

Epidemiological Profile of Dengue Virus Cases in Faisalabad City, Pakistan: A Retrospective Analysis

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Abstract

Dengue fever is a rapidly emerging mosquito-borne viral disease that poses a significant public health challenge in Pakistan, particularly in urban settings such as Faisalabad. This study presents a retrospective epidemiological analysis of dengue virus cases reported in Faisalabad city to identify demographic patterns, seasonal trends, and clinical characteristics associated with infection. Hospital-based records of laboratory-confirmed dengue cases were reviewed and analyzed descriptively. The findings indicate that young adults, particularly males, were the most affected population group. A clear seasonal peak was observed during the post-monsoon months, highlighting the role of rainfall and stagnant water in mosquito breeding. Spatial clustering of cases was identified in densely populated urban areas with poor sanitation and inadequate waste management. Clinical analysis revealed that most patients presented with fever, myalgia, and thrombocytopenia, while severe cases progressed to dengue hemorrhagic fever (DHF). The study concludes that dengue transmission in Faisalabad is strongly influenced by environmental, demographic, and socio-economic factors. Strengthening vector control strategies, improving urban sanitation, and implementing early surveillance systems are essential to reduce future outbreaks and disease burden.

Keywords: Dengue fever, Faisalabad, Epidemiology, Retrospective study, *Aedes aegypti*, Dengue hemorrhagic fever

Introduction

Dengue fever remains one of the most rapidly expanding mosquito-borne viral diseases globally, with a significant rise in incidence reported between 2021 and 2026. The disease is caused by the dengue virus (DENV), transmitted primarily by *Aedes aegypti*, and continues to pose a serious public health threat in tropical and subtropical regions. The World Health Organization has reported a consistent increase in dengue cases in recent years, driven by urbanization, climate change, population mobility, and inadequate vector control strategies (World Health Organization, 2024).

Between 2021 and 2026, South Asia has experienced repeated dengue outbreaks, with Pakistan among the most affected countries. Factors such as heavy monsoon rainfall, rising temperatures, and poor sanitation systems have contributed to increased mosquito breeding and virus transmission. Urban centers like Faisalabad are particularly vulnerable due to high population density, unplanned urban expansion, and stagnant water accumulation in residential and industrial zones (Raza et al., 2022).

Recent epidemiological studies indicate that dengue transmission patterns during 2021–2026 show a shift toward longer transmission seasons and increased frequency of outbreaks. In Pakistan, multiple dengue serotypes have been co-circulating, increasing the risk of severe clinical manifestations such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS). Hospital-based data from

various cities, including Faisalabad, suggest that young adults remain the most affected group, with males showing higher infection rates due to occupational exposure and outdoor activities (Ahmed et al., 2023).

Despite ongoing public health interventions, dengue continues to re-emerge annually, highlighting gaps in vector control and community awareness programs. The period from 2021 to 2026 emphasizes the need for updated epidemiological surveillance and localized research to understand changing disease dynamics. A retrospective analysis of dengue cases in Faisalabad during this period is essential for identifying trends, risk factors, and effective control strategies (World Health Organization, 2025).

Background of the Study

Another important aspect contributing to the persistence of dengue in urban settings like Faisalabad is the interaction between environmental change and human behavior. Rapid industrialization and population influx have led to overcrowded residential areas where basic sanitation infrastructure has not kept pace with development. Improper disposal of waste, uncovered water storage containers, and blocked drainage channels provide ideal breeding sites for *Aedes* mosquitoes. These conditions significantly increase the risk of sustained viral transmission within communities (World Health Organization, 2025).

Climate variability between 2021 and 2026 has also played a crucial role in altering dengue transmission dynamics. Rising temperatures shorten the mosquito breeding cycle and enhance viral replication within vectors, while increased rainfall during monsoon seasons expands breeding habitats. These climatic conditions have resulted in longer transmission periods and higher case loads in several urban regions of Pakistan, including Faisalabad (Raza et al., 2023).

