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EPIDEMIOLOGICAL ANALYSIS OF DENGUE INFECTION IN INDIA: INSIGHTS FROM MAY 2024

RUPINDER BAKSHI[1], KARASHDEEP KAUR[2], PALIKA SHARMA[2], JASPREET KAUR BOPARAI[2], SATINDER KAUR[2]

Affiliation of Authors:

[1]Professor and Head, Department of Microbiology, Government Medical College, Patiala-147001, IND,

[2]Research Scientist, Viral Research & Diagnostic Laboratory, Department of Microbiology, Government Medical College, Patiala-147001, IND,

Corresponding Author: Dr. Rupinder Bakshi; Professor and Head/PI, Department of Microbiology, Government Medical College, Patiala-147001 IND Email: drrupinder.vrdl@gmail.com; Orcid id: 0000-0002-4312-3735; Phone number: +919815320300

Short running title: Dengue 2024

Abstract

From May 2024 onwards, India witnessed a surge in dengue infections, with a total of 29,876 patients testing positive, translating to a positivity rate of 47%. Epidemiological trends revealed that middle-aged males (20–40 years) constituted 64% of positive cases during rainy season. A disproportionately higher burden of cases was observed in rural areas compared to urban centers, highlighting the pressing need for targeted interventions. This article explores the distribution, demographic patterns, and contributing factors to this outbreak, offering recommendations for improved control and prevention strategies.

Keywords: Dengue, *Aedes aegypti*, NS1 antigen, Punjab

Introduction

Dengue fever, caused by the dengue virus (DENV), is transmitted primarily by *Aedes aegypti* and *Aedes albopictus* mosquitoes. The disease manifests in a spectrum ranging from asymptomatic cases to severe dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) [1]. With an estimated 390 million infections annually, dengue remains a pressing global

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health concern; it has become a recurrent public health challenge in India, particularly during and after the monsoon season [2]. The onset of monsoon seasons in tropical and subtropical regions in mid-2024 led to an upsurge in dengue cases. Rising global temperatures and erratic rainfall patterns were critical in expanding the geographical reach of *Aedes* mosquitoes into temperate regions, increasing the disease's incidence

Differentiating dengue from other febrile illnesses (e.g., malaria, chikungunya) remains challenging, particularly during peak transmission seasons. Clinical Features of dengue and other diseases are quite similar such as mild symptoms are fever, headache, retro-orbital pain, myalgia, and rash and severe ranges from plasma leakage, thrombocytopenia, organ dysfunction, and shock [3]. Symptoms also vary with severity of diseases like in Dengue fever (df) mainly common symptoms are there such as high fever (40°c/104°f), severe headache and retro-orbital (behind the eyes) pain, muscle and joint pain (hence "breakbone fever"), nausea, vomiting, rash and mild bleeding (e.g., nose or gums) [4]. Dengue Hemorrhagic Fever (DHF) shows symptoms of dengue fever, plus severe abdominal pain, persistent vomiting, bleeding tendencies (e.g., blood in stool, gums, or under the skin), fluid accumulation (pleural effusion, ascites) while Dengue Shock Syndrome (DSS) shows severe plasma leakage leading to hypotension (low blood pressure), circulatory failure and organ dysfunction [5,6].

The year 2024 marked a significant increase in dengue incidence across the country, with rural areas bearing the brunt of the outbreak. This article provides a comprehensive analysis of the cases recorded from May 2024, focusing on epidemiological trends, demographic patterns, and the rural-urban disparity.

Materials and Methods

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Data Collection: Data was obtained from public health departments, hospitals, and diagnostic laboratories across tertiary care center Patiala. Case definitions were based on World Health Organization (WHO) guidelines for dengue, confirmed by laboratory tests (NS1 antigen, IgM). A total of 63,569 serum samples were tested for dengue in all suspected individuals. Demographics data of each patient such as age, gender, and geographic location were gathered during sample collection. Rural vs. urban population was categorized by population density and municipal boundaries. Descriptive statistics and proportional analyses were employed to identify trends.

Results

Overall Positivity and Demographic Distribution

In the present study epidemiological Analysis of Dengue Infection was conducted on 63,569 serum samples during the peak period of dengue infection. Out of 63,569 individuals tested for dengue, 29,876 were positive (positivity rate: 47%) as shown in Table 1. Among these males accounted for 64% of cases as depicted in Table 2.

Table 1: Overview of Test Results

Category	Count
Total Samples Tested	63,569
Positive Cases	29,876
Negatives	33,693

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Table 2: Gender Distribution of Positive Cases

Gender	Percentage	Count
Males	64%	19,121
Females	36%	10,755

Table 3 showed that out of 29,876 positive males (59%) showing the highest prevalence in the 20–40 age groups followed by 41-60 years (26%), 61-80years (11%) and 0-20 years (4%).

