ISSN: 2581 – 3633

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at: https://www.ijmacr.com

Volume – 9, Issue – 6, November – 2026, Page No.: 203 – 220

Clinico-Epidemiological Profile of Adult Dengue Patients in A Tertiary Care Centre of Ernakulam

[1]Dr. Greeshma Sumanasan, Junior Resident, Department of Internal Medicine, Government Medical, College, Ernakulam

[2]Dr. Jacob K. Jacob, Professor and HOD, Department of General Medicine, Government Medical College, Ernakulam

[3]Dr Alwin Antony, Assistant Professor, Department of Community Medicine, Government Medical College, Ernakulam

Corresponding Author: Dr. Greeshma Sumanasan, Junior Resident, Department of Internal Medicine, Government Medical, College, Ernakulam

How to citation this article: Dr. Greeshma Sumanasan, Dr. Jacob K. Jacob, Dr Alwin Antony, "Clinico-Epidemiological Profile of Adult Dengue Patients in A Tertiary Care Centre of Ernakulam", IJMACR– November – 2026, Volume – 9, Issue – 6, P. No. 203 – 220.

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Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Dengue is an important mosquito-borne viral infection associated with a wide spectrum of clinical manifestations, ranging from uncomplicated febrile illness to severe disease and death. Understanding its clinical profile, seasonal distribution, severity patterns, and hospital outcomes can help improve patient management and healthcare planning. Aim and **Objectives**: To evaluate the demographic and clinical characteristics, seasonal trends, disease severity, laboratory parameters, and hospital outcomes among adults admitted with laboratory-confirmed dengue at a tertiary care centre in Ernakulam, Kerala. Materials and **Methods**: This retrospective, hospital-based study included 1,125 adults with laboratory-confirmed dengue admitted over a 12-month period. Data on demographic characteristics, month of admission, presenting symptoms, clinical severity, laboratory findings, complications, duration of hospital stay, and mortality were analysed. Patients were classified into dengue fever without warning signs, dengue fever with warning signs, and severe dengue. Appropriate descriptive and inferential statistical analyses were performed, with statistical significance set at $p < 0.05$.

Results: The mean age of the study population was 39.53 ± 14.78 years, and males constituted 64.2% of patients. Rural residents accounted for 60.8% of admissions. The highest number of admissions occurred in August (14.2%), followed by July (11.6%) and September (11.0%). Dengue fever without warning signs was observed in 51.3% of patients, dengue fever with warning signs in 37.8%, and severe dengue in 10.9%. Fever was present in all patients, while headache (79.5%) and myalgia (71.6%) were the most frequent associated symptoms. Hepatomegaly was documented in 18.0% of patients, and 5.9% required intensive care

admission. Overall mortality was 3.7% (42/1,125). The mean hospital stay was 5.41 days, with a statistically significant difference in duration of hospitalization across the three severity categories (ANOVA, $F = 1739.81$, $p < 0.001$). Age and sex were not significantly associated with disease severity. Admission vital signs and individual baseline haematological parameters demonstrated limited ability to distinguish patients who died from those who recovered. The exploratory multivariable mortality model also showed limited predictive performance.

Conclusion: Dengue admissions in this cohort predominantly involved young and middle-aged adults, with a male predominance and seasonal clustering during the monsoon and post-monsoon months. Increasing disease severity was associated with a substantially longer hospital stay, highlighting the importance of early clinical assessment and appropriate resource allocation. The limited predictive performance of admission parameters for mortality suggests that clinical decisions should incorporate repeated assessment, serial laboratory monitoring, and evolving clinical findings rather than relying solely on a single admission measurement.

Keywords: Dengue; clinical profile; severe dengue; warning signs; seasonal trends; thrombocytopenia; hospital outcomes; mortality; retrospective study.

Introduction

Dengue is one of the most important mosquito-borne viral infections worldwide and represents a significant public health challenge, particularly in tropical and subtropical regions. It is caused by the dengue virus (DENV), which belongs to the family *Flaviviridae* and is transmitted predominantly through the bites of infected female *Aedes aegypti* mosquitoes. Four antigenically distinct dengue virus serotypes, designated DENV-1, DENV-2, DENV-3, and DENV-4, are recognized. Infection with one serotype generally provides long-term protection against the same serotype but does not confer lasting protection against the other serotypes. Consequently, individuals may experience repeated dengue infections during their lifetime, and secondary infection with a different serotype may increase the risk of severe disease in certain circumstances [1–3].