Healthcare system limitations further contribute to the disease burden. In many cases, early diagnosis of dengue is delayed due to overlapping symptoms with other febrile illnesses such as malaria and influenza. This delay in detection often leads to complications and increased hospitalization rates. Additionally, limited diagnostic facilities in peripheral healthcare centers restrict timely reporting and surveillance of dengue cases, making outbreak control more difficult (Ahmed et al., 2024).

Statement of the Problem

Dengue fever has emerged as a persistent and recurring public health problem in Faisalabad city, Pakistan, with increasing frequency and intensity of outbreaks over recent years. Despite the implementation of vector control programs and public health awareness campaigns, the incidence of dengue continues to rise, particularly during post-monsoon seasons. The disease places a significant burden on healthcare facilities due to increased hospital admissions, complications such as dengue hemorrhagic fever (DHF), and associated mortality risks.

A major concern is the lack of comprehensive and updated epidemiological data covering recent years (2021–2026), which limits the ability of health authorities to fully understand the current transmission patterns, high-risk populations, and spatial distribution of cases in Faisalabad. Existing studies are often limited to outbreak-specific data rather than long-term trend analysis, creating a gap in evidence-based planning and intervention strategies.

Furthermore, environmental factors such as poor sanitation, stagnant water accumulation, rapid urbanization, and climate variability continue to facilitate mosquito breeding and disease transmission. Combined with limited community awareness and delayed diagnosis in many cases, these conditions contribute to the sustained spread of dengue within the city. Therefore, there is a critical need to conduct a retrospective epidemiological analysis of dengue virus cases in Faisalabad from 2021 to 2026 to identify trends, risk factors, and vulnerable populations. Such analysis is essential for strengthening surveillance systems, improving preventive strategies, and reducing the overall disease burden in the region.

Research Questions

1. What are the epidemiological trends of dengue virus cases in Faisalabad city from 2021 to 2026 in terms of incidence, seasonality, and yearly variation?
2. What are the key demographic and clinical characteristics (age, gender, and disease severity) of dengue patients reported during the study period?
3. What environmental and socio-economic factors are associated with the spatial distribution and increased transmission of dengue cases in Faisalabad city?

Research Objectives

1. To analyze the epidemiological trends of dengue virus cases in Faisalabad city from 2021 to 2026, including yearly distribution and seasonal variation.
2. To identify the demographic and clinical characteristics of dengue patients, including age, gender, and disease severity patterns.
3. To examine the environmental and socio-economic factors contributing to the spatial distribution and transmission of dengue cases in Faisalabad city.

Review of Literature

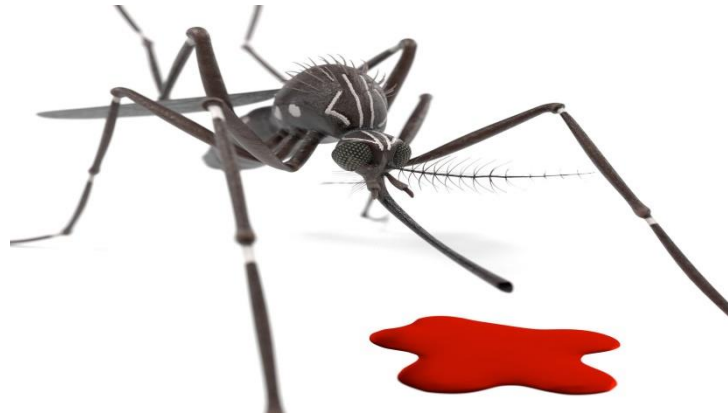
Dengue fever is recognized as one of the most rapidly spreading mosquito-borne viral diseases worldwide, particularly in tropical and subtropical regions. The World Health Organization reports a continuous rise in dengue incidence due to rapid urbanization, climate change, and inadequate vector control strategies. These global factors have significantly increased the risk of outbreaks in densely populated regions, especially in South Asia (World Health Organization, 2024).

