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Original Research Article

The Demographic and Seasonal Variation of Dengue Virus Infection in Gondia, A Tribal District in Maharashtra, India

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Abstract

Introduction: Dengue remains one of the most important mosquito-borne viral infections in India, with substantial geographic heterogeneity and marked seasonal variation. Local laboratory-based surveillance data are essential for understanding transmission patterns and for guiding vector control strategies at district level.

Objectives: To describe the temporal, demographic and geographic distribution of laboratory-confirmed dengue cases in Gondia district, Maharashtra, over a three-year period.

Methods: This study was conducted at the Department of Microbiology, Government Medical College, Gondia, which serves as a sentinel centre for vector born disease surveillance. The study period extended from January 2023 to December 2025. Serum samples obtained from patients presenting with dengue-like illness were tested for dengue-specific IgM antibodies using the dengue MAC ELISA.

Results: A total of 696 laboratory-confirmed dengue cases were recorded during the study period. Year-wise positivity showed a decreasing trend. A clear seasonal peak was observed during September 2023, corresponding to the post-monsoon period. Females constituted 54.5% of positive cases. The most affected age group was 21 to 30 years (28.2%). Geographic clustering was observed in Gondia followed by Goregaon.

Conclusion: This study demonstrates marked seasonal and demographic variation in dengue positivity in Gondia district. Continuous laboratory-based surveillance remains a critical tool for early outbreak detection and for strengthening district-level vector control programmes.

Keywords: Dengue, surveillance, seasonality, Maharashtra.

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Introduction

Dengue is one of the most important mosquito-borne viral infections affecting humans worldwide and is a major public health problem in tropical and subtropical regions. It is caused by dengue virus (DENV), a single-stranded positive-sense RNA virus belonging to the genus Flavivirus (family Flaviviridae) and is transmitted primarily by Aedes aegypti and Aedes albopictus mosquitoes. Four antigenically distinct but closely related serotypes (DENV-1 to DENV-4) circulate globally and are responsible for repeated epidemics and endemic transmission in many countries [1,2]

The World Health Organization (WHO) estimates that nearly half of the world's population is at risk of dengue infection, with approximately 100–400 million infections occurring annually. (WHO, 2023)2 Dengue has shown a remarkable expansion in geographical distribution over the last few decades, driven by rapid urbanization, population growth, climate variability, inadequate water management and increasing human mobility[3] India bears a substantial proportion of the global dengue burden and reports large inter-annual and regional variation in case numbers. Dengue transmission in the country is characteristically seasonal, with a marked increase during the monsoon and post-monsoon months, coinciding with favourable environmental conditions for Aedes breeding [4,5]. The epidemiology of dengue in India has also evolved from being largely confined to urban areas to widespread involvement of peri-urban and rural settings, largely attributable to unplanned development, household water storage practices and inadequate vector control [6]

Surveillance remains the cornerstone of dengue prevention and control. Laboratory-based surveillance, particularly using routinely generated diagnostic data, provides valuable insight into local transmission dynamics, seasonal trends and population groups at risk. In resource-limited settings, such surveillance systems often represent the most feasible and sustainable approach for monitoring dengue activity and for guiding timely public health interventions [7]. Despite the recognized public health importance of dengue, district-level epidemiological data from several parts of central and eastern India remain sparse. Gondia district, located in eastern Maharashtra, is predominantly semi-urban and rural in character and has environmental and socio-demographic conditions conducive to Aedes mosquito proliferation. However, published information describing the temporal and demographic distribution of dengue in this region is limited. The present study was therefore undertaken to describe the age, sex, month and taluka-wise distribution of laboratory-confirmed dengue cases reported over a three-year period in Gondia district, with the objective of generating baseline epidemiological evidence to support local surveillance and vector-control strategies.

Material and Methods

A cross-sectional study was conducted in the Department of Microbiology, Government Medical College, Gondia, which serves as a sentinel centre for vector borne diseases. The study was carried out from January 2023 to December 2025.

Serum samples obtained from patients presenting with dengue-like clinical illness were tested for the detection of dengue-specific IgM antibodies using the dengue IgM capture enzyme-linked immunosorbent assay (MAC-ELISA).

