



# A study on Dengue infection, seroprevalence and its seasonal distribution among patients attending a Tertiary Care Hospital, Kanchipuram, India

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## ABSTRACT

Dengue fever, an acute arboviral disease transmitted by *Aedes* mosquitoes, poses a serious and potentially fatal threat to humans. Increasing urbanization and changing climatic conditions have led to a progressive increase in dengue cases worldwide. This current study was done to elucidate the seroprevalence and incidence of dengue virus (DENV) in patients admitted to a healthcare facility in India. The study was conducted at Meenakshi Medical College Hospital and Research Institute, Kanchipuram, India, from January 2022 to 2023. Over the course of 13 months, blood samples were collected from individuals suspected of having dengue and analyzed for dengue markers NS1 Ag, IgM, and IgG antibodies using the MAC-ELISA method. Of the 416 suspected cases, 102 (25%) had a positive result for DENV infection, with a higher incidence in men (54%) than in women (45%). Predominant cases were found in the age group 16–30 years (34.3%), then at 1–15 years (21.5%). Among the seropositive, 55.3% indicated a recent primary infection. In terms of temporal distribution, dengue cases occurred predominantly after the monsoon, particularly in November (27.4%) and October (17.4%). The importance of dengue in research on climate-related infectious diseases underscores its importance. Timely identification, continuous surveillance, and supportive measures are critical to mitigating the severity and mortality of dengue cases.

## INTRODUCTION

Dengue is a viral illness that is spread by *Aedes* mosquitoes and is mainly prevalent in tropical and subtropical areas across the globe [1]. According to the World Health Organisation, approximately 50% of the population is susceptible to dengue viral infection, underscoring the substantial impact of this disease. The Dengue virus (DENV), belongs to the Flaviviridae family, which is characterized by a

single-stranded RNA virus [2]. It has four antigenically distinct serotypes, DENV-1 to DENV-4, with different genotypes [3,4]. Simultaneously circulation of multiple DENV serotypes during outbreaks complicates disease management and control efforts, necessitating comprehensive and adaptive public health strategies to mitigate the impact of the disease [5].

The etiology of dengue viral infection is attributed to the genus *Aedes*, predominantly transmitted by the *Aedes aegypti* mosquito. During the post-monsoon season, the transmission landscape becomes more intense as the vector population multiplies at a higher rate [6]. Temperature fluctuations have complex effects on different aspects of Dengue dynamics, including vector-to-human and human-to-vector transmission dynamics, as well as mosquito survival rates [7].

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Dengue fever (DF) is clinically defined by an abrupt onset of fever and a variety of symptoms including headaches, retro-orbital pain, myalgia, arthralgia, and a distinctive rash. Furthermore, individuals afflicted with Dengue may display warning indications such as lymphadenopathy, petechial, nausea, hepatomegaly, and hemorrhagic manifestations [8].

Given the urgent necessity to reduce the impact of viral infection, early identification and vector control measures become crucial strategies. Given this imperative, the present study was designed to assess the frequency and occurrence rates of DENV infection among patients in a tertiary care hospital setting. Proactively identifying and effectively managing cases are crucial in reducing the severity and mortality rates of Dengue infections.

This investigation aims to conduct a comprehensive analysis of the dynamics of Dengue infection, elucidating the prevalence of antibodies in the population and patterns of occurrence throughout the year in DF are important aspects to understand for effective disease monitoring and control. These insights have important implications for developing interventions that target specific issues, as well as strategies for effectively managing and implementing vector control measures.

## MATERIALS AND METHODS

### Study design

The study aimed to investigate the prevalence and frequency, of Dengue-infected patients who attended Meenakshi Medical College in Kanchipuram, India, from January 2022 to January 2023.

### Informed consent

A patient informed consent form was acquired from all individuals to ensure their voluntary participation in the study.

### Sample collection

Serum samples were obtained from patients who were clinically suspected of having a Dengue viral infection. The collection process followed rigorous aseptic protocols to avoid any contamination.

### Laboratory analysis

The solid phase enzyme-linked immunosorbent assay (MAC-ELISA) technique was employed to analyze the serum samples. This assay aimed to qualitatively detect three crucial components: Dengue NS1 antigen, Dengue IgM antibodies, and Dengue IgG antibodies. The kits used for these analyses were obtained from J. Mitra & Co. Pvt. Ltd. in New Delhi, India.

