

Seroprevalence of Dengue Infection in Lahore During Rainfall Season of 2024

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ABSTRACT

Objective: To determine the seroprevalence of dengue virus (DENV) IgM and IgG antibodies among clinically suspected dengue cases from different population groups in Lahore during the 2024 rainfall season.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Virology, Chughtai Institute of Pathology Lahore, Pakistan from Jul to Dec 2024.

Methodology: A total of 681 clinically suspected dengue cases from various age groups were included. Serum samples were tested for anti-dengue IgM and IgG antibodies using enzyme-linked immunosorbent assay (ELISA). IgM and IgG results were analyzed independently.

Results: Of the 681 cases, 70.3% (n=479) were seropositive for dengue IgM antibodies, while 17.9% (n=122) were seropositive for dengue IgG antibodies. The highest proportion of IgG seropositivity was observed in the (25–44) year age group. September recorded the highest number of IgM-positive cases, accounting for 51.9% (n=249) of all IgM seropositive cases.

Conclusion: A substantial proportion of suspected dengue cases in Lahore showed evidence of recent and past dengue infection during the monsoon season. These findings highlight seasonal dengue transmission and support the need for continued surveillance during peak periods.

Keywords: Dengue Virus, Dengue Fever, IgM, IgG, ELISA, Seroprevalence.

How to Cite This Article: Liaquat S, Tariq WUZ, Chughtai O, Batool H, Tanveer H, Khattak S. Seroprevalence of Dengue Infection in Lahore During Rainfall Season of 2024. *Pak Armed Forces Med J* 2026; 76(Suppl-9): S1483-S1487. DOI: <https://doi.org/10.51253/pafmj.v76iSUPPL-9.14149>

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INTRODUCTION

Dengue fever remains a major public health problem in tropical and subtropical regions worldwide, particularly in South Asia, including Pakistan. Globally, an estimated 390 million dengue infections occur annually, of which nearly 96 million are clinically apparent, making dengue the most rapidly spreading mosquito-borne viral disease worldwide.¹ The global burden has increased substantially, with reported cases rising from 2.2 million in 2010 to over 4.2 million in 2019, and dengue is now endemic in more than 129 countries.² Over 70% of the population at risk, approximately 1.8 billion people, resides in the WHO South-East Asia and Western Pacific regions, although the true burden is likely underestimated due to underreporting and misclassification.³

Pakistan has experienced recurrent dengue outbreaks over the past decade, reflecting a growing national disease burden. In 2019, approximately 53,000 cases and 95 deaths were reported, followed by a decline in 2020 (3,442 cases) and a resurgence in 2021 and 2022 with 48,906 and 41,476 confirmed cases,

respectively, largely affecting Lahore and the twin cities.⁴ Lahore remains one of the most affected urban centers due to its subtropical climate, monsoon rainfall (July–September), and favorable breeding conditions for *Aedes aegypti*.⁵ Several studies have demonstrated a positive association between temperature, rainfall, and dengue incidence, highlighting the role of climatic factors in disease transmission.⁶

Laboratory diagnosis of dengue includes detection of anti-dengue IgM and IgG antibodies, and viral RNA by PCR, with IgG antibodies serving as markers of prior exposure.⁷ Despite numerous national and international studies on dengue epidemiology, data on population-level IgG seroprevalence from Lahore remain limited, particularly regarding prior exposure and risk stratification for severe disease.^{8,9}

This gap in local evidence provides a strong rationale for conducting the present study to assess dengue IgG seroprevalence in Lahore, thereby supporting targeted surveillance and informed public health interventions.

METHODOLOGY

This cross-sectional analytical study was conducted over a six-month period from 1st July to 31st December 2024 at the Department of Virology,

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Received: 01 Jan 2026; revision received: 29 Jan 2026; accepted: 30 Jan 2026

Chughtai Institute of Pathology, Lahore, Pakistan. Ethical approval for the study was obtained from the Institutional Review Board of Chughtai Institute of Pathology (Approval No. CIP/IRB/1140 4-10-2023), and the study was carried out in accordance with the ethical principles outlined in the Declaration of Helsinki.

Inclusion Criteria: Participants of either gender, aged one year and above, who were residents of Lahore and presented with clinical suspicion of dengue infection were included.

Exclusion Criteria: Those patients clinically suspected of having other viral fevers than dengue were excluded.

