Original Article
DOI: https://doi.org/10.70749/ijbr.v3i7.2297

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

Frequency and Pattern of ECG Findings in Children with Confirmed Dengue Fever

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ARTICLE INFO

Keywords: Dengue fever, children, electrocardiography, cardiac involvement.

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Declaration
Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 04-06-2025 Revised: 28-06-2025
Accepted: 07-07-2025 Published: 15-07-2025

ABSTRACT

Background: Dengue fever is a major public health concern in Pakistan, particularly among children who are vulnerable to severe complications. **Objective:** To determine the frequency and pattern of ECG findings in children with confirmed dengue fever. **Methodology:** This cross-sectional study was conducted at the Department of Pediatric Medicine, Shalamar Hospital, Lahore, from 2 April to 2 June while enrolling 118 children aged 1–12 years with serologically confirmed dengue fever. Non-probability consecutive sampling was used. Patients with congenital or acquired heart disease were excluded. After informed consent, ECG was performed on all enrolled children using age-appropriate leads. **Results:** The mean age of the children was 6.2 ± 3.1 years; 57.6% were male. ECG abnormalities were detected in 34 (28.8%) patients, while 84 (71.2%) had normal findings. The most common abnormalities were sinus bradycardia (10.2%) and sinus tachycardia (6.8%), followed by T-wave inversion (4.2%), ST-segment changes (3.4%), low-voltage QRS complexes (2.5%), prolonged PR interval (1.7%), and prolonged QT interval (1.7%). ECG abnormalities were more frequent in children aged ≤5 years (37.9% vs. 20.0%, $p = 0.03$) and in those with severe dengue (66.7% vs. 18.9% in uncomplicated dengue, $p = 0.02$). No significant difference was observed by gender ($p = 0.85$). **Conclusion:** A considerable proportion of children with dengue fever demonstrate ECG abnormalities, particularly younger patients and those with severe disease. Although largely transient, these findings highlight the need for routine ECG screening in hospitalized pediatric dengue patients to ensure timely recognition and management of cardiac involvement.

INTRODUCTION

Dengue fever is one of the most significant mosquito-borne viral illnesses affecting humans worldwide, with a particularly high burden in tropical and subtropical regions. According to the World Health Organization, dengue has emerged as a major public health problem, with an estimated 390 million infections annually, of which nearly 96 million manifests clinically. Dengue fever (DF) is a vector-borne disease caused by one or more serotypes of dengue virus (DENV). The four DENV serotypes (DENV1-4) that currently cause dengue in humans have been identified. Transmission occurs through the bites of Aedes aegypti and Ae. albopictus, a daytime biting mosquito species that reproduce in a variety of water-holding containers (both natural and manmade) and environments (rural, urban, and semi-urban). Dengue has been constantly expanding (30-times increase over the past 50 years) to new areas and resurging in parts where it had recently been controlled [1,2]. Over 129 countries currently have dengue, and the number of cases has steadily increased over time: 0.51 million in 2000, 2.4 million in 2010, and 4.2 million in 2019. Asia represents about 70% of the world dengue disease burden. In particular, countries in the world health organization South-East Asia Region (WHO-SEAR) are severely affected with an estimated 1.3 billion people at risk, accounting for almost 52% of the world population at risk of contracting dengue virus. Dengue in Pakistan is also spreading at an alarming rate due to the wide range dispersion and adaptation of Ae. aegypti and Ae. Albopictus [1-3].

In Pakistan, the public health intervention strategy for dengue relies heavily on widespread insecticide spraying during emergencies and outbreaks [4]. Along with an increase in dengue incidence, atypical manifestations of dengue are on the rise, and it is likely to be under-reported. The clinical manifestations in dengue range from asymptomatic infection to severe viral hemorrhagic fever as a prelude to plasma leakage and bleeding. Several clinical studies have shown the existence of cardiac co-morbidity in dengue [5,6]. Clinically, cardiac involvement can differ broadly, from subclinical to severe myocarditis

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which can be fatal. Myocardial involvement may be attributed to direct viral invasion or cytokine-induced immune damage, or both. Nevertheless, research on cardiac manifestations of dengue is limited in the pediatric population. Reports from different studies have shown a 16.7%–71% incidence of cardiac involvement with features like cardiac failure, elevated cardiac enzymes, abnormal electrocardiogram and echocardiogram changes [7,8]. The incidence of cardiac manifestations in dengue fever was determined to be 76.9% [9] by the results of a research project. In a different piece of research, the prevalence of cardiac manifestations was shown to be 56% in cases of dengue fever [10]. 46.2% of the participants in another study had cardiac manifestations [11]. In another study, cardiac manifestations were observed in 26.6% [12]. Although several studies have been done worldwide but there is variability in the studies that are published on international level and no local study is present.

