drivers of disease severity. Structural barriers to travel and critical misconceptions were more influential.

Variable	Category	Non-severe dengue, *n* (%)	Severe dengue, *n* (%)	Total, *n* (%)	Statistical test	Test statistic (df)	*P*-value	Effect size
Traditional/non-medical remedy use	No	89 (30.5%)	40 (40.8%)	129 (33.1%)	Chi-square test	3.542 (1)	0.060	Phi = 0.095
	Yes	203 (69.5%)	58 (59.2%)	261 (66.9%)	Chi-square test	3.542 (1)	0.060	Phi = 0.095
Papaya leaf juice	No	132 (45.2%)	29 (29.6%)	161 (41.3%)	Chi-square test	7.379 (1)	0.007	Phi = 0.138
	Yes	160 (54.8%)	69 (70.4%)	229 (58.7%)	Chi-square test	7.379 (1)	0.007	Phi = 0.138
Papaya fruit extract	No	162 (55.5%)	64 (65.3%)	226 (57.9%)	Chi-square test	2.908 (1)	0.088	Phi = 0.086
	Yes	130 (44.5%)	34 (34.7%)	164 (42.1%)	Chi-square test	2.908 (1)	0.088	Phi = 0.086
Traditional healer remedy	No	270 (92.5%)	91 (92.9%)	361 (92.6%)	Chi-square test	0.016 (1)	0.898	Phi = 0.006
	Yes	22 (7.5%)	7 (7.1%)	29 (7.4%)	Chi-square test	0.016 (1)	0.898	Phi = 0.006
Homeopathy	No	272 (93.2%)	92 (93.9%)	364 (93.3%)	Chi-square test	0.062 (1)	0.803	Phi = 0.013
	Yes	20 (6.8%)	6 (6.1%)	26 (6.7%)	Chi-square test	0.062 (1)	0.803	Phi = 0.013

TABLE 4: Traditional and non-medical practices by dengue severity.

Data are presented as *n* (%). Individual practices were recorded separately.

Caregiver knowledge, misconceptions and warning sign recognition

Table 5 shows gaps in caregivers' knowledge, cognitive misconceptions and recognition of critical warning and shock signs ($N = 390$). Nearly half of all participants (188, 48.2%) believed that clinical recovery occurred immediately after the fever subsided. This misconception was more common among caregivers of non-severe cases (168/292, 57.5%) than among caregivers of severe cases (20/98, 20.4%). Recognition of critical shock signs was also limited. Early shock signs went unrecognised by caregivers in 88 of 98 severe cases (89.8%) and 201 of 292 non-severe cases (68.8%). These findings showed that caregivers' interpretation of defervescence as recovery and their poor awareness of haemodynamic warning signs delayed appropriate hospital presentation.

Variable	Category	Non-severe dengue, *n* (%)	Severe dengue, *n* (%)	Total, *n* (%)	Statistical test	Test statistic (df)	*P*-value	Effect size
Warning-sign recognition	Poor	260 (89.0%)	92 (93.9%)	352 (90.3%)	Chi-square test	1.874 (1)	0.171	Phi = 0.069
	Good	32 (11.0%)	6 (6.1%)	38 (9.7%)	Chi-square test	1.874 (1)	0.171	Phi = 0.069
Shock-sign recognition	Not recognised	201 (68.8%)	88 (89.8%)	289 (74.1%)	Chi-square test	15.690 (1)	<0.001	Phi = 0.201
	Recognised	91 (31.2%)	10 (10.2%)	101 (25.9%)	Chi-square test	15.690 (1)	<0.001	Phi = 0.201
Critical-phase awareness	No	284 (97.3%)	95 (96.9%)	379 (97.2%)	Chi-square test	- (1)	1.000	Phi = 0.008
	Yes	8 (2.7%)	3 (3.1%)	11 (2.8%)	Chi-square test	- (1)	1.000	Phi = 0.008
High-fever misconception	No	91 (31.2%)	30 (30.6%)	121 (31.0%)	Chi-square test	0.010 (1)	0.919	Phi = 0.005
	Yes (misconception)	201 (68.8%)	68 (69.4%)	269 (69.0%)	Chi-square test	0.010 (1)	0.919	Phi = 0.005
Belief that recovery occurs after the fever subsides	No	124 (42.5%)	78 (79.6%)	202 (51.8%)	Chi-square test	39.521 (1)	<0.001	Phi = 0.319
	Yes (misconception)	168 (57.5%)	20 (20.4%)	188 (48.2%)	Chi-square test	39.521 (1)	<0.001	Phi = 0.319

TABLE 5: Caregiver knowledge, awareness and misconceptions by dengue severity.