Table 3: Distribution of Positive Dengue Cases by Age Group and Gender

S.No	Age Group	Total Male Cases	Total Female Cases	Total Cases
1	0–20	765	430	1,195
2	21–40	11,290	6,125	17,415
3	41–60	4,971	3006	7,977
4	61–80	2,095	1,194	3,289
Total		19,121	10,755	29,876

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Rural Areas contributed about 61% of the total cases while urban areas accounted for 39% of cases as shown in fig 1.

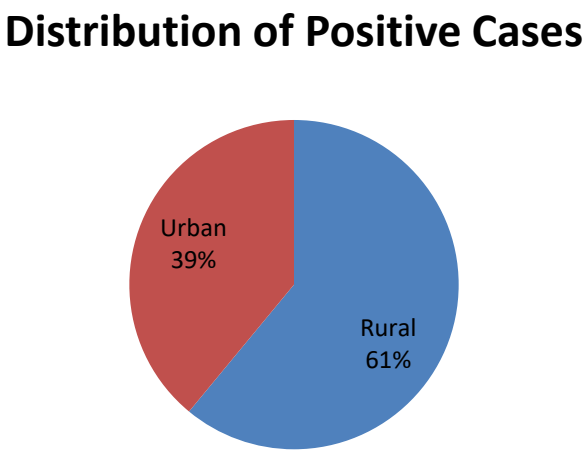

Fig. 1: Distribution of positive Dengue cases between Urban and Rural areas, highlighting rural dominance (61%) over urban (39%).

The total of 29,876 dengue positive cases during the rainy season can be distributed month wise, based on typical seasonal patterns of dengue transmission. In the current investigation, the rainy season spans from June to September, and the peak of dengue cases often occurs in the months of August and September as shown in fig 2.

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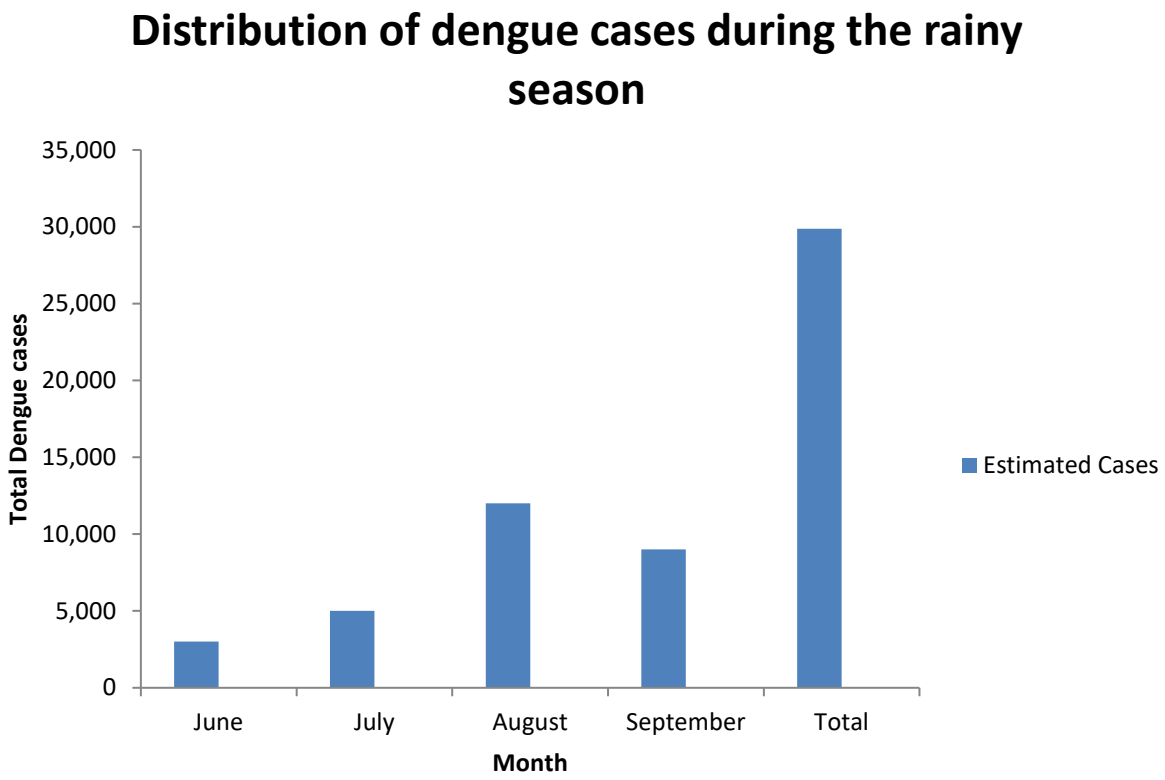