The global burden of dengue has increased substantially over recent decades because of a combination of climatic, environmental, demographic, and socioeconomic factors. Rapid urbanization, population growth, inadequate water management, increased human mobility, and the expansion of mosquito breeding habitats have contributed to the geographical spread of dengue transmission. Climate-related factors, including rainfall, temperature, and humidity, influence mosquito survival, breeding, and viral transmission. Dengue outbreaks can place considerable pressure on healthcare systems, particularly during seasonal epidemics when hospitals experience an increased number of febrile patients requiring clinical assessment, laboratory investigations, and supportive treatment [1,4,5]. India remains an important dengue-endemic country, with recurrent outbreaks reported from different geographical regions. The epidemiology of dengue in India has evolved considerably, with increasing recognition of transmission beyond major urban centres into peri-urban and rural areas. The circulation of multiple dengue virus serotypes, differences in local vector ecology, population density, climatic conditions, and variations in healthcare access contribute to regional differences in disease occurrence and clinical presentation. Previous

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epidemiological reviews have emphasized the changing distribution of dengue and the importance of strengthening surveillance, laboratory diagnosis, vector control, and clinical preparedness [5–7]. Kerala is particularly relevant to dengue epidemiology because of its tropical climate, seasonal rainfall, high population mobility, and extensive network of urban and rural settlements. Rainfall and environmental conditions during the monsoon and post-monsoon periods may favour the development of mosquito breeding sites and influence dengue transmission. Nevertheless, the timing and magnitude of outbreaks may vary between districts and years. Research conducted in Kerala has demonstrated changes in dengue virus serotype distribution and differences in clinical manifestations among infected individuals. A study of dengue infections in southern Kerala between 2017 and 2019 documented changes in serotype predominance and reported an association between DENV-3 infection, warning signs, and lower platelet counts [8]. Such observations underline the importance of examining local epidemiological patterns rather than assuming that findings from one geographical area are universally applicable.

The clinical manifestations of dengue range from asymptomatic infection and uncomplicated febrile illness to severe disease involving plasma leakage, significant bleeding, shock, and organ dysfunction. Symptomatic patients commonly present with fever, headache, myalgia, arthralgia, nausea, vomiting, and skin rash. Some patients develop warning signs, including persistent vomiting, abdominal pain or tenderness, mucosal bleeding, fluid accumulation, lethargy, and changes in haematocrit accompanied by a rapid decline in platelet count. Severe dengue may develop around the time of defervescence, when the transition from the febrile phase to the critical phase can be associated with increased vascular permeability and circulatory compromise. Recognition of these clinical changes is essential because timely supportive management and appropriate fluid therapy can substantially improve outcomes [2,9,10].

The World Health Organization classifies symptomatic dengue into dengue without warning signs, dengue with warning signs, and severe dengue. This classification helps clinicians identify patients who may require closer observation, hospital admission, intensive monitoring, or emergency intervention. However, disease severity cannot always be reliably predicted from the initial clinical presentation alone. Some patients who initially appear relatively stable may develop complications during the subsequent course of illness. Therefore, repeated clinical assessment, careful evaluation of haemodynamic status, monitoring of fluid balance, and serial laboratory investigations are important components of dengue management [9–11].

Laboratory investigations play a central role in the diagnosis and clinical assessment of dengue. Depending on the duration of illness, diagnostic approaches may include detection of viral nucleic acid, non-structural protein 1 antigen, or dengue-specific antibodies. Haematological investigations commonly include complete blood counts, platelet counts, total leukocyte counts, and haematocrit measurements. Thrombocytopenia and leukopenia are frequently observed, while a rising haematocrit may indicate plasma leakage when interpreted in conjunction with the patient's clinical condition and previous measurements. Liver enzyme abnormalities may also occur, reflecting hepatic involvement. Nevertheless, individual laboratory

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values vary according to the stage of illness, hydration status, underlying conditions, and the timing of sample collection [2,10,12].

The relationship between laboratory parameters and adverse outcomes remains an important area of clinical investigation. Although thrombocytopenia, haemoconcentration, hepatic dysfunction, and other biochemical abnormalities may accompany more complicated disease, their prognostic value depends on the clinical context and the evolution of these parameters over time. A single measurement obtained at admission may not adequately represent the subsequent disease trajectory. Consequently, the interpretation of laboratory findings should be integrated with clinical warning signs, serial measurements, organ function, and the patient's response to treatment. Studies evaluating these relationships may help identify the strengths and limitations of routinely available admission parameters in predicting clinical outcomes [10–13].

Hospital outcomes are influenced not only by the biological severity of dengue but also by the timing of presentation, the recognition of warning signs, the availability of appropriate monitoring, and the management of complications. Patients with severe disease may require prolonged hospitalization, intensive care, and closer monitoring of haemodynamic status and organ function. Conversely, patients with uncomplicated dengue may recover with supportive treatment and appropriate follow-up. Assessing the duration of hospital stay, intensive care utilization, complications, and mortality alongside disease severity can provide valuable information for clinical decision-making and hospital resource planning [9–11,13].

Despite advances in dengue surveillance and clinical management, locally generated hospital data remain important for understanding the demographic profile, seasonal distribution, clinical spectrum, and outcomes of affected patients. Hospital-based studies from different regions of India have described variations in presenting symptoms, laboratory abnormalities, disease severity, and clinical outcomes. However, findings from one institution may not necessarily reflect the pattern observed in another because of differences in patient populations, referral pathways, circulating serotypes, seasonal exposure, and admission practices [6–8,14,15].