Data are presented as *n* (%). Failure to recognise shock signs was more common among children with severe dengue, whereas the misconception that recovery occurs after fever subsides was more common among children with non-severe dengue.

Multivariable logistic regression analysis for predictors of severe dengue

Multivariable logistic regression was performed using 384 complete cases. Six participants with undisclosed household income were excluded. The six excluded participants had all presented after four days of illness, comprising three children with severe dengue and three with non-severe dengue. Therefore, the complete-case regression sample included 136 children with delayed presentation (71 severe and 65 non-severe) and 248 children with non-delayed presentation (24 severe and 224 non-severe).

Table *6* presents the results. Adjusted odds ratios and 95% confidence intervals were shown in the forest plot (Figure *2*).

Variable	Category	COR (95% CI)	COR Wald χ^2	COR *P*-value	AOR (95% CI)	AOR Wald χ^2	AOR *P*-value
Age group	<5 years	Reference	N/A	N/A	Reference	N/A	N/A

	5-10 years	0.84 (0.49-1.44)	0.384	0.535	0.79 (0.44-1.42)	0.512	0.474
	>10 years	0.94 (0.52-1.69)	0.042	0.837	0.86 (0.45-1.65)	0.201	0.654
Comorbidity	No	Reference	N/A	N/A	Reference	N/A	N/A
	Yes	0.65 (0.34-1.22)	1.826	0.177	0.58 (0.29-1.15)	2.540	0.111
Delayed presentation	No (≤ 4 days)	Reference	N/A	N/A	Reference	N/A	N/A
	Yes (> 4 days)	10.12 (5.68-18.04)	54.210	<0.001	9.45 (5.12-17.44)	42.810	<0.001
Monthly household income	<15,000 BDT	Reference	N/A	N/A	Reference	N/A	N/A
	15,000-25,000 BDT	1.24 (0.72-2.13)	0.620	0.431	1.22 (0.68-2.19)	0.420	0.517
	>25,000 BDT	1.09 (0.58-2.02)	0.068	0.794	1.11 (0.57-2.18)	0.081	0.776
Traditional/non-medical remedy use	No	Reference	N/A	N/A	Reference	N/A	N/A
	Yes	0.59 (0.37-0.96)	4.603	0.032	0.62 (0.37-1.04)	3.210	0.073
Warning-sign recognition	Poor	Reference	N/A	N/A	Reference	N/A	N/A
	Good	0.97 (0.52-1.80)	0.011	0.918	0.89 (0.44-1.80)	0.102	0.749
Shock-sign recognition	Not recognised	Reference	N/A	N/A	Reference	N/A	N/A
	Recognised	0.26 (0.13-0.53)	13.420	<0.001	0.31 (0.14-0.68)	9.120	0.003
Critical-phase awareness	No	Reference	N/A	N/A	Reference	N/A	N/A
	Yes	1.15 (0.30-4.41)	0.039	0.844	1.28 (0.30-5.45)	0.112	0.738
High-fever misconception	No	Reference	N/A	N/A	Reference	N/A	N/A
	Yes (misconception)	0.96 (0.59-1.59)	0.021	0.886	0.88 (0.51-1.53)	0.198	0.656
Belief that recovery occurs after the fever subsides	No	Reference	N/A	N/A	Reference	N/A	N/A
	Yes (misconception)	0.23 (0.13-0.40)	35.810	<0.001	0.26 (0.14-0.48)	24.610	<0.001
Travel/access-related delay	No	Reference	N/A	N/A	Reference	N/A	N/A
	Yes	5.02 (2.98-8.46)	38.650	<0.001	4.68 (2.69-8.13)	32.140	<0.001

TABLE 6: Multivariable logistic regression analysis of factors associated with severe dengue.

Model fit: Hosmer-Lemeshow $\chi^2 = 7.120$, df = 8, $P = 0.524$; Nagelkerke $R^2 = 0.482$. Complete-case analysis included 384 participants, excluding six participants with incomplete household income data. All six excluded participants had presented after four days of illness: three children had severe dengue and three had non-severe dengue. Therefore, the complete-case regression sample included 136 children with delayed presentation (71 with severe dengue and 65 with non-severe dengue) and 248 children with non-delayed presentation (24 with severe dengue and 224 with non-severe dengue).