Blood samples were collected and serum was separated in accordance with standard guidelines. The samples were processed using the Dengue IgM Capture ELISA kit manufactured by National Institute of Virology, Pune. ELISA test was performed as per manufacturer’s instructions. The optical density (OD) was measured at 450 nm within 10 minutes of stopping the reaction.

Samples were interpreted as negative if the OD value was less than twice the OD of the negative control. Samples were considered positive if the OD value exceeded three times the OD of the negative control. Samples with OD values exceeding twice but less than three times the OD of the negative control were considered equivocal. To detect the early cases having fever for less than five days, NS1 antigen test was performed using rapid immunochromatography.

Observation and Result

During the three-year study period, 696 (5.9%) laboratory-confirmed dengue cases were identifiedout of 11948 tested. Year-wise distribution is depicted in table 1.

Table 1: Year-wise distribution of dengue positive cases (N=11948)

Year	Total samples tested (%)	No. of positive cases (%)
2023	4433 (37.1)	415 (3.5)
2024	4222 (35.3)	246 (2.1)
2025	3293 (27.6)	35 (0.3)
Total	11948	696 (5.9)

As per Fig. 1, a pronounced seasonal pattern was observed. The highest number of positive cases occurred during September 2023 followed by August 2024. Post-monsoon clustering was evident across all three years.

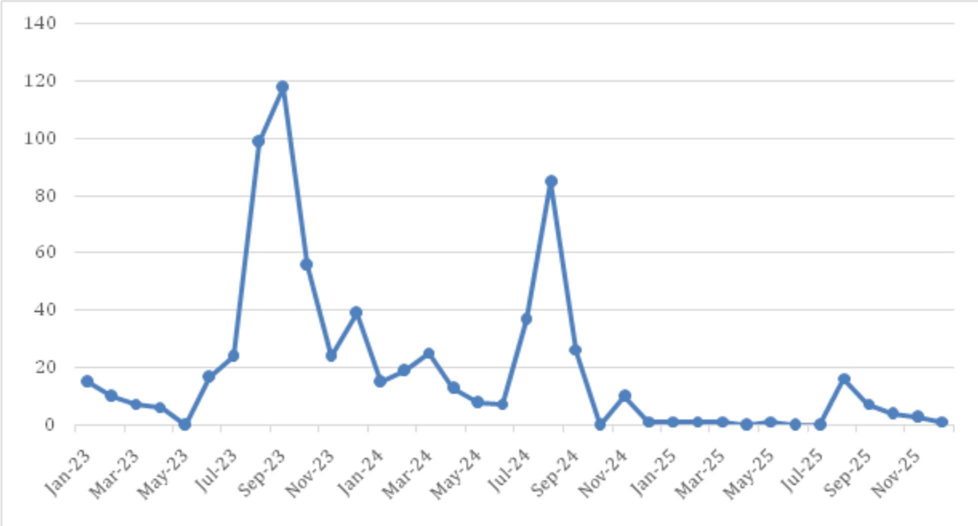

Figure 1: Monthly distribution of positive cases

Out of total positive cases (n=696), a slight female (54.5%) predominance was observed. Table 2 & Fig.3 show the most affected age group was 21 to 30 years followed by 11 to 20 years.

Table 2: Gender-wise distribution of positive cases (N=696)

Age	Male (%)	Female (%)	Total (%)
0 to 10	9 (1.3)	13(1.9)	22(3.2)
11 to 20	63(9.1)	83(11.9)	146(21)
21 to 30	80(11.5)	116(16.7)	196(28.2)
31 to 40	58(8.3)	69(9.9)	127(18.2)
41 to 50	40(5.7)	44(6.3)	84(12.1)
>50	67(9.6)	54(7.8)	121(17.4)
Total	317 (45.5)	379 (54.5)	696 (100)