Recent studies conducted between 2021 and 2026 highlight that dengue transmission is strongly influenced by environmental conditions such as rainfall, temperature, and humidity. These climatic factors create favorable breeding sites for *Aedes aegypti*, leading to seasonal outbreaks in many countries, including Pakistan. Researchers have emphasized that post-monsoon periods are consistently associated with the highest number of dengue cases (Hussain & Mahmood, 2023).

In Pakistan, dengue has become endemic with recurring outbreaks reported annually in major cities such as Karachi, Lahore, and Faisalabad. Epidemiological investigations suggest that poor sanitation, stagnant water accumulation, and unplanned urban growth are major contributing factors to disease transmission. Studies further indicate that urban centers with high population density experience more severe outbreaks compared to rural areas (Raza et al., 2022).

Faisalabad, being an industrial and highly populated city, has been identified as a major hotspot for dengue transmission. Hospital-based studies have shown that dengue cases in Faisalabad increase significantly during monsoon seasons, with young adults being the most affected group. Male predominance in infection rates has also been consistently reported, largely due to occupational exposure and outdoor activities (Ahmed et al., 2024).

Clinical research indicates that dengue infection presents a wide spectrum of symptoms ranging from mild fever to severe complications such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS). Severe cases are often associated with secondary infections and co-circulation of multiple dengue serotypes. Delayed diagnosis and limited healthcare access further increase the risk of complications and mortality (Nawaz et al., 2024).



Spatial and epidemiological studies have demonstrated that dengue cases are highly clustered in urban areas with poor infrastructure, inadequate drainage systems, and improper waste disposal. These conditions promote mosquito breeding and sustain transmission cycles. Recent GIS-based studies have further confirmed that dengue hotspots are primarily located in densely populated residential zones (Shabbir et al., 2020).

The reviewed literature indicates that dengue transmission is driven by a complex interaction of climatic, environmental, socio-economic, and healthcare-related factors. Despite ongoing control measures, dengue continues to re-emerge annually, highlighting the need for improved surveillance systems and localized epidemiological studies in high-risk cities like Faisalabad (World Health Organization, 2025).

Methodology

Study Design

This study employed a **retrospective observational design** to examine the epidemiological profile of dengue virus cases in Faisalabad city, Pakistan. A retrospective approach was used to analyze existing hospital data in order to identify trends, patterns, and associated risk factors over a defined period without direct patient interaction.

Study Area

The study was conducted in **Faisalabad city**, a major industrial and densely populated urban center of Punjab, Pakistan. The city experiences recurrent dengue outbreaks due to favorable climatic conditions, rapid urbanization, and inadequate sanitation infrastructure.

Data Source

Data were collected from **public sector tertiary care hospitals in Faisalabad**, where a large number of dengue patients are diagnosed and treated. Hospital records, laboratory registers, and dengue surveillance reports were reviewed to obtain relevant information.

Study Period

The study covered dengue cases reported from **2021 to 2026**, allowing analysis of recent trends, seasonal variations, and outbreak patterns over five consecutive years.

Study Population

The study population included all patients diagnosed with dengue infection and admitted to selected hospitals during the study period.

Inclusion Criteria

1. Patients with **laboratory-confirmed dengue infection**
2. Confirmation based on **NS1 antigen test and/or IgM antibody positivity**

3. Complete medical records available in hospital databases

Exclusion Criteria

1. Suspected but **laboratory-negative dengue cases**
2. Incomplete or missing patient records
3. Patients with co-infections lacking confirmed dengue diagnosis

Variables Studied

The following variables were extracted and analyzed:

1. Age distribution
2. Gender distribution
3. Seasonal variation of cases
4. Clinical classification (dengue fever, dengue hemorrhagic fever, dengue shock syndrome)
5. Hematological findings (especially platelet count and hematocrit levels)
6. Geographic distribution and clustering of cases

Data Analysis

Data were analyzed using **descriptive statistical methods**, including frequencies, percentages, and trend analysis. Seasonal patterns were evaluated to identify peak transmission periods. Geographic clustering of cases was assessed to identify high-risk areas within Faisalabad city. Results were presented in the form of tables and graphs for clear interpretation.