COR, crude odds ratio; CI, confidence interval; AOR, adjusted odds ratio

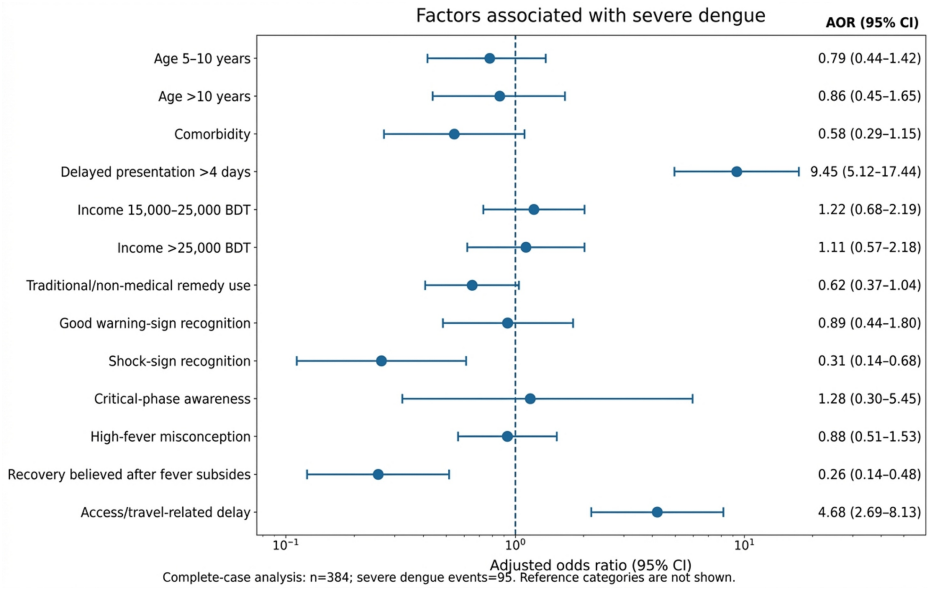


FIGURE 2: Multivariable logistic regression analysis of independent predictors associated with severe dengue among hospitalised children (N = 384).

Adjusted odds ratios (AORs) with corresponding 95% confidence intervals (CIs) were calculated using a complete-case multivariable binary logistic regression model (N = 384 total analytic sample; 95 severe dengue events). The vertical dashed line at 1.0 represents the reference line of no effect. Circular data markers indicate point estimates, and horizontal error bars denote 95% CIs. Reference categories for categorical predictor variables are indicated as "Reference" or "Ref". Delayed hospital presentation of more than four days demonstrates a strong independent association with severe dengue progression (AOR = 9.45, 95% CI: 5.12-17.44, $P < 0.001$).

After adjustment for potential confounders, delayed hospital presentation (>4 days) was the strongest independent risk factor. It increased the adjusted odds of severe dengue by more than ninefold (AOR = 9.45, 95% CI: 5.12-17.44, $P < 0.001$). Travel-related delay also independently increased the odds of severe disease (AOR = 4.68, 95% CI: 2.69-8.13, $P < 0.001$). These findings showed that access barriers and delays in presentation were critical determinants of severe dengue outcomes in children.

Figure 2 shows how the multivariable regression model compared the relative magnitude and statistical weight of each independent predictor on a common logarithmic axis. The graphical distribution clearly separated the main clinical drivers, led by delayed presentation of more than four days, from structural and cognitive confounders. It showed that delays and failure to recognise critical thresholds had the strongest compounding effects on susceptibility to severe dengue.

Multivariable logistic regression analysis for predictors of delayed hospital presentation

Table 7 presents the multivariable logistic regression model of the direct determinants of delayed hospital presentation ($N = 384$). The analysis showed that the misconception that a reduction in fever signalled recovery was a major independent factor associated with delayed care-seeking (AOR = 3.71, 95% CI: 2.25-6.12, $P < 0.001$). Travel barriers also significantly predicted delayed hospital arrival (AOR = 4.52, 95% CI: 2.68-7.63, $P < 0.001$). Taken together, the two multivariable models demonstrated distinct associations with severe dengue and delayed hospital presentation. In Model 1, delayed hospital presentation and travel/access-related barriers were independently associated with severe dengue (Table 6). In Model 2, travel/access-related barriers and the misconception that clinical recovery occurs after fever subsides were independently associated with delayed hospital presentation (Table 7). These findings suggest an association between caregiver misconceptions, healthcare-seeking delays and severe dengue; however, the cross-sectional design does not establish a causal pathway between these factors.

