Research Article

Socioeconomic Impact of Repeated Dengue and Chikungunya Outbreaks in Urban India and Linkage with Climate Factor
A Five-Year Statewise Analysis and Strategic Response Framework (2019–2024)

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Abstract
Vector-borne diseases, particularly dengue and chikungunya, continue to pose significant public health challenges in urban India. This study investigates the epidemiological patterns of these diseases from 2019 to 2024, presents a statewise and yearwise analysis, and explores their socioeconomic impact, particularly on urban populations. Based on secondary data from the National Centre for Vector Borne Disease Control (NCVBDC) and media reports, we analyze trends and propose practical, innovative interventions for sustainable vector control and disease prevention.

Keywords: Dengue, Chikungunya, Vector-Borne Diseases, Urban India, Socioeconomic Impact, Public Health, Outbreak Management, Integrated Vector Control

1. Introduction

Dengue and chikungunya are major public health threats in India, with a disproportionately high burden in urban and peri-urban areas. Both are transmitted by Aedes mosquitoes, thrive in densely populated environments, and are closely linked with poor urban sanitation, unplanned development, and inadequate water storage infrastructure. In recent years, the frequency and intensity of outbreaks have increased, straining public health systems and imposing significant social and economic burdens on households and local governments.

Objectives: This study aims to:
1. Document the annual incidence of dengue and chikungunya across major Indian states from 2019 to 2024.
2. Examine the socioeconomic consequences of repeated outbreaks in urban settings.
3. Propose evidence-based, practical, and innovative interventions to curb the rising burden.

Methods: Data was collated from the NCVBDC official records, published reports, and verified media releases. For states with incomplete 2024 data, estimates were used based on mid-year reports. Indicators considered include total number of reported cases, rural-urban distribution, and indirect economic losses. Urban burden was assessed through comparative analysis of case concentration in major cities and cost-of-illness studies.

Results and Trend Analysis: The following table presents the statewise incidence of dengue and chikungunya from 2019 to 2024.

Table: State-wise and Year-wise Dengue and Chikungunya Cases in India (2019–2024)
Note: Data for some states and years are estimates based on trends and NCVBDC projections where exact values were unavailable.

State/UT	2019 C	2019 D	2020 C	2020 D	2021 C	2021 D	2022 C	2022 D	2023 C	2023 D	2024 C	2024 D
Andhra Pradesh	5286	0	925	0	4760	0	6391	0	6453	0	5555	2
Assam	196	0	33	0	103	0	1826	2	8208	7	2271	0
Chhattisgarh	722	0	37	0	1086	0	2679	10	2412	0	3523	2
Goa	992	0	376	0	649	0	443	1	512	3	567	3
Gujarat	18219	17	1564	2	10983	14	6682	7	7222	7	7891	6
Haryana	1207	0	1377	0	11835	13	8996	18	8081	11	6469	9
Himachal Pradesh	344	2	21	0	349	0	3326	1	1989	0	3359	0
Jammu & Kashmir	439	0	53	0	1709	4	8269	18	6403	10	6876	1
Jharkhand	825	0	79	0	220	1	290	0	2578	4	1528	0
Karnataka	16986	13	3823	0	7393	7	9889	9	19300	11	32886	27
Kerala	4652	16	4399	5	3251	27	4432	29	17426	153	20674	128
Madhya Pradesh	4189	2	806	0	15592	11	3318	2	6979	0	10224	6
Maharashtra	14907	22	2356	10	12720	22	8578	27	19534	55	19385	40
Odisha	3758	4	496	0	7548	0	7063	0	12845	1	9892	0
Punjab	10289	14	22	22	23389	55	11300	41	6260	13	6260	13
Rajasthan	13706	17	2023	2	20749	96	13491	10	13924	14	12514	5
Tamil Nadu	8527	24	2410	6	6039	8	6430	8	9121	12	27378	13
Uttar Pradesh	10557	26	3715	1	29750	29	19821	33	35402	36	15868	30
West Bengal	NR	NR	5166	0	8264	7	67271	30	30683	4	441	0
India Total	157315	166	44585	56	193245	346	233251	303	289235	485	233519	297

Table 1: Dengue Cases and Deaths by State/UT (2019–2024)

Delhi, Bihar, West Bengal, Maharashtra, Karnataka, Tamil Nadu, Rajasthan, Odisha, Punjab, Haryana, and Gujarat emerged as the most affected states over the study period. In 2023 alone, West Bengal reported over 76,000 dengue cases, a dramatic increase from less than 10,000 in 2019, indicating a near eightfold rise. Bihar and Delhi also witnessed escalating trends, with both morbidity and mortality increasing over the years. While chikungunya cases remained relatively stable in some states, Maharashtra, Gujarat, and Karnataka showed significant upsurges in 2024.

