



## Original Research Article

# CHIKUNGUNYA VIRUS INFECTION IN GONDIA, A TRIBAL DISTRICT IN MAHARASHTRA, INDIA: A DEMOGRAPHICAL STUDY

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### ABSTRACT

**Background:** Chikungunya virus infection continues to pose a significant public health challenge in India, with recurrent outbreaks and marked seasonal variation. District-level laboratory surveillance is essential to understand local transmission dynamics and to guide targeted vector control measures. The objective is to describe the demographic, temporal and spatial distribution of laboratory-confirmed chikungunya cases in Gondia district, Maharashtra, during 2024–2025 and to compare the month-wise trend with dengue during the same period.

**Materials and 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. Serum samples received from clinically suspected chikungunya cases during January 2024 to December 2025 were tested for chikungunya IgM-capture ELISA. Data on age, sex, month of reporting and taluka of residence were analysed. Descriptive statistics were used to assess trends and distribution patterns.

**Results:** A total of 6,507 samples were tested using IgM ELISA during the study period, of which 181 were laboratory confirmed for chikungunya virus infection, giving an overall positivity of 2.8%. The positivity rate was higher in 2024 as compared to 2025. Males constituted 52% of cases, while females accounted for 48%, indicating near equal sex distribution. The majority of infections were observed among adults, particularly in the 21-30-year age group followed by 31-40. Month-wise analysis demonstrated distinct seasonal peaks, with a major increase during the monsoon and post-monsoon period and a smaller rise during early months of the year. Spatial analysis revealed marked clustering of cases in Gondia taluka (98 cases, 54.1%), followed by Sadak Arjuni, Goregaon and Amgaon, while comparatively fewer cases were reported from peripheral talukas.

**Conclusion:** The present laboratory-based surveillance highlights clear spatio-temporal clustering and predominance of chikungunya infection among the adult population in Gondia district, with transmission peaks corresponding to favourable vector breeding seasons. Concentration of cases in specific talukas underscores the need for focused vector control and strengthened surveillance at sub-district level. Continuous laboratory surveillance remains crucial for early detection of transmission trends and for guiding district-specific public health interventions.

**Keywords:** Chikungunya, surveillance, seasonality, Maharashtra, dengue.

## INTRODUCTION

Chikungunya is a re-emerging mosquito-borne viral infection caused by the Chikungunya virus (CHIKV), an Alphavirus transmitted principally by *Aedes aegypti* and *Aedes albopictus* mosquitoes. The disease is characterized by acute onset of fever, severe polyarthralgia, myalgia, headache, and rash, and may lead to persistent joint pain and disability in a significant proportion of affected individuals.<sup>[1]</sup> (WHO,2025)

Despite being endemic in many tropical and subtropical regions, CHIKV has displayed a marked resurgence in recent years. Globally, CHIKV cases have been reported in multiple WHO regions through 2024–2025, with heterogeneous regional trends influenced by climate, vector ecology, and population susceptibility. In India, chikungunya remains a significant public health concern, with periodic outbreaks recorded across numerous states, including Maharashtra, Karnataka, and Tamil Nadu, as identified by national surveillance data.<sup>[1]</sup> (WHO,2025)

The epidemiology of chikungunya in outbreak settings in India shows substantial local transmission and high seropositivity, indicating a sustained disease burden within communities during epidemic waves. Previous outbreak investigations have documented considerable variation in age distribution, with adults in productive age groups frequently affected, and relatively balanced sex ratios among cases.<sup>2</sup> (Nagarajan et al). Seasonal peaks are commonly observed during monsoon and post-monsoon months, correlating with increased mosquito breeding following rainfall.<sup>[1]</sup> (WHO,2025)

However, district-level epidemiological investigations remain limited, particularly for many parts of central and eastern Maharashtra. This study therefore aims to describe the age, sex, month-wise and taluka-wise distribution of chikungunya cases in Gondia district during 2024–2025, providing detailed insights into local transmission dynamics and temporal trends. Such granular evidence is critical for planning targeted vector control, surveillance, and public health interventions at the district and sub-district levels.