Variable	Category	COR (95% CI)	COR Wald χ^2	COR *P*-value	AOR (95% CI)	AOR Wald χ^2	AOR *P*-value
Hospital	Mugda Medical College Hospital	Reference	N/A	N/A	Reference	N/A	N/A

	Insaf Barakah Hospital	1.05 (0.70-1.57)	0.048	0.826	0.98 (0.63-1.52)	0.010	0.920
Residence	Urban (Dhaka city)	Reference	N/A	N/A	Reference	N/A	N/A
	Slum area	0.88 (0.49-1.57)	0.197	0.657	0.84 (0.45-1.56)	0.312	0.576
	Outside Dhaka	0.96 (0.58-1.60)	0.019	0.889	0.95 (0.55-1.64)	0.024	0.877
Monthly household income	<15,000 BDT	Reference	N/A	N/A	Reference	N/A	N/A
	15,000-25,000 BDT	1.12 (0.70-1.79)	0.228	0.633	1.10 (0.67-1.81)	0.141	0.707
	>25,000 BDT	0.79 (0.46-1.36)	0.716	0.398	0.76 (0.43-1.34)	0.910	0.340
Caregiver education	Lower (below or equal to primary)	Reference	N/A	N/A	Reference	N/A	N/A
	Higher (higher or equal to secondary)	1.12 (0.74-1.69)	0.268	0.605	1.15 (0.74-1.79)	0.380	0.538
Traditional/non-medical remedy use	No	Reference	N/A	N/A	Reference	N/A	N/A
	Yes	1.25 (0.81-1.93)	1.010	0.315	1.18 (0.74-1.88)	0.450	0.502
Initial healthcare-seeking	Doctor/Hospital	Reference	N/A	N/A	Reference	N/A	N/A
	Pharmacy	0.82 (0.47-1.41)	0.532	0.466	0.85 (0.48-1.51)	0.312	0.576
	Social media/Internet	1.27 (0.62-2.62)	0.422	0.516	1.34 (0.63-2.85)	0.620	0.431
	Traditional healer	1.01 (0.34-3.00)	0.001	0.981	1.02 (0.33-3.15)	0.001	0.970
Travel/access-related delay	No	Reference	N/A	N/A	Reference	N/A	N/A
	Yes	4.85 (2.95-7.98)	35.420	<0.001	4.52 (2.68-7.63)	30.120	<0.001
High-fever misconception	No	Reference	N/A	N/A	Reference	N/A	N/A
	Yes (misconception)	1.17 (0.76-1.82)	0.512	0.474	1.12 (0.71-1.77)	0.210	0.647
Belief that recovery occurs after fever subsides	No	Reference	N/A	N/A	Reference	N/A	N/A
	Yes (misconception)	3.92 (2.44-6.30)	28.410	<0.001	3.71 (2.25-6.12)	24.810	<0.001
Warning-sign recognition	Poor	Reference	N/A	N/A	Reference	N/A	N/A
	Good	1.09 (0.64-1.86)	0.100	0.752	1.02 (0.58-1.79)	0.004	0.950

TABLE 7: Factors associated with delayed hospital presentation (multivariable logistic regression).

Model fit: Hosmer-Lemeshow $\chi^2 = 9.410$, df = 8, $P = 0.309$; Nagelkerke $R^2 = 0.314$. Complete-case analysis included 384 participants, excluding six participants with undisclosed household income. All six excluded participants had presented after four days of illness: three children had severe dengue and three had non-severe dengue. Therefore, the complete-case regression sample included 136 children with delayed presentation (71 with severe dengue and 65 with non-severe dengue) and 248 children with non-delayed presentation (24 with severe dengue and 224 with non-severe dengue).

COR, crude odds ratio; CI, confidence interval; AOR, adjusted odds ratio

Discussion

This hospital-based cross-sectional study (*N* = 390) examined caregiver-related and healthcare-access factors associated with severe dengue and delayed hospital presentation among hospitalised children in Dhaka, Bangladesh. The two multivariable regression models evaluated these outcomes separately and identified distinct patterns of association. The findings highlight the importance of timely healthcare-seeking and caregiver recognition of dengue-related risks.

In our cohort of 390 children, delayed presentation (>4 days of illness) was observed in 74 of 98 severe cases (75.5%) and 68 of 292 non-severe cases (23.3%). Multivariable logistic regression indicated that delayed presentation was strongly and independently associated with severe dengue (AOR = 9.45, 95% CI: 5.12-17.44, *P* < 0.001). When caregivers delay hospital presentation beyond the first four days of symptoms without structured clinical monitoring, children risk entering the critical phase undetected, compounding the likelihood of preventable complications. This finding aligns with broader observations from multicentre hospital-based studies in Bangladesh [13]; similarly, a study from the Department of Paediatrics of Shaheed Suhrawardy Medical College Hospital [14] and another study from MR Khan Shishu Hospital [15] noted that delayed care-seeking significantly increases the risk of vascular leakage and critical complications during major outbreak seasons.