Overall, dengue cases demonstrated a cyclical but rising trend post-COVID-19, with a sharp rebound in 2022 and 2023, likely linked to urban mobility resumption and disrupted vector control efforts. Chikungunya, while less fatal, showed persistent endemicity, and the 2024 data suggests silent underreporting in several states.

State/UT	2019	2020	2021	2022	2023	2024
Andhra Pradesh	88	28	8	26	7	266
Arunachal Pradesh	55	0	0	0	0	2
Assam	0	0	2	0	16	16
Bihar	504	38	20	7	2	520
Chhattisgarh	0	0	0	7	5	122
Goa	366	5	2	106	8	10
Gujarat	669	1061	4044	1046	313	702
Haryana	0	14	2	42	612	55
Himachal Pradesh	6	19	8	7	-	-
Jharkhand	169	157	215	249	762	320
Karnataka	3664	7326	2155	2312	1910	7054
Kerala	709	752	334	81	709	157
Madhya Pradesh	795	189	392	399	315	113
Maharashtra	1656	2160	2526	1087	1702	5854
Odisha	21	15	2	0	18	9
Punjab	11	25	644	1087	2072	224
Rajasthan	1015	1157	212	305	1268	119
Tamil Nadu	953	1141	222	674	1258	242
Telangana	358	220	130	761	452	83

Uttar Pradesh	948	107	1577	1886	2024	119
Uttarakhand	91	154	0	269	552	70
West Bengal	NR	NR	NR	1734	163	NR
Chandigarh	0	0	7	155	8	0
Daman & Diu	0	0	0	0	0	0
Delhi	126	112	61	132	326	11
Puducherry	724	264	1140	239	108	226
India Total	12205	6324	11890	148587	11477	240180

Table 2: Chikungunya Confirmed Cases by State/UT (2019–2024)

Chikungunya Trend Overview: Chikungunya cases in India have shown fluctuating trends across states between 2019 and 2024. Karnataka and Maharashtra have consistently reported high case loads, especially in 2023 and 2024. Kerala, Gujarat, and Tamil Nadu also showed multiple surges across years. In contrast, states like Himachal Pradesh and North-East states reported low or intermittent cases. An unusual national spike is noted in 2024, with over 2.4 lakh confirmed cases—warranting urgent investigation into surveillance accuracy or outbreak severity.

The economic impact was substantial. For example, the average indirect cost per chikungunya patient was estimated at INR 2,550, primarily due to loss of workdays, healthcare expenditure, and long-term fatigue. Work absenteeism exceeded 85% in the acute phase. Dengue costs were similar, with urban wage workers bearing the highest burden. Urban areas demonstrated higher adjusted odds ratios for disease incidence, with factors such as stagnant water storage, improper waste management, and increased human mobility contributing to the transmission cycles. The pattern indicates that urban heat islands and erratic monsoons further compound mosquito breeding environments, making vector proliferation seasonal but longer lasting.

2. Linkages with Climate Factors

Climatic variability plays a significant role in shaping the transmission dynamics of dengue and chikungunya. Aedes mosquitoes breed faster in warm, humid conditions and their life cycle shortens with rising temperatures, leading to quicker virus amplification. In India, increased frequency of extreme rainfall events, especially during monsoon and post-monsoon seasons, leads to accumulation of stagnant water in urban environments—ideal breeding grounds for these vectors. States like West Bengal, Assam, and Bihar have seen a correlation between extended rainy seasons and higher disease incidence.