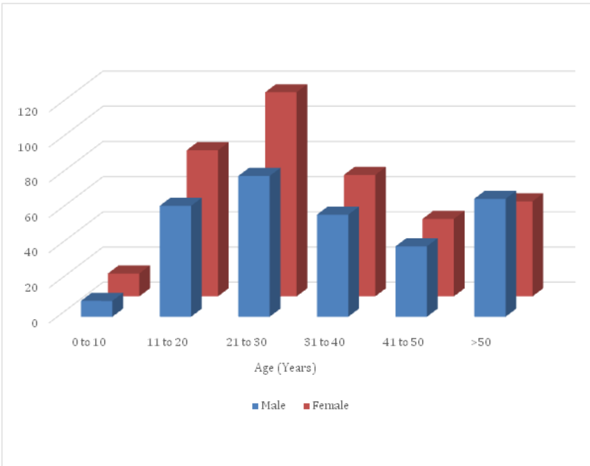

Figure 2: Age-wise distribution of positive cases

The highest number of cases was recorded from Gondia taluka (377; 54.2%), followed by Goregaon (82; 11.8%) and Salekasa (51; 7.3%). Amgaon contributed 48 cases (6.9%), while Arjuni-Morgaon and Sadak-Arjuni reported an equal number of cases (45 each; 6.5%). Tirora accounted for 30 cases (4.3%) and Deori for 16 cases (2.3%). Only sporadic cases were received from neighbouring districts, with one case each from Bhandara and Balaghat (Madhya Pradesh) (0.1% each). Overall, a clear clustering of cases was observed in Gondia taluka, indicating a higher burden of disease in the district headquarters and its surrounding areas. (See figure 3)

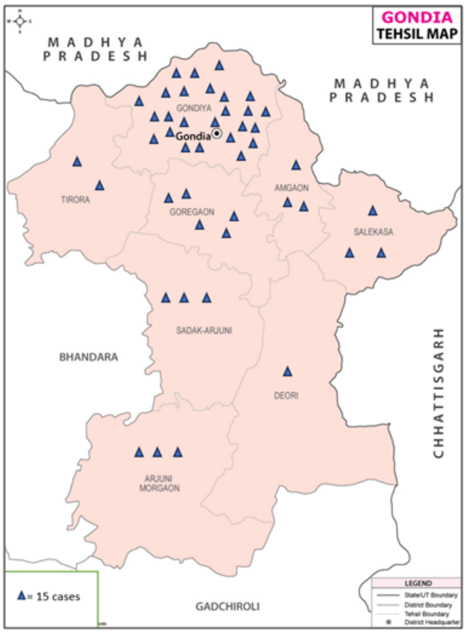

Figure 3: Mapping of positive dengue cases in Gondia district

Discussion

The present three-year laboratory-based surveillance study from Gondia district demonstrates clear and consistent patterns with respect to seasonality, age distribution, gender distribution and geographic clustering of dengue cases. Each of these findings is discussed below in the context of recent local, regional and national evidence.

Seasonal (month-wise) distribution: A pronounced seasonal pattern was observed in the present study, with a sharp rise in dengue positivity during the monsoon and immediate post-monsoon months and a clear peak in September 2023, followed by a secondary rise during August 2024. Such seasonality is well recognised in India and reflects the strong influence of rainfall, humidity and ambient temperature on the density and survival of Aedes mosquitoes. Similar post-monsoon peaks have been consistently reported from several parts of the country. In a national analysis of dengue surveillance data from India during 2014–2017, Murhekar et al demonstrated that the majority of reported dengue cases occurred between August and November, with September and October contributing the highest proportions of cases.4 Similarly, a recent epidemiological analysis in Uttar Pradesh also showed clustering of dengue cases during the monsoon and post-monsoon period, with a distinct peak during September to November [8]

Studies from central India show comparable trends. Deshkar et al. reported that dengue activity in a tertiary care hospital from central India was highest during August to November [9]. Likewise, Madkey et al., in their sentinel surveillance study from Gondia district for the period 2018–2020, observed the maximum number of dengue cases during September [10].

Age-wise distribution: In the present study, the highest proportion of dengue-positive cases was observed in the 21–30-year age group (28.2%), followed by the 11–20-year and 31–40-year age groups. This predominance of young adults is in agreement with several recent Indian studies.