## MATERIALS AND METHODS

A cross-sectional, laboratory-based study was undertaken in the Department of Microbiology, Government Medical College, Gondia, which serves as a sentinel centre for surveillance of vector-borne diseases. The study period extended from January 2024 to December 2025.

Serum samples collected from patients with clinical features suggestive of chikungunya infection were tested for the presence of chikungunya virus-specific IgM antibodies using a chikungunya IgM capture enzyme-linked immunosorbent assay (MAC-

ELISA). Blood samples were collected and serum was separated following standard laboratory procedures. Testing was performed using the Chikungunya IgM Capture ELISA kit supplied by the National Institute of Virology, Pune, in accordance with the manufacturer's instructions. Optical density (OD) values were recorded at 450 nm within 10 minutes of completion of the reaction.

Samples with OD values less than twice that of the negative control were considered negative, while those with OD values exceeding three times the negative control were considered positive. Samples with OD values between two and three times the negative control were classified as equivocal.

## RESULTS

### Study population and overall laboratory positivity

A total of 6,507 serum samples received from clinically suspected chikungunya cases from Gondia district were tested during the study period (January 2024–December 2025). Of these, 181 samples were laboratory confirmed for chikungunya virus infection, yielding an overall positivity of 2.8%.

Year-wise analysis showed that 4,222 samples were tested in 2024, with 142 positives, while 2,285 samples were tested in 2025, with 39 positives. Thus, 78.5% (142/181) of the total laboratory-confirmed cases were reported in 2024 and 21.5% (39/181) in 2025.

Of the 181 laboratory-confirmed chikungunya cases, 95 (52.5%) were males and 86 (47.5%) were females, indicating a near-equal sex distribution with a slight male predominance.

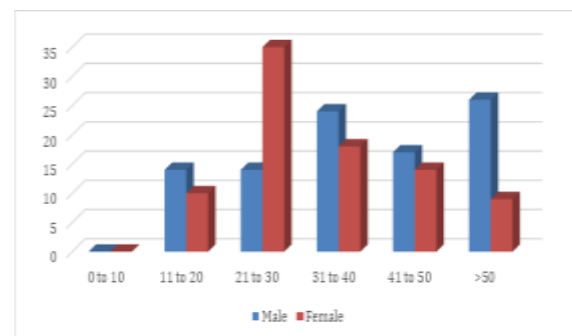


Figure 1: Age-wise and sex-wise distribution

Age-wise analysis from [Table 1] demonstrated that chikungunya infection predominantly affected adults. The majority of laboratory-confirmed cases were observed in the 21–30-year age group, followed by individuals aged between 31–40 years. Very few cases were recorded in adolescents and young adults, and no laboratory-confirmed cases were observed in children below 10 years of age.

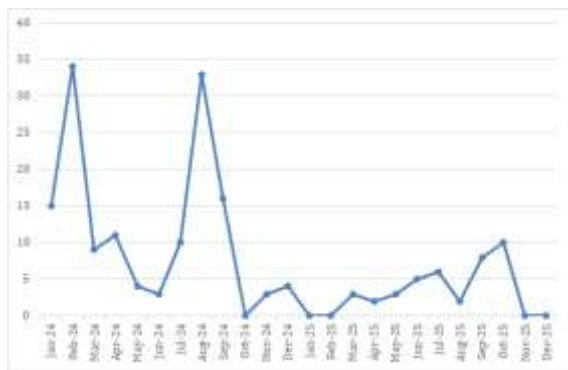
On stratification by age and sex, a higher number of female cases was observed in the 21–30-year age group, whereas males predominated in the 31–40-year and >50-year age groups.