Against this background, the present study was undertaken to evaluate the clinical profile, disease severity, seasonal trends, laboratory characteristics, and hospital outcomes among 1,125 adults with laboratory-confirmed dengue admitted to a tertiary care centre in Ernakulam, Kerala. The study also examined the relationship between clinical severity and duration of hospitalization and explored whether demographic characteristics and routinely available admission parameters were associated with disease severity and mortality. By describing the experience of a large hospital-based cohort over a 12-month period, this study aims to contribute to the understanding of dengue epidemiology and clinical outcomes in Kerala and to identify areas requiring further investigation, particularly the prognostic value of admission measurements and the potential importance of serial clinical and laboratory monitoring.

Materials And Methods

Study Design and Setting

This retrospective, hospital-based observational study was conducted at a tertiary care centre in Ernakulam, Kerala, India. The study evaluated the demographic characteristics, clinical presentation, seasonal distribution, laboratory parameters, disease severity, and

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hospital outcomes of adults admitted with laboratory-confirmed dengue infection over a 12-month period. 2.2

Study Population

The study included 1,125 adult patients with laboratory-confirmed dengue who were admitted to the hospital during the study period. Patient information was obtained from hospital medical records and relevant laboratory reports. The analysis focused on demographic characteristics, presenting symptoms, clinical findings, laboratory investigations, complications, disease severity, duration of hospitalization, intensive care unit admission, and final clinical outcomes.

Inclusion Criteria

1. Adults aged 18 years or older.
2. Patients admitted to the study hospital during the specified 12-month study period.
3. Patients with laboratory-confirmed dengue infection.
4. Patients whose medical records contained sufficient information for the relevant analyses.

Exclusion Criteria

1. Patients younger than 18 years.
2. Patients with suspected dengue without laboratory confirmation.
3. Patients with duplicate admission records for the same episode, where applicable.
4. Patients with insufficient or unavailable medical records for the principal study variables.

Data Collection

Relevant information was extracted retrospectively from hospital records using a structured data collection proforma. The variables included age, sex, residence, migration status, history of travel to an endemic area, previous dengue infection, and month of admission.

Clinical information included presenting symptoms, examination findings, warning signs, complications, intensive care requirements, and final hospital outcome. Laboratory parameters documented at admission were reviewed, including platelet count, total leukocyte count, haematocrit, and other available biochemical and haematological measurements.

The duration of hospitalization was recorded in days. Final outcomes were classified as recovery or death according to the hospital records.

Assessment of Disease Severity

Patients were categorized into three clinical severity groups according to the classification documented in their medical records:

1. Dengue without warning signs (DF-WS).
2. Dengue with warning signs (DF+WS).
3. Severe dengue.

The distribution of patients across these categories was assessed. Associations between disease severity and demographic characteristics, clinical findings, laboratory parameters, and duration of hospitalization were examined where appropriate.

Assessment of Seasonal Distribution and Clinical Outcomes

Seasonal trends were evaluated by recording the month of hospital admission and calculating the number and proportion of dengue cases admitted during each calendar month.

Clinical outcomes were assessed using the duration of hospitalization, requirement for intensive care, documented complications, and in-hospital mortality. The relationship between disease severity and length of hospital stay was evaluated to determine whether hospitalization duration differed significantly across the three severity categories.

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Statistical Analysis

Data were summarized using descriptive and inferential statistical methods. Continuous variables were expressed as means and standard deviations, with medians and ranges reported where appropriate. Categorical variables were summarized as frequencies and percentages.

Results

A total of 1,125 adults with laboratory-confirmed dengue were included in the analysis. Unless otherwise noted, all percentages are calculated on the full analytic sample (N = 1,125), and descriptive summaries report mean values with standard deviations. Continuous variables were inspected for central tendency and dispersion, and categorical variables were summarized by frequencies and proportions. Inferential tests were performed where appropriate, with two-tailed significance set at $\alpha = .05$.

Demographic Characteristics

The mean age of the cohort was 39.53 years (SD = 14.78; range = 18–80), and the median age was 37 years. When grouped into ordered bands, most patients were between 21 and 40 years (51.0%), followed by 41–60 years (31.9%), ≥ 61 years (9.1%), and ≤ 20 years (8.0%). Males constituted 64.2% of the sample (n = 722) and females 35.8% (n = 403). A majority of patients resided in rural settings (60.8%) rather than urban (39.2%). Most were native residents (89.9%) rather than migrants (10.1%). Fourteen percent reported travel to an endemic area preceding illness, and 10.8% reported a prior episode of dengue illness.

Seasonality analyses based on admission month showed clear clustering in the monsoon and post-monsoon period. The highest volumes occurred in August (14.2%), September (11.0%), July (11.6%), October (10.0%), and June (10.0%), consistent with known ecological patterns of vector abundance.

