

Vital Surveillances

Epidemiological Characteristics of Dengue Fever — China, 2005–2023

Zhuowei Li¹; Xiaoxia Huang¹; Aqian Li¹; Shanshan Du¹; Guangxue He¹; Jiandong Li^{1,✉}

ABSTRACT

Introduction: The global incidence of dengue fever has increased significantly over the past two decades, and China faces a significant upward trend in dengue control challenges.

Methods: Data were obtained from China's NNDRS from 2005 to 2023. Joinpoint regression software was used to analyze temporal trends, while SaTScan software was used to analyze spatial, seasonal, and spatiotemporal distributions. ArcGIS software was used to visualize clusters.

Results: A total of 117,892 dengue cases were reported from 2005 to 2023, with significant fluctuation in annual reported cases. Dengue was not endemic in China. Autochthonous outbreaks most likely occurred in the southwestern, southeastern coastal, and inland areas of China. These outbreaks have occurred between June and November, generally peaking in September or October, around epidemiological week (EW) 40.

Conclusions: Dengue challenges in China are increasing. Timely case monitoring, proactive control interventions, and staff mobilization should be implemented before June to ensure a timely response to autochthonous outbreaks.

Dengue virus (DENV) is the most widespread arbovirus and causes the highest number of arboviral disease cases globally. DENV contains four serotypes (DENV-1, DENV-2, DENV-3, and DENV-4). Infection with one serotype can induce only transient immunity to the others; secondary infections with a different serotype may increase the risk of severe dengue (1–3). Over the past two decades, the global incidence of dengue has increased markedly (4), and the challenges of dengue outbreaks faced by China have also shown a cyclical upward trend (5). Since the first confirmed autochthonous outbreak of dengue was

reported in Guangdong Province in 1978, outbreaks caused by all four DENV serotypes have been reported successively on a fluctuating scale in China (5). In January 2024, several Member States from the World Health Organization (WHO) Regions of the Americas, Africa, Western Pacific, and Southeastern Asia reported a significant increase in dengue circulation (6). Travel-related cases may always occur in areas with the potential for rapid dengue transmission, posing an increasing risk of autochthonous outbreaks in China.

To better understand the dengue epidemic in China, we analyzed the epidemiological characteristics of reported dengue cases in China from 2005 to 2023. We examined temporal, spatial, and population characteristics, as well as clustering patterns.

METHODS

Data Collection

Dengue case data for China from January 1, 2005, to December 31, 2023, were obtained from the Chinese National Notifiable Disease Reporting System (NNDRS). Demographic data stratified by age and sex were obtained from the National Bureau of Statistics of China (<https://www.stats.gov.cn/sj/tjgb/rkpcgb/>, accessed on January 5, 2024).

Descriptive Analysis

Descriptive epidemiologic methods were used to analyze the reported cases. Joinpoint regression software was used to analyze temporal trends of dengue cases. Incidence was analyzed by spatial, space-time, and seasonal scanning with SaTScan (version 10.1.2; Information Management Services, Maryland, USA) software at the prefecture and month levels, respectively. Datasets were prepared based on incidence, population by district, and geographic coordinates. The maximum scanning window was set to 25% of the total population. The maximum temporal clustering scale was set to 50% of the total study length, and the step size was set to 1 month, as

described previously (7). Dengue clusters were identified using a model based on the maximum log-likelihood ratio (LLR) and graded by log-likelihood values. A cluster of dengue cases in the selected region was accepted when $P \leq 0.05$. Areas under risk were calculated by comparing the number of cases within each window to the expected number using a Poisson model. Relative risk (RR) in the SaTScan output file refers to the ratio of estimated risks within and outside the cluster. Areas at risk of infection were determined by the RR.

RESULTS

From 2005 to 2023, a total of 117,892 cases were reported in China. Of these, 67,073 (56.89%) were laboratory-confirmed cases, and 3,225 (2.74%) were imported cases. The national incidence of dengue significantly increased from 2005 to 2023 (AAPC=30.27%, 95% CI: 21.44, 159.66%) with an average incidence rate of 0.45/100,000. The number of reported cases peaked in 2014 (47,047 cases), 2019 (22,726 cases), and 2023 (19,935 cases), accounting for approximately 76.09% of total reported cases (Figure 1A). The number of annual reported cases fluctuated significantly, ranging from 59 cases (2005) to 47,047 cases (2014), and exhibited three successive

phases (Figure 1A). A low-incidence phase was observed during 2005–2012, with an average incidence rate of 0.03/100,000 (AAPC=−10.54%, 95% CI: −30.84, 10.80%). A high-incidence phase was observed during 2013–2019, with an average incidence rate of 0.96/100,000 (AAPC=−13.25%, 95% CI: −40.26, 16.68%). A significant decline in cases, with an average incidence rate of 0.03/100,000 (AAPC=−14.88%, 95% CI: −58.37, 59.20%), was seen during the COVID-19 pandemic from 2020 to 2022. In 2023, the number of cases approached the 2019 peak, continuing the characteristics of the high-incidence phase.