### Procedure for MAC-ELISA

The serum samples were subjected to the MAC-ELISA method to qualitatively identify the presence of Dengue NS1 antigen. The optical density (OD) of the reaction was measured at a wavelength of 450 nm, and the results were analyzed according to the manufacturer's guidelines. The analysis additionally involved the detection of Dengue-specific IgM and IgG antibodies in the serum. These antibodies yield valuable insights into the patient's immune response to the virus. The

OD was measured at a wavelength of 450 nm, and the analysis was performed following the manufacturer's guidelines [9,10].

### Exclusion criteria

Patients who tested positive for antibodies against malaria and typhoid were excluded from the study in order to maintain the study's specific focus on DENV infection.

### Clinical data collection

Pertinent clinical history and examination data were obtained from patient records. This information includes symptoms, medical history, physical examination findings, and any other relevant data.

### Data analysis

The gathered data underwent comprehensive analysis. Descriptive statistics were used to summarise the characteristics of patients, the rates of seroprevalence, and the distribution of cases over time. An investigation was conducted to analyze the fluctuations in different seasons and to detect the patterns of infection caused by the DENV.

### Ethical considerations

The study protocol was approved by the Institutional Ethics Committee of the Central Research Laboratory, Meenakshi Medical College Hospital & Research Institute, Tamil Nadu, India with approval number MMCHRI IEC / FACULTY/18/2022. The study adhered rigorously to ethical guidelines and principles, which encompassed obtaining informed consent, safeguarding patient confidentiality, and ensuring the integrity of the research process.

## RESULTS

A total of 416 suspected cases of Dengue infection were observed during the study period from January 2022 to 2023. A total of 102 samples were verified to be positive for Dengue viral infection, resulting in a positivity rate of 25% (Table 1). Demographic distribution: The distribution analysis based on gender showed that males comprised the majority, representing 54% of the positive cases, while females accounted for 45%. An analysis based on age revealed that the age group most impacted by Dengue infection was individuals between the ages of 16 and 30, accounting for 34.3% of cases. This was followed by individuals aged 1 to 15, comprising 21.5% of cases (Table 2).

Dengue diagnostic markers and interpretation: Regarding diagnostic markers, the majority of patients (55%) tested positive for the NS1 antigen, which suggests an infection. In 38% of cases, a primary infection was observed that lacked the NS1 protein but had IgM antibodies. Only a small fraction (7%) exhibited secondary infection, which was confirmed solely by the presence of IgG antibodies.

Analysis of marker combinations unveiled intricate patterns: 16% of cases exhibited evidence of recent primary infection through the presence of both NS1 and IgM markers, while 3% showed indications of both recent primary and secondary infections through the presence of both IgM and IgG

**Table 1.** Age group and sex-wise distribution of Dengue cases ( $N = 102$ ).

S.no	Age groups	Males	Females	Total no. of patients (n = 102)	Percentage (%)
1	<15	16	13	29	28.4
2	16–30	22	17	39	38.2
3	31–45	11	09	19	18.6
4	46–60	07	08	15	14.7
5	Total	55	47	102	100

**Table 2.** Dengue diagnostic markers & interpretation of Dengue infected patients.

Dengue diagnostic markers			Interpretation of results	Total no. of positivity
NS1 Ag	IgM	IgG		
+	-	-	Recent primary infection	55%
-	+	-	Primary infection	38%
-	-	+	Secondary infection	7%
+	+	-	Recent primary infection	16%
+	-	+	Recent primary and secondary infection	3%
-	+	+	Recent secondary infection	2%
+	+	+	2nd exposure of infection or recent secondary infection	5.2%
-	-	-	Unknown febrile infection	75%

**Table 3.** Periodic/month-wise distribution of Dengue positive cases.

S.no	Seasonal variation	Total no. (102)
	January	7.8%
	Feb	3%
	Mar	7.8%
	Apr	3%
	May	3%
	Jun	4.1%
	Jul	6.8%
	Aug	5.8%
	Sep	9.8%
	Oct	17.6%
	Nov	28.4%
	Dec	3%

markers. A small proportion (2%) exhibited recent secondary infection with both IgM and IgG. The simultaneous presence of all three markers suggests either a second exposure to infection or a recent secondary infection, which accounts for 5.2% of the cases. The predominant portion (75%) lacking any of the indicators continued to be categorized as an unidentified febrile infection.