Table 1: Age: Summary Statistics (Years)

Statistic	Value
n (valid)	1,125
Mean	39.53
SD	14.78
Median	37.00
Range	62
Minimum	18
Maximum	80

Table 2: Age Distribution (Grouped)

Age band	n	%
≤ 20	90	8.0
21–40	574	51.0
41–60	359	31.9
≥ 61	102	9.1

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Total	**1,125**	**100.0**

Table 3: Sex, Residence, Ethnicity, Travel, and Past Dengue

Variable	Category	n	%
Sex	Male	722	64.2
	Female	403	35.8
Residence	Rural	684	60.8
	Urban	441	39.2
Ethnicity	Native	1,011	89.9
	Migrant	114	10.1
Travel to endemic area	Yes	158	14.0
	No	967	86.0
Past dengue	Yes	122	10.8
	No	1,003	89.2

Table 4: Month of Admission

Month	n	%	Month	n	%
Jan	61	5.4	Jul	131	11.6
Feb	76	6.8	Aug	160	14.2
Mar	93	8.3	Sep	124	11.0
Apr	78	6.9	Oct	112	10.0
May	90	8.0	Nov	64	5.7
Jun	112	10.0	Dec	24	2.1

Clinical Severity Distribution

At presentation, 51.3% of patients met criteria for dengue fever without warning signs (DF-WS), 37.8% had dengue fever with warning signs (DF+WS), and 10.9% fulfilled criteria for severe dengue. This gradient of severity provided natural strata for comparative analyses reported below.

Table 5: Clinical Severity Categories

Severity	n	%
DF-WS	577	51.3
DF+WS	425	37.8
Severe dengue	123	10.9
Total	1,125	100.0

Presenting Symptoms and Examination Findings

Fever was universal (100%), as expected in an inpatient cohort. Headache (79.5%) and myalgia (71.6%) were the most frequent constitutional symptoms. Gastrointestinal symptoms were also common: nausea occurred in 53.8% and vomiting in 47.7%. Rash was present in 27.1%. Retro-orbital pain, a classic but not ubiquitous feature of dengue, was reported by

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16.9% of patients. Neurological symptoms at presentation were less frequent: altered consciousness in 5.7% and seizures in 2.0%.

On examination and during hospitalization, hepatomegaly was documented in 18.0%, pleural effusion in 11.0%, and ascites in 7.6%. Objective bleeding was recorded in 7.8%, with specific bleeding phenotypes including gastrointestinal bleeding (3.0%) and epistaxis (2.3%). A total of 5.9% required admission to the intensive care unit.

Table 6: Presenting Symptoms

Symptom	**Category**	**n**	**%**
Fever	Yes	1,125	100.0
Headache	Yes	894	79.5
	No	231	20.5
Myalgia	Yes	805	71.6
	No	320	28.4
Nausea	Yes	605	53.8
	No	520	46.2
Vomiting	Yes	537	47.7
	No	588	52.3
Rash	Yes	305	27.1
	No	820	72.9
Retro-orbital pain	Yes	190	16.9
	No	935	83.1
Altered consciousness	Yes	64	5.7
	No	1,061	94.3
Seizures	Yes	23	2.0
	No	1,102	98.0

Table 7: Examination Findings, Complications, and Escalation of Care

Variable	**Category**	**n**	**%**
Hepatomegaly	Yes	202	18.0
	No	923	82.0
Pleural effusion	Yes	124	11.0
	No	1,001	89.0
Ascites	Yes	85	7.6
	No	1,040	92.4
Any bleeding	Yes	88	7.8
	No	1,037	92.2

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Gastrointestinal bleed	Yes	34	3.0
	No	1,091	97.0
Epistaxis	Yes	26	2.3
	No	1,099	97.7
ICU admission	Yes	66	5.9
	No	1,059	94.1

Diagnostic Testing and Laboratory Parameters

At the time of admission or during early hospitalization, NS1 antigen testing was positive in 64.4% of patients and negative in 35.6%. IgM serology was positive in 32.6% and negative in 67.4%, reflecting both the early timing of many admissions and heterogeneity in illness day at testing. Liver function tests were deranged in 25.1% of the cohort and normal in 74.9%. Prothrombin time (PT-INR) was prolonged in 7.1% and normal in the remainder. Creatine kinase (CK) was elevated in 4.9%. Serum creatinine was elevated in 6.0% overall, consistent with limited renal involvement in this series.