Dengue was reported in all months; however, the vast majority of cases were reported from June to November. The peak occurred from August to October ($n=101,653$, $RR=18.60$, $LLR=97,644.65$), accounting for 86.23% of the total (Figure 1B). When analyzed by epidemiological week (EW) of onset or reporting, the number of cases generally peaked at EW 40 ($n=15,166$, Figure 1C). In low-incidence years, the peak could appear later, such as in EW 43 in 2012.

The overall male-to-female case ratio was 1.11. A relatively similar age distribution was observed for both males and females (Figure 2A). Cases were reported in all age groups; the majority ($n=68,698$; 58.27%) were 20–49 years of age (Figure 2B). The main difference in

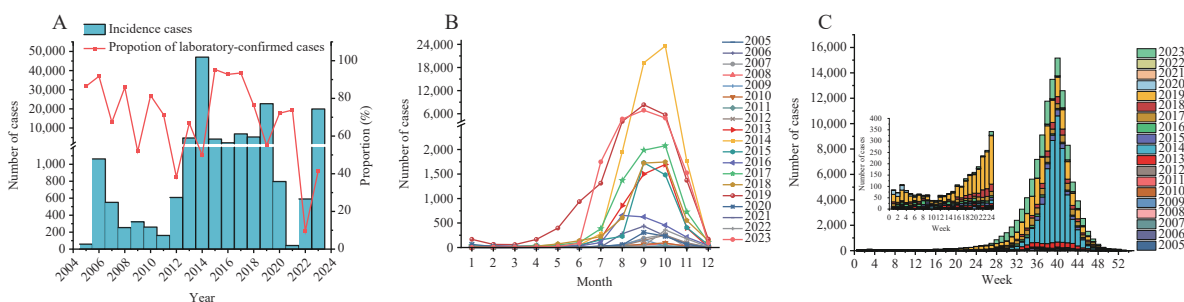


FIGURE 1. Distribution of dengue cases in the Chinese mainland during 2005–2023. (A) By year; (B) By month; (C) By week.

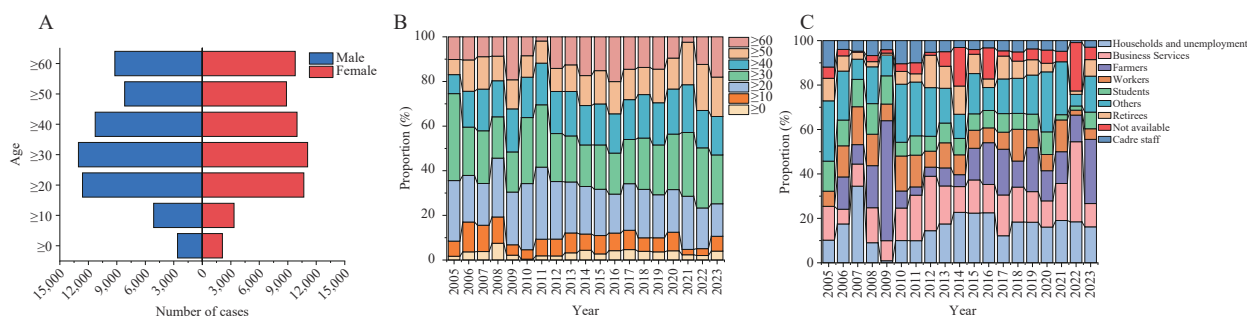


FIGURE 2. Distribution of dengue by (A) gender, (B) age, and (C) occupation.

the sex ratio was that the proportion of females was lower than that of males of the same age in the 50–59 (0.92:1) and 60 and above age groups (0.94:1), while the opposite was true for the 0–9 (1.24:1), 10–19 (1.53:1), 20–29 (1.18:1), 30–39 (1.18:1), and 40–49 (1.13:1) age groups. The highest incidence of cases was observed among households and unemployed individuals ($n=22,943$, 19.46%), followed by farmers ($n=16,901$, 14.34%) and businesspeople ($n=15,258$, 12.94%) (Figure 2C).

From 2005 to 2023, dengue was reported in 30 provincial-level administrative divisions (PLADs), including 302 prefectures and 1,694 counties. The top five PLADs with high dengue incidence — Guangdong (68,070, 57.74%), Yunnan (30,785, 26.11%), Fujian (3,742, 3.17%), Zhejiang (3,260, 2.77%), and Guangxi (3,136, 2.66%) — contributed 92.45% of the total cases. Additionally, 68.34% of cases were reported from the top five prefectures: Guangzhou (45,977, 39.00%), Xishuangbanna (15,871, 13.46%), Dehong (10,073, 8.54%), Foshan (5,998, 5.09%), and Zhongshan (2,652, 2.25%). The top five counties — Baiyun (13,303, 11.28%), Jinghong (11,171, 9.48%), Ruili (9,210, 7.81%), Haizhu (6,899, 5.85%), and Liwan (6,680, 5.67%) — accounted for 40.09% of cases. Dengue exhibited obvious geographical clustering in the Chinese mainland.