Sample size was calculated using the OpenEpi calculator, assuming an expected dengue seroprevalence of 33.3%, based on previously published local data from Pakistan.¹ The minimum calculated sample size was 681 participants. A non-probability consecutive sampling technique was used to recruit eligible participants during the study period.

Written informed consent was obtained from all adult participants prior to enrollment. In the case of pediatric participants, consent was obtained from parents or legal guardians. Participants were recruited through outpatient diagnostic centers of Chughtai Laboratory, Lahore, based on clinical suspicion of dengue as determined by the referring clinician (Figure-1).

Sample collection involved venous blood sampling, whereby 3 mL of serum in clot activator tube was collected from each participant under strict aseptic conditions. Samples were appropriately labeled, transported to the Department of Virology, and centrifuged at 3,500 rpm for 4 minutes to separate serum. Serum samples were tested for anti-dengue IgM and IgG antibodies using enzyme-linked immunosorbent assay (ELISA) kit (International Immuno-Diagnostics, USA), following the manufacturer's instructions. Optical density values were measured using an ELISA plate reader, and results were interpreted according to the kit-provided cutoff values.

For the purpose of this study, dengue seropositivity was defined as the presence of detectable anti-dengue IgM and/or IgG antibodies. Primary infection was operationally defined as IgM positivity with absent or low IgG levels, whereas past exposure was defined by isolated IgG positivity. Age

groups were categorized according to predefined ranges (1 to 60 years) and seasonal variation was assessed based on the month of sample collection.

Data were recorded on a structured proforma designed specifically for the study, which included demographic details, clinical suspicion, laboratory findings, and month of testing. Study parameters included age, gender, month of testing, and dengue IgM and IgG serostatus.

Data analysis was performed using Statistical Package for the Social Sciences (SPSS) version 31. Categorical variables as age groups, season and serostatus of dengue were expressed as frequencies and percentages. Associations between demographic variables and dengue seropositivity were assessed using the Chi-square test. A p -value ≤ 0.05 was considered statistically significant.

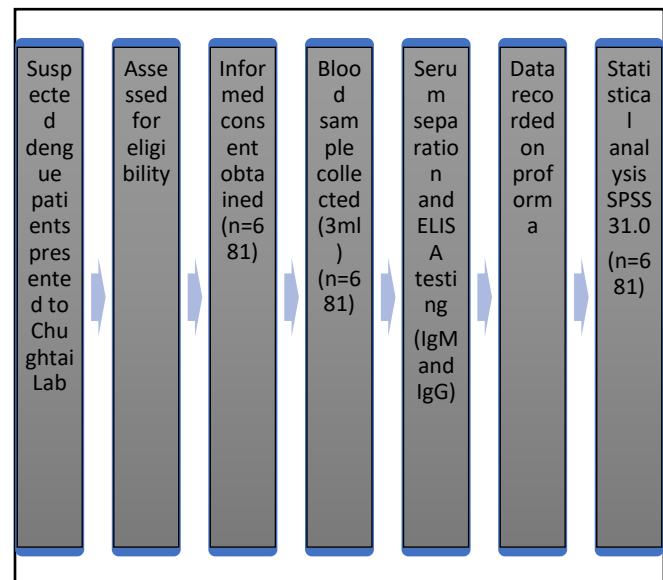


Figure-1: Patient Flow Diagram (n=681)

RESULTS

A total of 681 clinically suspected dengue cases were included in our study. Among these, 82.1% (n=559) were seronegative and 17.9% (n=122) were seropositive for dengue IgG antibodies. For dengue IgM antibodies, 70.3% (n=479) cases were seropositive, while 29.6% (n=202) were seronegative.

Among dengue IgM-seropositive cases, 64.9% (n=311) were males and 35.1% (n=168) were females, indicating a higher proportion of seropositivity among male patients (Figure-2).

Age-wise distribution of dengue IgM and IgG seropositivity is shown in Figure-3. Analysis revealed

that the highest proportion of dengue IgG seropositive cases was observed among middle-aged adults 6.6% (n=45), followed closely by older adults 6.3% (n=43). Young adults and children accounted for 3.4% (n=23) and 1.6% (n=11) of IgG-positive cases, respectively.