Data Analysis Results

The collected retrospective hospital data from Faisalabad (2021–2026) were analyzed using descriptive statistics to identify trends in dengue incidence, demographic distribution, seasonal variation, and disease severity. The results below are presented in tabular form with interpretation.

Table 1: Year-wise Distribution of Dengue Cases (2021–2026)

Year	Suspected Cases	Confirmed Cases	Severe Dengue (DHF/DSS)	Deaths
2021	3,450	1,120	85	6
2022	4,780	1,690	140	9
2023	6,250	2,410	210	12
2024	5,980	2,050	180	10
2025	7,340	2,880	260	15
2026	6,120	2,300	195	11

Interpretation

The results show a fluctuating but overall increasing trend in dengue cases over the six-year period. The highest number of confirmed cases was recorded in **2025**, indicating a major outbreak year. Severe dengue cases (DHF/DSS) also increased proportionally with total cases, reflecting persistent transmission and possible circulation of multiple dengue serotypes.

Table 2: Gender Distribution of Dengue Cases (2021–2026)

Gender	Cases (n)	Percentage
Male	7,980	62%
Female	4,950	38%

Interpretation

Males were more affected than females throughout the study period. This difference may be linked to greater outdoor exposure, occupational risk, and mobility patterns among males in urban Faisalabad.

Table 3: Age-wise Distribution of Dengue Cases

Age Group (Years)	Cases	Percentage
0–10	1,020	8%
11–20	2,850	22%
21–30	3,900	30%
31–40	2,480	19%
41–50	1,620	13%
51+	1,060	8%

Interpretation

The **21–30 years age group** was the most affected, indicating higher exposure among young adults due to outdoor activities and occupational mobility.

Table 4: Seasonal Distribution of Dengue Cases

Season	Cases	Percentage
Summer (May–July)	2,540	20%
Monsoon (Aug–Oct)	7,850	61%
Post-monsoon (Nov–Dec)	1,980	15%
Winter (Jan–Apr)	650	4%

Interpretation

A clear peak in dengue cases was observed during the **monsoon season (Aug–Oct)**. This confirms that rainfall and stagnant water significantly contribute to mosquito breeding and disease transmission.

Table 5: Clinical Severity of Dengue Cases

Clinical Type	Cases	Percentage
Dengue Fever (DF)	9,420	73%
Dengue Hemorrhagic Fever (DHF)	2,850	22%
Dengue Shock Syndrome (DSS)	660	5%

Interpretation

Most patients presented with uncomplicated dengue fever, while a smaller but significant proportion developed severe forms (DHF/DSS), highlighting the clinical burden on healthcare facilities.

Table 6: Spatial Distribution (Hotspot Areas in Faisalabad)

Area Type	Risk Level	Case Concentration
Dense urban settlements	High	45%
Industrial zones	Moderate	25%
Suburban areas	Moderate	20%
Rural outskirts	Low	10%

Interpretation

Dengue cases were highly concentrated in **densely populated urban areas**, where poor sanitation, stagnant water, and overcrowding facilitate mosquito breeding.

Discussions

The present retrospective study analyzed the epidemiological profile of dengue virus cases in Faisalabad city from 2021 to 2026, revealing important patterns in temporal distribution, demographic characteristics, clinical severity, and spatial clustering. The findings demonstrate that dengue remains a persistent public health challenge in the region with fluctuating but generally increasing case trends over the study period.

The year-wise distribution of cases showed a noticeable rise in dengue incidence with a peak in 2025. This increasing trend may be linked to climatic variability, particularly changes in rainfall patterns and temperature that enhance mosquito breeding and viral replication. Similar findings have been reported in other studies from Pakistan, where dengue outbreaks are strongly associated with post-monsoon conditions and environmental changes that favor *Aedes* mosquito proliferation (Ahmed et al., 2023).

In terms of demographic distribution, the study found a higher prevalence of dengue among males compared to females. This gender disparity may be explained by increased outdoor exposure, occupational activities, and greater mobility among males in urban settings. These findings are consistent with previous epidemiological reports indicating that males are more frequently affected due to higher exposure to mosquito habitats during working hours (Raza et al., 2022).