**Table 1: Age- and sex-wise distribution of laboratory-confirmed chikungunya cases. (N=181)**

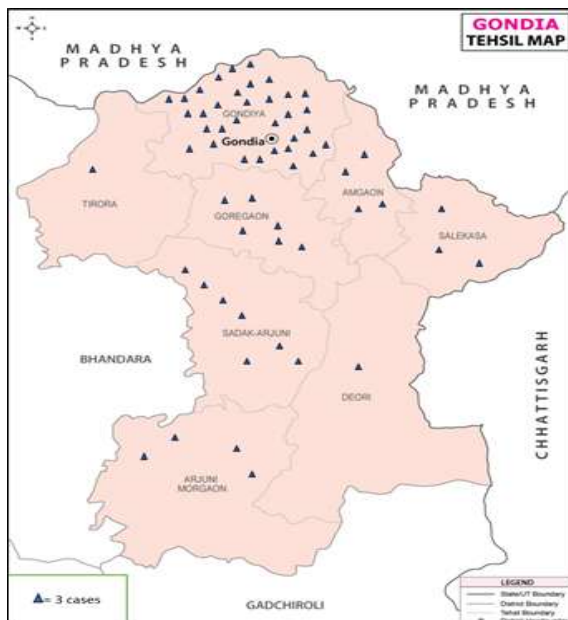
Sr No	Age (Years)	Malen (%)	Females n (%)	Total N (%)
1	0 to 10	0 (0 %)	0 (0 %)	0 (0 %)
2	11 to 20	14 (7.7 %)	10 (5.5 %)	24 (13.3 %)
3	21 to 30	14 (7.7 %)	35 (19.3 %)	49 (27.1 %)
4	31 to 40	24 (13.3 %)	18 (9.9 %)	42 (23.2 %)
5	41 to 50	17 (9.4 %)	14 (7.7 %)	31 (17.1 %)
6	>50	26 (14.4 %)	9 (5 %)	35 (19.3 %)
Total N (%)		95 (52.5 %)	86 (47.5 %)	181 (100 %)

**Month-wise (temporal) distribution**

Month-wise distribution of laboratory-confirmed cases demonstrated a distinct seasonal pattern. A smaller rise in cases was observed during the early months of 2024, followed by a major peak during the monsoon and post-monsoon period of 2024, with the highest number of cases recorded in August 2024. Thereafter, the number of cases declined towards the end of 2024 and remained low during the initial months of 2025, with a minor increase again during the middle of 2025.



**Figure 2: Month-wise trend of laboratory-confirmed chikungunya cases during 2024–2025.**



**Figure 3: Mapping of positive chikungunya cases in Gondia district.**

**Taluka-wise (spatial) distribution:** Taluka-wise analysis of the 181 laboratory-confirmed chikungunya cases from Gondia district revealed

marked geographic clustering. The highest number of cases was reported from Gondia taluka (98 cases; 54.1%), followed by Sadak Arjuni (22; 12.2%), Goregaon (19; 10.5%), Amgaon (14; 7.7%) and Arjuni Morgaon (13; 7.2%). A comparatively lower number of cases were reported from Salekasa (9; 5%), while Deori and Tirora reported the least number of cases (3 each; 1.7%).

**Temporal comparison of dengue and chikungunya trends:**

Month-wise comparison in figure no. 4 showed that both dengue and chikungunya demonstrated marked seasonal clustering. The principal rise for both infections occurred during the monsoon and post-monsoon months of 2024, with overlapping peaks during July–September and a maximum in August 2024. During 2025, both infections showed relatively low and fluctuating activity. In the study, dengue and chikungunya co-infection was seen in eight (4.4%, 8/181) cases.