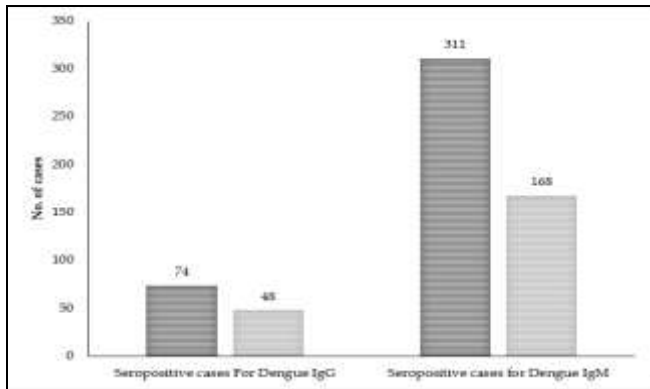


Figure-2: Gender-wise distribution of Dengue IgM and IgG Seropositive cases (n=681)

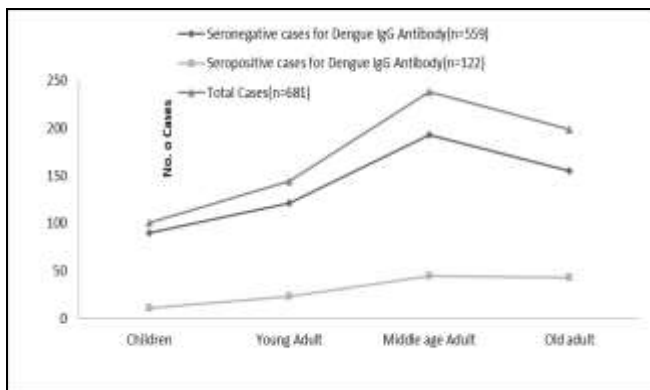


Figure-3: Age-wise Distribution of Dengue IgG Cases (n=681)

The temporal distribution of dengue IgM seropositive cases demonstrated a clear seasonal pattern (Figure-4). The highest number of IgM-positive cases was recorded in September, accounting for 51.9% (n=249) of all IgM-confirmed cases. This was followed by October, with 39.8% (n=191) seropositivity. A marked decline was observed in November, with only 0.4% (n=2) of cases testing positive for dengue IgM antibody.

DISCUSSION

In this cross-sectional study of 681 clinically suspected dengue patients, we found that 17.9% (n=122) were seropositive for dengue IgG antibodies, indicating past exposure, while 70.3% (n=479) were seropositive for dengue IgM antibodies, reflecting recent or acute infection. Among IgM-seropositive cases, males were disproportionately affected (64.9%)

compared to females (35.1%), suggesting a gender-specific difference in recent dengue exposure. These findings highlight the ongoing transmission and immunological response to dengue virus within the studied population.

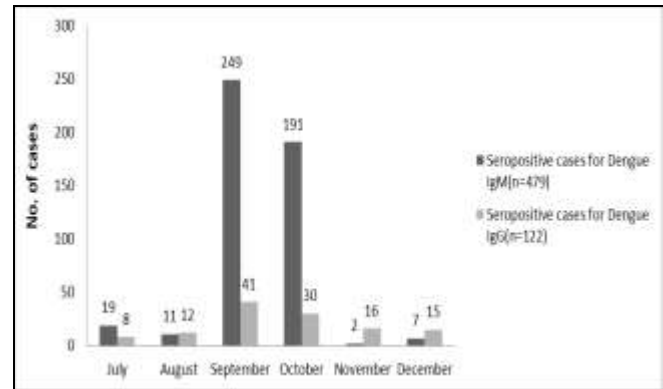


Figure-4: Month-wise Distribution of Dengue IgM and IgG Seropositive Cases (n=681)

The dengue IgM seropositivity observed in our study (70.3%) is considerably higher than pooled estimates reported from the broader South Asian region. A systematic review encompassing SAARC countries documented wide variability in dengue IgM seroprevalence, with an overall pooled estimate of approximately 34.2% and about 35.2% reported specifically from Pakistan among clinically suspected cases.¹⁰ The substantially higher IgM positivity in our cohort indicates a period of intensified recent transmission, likely driven by peak seasonal vector activity and localized outbreak dynamics during the study period.