During the low-incidence phase from 2005 to 2012, clusters occurred mainly in Guangdong (11 prefectures, $n=2,217$), Yunnan (3 prefectures, $n=181$), Fujian (1 prefecture, $n=142$), and Zhejiang (1 prefecture, $n=201$). During the high-incidence phase, the geographic scope of clusters expanded, and autochthonous outbreaks occurred in the southwestern, southeastern coastal, and inland areas of Chinese mainland. This was especially true in the Pearl River Delta (PRD) and the Border of Yunnan and Myanmar (BYM), with cases reported in Guangdong (10 prefectures, $n=62,375$), Yunnan (7 prefectures, $n=29,578$), Fujian (1 prefecture, $n=1,831$), Zhejiang (1 prefecture, $n=1,583$), Jiangxi (1 prefecture, $n=833$), and Guangxi (1 prefecture, $n=1,842$).

The spatiotemporal analysis of incidence, population, and geographic coordinates from 2005 to 2023 identified significant dengue clusters categorized into three levels. The primary cluster emerged in Guangzhou ($n=37,382$) and Foshan ($n=3,543$) in Guangdong Province in 2014 (RR : 589.08, LLR : 210,880.11), and in seven prefectures in southwestern Yunnan Province ($n=27,689$) (Xishuangbanna, Pu'er,

Lincang, Dehong, Dali, Chuxiong, Baoshan) from 2015 to 2023 (RR : 56.27, LLR : 80,673.22). Secondary clusters ($n=5,387$) were identified in southeastern prefectures of Zhejiang (11 prefectures), Anhui (5 prefectures), Fujian (9 prefectures), Jiangxi (10 prefectures), and Guangdong (4 prefectures) in 2019 (RR : 7.05, LLR : 5,807.61), and in Chongqing Municipality ($n=1,411$) in 2019 (RR : 9.95, LLR : 1,965.70). Tertiary clusters were found in Puyang ($n=90$), Henan Province (RR : 5.34, LLR : 77.56) in 2019, and Jining ($n=81$), Shandong Province (RR : 2.16, LLR : 18.92) in 2017. The frequency of high-risk areas suggests that dengue is not endemic in China; however, widespread areas are vulnerable to autochthonous outbreaks.

CONCLUSIONS

Dengue affects people in most countries in the tropics and subtropics. Dengue is not endemic in the Chinese mainland; however, the vectors that transmit DENV are widely distributed. *Aedes aegypti* is established notably in parts of Yunnan, Hainan, and Guangdong, and *Aedes albopictus* is widely established in much of China (5). In this study, the spatial, temporal, and demographic epidemiological characteristics of dengue, as well as the areas with local transmission risks, were revealed in China from 2005 to 2023. No significant gender or occupational differences were observed in the reported cases. It could be supposed that susceptibility to dengue might mainly depend on the proximity to the source of infection and the chance of being bitten by infected mosquitoes in China. The likelihood of onward DENV transmission is linked to the importation of the virus into receptive areas with active, competent vectors (6,8). Globally increased dengue circulation over the past two decades has markedly increased the risk of importation of the virus by viremic travelers into China. All autochthonous outbreaks of dengue in China have so far occurred between June and November, generally peaking in September or October, around EW 40. The spatial and spatiotemporal distribution of dengue in the past 19 years demonstrated that broad areas in China are facing the risk of autochthonous outbreaks, which most likely occur in the southwestern, southeastern coastal, and inland areas of south China, especially in the areas of the PRD and BYM. Most PLADs in South China have reported locally acquired dengue cases.

Factors contributing to local transmission include

high mosquito populations, susceptibility to circulating DENV serotypes, and favorable environmental conditions — such as air temperature, precipitation, and humidity — that affect mosquito reproduction, feeding patterns, and the DENV incubation period (9–11). Timely, proactive control interventions and qualified staff are also key influencing factors. Proactive prevention and control interventions should be deployed, and staff training and mobilization should be carried out before June for timely responses to autochthonous outbreaks in the Chinese mainland.

This study is based on the analysis of online active reporting data from the NNDRS system, which, to some extent, affects the accurate portrayal of dynamic dengue epidemic characteristics in specific regions. However, it can reflect the overall dengue trend in China and provide a reference for promoting the proactive deployment of prevention and control.

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* Corresponding author: Jiandong Li, lijd@ivdc.chinacdc.cn.

¹ National Key Laboratory of Intelligent Tracking and Forecasting for Infectious Diseases, NHC Key Laboratory of Biosafety, NHC Key Laboratory of Medical Virology and Viral Diseases, National Institute for Viral Disease Control and Prevention, Chinese Center for Diseases Control and Prevention, Beijing, China.

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