**Figure 4: Month-wise comparison of chikungunya & dengue cases**

**DISCUSSION**

In the present study, the overall chikungunya IgM seropositivity among clinically suspected cases was 2.8% (181/6,507). This magnitude of laboratory positivity is comparable to several recent non-outbreak and routine febrile illness surveillance studies, and is considerably lower than rates reported during focal epidemic investigations.<sup>[2]</sup>

Recent acute febrile illness surveillance conducted in an urban coastal setting of eastern India reported chikungunya IgM positivity of approximately 2% among clinically suspected cases, closely mirroring the seropositivity observed in the present study. Such low confirmation rates were attributed to broad syndromic screening of undifferentiated fever cases and the inclusion of non-chikungunya viral illnesses within the testing pool.<sup>[3]</sup> Similarly, a recent hospital-based pooled analysis from north-eastern India

demonstrated a chikungunya laboratory positivity, although slightly higher of around 11% among suspected cases, again comparable to the low endemic transmission level observed in Gondia district.<sup>[4]</sup>

In the present study, males constituted 52.5% and females 47.5% of laboratory-confirmed chikungunya cases, indicating a near-equal sex distribution with slight male predominance. This finding is consistent with recent Indian hospital-based evidence, where most studies report only a marginal excess of male cases and no consistent sex-specific risk for chikungunya infection.<sup>[2]</sup>

In the present study, chikungunya predominantly affected young and middle-aged adults, with the highest proportion of cases in the 21–30 years (27.1%) and 31–40 years (23.2%) age groups, and no laboratory-confirmed cases below 10 years of age. A similar adult-predominant pattern has been reported from long-term surveillance in Akola, where the 21–30-year group constituted the largest share of positives, followed by the 31–40-year group.<sup>[5]</sup> Likewise, laboratory surveillance from Madhya Pradesh demonstrated that nearly 58% of confirmed cases belonged to the 16–45-year age group, with only a small proportion of infections in young children.<sup>[6]</sup> In contrast, a hospital-based study from Warangal reported a relatively higher contribution of paediatric and adolescent cases, indicating that age distribution may vary across regions and transmission settings.<sup>[7]</sup>

In this study, chikungunya cases demonstrated a distinct seasonal trend, with a major peak during the monsoon and post-monsoon period (July–September) and the highest number of cases in August 2024, followed by a decline towards the end of the year and low activity in early 2025. This seasonal pattern aligns with multiple surveillance reports from India and the broader region showing that *Aedes*-borne arboviruses, including chikungunya and dengue, exhibit marked monsoon-linked seasonality. Systematic reviews of dengue and chikungunya distribution in the Hindu Kush Himalayan region reported that both infections typically increase with the onset of monsoon (July in India) and peak in the post-monsoon months (September–November) due to enhanced mosquito breeding conditions from rainfall, humidity, and elevated temperatures.<sup>[8]</sup>

Similarly, laboratory surveillance of chikungunya in Madhya Pradesh documented higher positivity during the monsoon and post-monsoon period, with significant increase in cases during months of increased rainfall and humidity, reflecting the well-established dependence of *Aedes aegypti* on wet season ecological conditions.<sup>[6]</sup>

The taluka-wise analysis revealed marked geographic clustering of chikungunya cases within Gondia district, with Gondia taluka reporting the highest share (54.1%), followed by progressively lower counts in surrounding talukas (Sadak Arjuni, Goregaon, Amgaon, etc.). Such spatial heterogeneity

at sub-district level is a recognized feature of arboviral transmission, where local differences in population density, vector breeding habitats, environmental conditions, and human mobility create micro-epidemiological clusters. While few published studies directly compare taluka-level chikungunya distribution, spatial epidemiological analyses from other Indian settings (e.g., Karnataka) have documented district-level variation in chikungunya incidence, with some districts maintaining higher incidence over several years while others show declining or sporadic transmission.<sup>[9]</sup>

These patterns imply that, much like in Karnataka where certain districts showed persistent transmission, Gondia taluka may represent a localized hotspot within the district, possibly reflecting ecological suitability for *Aedes* vectors, concentration of human hosts, and localized rainfall and water stagnation patterns. Such clustering emphasizes the need for targeted vector control and community engagement in high-burden talukas, rather than uniform district-wide interventions.