Table 8: Virologic and Biochemical Diagnostic Profiles

Test	**Category**	**n**	**%**
NS1	Positive	724	64.4
	Negative	401	35.6
IgM	Positive	367	32.6
	Negative	758	67.4
Liver function tests (LFT)	Deranged	282	25.1
	Normal	843	74.9
PT-INR	Prolonged	80	7.1
	Normal	1,045	92.9
CK	Elevated	55	4.9
	Normal	1,070	95.1
Serum creatinine	Elevated	68	6.0
	Normal	1,057	94.0

The distribution of core hematological variables at admission is shown in Table 9. Mean platelet count at admission was 121,924.60/µL (SD = 65,517.38; median = 104,312/µL; range = 15,260–249,980/µL). Hematocrit averaged 40.63% (SD = 4.03; range = 35.0–52.0). Mean white blood cell (WBC) count was 5,404.79/µL (SD = 1,733.28; range = 2,002–8,989/µL). Mean systolic blood pressure (SBP) was 108.41 mmHg (SD = 13.72; range = 80–130), and mean diastolic blood pressure (DBP) was 69.01 mmHg (SD = 7.53; range = 50–80).

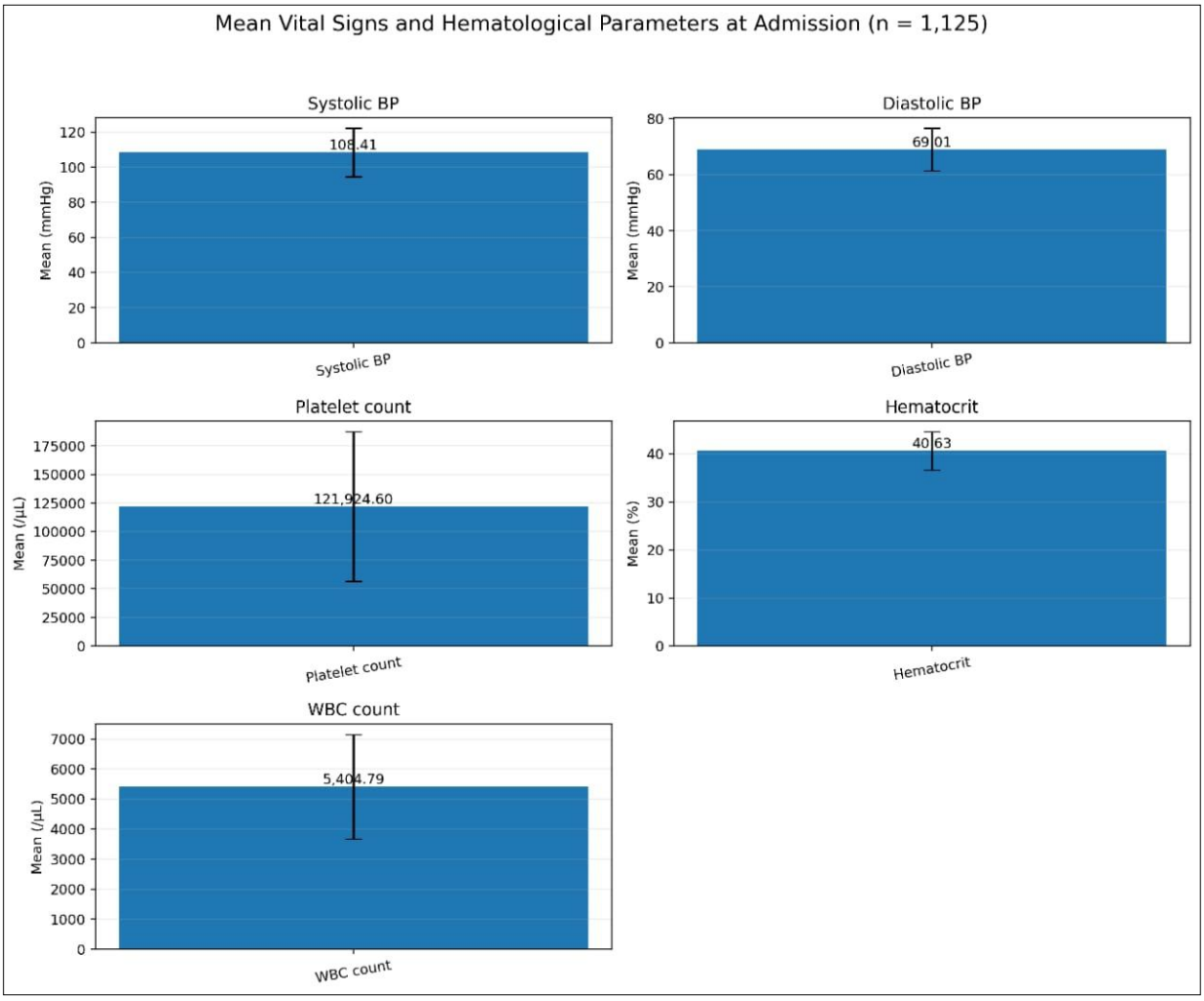
Table 9: Vital Signs and Admission Hematologic Parameters

Variable	**n**	**Mean**	**SD**	**Median**	**Minimum**	**Maximum**
Systolic BP (mmHg)	1,125	108.41	13.72	110.00	80	130

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Diastolic BP (mmHg)	1,125	69.01	7.53	70.00	50	80
Platelet count (/µL)	1,125	121,924.60	65,517.38	104,312.00	15,260	249,980
Hematocrit (%)	1,125	40.63	4.03	39.90	35.0	52.0
WBC count (/µL)	1,125	5,404.79	1,733.28	5,242.00	2,002	8,989

Neurodiagnostic testing was performed selectively. Cerebrospinal fluid (CSF) pleocytosis was present in 6.0% among those tested on clinical grounds. Electroencephalography (EEG) was normal in 86.2%, abnormal with burst-suppression in 2.1% and with electrographic seizures in 2.0%; EEG was not performed in 9.7%. Cranial CT/MRI was normal in 88.1%, showed cerebral edema in 3.4% and intracranial hemorrhage in 1.6%; neuroimaging was not performed in 6.9%.