In urban settings like Dhaka, socioeconomic constraints extend far beyond basic living conditions; they directly restrict access to timely outpatient diagnostics, private consultations, and affordable emergency transport. Families facing financial distress frequently attempt prolonged home management before seeking hospital care, compounding clinical vulnerability. While lower-income households formed a notable proportion of severe cases, multivariable adjustment indicated that household income brackets did not reach independent statistical significance as direct predictors of severe disease progression in our final model, aligning with broader patterns where structural financial limitations and daily-wage dependencies intersect with care-seeking delays. These observations align closely with findings from two other urban studies in Dhaka [16,17], which highlighted that lower socioeconomic strata face disproportionate barriers and heightened disease severity during urban dengue outbreaks.

This study identified travel- and access-related barriers as major contributors to disease severity and care-seeking delays. Travel-related delay was significantly more frequent among severe dengue cases (54/98, 55.1%, vs. 57/292, 19.5%) and was independently associated with severe dengue (AOR = 4.68, 95% CI: 2.69-8.13, *P* < 0.001; Table *6*) and delayed hospital presentation (AOR = 4.52, 95% CI: 2.68-7.63, P < 0.001; Table *7*).

In a sprawling urban metropolis like Dhaka, coupled with patients travelling from surrounding peri-urban and rural districts, geographical distance, traffic congestion, and transportation bottlenecks severely hamper timely access to healthcare. A study of urban Bangladesh has widely documented similar structural barriers and geographical challenges in resource-constrained endemic settings, where logistical hurdles delay life-saving hospital admissions [16] and worsen clinical prognoses; a KAP study of Dhaka city was recently reinforced by their multicentre survey mapping healthcare access barriers across Dhaka dengue hotspots [18].

Caregiver knowledge gaps and cognitive misconceptions also contributed to delays in seeking care, alongside logistical and travel constraints. A common belief was that clinical recovery occurs immediately after the fever subsides. This belief was reported by 188 caregivers (48.2%), including 20 of 98 severe cases (20.4%) and 168 of 292 non-severe cases (57.5%). In our multivariable analysis (Table *7*), this misconception was independently and strongly associated with delayed hospital presentation (AOR = 3.71, 95% CI: 2.25-6.12, *P* < 0.001). In contrast, in the separate model evaluating severe dengue (Table *6*), this misconception showed an inverse association with severe dengue (AOR = 0.26, 95% CI: 0.14-0.48, *P* < 0.001). These findings represent associations with two different outcomes and should not be interpreted as evidence of a causal or protective effect.

Many caregivers may interpret defervescence as a sign of convalescence rather than the onset of the critical phase. This misconception highlights the importance of educating caregivers that dengue can become more dangerous around the time fever subsides. A study conducted during a Dhaka-based outbreak assessment demonstrated that sociodemographic knowledge gaps directly influence improper health-seeking behaviours and delayed hospital arrivals [17], while another study on slum dwellers in Dhaka city similarly underscored widespread community-level gaps in recognising infection trajectories [19]. These findings align with those of a Sri Lankan study on how health-seeking delays shape endemic disease burdens [20].

Before hospital admission, many caregivers reported using traditional home remedies and other non-medical practices. These culturally embedded practices may support care during febrile illness. However, multivariable analysis found no independent association with disease severity after accounting for structural travel barriers and cognitive delays. Overall, traditional or non-medical remedies were used in 261 cases (66.9%). This included 58 of 98 severe cases (59.2%) and 203 of 292 non-severe cases (69.5%).

A notable finding was the widespread use of Carica papaya leaf extract (papaya leaf juice) by caregivers to manage fever or thrombocytopenia at home. Despite its common use, papaya leaf intake was not independently associated with changes in or prevention of severe disease progression. This finding helps bridge the gap between biochemical evidence and real-world clinical outcomes. Clinical trials and randomised controlled evaluations have reported biochemical benefits of Carica papaya leaf extract, including faster platelet recovery and shorter hospital stays in controlled settings [21,22]. However, our findings highlight an important real-world concern. While bivariate analysis showed a higher frequency of Carica papaya leaf extract (papaya leaf juice) use among severe cases, traditional remedies were analysed as a composite category in our multivariable model. Reliance on home remedies may create a false sense of security and may coexist with delays in seeking care. Among the 98 severe cases, 74 (75.5%) presented after four days. As a result, families may delay seeking hospital care beyond the safe defervescence period, allowing unmonitored plasma leakage to progress to severe dengue shock. Educational interventions should address these risks and misconceptions, rather than focusing solely on discouraging traditional home remedies.