In the present study, both dengue and chikungunya demonstrated a clear monsoon-linked rise, with cases beginning to increase from July, peaking during the late monsoon/post-monsoon period (August–September) and declining sharply thereafter. Dengue showed a sharper and higher peak than chikungunya, whereas chikungunya followed a lower but temporally concordant peak, indicating parallel transmission dynamics. This temporal pattern is consistent with laboratory-based surveillance from central India (Madhya Pradesh), where both dengue and chikungunya activity increased during the monsoon and immediate post-monsoon months, with dengue contributing the larger proportion of arboviral diagnoses and chikungunya showing a smaller, synchronous seasonal rise.<sup>[6]</sup> (Joshi) Similar concurrent seasonal peaks of dengue and chikungunya during August–October have been reported in community-based acute febrile illness surveillance from coastal Andhra Pradesh (Visakhapatnam), reflecting co-circulation of *Aedes*-borne viruses during periods of optimal vector density.<sup>[3]</sup>

Further, a regional systematic review from South and South-East Asia demonstrated that both dengue and chikungunya consistently exhibit maximum transmission during monsoon and post-monsoon months, with dengue showing more pronounced and sustained peaks compared with chikungunya, a trend that closely mirrors the relative magnitude and timing observed in the present study.<sup>[8]</sup>

In the present study conducted in Gondia district, eight cases of dengue–chikungunya coinfection were detected, indicating concurrent circulation of these arboviruses in the study area. Co-circulation of Dengue and Chikungunya is common in tropical regions because both viruses are transmitted by the same mosquito vectors, primarily *Aedes aegypti* and *Aedes albopictus*. Experimental studies have demonstrated that *Aedes aegypti* mosquitoes can

acquire both dengue virus (DENV) and chikungunya virus (CHIKV) during a single blood meal and subsequently transmit both viruses simultaneously through their saliva.<sup>[10]</sup> Once ingested, both viruses replicate in the mosquito midgut and disseminate to the salivary glands, enabling concurrent transmission to humans during subsequent bites. These findings indicate that mosquito coinfection does not significantly impair viral replication and may even facilitate replication of one or both viruses within the vector.<sup>[11]</sup> Human coinfections with dengue and chikungunya have also been reported in several clinical studies from endemic regions. A hospital-based study from India investigating acute febrile illness found that approximately 10.7% of laboratory-confirmed arboviral infections were dengue–chikungunya coinfections, highlighting the epidemiological significance of dual infection during outbreaks. The overlapping ecological niches of *Aedes* vectors, combined with similar seasonal peaks during monsoon and post-monsoon months, facilitate simultaneous transmission of both viruses.<sup>[12]</sup> The occurrence of coinfection also complicates clinical diagnosis due to overlapping symptoms such as fever, rash, myalgia, and arthralgia. Therefore, integrated arboviral surveillance and multiplex laboratory testing are essential for accurate diagnosis and effective public health response in endemic settings.

#### Limitations of the study

This was a laboratory-based, facility-based surveillance study and may not reflect the true community burden of chikungunya in the district. Only clinically suspected cases referred for testing were included, leading to possible selection bias. Limited clinical and epidemiological variables (travel history, occupation, comorbidities, and household clustering) were unavailable, restricting risk-factor analysis. Confirmation was based on serological testing, and molecular confirmation was not performed, which may have led to under-detection of early infections. Taluka-wise distribution represents the place of reporting rather than precise place of infection, limiting accurate spatial inference.

## CONCLUSION

The present laboratory-based surveillance from Gondia district demonstrates a low overall chikungunya seropositivity (2.8%) during 2024–2025, with a marked seasonal clustering during the monsoon and post-monsoon months and a predominant involvement of young and middle-aged adults. The near-equal male–female distribution suggests comparable exposure risk among both sexes. The temporal concurrence of dengue and chikungunya peaks, with dengue showing a higher

magnitude, highlights simultaneous circulation of *Aedes*-borne viruses in the district. The observed geographical clustering of cases in Gondia taluka indicates focal transmission, emphasizing the need for targeted vector control and intensified surveillance in high-burden areas, particularly during the monsoon season.

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