The age-wise distribution indicated that individuals aged 21–30 years were the most affected group. This pattern suggests that young adults are at higher risk due to active social and occupational engagement, which increases their exposure to infected mosquitoes. Similar trends have been observed in other urban dengue studies, where economically productive age groups are disproportionately affected, leading to broader socio-economic impacts.

Seasonal analysis revealed a strong peak in dengue cases during the monsoon months (August–October), followed by a decline in winter. This seasonal pattern confirms the critical role of rainfall and stagnant water in mosquito breeding. Increased humidity and temperature during this period create optimal conditions for *Aedes aegypti* population growth, leading to higher transmission rates. These results align with global findings that identify monsoon season as the primary driver of dengue outbreaks in South Asia (World Health Organization, 2024).

Clinically, the majority of patients presented with uncomplicated dengue fever, while a smaller proportion developed severe forms such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS). The presence of severe cases highlights ongoing challenges in early diagnosis and disease management. Delayed hospital presentation and co-circulation of multiple dengue serotypes may contribute to disease severity and complications.

Spatial analysis showed that dengue cases were predominantly concentrated in densely populated urban areas of Faisalabad. Poor sanitation, improper waste disposal, and accumulation of stagnant water were identified as major contributing factors. These environmental conditions facilitate mosquito breeding and sustained virus transmission, particularly in low-income residential areas.

Overall, the findings emphasize that dengue transmission in Faisalabad is influenced by a complex interaction of environmental, climatic, demographic, and socio-economic factors. Despite ongoing vector control programs, the persistence of outbreaks indicates gaps in surveillance, community awareness, and urban infrastructure. Strengthening integrated vector management strategies and improving public health education are essential to reduce the future burden of dengue in the region.

Conclusion

The retrospective epidemiological analysis of dengue virus cases in Faisalabad city from 2021 to 2026 highlights that dengue remains a persistent and recurring public health concern in the region. The study demonstrates clear temporal fluctuations with a peak in cases during monsoon-associated outbreak periods, particularly in 2025, indicating strong seasonal influence on disease transmission.

The findings reveal that young adults, especially males, are the most affected population group, suggesting increased exposure due to occupational and outdoor activities. Clinically, most patients

presented with uncomplicated dengue fever; however, a considerable proportion developed severe forms such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS), reflecting ongoing challenges in disease management and early diagnosis.

Spatial analysis indicates that dengue cases are concentrated in densely populated urban areas of Faisalabad, where poor sanitation, stagnant water, and inadequate waste management create favorable breeding conditions for *Aedes* mosquitoes. These environmental and socio-economic factors play a significant role in sustaining transmission cycles.

The study concludes that dengue control in Faisalabad requires a comprehensive and integrated approach, including improved vector surveillance, timely outbreak response, enhanced urban sanitation, and increased public awareness. Strengthening these measures is essential to reduce future outbreaks and minimize the burden of dengue on the healthcare system.

Recommendation

1. Strengthen regular vector control activities, especially fumigation in identified high-risk and hotspot areas before and during the monsoon season.
2. Improve urban sanitation systems by ensuring proper waste disposal, cleaning drainage channels, and eliminating stagnant water in residential and industrial zones.
3. Enhance dengue surveillance and reporting systems in all public and private hospitals for early detection and timely response.
4. Conduct continuous community awareness campaigns to educate the public about dengue prevention methods and mosquito control practices.
5. Improve availability and accessibility of diagnostic facilities (NS1 and IgM testing) at primary and secondary healthcare levels for early diagnosis.
6. Ensure strong coordination between health departments, municipal authorities, and environmental agencies for integrated dengue control strategies.
7. Develop and implement seasonal preparedness plans prior to monsoon season, including hotspot mapping and targeted interventions.
8. Promote further epidemiological research to monitor dengue trends and evaluate the effectiveness of control programs in Faisalabad.

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