Furthermore, our findings show that failure to recognise critical signs of shock was significantly associated with severe disease outcomes. This failure occurred in 88 of 98 severe cases (89.8%), compared with 201 of 292 non-severe cases (68.8%). Failure to recognise early signs of haemodynamic instability was more common among children with severe dengue. This finding highlights the importance of caregiver awareness and timely clinical assessment.

A multicentre study in Bangladesh found that poor caregiver awareness of clinical warning signs and delayed recognition of haemodynamic instability substantially increased the risk of severe dengue presentations [23]. Another study in a non-endemic area confirmed the importance of early clinical recognition and a prompt response from parents in reducing severe morbidity [5]. These findings highlight the need for a two-pronged public health strategy to reduce severe dengue morbidity in children. This strategy should address structural barriers to travel and equip caregivers with targeted education on early warning signs and the critical period around defervescence.

Limitations

Several limitations should be considered. The cross-sectional design prevents us from establishing causal relationships or the temporal sequence among caregiver beliefs, healthcare-seeking behaviour, delayed presentation and severe dengue. The hospital-based design may limit generalisability to children treated in primary care or in the community. It may also introduce selection bias by excluding severe out-of-hospital cases or mild episodes managed entirely at home, which may account for the statistical uncertainty and confidence interval observed in our regression model for delayed presentation. Caregiver reports of illness onset, healthcare-seeking actions and home practices may be affected by recall or social desirability bias. Despite these limitations, our large sample (N = 390; analytic regression sample, N = 384) provides actionable data to guide targeted public health interventions and paediatric dengue management policies in Bangladesh.

Conclusions

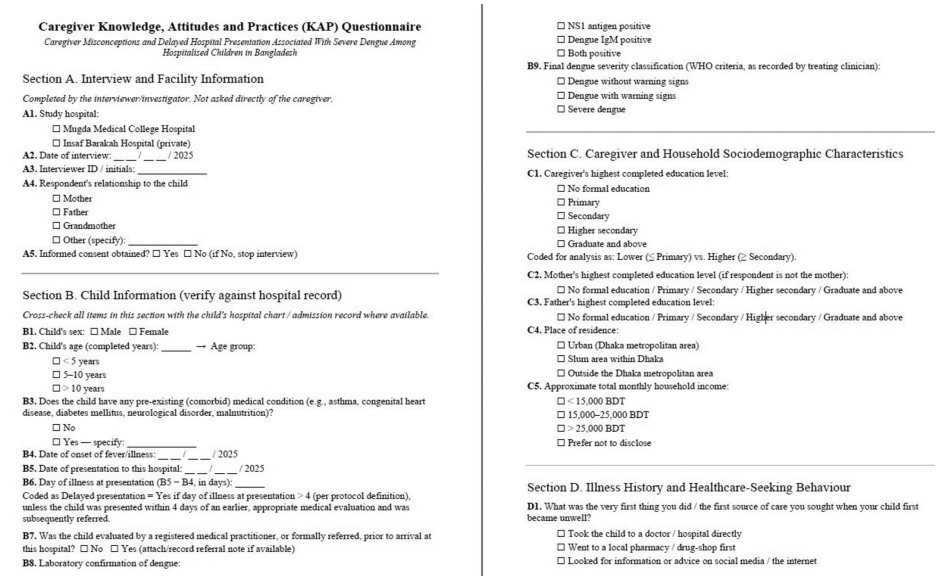
This study identified substantial gaps in caregiver understanding of dengue among hospitalised children in Bangladesh, particularly poor recognition of warning signs and the critical phase, alongside the widespread misconception that fever subsiding indicates recovery. Delayed hospital presentation occurred in 36.4% of children and was independently associated with severe dengue. Travel-related and access barriers were also independently associated with severe dengue and delayed hospital presentation. Furthermore, traditional or non-medical remedies were frequently used, highlighting how home management practices intersect with health-seeking behaviours.