Seasonal distribution: Upon analyzing the seasonal fluctuation of Dengue cases, it was noted that the greatest number of cases occurred during the period from June to September. The month of November had the largest percentage (27.4%) of Dengue cases, with October coming in second (17.4%). Subsequent months exhibited comparatively lower proportions of positive cases, varying between 3% and 9.8% (Table 3).

## DISCUSSION

The occurrence of Dengue, a disease that is becoming more prevalent and important, has been steadily increasing in recent years [11]. The rise in Dengue cases can be attributed to factors such as the growth of cities and insufficient sanitation measures, which together create favorable conditions for the spread of Dengue-carrying mosquitoes. India, in the South-East Asia region, has been consistently dealing with outbreaks of DF and Dengue haemorrhagic fever. Subsequent infections with dengue serotypes are multifaceted, and may progress to severe life-threatening complications. Therefore, the prevalence and distribution of dengue serotypes are crucial for effective dengue prevention and control strategies [9].

During a 1-year period, this study aimed to determine the frequency and early identification of Dengue infection in individuals who were suspected to have the disease. Among the 416 cases that were clinically suspected of Dengue, 102 (25%) were confirmed to be infected using NS1 or IgM/IgG ELISA,

which is compared with the findings of other studies [10]. The significant percentage of positive cases identified by the NS1 antigen (55%) highlights the test's sensitivity in aiding early disease detection. The subsequent occurrence of IgG and IgM antibodies, although following NS1, also aligns with findings from comparable studies [12]. The age group most impacted in terms of demographic distribution was between 16 and 44 years, with the age group of 45 to 60 years following closely behind. These findings contrast with certain Indian studies that have identified individuals under the age of 15 as the most susceptible group [13,14].

The study revealed a male predominance of 54%, which aligns with previous research and highlights the need for further investigation into gender-related susceptibility differences [15,16]. The study demonstrated that there was a significant increase in Dengue cases during the post-monsoon season, accounting for 28% of the total cases, with the monsoon period following closely behind. These observations support previous studies, which suggest that post-monsoon periods are particularly favorable for the transmission of Dengue [17]. The enduring occurrence of Dengue infections in the post-monsoon seasons, regardless of whether it is an epidemic or non-epidemic year, highlights the impact of environmental conditions on the life cycle of the *Aedes* mosquito vectors.

The study offers valuable insights into the local epidemiological landscape of DENV infection. Nevertheless, it is important to consider that these results should be understood in light of the study's constraints, including its exclusive focus on one center and its restricted timeframe. Notwithstanding these constraints, the findings emphasize the significance of dengue infection was particularly observed in the post-monsoon season and the necessity of proactive measures to control the spread of Dengue is crucial, for the good impact on public health.

Limitations of the study: Dengue symptoms overlap with other febrile illnesses, leading to misdiagnosis. Underreporting is common, especially in areas with limited healthcare infrastructure. Seroprevalence can change rapidly due to outbreaks, migration, and other factors. Cross-sectional studies provide a snapshot but may not reflect longer term trends. Many regions affected by dengue have limited resources for comprehensive surveillance and research. This affects the quality and scope of data collected.

## CONCLUSION

Seasonal fluctuations may contribute to the re-emergence of Dengue viral infection, a matter of public health significance. Significantly, adults exhibited greater vulnerability to infection, particularly in the monsoon and post-monsoon periods. The implications of recent findings for dengue prevention highlight the need for a comprehensive and integrated approach. Due to the increased likelihood of transmission during the post-monsoon identified high-risk periods, it is crucial to strengthen prevention strategies and implement integrated vector control measures. The primary focus should be to reduce the populations of *A. aegypti* and, the transmission of the virus. This study emphasizes the importance of taking proactive actions, such as consistently monitoring vectors, implementing community awareness campaigns,

and promoting personal protection practices, particularly during periods of increased transmission risk. In conclusion, our study offers valuable insights into Dengue infection, supporting the implementation of focused interventions to reduce its impact on individuals and communities. In light of the changing nature of the Dengue threat worldwide, it is crucial for healthcare systems and public health authorities to maintain flexibility and attentiveness in their efforts to control and prevent it.

## AUTHOR CONTRIBUTIONS

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work. All the authors are eligible to be an author as per the International Committee of Medical Journal Editors (ICMJE) requirements/guidelines.

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## DATA AVAILABILITY

All data generated and analyzed are included in this research article.

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## USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declares that they have not used artificial intelligence (AI)-tools for writing and editing of the manuscript, and no images were manipulated using AI.

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