Fig. 2: Monthly distribution of Dengue cases during the rainy season, Showing estimated cases and total contribution across June to September

Discussion

The findings of this study provide critical insights into the epidemiology of dengue infections, particularly during the peak period of transmission in the rainy season. The positivity rate of 47% among the 63,569 serum samples tested, with 29,876 positive cases, underscores the substantial burden of dengue in the region during this period (Table 1). This figure is consistent with the findings of other studies which have reported varying positivity rates during the peak of the rainy season, ranging from 30% to 60% in endemic regions [7]. The positivity rate in this study is

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relatively high, possibly reflecting an outbreak or a period of particularly favorable conditions for Aedes mosquito breeding.

The predominance of cases in middle-aged males (20–40 years) can be attributed to increased outdoor activities, exposing them to mosquito bites. Reduced use of preventive measures can be the possible cause of infection. The higher incidence in rural areas underscores systemic challenges such as Inadequate vector control measures, such as lack of regular fumigation, Poor awareness of dengue prevention strategies, Insufficient diagnostic facilities leading to underreporting in early stages. The trend that aligns with findings from previous research, where males are often disproportionately affected by dengue, especially in regions with active mosquito vectors. A study by Aamir et al. (2014) found a similar male predominance in dengue infections, attributing it to higher outdoor activity and exposure to mosquito vectors among males. The higher incidence of dengue in males could also be linked to behavioral and occupational factors, such as more time spent outdoors in rural areas or regions with higher vector density [8]. Kumar et al. (2020) in their study conducted in India found that males consistently accounted for a higher percentage of dengue cases, especially in urban slums [9]. Similarly, Prattay et al. (2022) in Bangladesh noted that males aged 18–40 years were more frequently affected, which aligns with the current study's finding that 59% of positive cases were in the 21–40 age group [10].

The disparity in dengue cases between rural and urban areas is a well-documented phenomenon. Man et al., (2023) observed in the study, where 61% of dengue cases were reported from rural areas, a similar pattern has been noted in current study [11]. Their study found that rural areas with poor sanitation and limited access to vector control interventions contributed to a higher number of dengue infections [11]. In contrast, urban areas, despite having a higher population

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density, tend to have better sanitation and more comprehensive vector control measures, leading to relatively lower incidence rates.

Another study by Kajeguka et al. (2023) in Tanzania also pointed to rural areas having higher dengue prevalence due to a lack of infrastructure to control mosquito breeding sites, such as standing water in farms, ponds, and open water storage containers [12]. They emphasized the importance of community-based vector control strategies, particularly in rural areas, to mitigate dengue transmission.

The monsoon season from May 2024 brought heavy rainfall, creating breeding hotspots for mosquitoes. Rural areas with unpaved roads, water-logging and poor sanitation systems exacerbated the problem. In the present study, June marks the beginning of the rainy season; cases start to rise but are typically not as high as the peak months. In July, the rains are heavy, and cases begin to increase. In august a significant rise in mosquito breeding due to stagnant water was observed in India. Later in September cases remain high, often still reaching peak levels before the rains start to subside. The findings of the present study are consistent with findings from several other studies. Karim et al. (2012) conducted a study in Bangladesh that identified a similar peak in dengue cases during the monsoon season (June to September). The study suggested that rainfall and high humidity play a significant role in creating ideal conditions for Aedes mosquitoes to breed [13]. Their findings were supported by Chakravarti (2005) in India who showed a clear correlation between increased rainfall and the rise in dengue cases, particularly during the post-monsoon period when mosquito larvae hatch [14]. Similarly, Islam et al. (2016) analyzed the relationship between rainfall and dengue incidence in India and found a clear link between increased rainfall and higher numbers of dengue cases [15].

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Enhance active case detection in rural regions using mobile healthcare units. Deploy rapid diagnostic kits in resource-limited settings. Conduct awareness campaigns on water storage practices and vector breeding prevention. Distribute insecticide-treated nets (ITNs) in rural areas. Intensify vector control programs with regular fogging in high-risk regions. Promote integrated pest management techniques, such as the use of *Wolbachia*-infected mosquitoes. Establish temporary dengue clinics in rural hotspots during peak transmission periods. Subsidize diagnostic and treatment costs for low-income populations.

Conclusion

The dengue outbreak in India from May 2024 revealed critical vulnerabilities, particularly in rural areas and among middle-aged males. Addressing these gaps through strengthened healthcare infrastructure, robust vector control, and community-driven interventions is essential to mitigate future outbreaks. Targeted rural-focused strategies and proactive surveillance systems will be instrumental in reducing the disease burden.

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