These findings provide actionable insights that can be directly integrated into paediatric dengue management and public health strategies. Clinical protocols and community-level interventions should prioritise targeted parental education focusing on early recognition of haemodynamic warning signs, understanding the high-risk window around defervescence, and emphasising the necessity of prompt hospital presentation rather than relying on unmonitored home remedies.

Because this was a hospital-based cross-sectional study, causal relationships and temporal sequences cannot be definitively established, and the findings may be subject to recall or selection biases. Consequently, these results, including the inverse associations observed for certain traditional remedies, should be interpreted cautiously. Further prospective longitudinal studies incorporating clinical, behavioural and health-system factors are warranted to better define the determinants of delayed presentation and severe dengue in children.

Appendices

Appendix A



Caregiver Knowledge, Attitudes and Practices (KAP) Questionnaire

Caregiver Misconceptions and Delayed Hospital Presentation Associated With Severe Dengue Among Hospitalized Children in Bangladesh

Section A. Interview and Facility Information

Completed by the interviewer/investigator. Not asked directly of the caregiver.

A1. Study hospital:
- ☐ Mugda Medical College Hospital
- ☐ Insaf Barakah Hospital (private)

A2. Date of interview: __ __ / __ __ / 2025

A3. Interviewer ID / initials: _____

A4. Respondent's relationship to the child
- ☐ Mother
- ☐ Father
- ☐ Grandmother
- ☐ Other (specify): _____

A5. Informed consent obtained? ☐ Yes ☐ No (if No, stop interview)

Section B. Child Information (verify against hospital record)

Cross-check all items in this section with the child's hospital chart / admission record where available.

B1. Child's sex: ☐ Male ☐ Female

B2. Child's age (completed years): _____ → Age group:
- ☐ < 5 years
- ☐ 5–10 years
- ☐ > 10 years

B3. Does the child have any pre-existing (comorbid) medical condition (e.g., asthma, congenital heart disease, diabetes mellitus, neurological disorder, malnutrition)?
- ☐ No
- ☐ Yes — specify: _____

B4. Date of onset of fever/illness: __ __ / __ __ / 2025

B5. Date of presentation to this hospital: __ __ / __ __ / 2025

B6. Day of illness at presentation (B5 − B4, in days): _____

Coded as Delayed presentation = Yes if day of illness at presentation > 4 (per protocol definition), unless the child was presented within 4 days of an earlier, appropriate medical evaluation and was subsequently referred.

B7. Was the child evaluated by a registered medical practitioner, or formally referred, prior to arrival at this hospital? ☐ No ☐ Yes (attach/record referral note if available)

B8. Laboratory confirmation of dengue:
- ☐ NS1 antigen positive
- ☐ Dengue IgM positive
- ☐ Both positive

B9. Final dengue severity classification (WHO criteria, as recorded by treating clinician):
- ☐ Dengue without warning signs
- ☐ Dengue with warning signs
- ☐ Severe dengue

Section C. Caregiver and Household Sociodemographic Characteristics

C1. Caregiver's highest completed education level:
- ☐ No formal education
- ☐ Primary
- ☐ Secondary
- ☐ Higher secondary
- ☐ Graduate and above

Coded for analysis as: Lower (≤ Primary) vs. Higher (≥ Secondary).

C2. Mother's highest completed education level (if respondent is not the mother):
- ☐ No formal education / Primary / Secondary / Higher secondary / Graduate and above

C3. Father's highest completed education level:
- ☐ No formal education / Primary / Secondary / Higher secondary / Graduate and above

C4. Place of residence:
- ☐ Urban (Dhaka metropolitan area)
- ☐ Slum area within Dhaka
- ☐ Outside the Dhaka metropolitan area