Graph 1: Vital Signs and Admission Hematologic Parameters

Table 10: Neurodiagnostic Findings

Modality	**Category**	**n**	**%**
CSF pleocytosis	Yes	68	6.0
	No	1,057	94.0
EEG	Normal	970	86.2

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	Burst suppression	24	2.1
	Electrographic seizures	22	2.0
	Not done	109	9.7
CT/MRI	Normal	991	88.1
	Edema	38	3.4
	Hemorrhage	18	1.6
	Not done	78	6.9

Hospital Stay and Clinical Outcomes

The mean duration of hospitalization was 5.41 days (SD = 2.72; median = 5; range = 2–15). Overall mortality was 3.7% (n = 42), while 96.3% (n = 1,083) were discharged alive after recovery.

Table 11: Hospital Stay and Outcome

Variable	**Category/Statistic**	**Value**
Hospital stay (days)	n (valid)	1,125
	Mean (SD)	5.41 (2.72)
	Median	5.00
	Range (min–max)	13 (2–15)
Outcome	Recovered	1,083 (96.3%)
	Died	42 (3.7%)

Hospital Stay by Severity

Length of stay differed markedly by clinical severity category. One-way ANOVA indicated a highly significant effect of severity on hospital days, **F**(2, 1122) = 1739.81, $p < .001$. Post-hoc tests (Tukey HSD, Bonferroni, Sidak, and Tukey-b) converged to show that all pairwise differences were significant at $p < .001$: severe dengue had substantially longer stays than DF+WS, which in turn had longer stays than DF-WS. Group means demonstrated a graded increase from DF-WS (M = 3.48 days) to DF+WS (M = 6.46 days) to severe dengue (M = 10.87 days), consistent with biological expectations of resource utilization and recovery time as clinical severity escalates.

Table 12: One-Way ANOVA: Hospital Stay by Severity

Source	**SS**	**df**	**MS**	**F**	**p**
Between groups	6,281.242	2	3,140.621	1739.806	< .001
Within groups	2,025.384	1,122	1.805		
Total	8,306.626	1,124			

Table 13: Post-Hoc Pairwise Differences (Tukey HSD)

Comparison	**Mean difference (days)**	**SE**	**p**	**95% CI (lower, upper)**
DF-WS vs. DF+WS	−2.976	.086	< .001	−3.18, −2.77
DF-WS vs. Severe	−7.390	.133	< .001	−7.70, −7.08

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DF+WS vs. Severe	−4.413	.138	< .001	−4.74, −4.09

Table 14: Homogeneous Subsets (Tukey HSD)

Severity	n	Mean hospital stay (days)
DF-WS	577	3.48
DF+WS	425	6.46
Severe dengue	123	10.87

Bivariate Associations with Severity and Outcome

Age and Sex Versus Severity

We examined whether age grouping or sex distribution varied by severity. The cross-tabulation of age bands by severity did not reveal significant differences, Pearson $\chi^2(6, N = 1,125) = 3.921$, $p = .687$. Similarly, the distribution of severity by sex was not significantly different, Pearson $\chi^2(2, N = 1,125) = 0.248$, $p = .883$. These null results suggest that, in this cohort, neither age (as categorized) nor sex was differentially associated with clinical severity at presentation.

Table 15: Age Distribution by Severity

Age band	DF-WS	DF+WS	Severe	Total
≤ 20	49	33	8	90
21–40	303	204	67	574
41–60	175	148	36	359
≥ 61	50	40	12	102
Total	577	425	123	1,125

Note. Pearson $\chi^2(6) = 3.921$, $p = .687$.

Table 16: Sex Distribution by Severity

Sex	DF-WS	DF+WS	Severe	Total
Female	210	151	42	403
Male	367	274	81	722
Total	577	425	123	1,125

Note. Pearson $\chi^2(2) = 0.248$, p = .883.