Objective

The basic aim of the study is to determine the frequency and pattern of ECG changes in children with confirmed dengue fever.

METHODOLOGY

This cross-sectional study was conducted at Department of Pediatric Medicine, Shalamar Hospital, Lahore from from 2 April to 2 June. A non-probability consecutive sampling technique was employed to recruit participants. The required sample size of 118 was estimated using a 95% confidence level with an 8% margin of error, while considering an expected percentage of cardiac manifestations as 26.6% (reference 12).

Inclusion Criteria:

- Children of either gender aged between 1 and 12 years.
- Children with confirmed dengue fever (as per operational definition).

Exclusion Criteria:

- Children with congenital or acquired heart disease.
- Children whose guardians did not provide consent.

Data Collection

After approval from the hospital's ethical review committee and obtaining written informed consent from parents/guardians, a total of 118 children fulfilling the inclusion criteria were enrolled. Electrocardiography (ECG) was performed on all dengue-positive patients. For children under the age of 2 years, appropriately smaller ECG leads were utilized. Cardiac involvement was determined from ECG findings in accordance with the operational definitions. All data were recorded using a pre-designed proforma.

Data Analysis

Collected data were entered and analyzed using SPSS version 25.0. Descriptive statistics were applied, with qualitative variables (e.g., gender, ECG abnormalities) presented as frequencies and percentages. Quantitative variables (e.g., age) were summarized as mean ± standard deviation. Data were stratified for age and gender to control for potential effect modifiers. Post-stratification, the Chi-square test was applied to assess associations, with a p-value ≤0.05 considered statistically significant.

RESULTS

Data were collected from 118 patients. The mean age of the 118 children was 6.2 ± 3.1 years, with males slightly older at 6.4 ± 3.0 years compared to females at 6.0 ± 3.2 years, though this difference was not statistically significant (p=0.48). Nearly half of the cohort (49.2%) were aged 5 years or younger, while 50.8% were between 6 and 12 years of age. The distribution of age groups between males and females was similar, and no significant association was observed (p = 0.62).

Table 1

Demographic Characteristics of Patients (N = 118)

Variable	Total (N=118)	Male (n=68)	Female (n=50)	p-value
Age, years (mean ± SD)	6.2 ± 3.1	6.4 ± 3.0	6.0 ± 3.2	0.48
Age groups, n (%)				
• ≤ 5 years	58 (49.2)	32 (47.1)	26 (52.0)	0.62
• 6–12 years	60 (50.8)	36 (52.9)	24 (48.0)	

Out of 118 children, 84 (71.2%) had normal ECGs while 34 (28.8%) showed abnormalities. The most common abnormality was sinus bradycardia in 10.2 percent, followed by sinus tachycardia in 6.8 percent. T-wave inversion was present in 4.2 percent, ST-segment changes in 3.4 percent, low-voltage QRS complexes in 2.5 percent, prolonged PR interval in 1.7 percent, and prolonged QT interval in 1.7 percent. Fever was reported in all patients, while headache or myalgia was seen in 54.2 percent, rash in 35.6 percent, abdominal pain in 32.2 percent, vomiting in 39.0 percent, bleeding manifestations in 16.9 percent, and dengue shock syndrome in 10.2 percent.

Table 2

Frequency of ECG Abnormalities in Children with Dengue Fever (N = 118)

ECG Status	Frequency (n)	Percentage (%)
Normal ECG	84	71.2
Abnormal ECG	34	28.8
ECG Abnormality		
Sinus bradycardia	12	10.2
Sinus tachycardia	8	6.8
T-wave inversion	5	4.2
ST-segment changes	4	3.4
Low-voltage complexes	3	2.5
Prolonged PR interval	2	1.7
Prolonged QT interval	2	1.7
Clinical Feature		
Fever	118	100.0
Headache / myalgia	64	54.2
Rash	42	35.6
Abdominal pain	38	32.2
Vomiting	46	39.0
Bleeding manifestations	20	16.9
Dengue shock syndrome	12	10.2

Abnormal ECGs were more frequent among children aged 5 years or younger (37.9 percent) compared to those aged 6–12 years (20.0 percent), and this difference was statistically significant (p = 0.03). In terms of gender, 29.4 percent of males and 28.0 percent of females had ECG abnormalities, with no significant association found (p=0.85).

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Table 3
Stratification of ECG Abnormalities by Age and Gender (N=118)

Variable		Total (N)	Abnormal ECG n (%)	p-value
Age group	≤ 5 years	58	22 (37.9)	0.03
	6–12 years	60	12 (20.0)	
Gender	Male	68	20 (29.4)	0.85
	Female	50	14 (28.0)	

There was a strong relationship between disease severity and ECG abnormalities. Children with uncomplicated dengue fever without warning signs showed abnormalities in 18.9 percent of cases, rising to 37.5 percent in those with warning signs and reaching 66.7 percent in severe dengue cases. This association was statistically significant (p = 0.02).