Our IgM seropositivity substantially exceeds figures reported in earlier Pakistani studies. For instance, a Lahore-based hospital study (2012–2013) documented IgM positivity of approximately 48% among febrile suspected cases, considerably lower than the 70.3% observed in our cohort, suggesting a markedly higher intensity of recent transmission during the current study period.^{11–13}

Likewise, dengue antibody surveillance in Faisalabad found an IgM seroprevalence of only 4.8% and IgG of 18.1%, reinforcing the influence of study setting and outbreak status on observed rates.¹⁴

Our IgG seroprevalence of 17.9% warrants contextual interpretation. Previous studies from Pakistan have reported substantially higher IgG positivity, particularly among confirmed dengue cases. For example, a Karachi-based study

documented IgG seropositivity approaching 90% among laboratory-confirmed dengue patients, a figure likely inflated by the inclusion of confirmed rather than clinically suspected cases.¹⁵ In contrast, population-based data from Rawalpindi demonstrated IgG seroprevalence of approximately 33.3% among healthy individuals, reflecting cumulative exposure in endemic settings even outside epidemic periods.¹ Accordingly, although the IgG proportion observed in our cohort appears lower, it remains consistent with intermediate endemic transmission and intermittent exposure patterns characteristic of clinically suspected populations.

The demographic trends observed in our study are concordant with existing literature. The predominance of male patients among IgM-seropositive cases mirrors findings from earlier studies conducted in Lahore and Karachi, where males consistently accounted for a higher proportion of dengue infections.^{15,16} This pattern is widely attributed to socio-behavioral factors, including increased outdoor exposure and differential healthcare-seeking behavior, rather than intrinsic biological susceptibility. Furthermore, the seasonal clustering of IgM-positive cases during September and October aligns with established dengue transmission dynamics in Pakistan, where post-monsoon environmental conditions favor *Aedes* mosquito proliferation and viral transmission.¹⁷

From an international perspective, our seroprevalence estimates differ markedly from hyperendemic regions. In Southeast Asian countries such as Malaysia, dengue IgG seroprevalence frequently exceeds 80%, reflecting sustained, long-standing transmission and early-life exposure.¹⁸ Conversely, studies from African settings, including Ghana, have reported moderate IgG prevalence (~33%) alongside markedly lower IgM positivity (~5–6%), underscoring the role of regional ecological and vector-related determinants.¹⁹ Similarly, Latin American studies, particularly from Colombia, report IgG seroprevalence exceeding 85% in adult populations.²⁰ Compared with these settings, our findings indicate moderate cumulative exposure with a pronounced surge of recent infections, consistent with outbreak-driven transmission in an endemic but non-hyperendemic context.

A key strength of this study lies in the simultaneous evaluation of dengue IgM and IgG antibodies in a large cohort of clinically suspected

cases, enabling differentiation between recent and prior exposure within the same population. Unlike many prior studies from Pakistan that focused exclusively on confirmed dengue patients or blood donors, our approach captures a broader clinical spectrum during an active transmission period, thereby providing temporal and epidemiological depth to dengue surveillance data.

This study demonstrates a substantial burden of acute dengue infection, accompanied by distinct gender and seasonal patterns and moderate levels of cumulative exposure. When interpreted alongside national and international evidence, these findings highlight the dual challenges of episodic outbreaks and persistent endemic transmission in urban Pakistan. Strengthened surveillance, timely diagnostics, and seasonally targeted vector control interventions remain critical to mitigating dengue-related morbidity and healthcare burden.

Further large-scale epidemiological studies are recommended to provide more comprehensive data on dengue transmission patterns. Additionally, integrating such studies with vector surveillance programs may support a better understanding of seasonal trends and age-specific seropositivity, informing evidence-based approaches to dengue management.

LIMITATIONS OF STUDY

Our study had certain limitations, including its reliance on passive laboratory-based surveillance from a single private institution, which may introduce selection bias, and the lack of clinical outcome data or molecular serotyping to identify specific circulating dengue strains.

CONCLUSION

The detection of dengue IgM and IgG antibodies among clinically suspected cases during the 2024 monsoon season in Lahore demonstrates the presence of recent and past dengue virus exposure in this population. Higher seropositivity was observed among males and adults aged 25–44 years, with a clear seasonal increase in IgM positivity during the late monsoon and early post-monsoon months. These findings provide descriptive insight into the age-wise and temporal distribution of dengue antibody detection and underscore the importance of continued dengue surveillance and timely laboratory diagnosis during peak transmission periods.

ACKNOWLEDGEMENT

The authors acknowledge the cooperation of laboratory personnel, and study volunteers who's contributed to this research.

Conflict of Interest: None.

Discolure:

Funding Source: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

SL & WUZT: Conception, study design, drafting the manuscript, approval of the final version to be published.

OC & HB: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

HT & SK: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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