Admission Vitals and Hematology Versus Mortality

Independent-samples *t* tests compared admission SBP, DBP, platelet count, hematocrit, and WBC counts between those who died and those who recovered. No statistically significant differences were observed for SBP (equal variances: $t(1123) = 0.378$, $p = .706$), DBP ($t(1123) = 0.265$, $p = .791$), platelet count ($t(1123) = 0.520$, $p = .603$), hematocrit ($t(1123) = −0.598$, $p = .550$), or WBC count (equal variances: F for Levene's = 5.071, $p = .025$; adjusted $t(\approx 45.6) = −0.676$, $p = .503$ using the unequal-variances line). Point estimates favored only trivial mean differences: for example, mean platelet count among deaths was 127,080/µL versus 121,725/µL among survivors, a non-significant difference that is clinically inconsistent with the expectation that more severe thrombocytopenia at a single time point would necessarily portend higher mortality.

Table 17: Admission Vitals and Hematology by Outcome

Variable	Outcome	n	Mean	SD	SE
Systolic BP	Died	42	109.19	13.37	2.06
	Recovered	1,083	108.37	13.74	0.42
Diastolic BP	Died	42	69.31	6.86	1.06
	Recovered	1,083	69.00	7.55	0.23
Platelet count	Died	42	127,080.05	61,908.93	9,552.76
	Recovered	1,083	121,724.66	65,672.27	1,995.57
Hematocrit	Died	42	40.262	3.632	0.560
	Recovered	1,083	40.641	4.046	0.123
WBC count	Died	42	5,253.83	1,463.78	225.87
	Recovered	1,083	5,410.65	1,743.21	52.97

Note. All between-group comparisons were non-significant at $\alpha = .05$.

Multivariable Modeling

Two logistic regression models were explored: (a) a severity model using a binary outcome and (b) a mortality model using death versus recovery as the outcome, each with the same covariate set (age, sex, platelet count, hematocrit, and WBC count).

Predictors of Severe Dengue (Binary)

An initial attempt to fit a multinomial or ordinal severity model was halted due to the more-than-two-level structure; the analysis then proceeded with a binary recode that grouped DF-WS and DF+WS as “No severe dengue” and retained “severe dengue” as “Yes.” The entry model using age, sex, platelet count, hematocrit, and WBC count produced an anomalous solution with perfect separation: the classification table showed 100.0% accuracy for both classes and a Nagelkerke R^2 reported as 1.000, with model estimation hitting the iteration limit and unstable coefficient estimates (e.g., very large standard errors and implausibly large or small exponentiated coefficients).

Table 18: Logistic Regression for Severe Dengue (Binary) — Model Diagnostics

Metric	Value
Sample included	1,125
Omnibus model χ^2 (df = 5)	776.52, $p < .001$
−2LL	Approached 0 (iteration limit reached)
Cox & Snell R^2	.499
Nagelkerke R^2	1.000
Hosmer–Lemeshow χ^2 (df = 8)	0.000, $p = 1.000$
Classification accuracy	100.0% (both classes)
Note	Convergence failure / separation; coefficients unstable

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Table 19: Logistic Regression for Mortality (Recovered = 1 vs. Death = 0)

Predictor	B	SE	Wald	df	p	OR
Age (years)	0.001	0.011	0.007	1	.932	1.001
Female (vs. male)	0.114	0.334	0.116	1	.733	1.121
Platelet count (/µL)	0.000	0.000	0.097	1	.755	1.000
Hematocrit (%)	0.060	0.070	0.731	1	.393	1.062
WBC count (/µL)	0.000	0.000	1.867	1	.172	1.000
Constant	−0.043	3.451	0.000	1	.990	0.958

Table 20: Mortality Model Diagnostics and Classification

Metric	Value
Omnibus model χ^2 (df = 5)	2.44, p = .786
−2 log likelihood	356.16
Cox & Snell R^2	.002
Nagelkerke R^2	.008
Hosmer–Lemeshow χ^2 (df = 8)	12.94, p = .114
Classification accuracy (overall)	96.3%
Sensitivity (death)	0%
Specificity (recovered)	100%
Note	Majority-class prediction; weak discriminative performance

Discussion

Dengue remains an important public health concern in India, with a wide clinical spectrum ranging from uncomplicated febrile illness to severe disease and death. Understanding its epidemiological characteristics, clinical manifestations, and hospital outcomes is essential for improving patient management and healthcare preparedness [1–7]. The present study evaluated 1,125 adults with laboratory-confirmed dengue admitted to a tertiary care centre in Ernakulam, Kerala, over a 12-month period.

The mean age of the study population was 39.53 ± 14.78 years, and males constituted 64.2% of patients. Adults aged 21–40 years represented the largest age group, while rural residents accounted for 60.8% of admissions. Similar demographic patterns have been reported in hospital-based studies from India [6,7,14–16]. The predominance of working-age adults may reflect occupational exposure, mobility, and healthcare-seeking behaviour, although these factors were not directly evaluated in the present study.

Admissions showed seasonal clustering, with the highest proportion recorded in August (14.2%), followed by July (11.6%) and September (11.0%). This pattern is consistent with the influence of monsoon and post-monsoon environmental conditions on dengue transmission. Rainfall, temperature, humidity, and the availability of mosquito breeding sites can influence vector populations and transmission dynamics [5–7,12]. These findings support strengthening vector-control activities and hospital preparedness before periods of anticipated increased transmission. However, the study

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assessed monthly hospital admissions and did not directly examine meteorological variables or community incidence.