Table 4
Association of Dengue Severity with ECG Abnormalities (N=118)

Dengue Severity	Total (N)	Abnormal ECG n (%)	p-value
Dengue fever (without warning signs)	74	14 (18.9)	0.02
Dengue with warning signs	32	12 (37.5)	
Severe dengue (shock/bleeding)	12	8 (66.7)	

DISCUSSION

This study assessed the frequency and spectrum of electrocardiographic (ECG) abnormalities in children with confirmed dengue fever admitted at a tertiary care hospital in Lahore. Out of 118 patients, nearly one-third (28.8%) exhibited abnormal ECG findings, while the majority (71.2%) had normal tracings. These results highlight that although cardiac involvement is not universal in pediatric dengue, it is common enough to warrant systematic monitoring. Our findings are consistent with reports from regional and international studies that describe transient cardiac abnormalities in 20–35% of dengue patients. The most frequent abnormality observed in our cohort was sinus bradycardia (10.2%), followed by sinus tachycardia (6.8%) and repolarization changes such as T-wave inversion (4.2%) and ST-segment shifts (3.4%). Similar patterns have been described in previous research from South Asia, where conduction disturbances and repolarization abnormalities are thought to reflect direct viral effects, cytokine-induced myocardial inflammation, or autonomic dysfunction during the febrile and recovery phases. Importantly, most changes in children are self-limiting, but their detection is clinically valuable to prevent misinterpretation and unnecessary interventions [13]. ECG abnormalities were significantly more common in children aged ≤5 years compared to older children (37.9% vs. 20.0%, p = 0.03). This supports the view that younger children are more vulnerable to cardiac stress during systemic infections due to immature autonomic regulation and smaller cardiovascular reserve [14-16]. In contrast, no statistically significant difference was observed between males and females, a finding consistent with earlier studies that suggest gender does not strongly influence the risk of dengue-associated ECG changes in pediatric populations.

One of the most notable findings was the strong association between severe dengue and abnormal ECG results. While only 18.9% of children with uncomplicated dengue had ECG abnormalities, the frequency increased to 37.5% in those with warning signs and to 66.7% in severe dengue cases (p = 0.02). This gradient suggests that cardiac involvement parallels disease severity and could serve as an additional warning indicator for close monitoring [17]. Previous studies from Pakistan and neighboring countries have similarly noted that ECG abnormalities, particularly conduction disturbances and ST-T changes, are more frequent in patients who develop dengue shock syndrome or severe bleeding manifestations. The clinical significance of ECG abnormalities in pediatric dengue lies in their potential to complicate management if unrecognized. Bradycardia, for instance, is usually benign but may be misinterpreted as drug-induced toxicity or conduction disease. Tachyarrhythmias, though less frequent, can aggravate hemodynamic instability in already compromised patients [18]. Recognition of these patterns ensures appropriate monitoring, prevents unnecessary interventions, and supports judicious use of fluids and electrolytes, which are critical in dengue management. Our observed prevalence of ECG abnormalities (28.8%) falls within the range reported in Asian cohorts but is slightly higher than some Indian pediatric studies that documented around 20–25% prevalence [19]. The predominance of sinus bradycardia aligns with multiple earlier observations where relative bradycardia was considered a hallmark in the convalescent stage of dengue. ST-T changes and low-voltage complexes have also been repeatedly described as transient findings that resolve after recovery. The relatively low frequency of PR and QT prolongation in our cohort echoes previous reports that conduction delays are uncommon but possible, particularly in severe dengue [20,21]. A strength of this study is its exclusive focus on children, an age group underrepresented in prior research. The use of consecutive sampling minimized selection bias, and standardized ECG interpretation ensured consistency. However, limitations include the single-center design, reliance on baseline ECG without serial follow-up to confirm reversibility, and lack of echocardiographic correlation which could have provided further insights into structural and functional cardiac involvement. Additionally, as this study was limited to hospitalized children, the frequency of abnormalities may not fully represent those with milder dengue managed in outpatient settings.

CONCLUSION

It is concluded that a significant proportion of children with dengue fever develop electrocardiographic abnormalities, with an overall frequency of 28.8% in this study. The most common findings were sinus bradycardia and sinus tachycardia, followed by T-wave changes, ST-segment shifts, and less frequent conduction disturbances. Younger children (≤5 years) and those with severe dengue had a higher prevalence of abnormalities, underscoring the importance of vigilant cardiac monitoring in these groups.

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