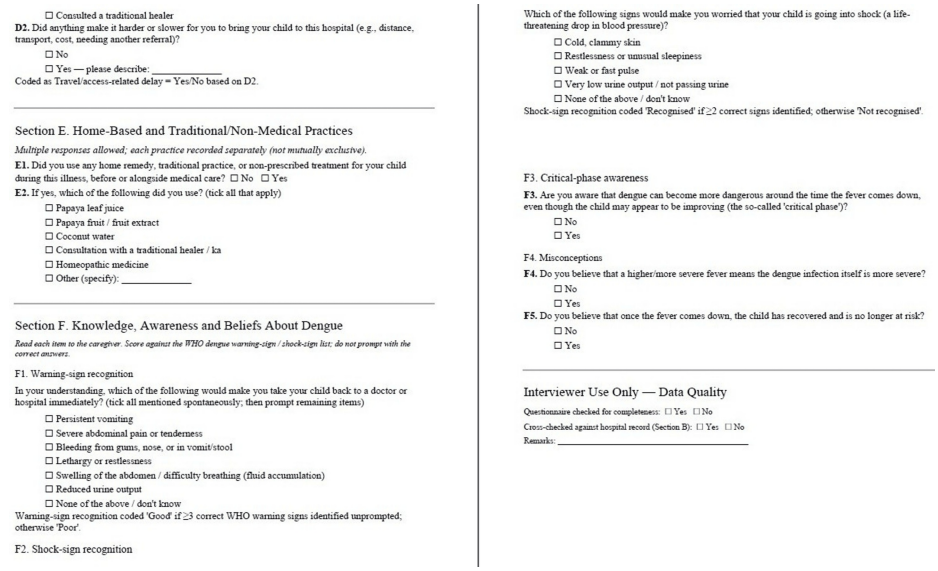
C5. Approximate total monthly household income:
- ☐ < 15,000 BDT
- ☐ 15,000–25,000 BDT
- ☐ > 25,000 BDT
- ☐ Prefer not to disclose

Section D. Illness History and Healthcare-Seeking Behaviour

D1. What was the very first thing you did / the first source of care you sought when your child first became unwell?
- ☐ Took the child to a doctor / hospital directly
- ☐ Went to a local pharmacy / drug-shop first
- ☐ Looked for information or advice on social media / the internet

FIGURE 3: Caregiver knowledge, attitudes and practices (KAP) questionnaire (Contd).

Appendix B



- ☐ Consulted a traditional healer

D2. Did anything make it harder or slower for you to bring your child to this hospital (e.g., distance, transport, cost, needing another referral)?
- ☐ No
- ☐ Yes — please describe: _____

Coded as Travel/access-related delay = Yes/No based on D2.

Section E. Home-Based and Traditional/Non-Medical Practices

Multiple responses allowed; each practice recorded separately (not mutually exclusive).

E1. Did you use any home remedy, traditional practice, or non-prescribed treatment for your child during this illness, before or alongside medical care? ☐ No ☐ Yes

E2. If yes, which of the following did you use? (tick all that apply)
- ☐ Papaya leaf juice
- ☐ Papaya fruit / fruit extract
- ☐ Coconut water
- ☐ Consultation with a traditional healer / ka
- ☐ Homeopathic medicine
- ☐ Other (specify): _____

Section F. Knowledge, Awareness and Beliefs About Dengue

Read each item to the caregiver. Score against the WHO dengue warning-sign / shock-sign list; do not prompt with the correct answers.

F1. Warning-sign recognition

In your understanding, which of the following would make you take your child back to a doctor or hospital immediately? (tick all mentioned spontaneously; then prompt remaining items)
- ☐ Persistent vomiting
- ☐ Severe abdominal pain or tenderness
- ☐ Bleeding from gums, nose, or in vomit/stool
- ☐ Lethargy or restlessness
- ☐ Swelling of the abdomen / difficulty breathing (fluid accumulation)
- ☐ Reduced urine output
- ☐ None of the above / don't know

Warning-sign recognition coded 'Good' if ≥3 correct WHO warning signs identified unprompted; otherwise 'Poor'.

F2. Shock-sign recognition

Which of the following signs would make you worried that your child is going into shock (a life-threatening drop in blood pressure)?
- ☐ Cold, clammy skin
- ☐ Restlessness or unusual sleepiness
- ☐ Weak or fast pulse
- ☐ Very low urine output / not passing urine
- ☐ None of the above / don't know

Shock-sign recognition coded 'Recognised' if ≥2 correct signs identified; otherwise 'Not recognised'.

F3. Critical-phase awareness

F3. Are you aware that dengue can become more dangerous around the time the fever comes down, even though the child may appear to be improving (the so-called 'critical phase')?
- ☐ No
- ☐ Yes

F4. Misconceptions

F4. Do you believe that a higher/more severe fever means the dengue infection itself is more severe?
- ☐ No
- ☐ Yes

F5. Do you believe that once the fever comes down, the child has recovered and is no longer at risk?
- ☐ No
- ☐ Yes

Interviewer Use Only — Data Quality

Questionnaire checked for completeness: ☐ Yes ☐ No

Cross-checked against hospital record (Section B): ☐ Yes ☐ No

Remarks: _____

FIGURE 4: Caregiver knowledge, attitudes and practices (KAP) questionnaire.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Ethics and Review Board (IERB), Mugda Medical College Hospital issued approval MuMCH-IRB/2025/134-5. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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