A hospital-based study from Udupi district, Karnataka, reported that the majority of dengue cases occurred in the 15–44-year age group, representing the economically and socially active population [11]. Similarly, Deshkar et al. observed that young adults constituted the largest group of dengue-positive patients in their five-year analysis from central India [9]. A recent regional epidemiological study from western India also demonstrated a higher burden of dengue among individuals aged between 20 and 40 years [12]. The predominance of young adults in the present study may be explained by greater outdoor exposure, occupational and travel-related mobility, and increased interaction with peri-domestic vector breeding sites. Furthermore, adults are more likely to seek laboratory testing for febrile illness in district-level facilities, which may influence the observed age distribution.

Gender-wise distribution: A notable finding of the present study is the slight female predominance (54.5%) among laboratory-confirmed dengue cases. This observation differs from the classical pattern reported in many Indian hospital-based studies, where males constitute the majority of cases.

Several studies from different parts of India have reported male predominance, often ranging from 55% to 65%. Deshkar et al. reported a higher proportion of male dengue patients in central India [9]. Kumar et al. from western Uttar Pradesh and Karoli et al. from northern India similarly demonstrated male predominance [11,13].

However, recent studies from semi-urban and rural settings have begun to show a narrowing gender gap and, in some instances, a female preponderance. Madkey et al., in their Gondia-based sentinel surveillance study, reported a relatively balanced distribution between males and females [10]. Prasith et al., while analysing dengue surveillance data in the Lao People's Democratic Republic, demonstrated that gender distribution can vary considerably depending on local exposure patterns and health-seeking behavior [14].

The slight female predominance observed in the present study may reflect greater peri-domestic exposure of women to Aedes breeding sites associated with household water storage practices, as well as improved access to diagnostic facilities for women in the district. It is also possible that male patients with mild illness may be under-represented due to differences in healthcare utilisation. Therefore, gender differences in laboratory surveillance data should be interpreted cautiously and in the context of local socio-behavioural factors.

Geographic (taluka-wise) distribution: The present study demonstrates marked geographic heterogeneity in dengue positivity within Gondia district, with more than half of all laboratory-confirmed cases originating from Gondia taluka. This pattern of spatial clustering is consistent with observations from other district- and state-level studies in India. A spatio-temporal analysis of dengue in Odisha reported significant clustering of cases in specific districts and urbanised areas, with clear heterogeneity in disease burden across administrative units [15]. Similar geographic variation has been documented in several state-level analyses, where urban and semi-urban blocks consistently contribute a disproportionate share of reported dengue cases [4,6].

Higher population density, increased construction activity, storage of water in domestic containers, and better access to diagnostic facilities are likely to contribute to the higher case detection in Gondia taluka. In contrast, the relatively lower number of cases reported from peripheral talukas such as Deori and Tirora may represent a combination of lower population density, reduced healthcare access and possible under-detection rather than true absence of transmission. The identification of such geographic clustering is particularly relevant for district-level public health planning, as it supports the need for focused vector-control activities and intensified surveillance in high-burden talukas.

Overall dengue burden and comparison with recent local and national data: Although the present study does not estimate community seroprevalence, the detection of 696 laboratory-confirmed dengue cases over a three-year period indicates sustained transmission in Gondia district. This is consistent with the broader national trend of persistent dengue activity reported by the national surveillance system [5]. Murhekar et al. have highlighted a stable but substantial burden of dengue in India, with considerable year-to-year and regional variation [4]. Local studies from Maharashtra also support the presence of endemic transmission. Serological studies from Akola and Pune have reported significant dengue positivity among patients presenting with acute febrile illness, indicating widespread circulation of dengue virus in the state (Katole, Alagarasu) [16,17]. The present findings therefore complement available serological and hospital-based data and contribute district-specific epidemiological evidence from an under-reported region of eastern Maharashtra.

Limitations: The present study is limited by the absence of clinical details, disease severity, outcome data and serotype information. The reliance on routine laboratory records also precludes estimation of true community incidence and may underestimate asymptomatic and mildly symptomatic infections. In addition, entomological and environmental indicators were not available for correlation with temporal trends. Despite these limitations, the study provides valuable, programmatically relevant information on dengue epidemiology at the district level.

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