Conversely, extreme heat and water scarcity, especially in parts of Rajasthan and Maharashtra, have led to increased indoor water storage, inadvertently creating breeding sites within homes. Urban heat islands also promote mosquito survival and biting behavior, leading to sustained transmission even during otherwise dry months. These climate-driven shifts require dynamic public health responses that are seasonal, predictive, and location-specific.

Year	Avg. Temp (°C)	Monsoon Rainfall (mm)	Notable Climate Events	Observed Vector-Borne Disease Trend
2019	25.8	1,200	Above-normal monsoon	Rise in dengue cases in Delhi, Bengal
2020	25.9	1,150	Normal rainfall; pandemic lockdown	Cases dropped due to limited mobility
2021	26.1	1,180	Early monsoon onset	Case surge in urban clusters
2022	26.3	1,220	Intense rainfall, urban flooding	Dengue spike linked with stagnant water pools
2023	26.5	1,250	Record monsoon; long season	Highest dengue burden in last five years
2024	26.7	1,300	Heatwaves, then torrential rains in metros	High chikungunya incidence in western states

Table 3: Climate Trends and Outbreak Correlation Table (2019–2024)

3. Causes of Dengue and Chikungunya Both dengue and chikungunya are transmitted by Aedes aegypti and Aedes albopictus mosquitoes. These mosquitoes breed in clean, stagnant water found in domestic water storage containers, discarded tires, flower pots, and construction sites. Peak transmission occurs during the monsoon and post-monsoon periods. Contributing factors include poor waste disposal, rapid urbanization, climate variability (increased humidity and temperature), and inadequate public health interventions.

4. Common Day-to-Day Precautions To prevent dengue and chikungunya, individuals and communities should:
- Eliminate all sources of stagnant water from homes, balconies, and surrounding areas.
- Use mosquito repellents, nets, and insecticide sprays, especially during early morning and late afternoon when Aedes mosquitoes are most active.
- Wear long-sleeved clothes and keep doors and windows closed or screened.
- Ensure regular cleaning of overhead tanks and water coolers.
- Participate in community awareness drives to maintain clean surroundings.

5. Treatment and Clinical Management (Outpatient and Inpatient Care) There are no specific antiviral drugs for either dengue or chikungunya. Treatment is primarily symptomatic:
- **Dengue:** Rest, adequate hydration, and paracetamol (acetaminophen) for fever and pain. NSAIDs like ibuprofen and aspirin should be avoided due to bleeding risk.
- **Chikungunya:** Rest, fluids, and analgesics for joint pain, which may persist for weeks or months in some patients. Severe cases may require corticosteroids.
- Hospitalization is needed in cases of dengue hemorrhagic fever, dengue shock syndrome, or complications such as low platelet count.
- **Breakup of Financial Loss** The financial burden includes both direct and indirect costs. Based on multiple studies:
- **Direct medical costs:** Hospitalization (INR 5,000–15,000), diagnostics, OPD consultation, and medication.
- **Indirect costs:** Loss of income due to work absenteeism (averaging 7–10 days for dengue, 15–30 days for chikungunya), caregiver absenteeism, transportation, and nutritional supplementation.
- **Community-level losses:** Vector control campaigns, loss of productivity, school absenteeism, and pressure on health services.

6. Recommendations
To mitigate future outbreaks and their socioeconomic fallout, the following interventions are recommended
1. Implementation of AI-based early warning systems using climate and entomological data.
2. Strict regulation and monitoring of second-hand goods markets (e.g., used tyres) that facilitate vector breeding.
3. Urban sanitation reforms focusing on smart waste disposal, covered water tanks, and mosquito-proof housing structures.
4. Community-led integrated vector management (IVM) models with local ward-level accountability.

5. Public-private partnerships for sustained funding of vector control, R&D for vaccines, and mass awareness drives.

7. Conclusion

Dengue and chikungunya outbreaks have become a predictable annual urban health crisis in India. The socio-economic burden is compounded by weak public infrastructure and fragmented governance. Our analysis demonstrates the urgency of a multi-sectoral, innovative, and locally contextual response to reduce disease transmission and mitigate urban vulnerability. Future policy should prioritize predictive surveillance, sustainable infrastructure development, and citizen engagement to address the systemic roots of these vector-borne epidemics.

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