Regarding disease severity, 51.3% of patients had dengue without warning signs, 37.8% had dengue with warning signs, and 10.9% had severe dengue. These findings highlight the importance of early recognition of warning signs and appropriate clinical monitoring. The World Health Organization classification emphasizes identifying patients at risk of severe plasma leakage, significant bleeding, and organ dysfunction [8,9]. Age and sex were not significantly associated with disease severity in this cohort, although this does not exclude possible associations in other populations [14,15,18].

Fever was documented in all patients, while headache (79.5%) and myalgia (71.6%) were the most common associated symptoms. Nausea and vomiting were reported in 53.8% and 47.7%, respectively. Hepatomegaly was present in 18.0% of patients, while pleural effusion and ascites were documented in 11.0% and 7.6%, respectively. These manifestations are consistent with the recognized clinical spectrum of dengue[2,8,9,13,16]. Fluid accumulation and bleeding require careful assessment because they may indicate complications or evolving severe disease.

Laboratory investigations are essential for monitoring dengue, particularly platelet count, haematocrit, leukocyte count, and liver and renal function where indicated [8,9,21]. In the present study, individual admission laboratory parameters showed limited ability to distinguish patients who died from those who recovered. This suggests that a single measurement may not adequately represent the dynamic progression of dengue. Serial clinical assessment and laboratory monitoring should therefore be interpreted together rather than relying on isolated admission values [14,15,18,19].

The mean duration of hospitalization was 5.41 days, with a statistically significant difference across the three severity categories (ANOVA, $F = 1739.81$, $p < 0.001$). This finding indicates that hospital stay varied substantially according to disease severity. Patients with warning signs or severe dengue may require closer observation, repeated investigations, and management of complications. These findings have implications for hospital bed management, staffing, and resource allocation during seasonal outbreaks. Group-specific lengths of stay and post-hoc comparisons should be reported to clarify the magnitude of these differences. Intensive care admission was required in 5.9% of patients, and overall mortality was 3.7% (42/1,125). Previous studies have identified clinical deterioration, comorbidities, and selected organ-related abnormalities as potential factors associated with adverse outcomes [15,18–20]. In the present study, the exploratory mortality model demonstrated limited predictive performance. Although overall classification accuracy was 96.3%, sensitivity for identifying deaths was 0%, indicating that the model failed to identify fatal outcomes at the selected threshold. Therefore, the high overall accuracy should not be interpreted as evidence of reliable mortality prediction. The relatively small number of deaths and imbalance between survivors and non-survivors may have contributed to the limitations, although further analysis is required to establish the reasons. Prediction models should be evaluated using clinically meaningful performance measures and validated before clinical application [22–24].

The principal strength of this study is its relatively large cohort of laboratory-confirmed dengue cases evaluated

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over 12 months. However, its retrospective, single-centre design limits generalizability, and the findings depend on the completeness of hospital records. The study was restricted to hospitalized adults and may not represent children, outpatients, or the wider community. In addition, the mortality analysis was limited by the small number of deaths and the poor sensitivity of the exploratory model. Prospective multicentre studies incorporating comorbidities, illness duration, serial laboratory measurements, and detailed clinical findings are needed to identify reliable predictors of severe dengue and mortality.

In conclusion, dengue admissions in this cohort predominantly involved young and middle-aged adults, with a male predominance and seasonal clustering during the monsoon and post-monsoon months. A substantial proportion of patients had warning signs or severe disease, and hospitalization duration differed significantly across severity categories. The findings emphasize seasonal preparedness, early recognition of warning signs, and repeated clinical and laboratory assessment. Further prospective research and validated prediction models are required to improve risk assessment and patient outcomes

Future Research Directions

Future studies should use prospective, preferably multicentre designs to examine the clinical progression and outcomes of dengue across different patient populations. Recording the day of illness at presentation, comorbidities, previous dengue infection, relevant treatment variables, and serial laboratory measurements may improve the understanding of factors associated with deterioration and mortality.

Further research should also evaluate the prognostic performance of combinations of clinical and laboratory variables rather than relying on individual measurements. Candidate models should undergo internal validation, external validation, and assessment of calibration and discrimination before clinical application.

In addition, linking hospital admission data with local meteorological information and vector surveillance could help clarify the relationship between seasonal environmental conditions and dengue-related hospital demand.

Conclusion

The present study describes the demographic characteristics, clinical manifestations, seasonal distribution, disease severity, and hospital outcomes of 1,125 adults with laboratory-confirmed dengue at a tertiary-care centre in Ernakulam, Kerala. Young and middle-aged adults and males constituted the majority of the cohort, while admissions were concentrated during the monsoon and post-monsoon months.

Although dengue without warning signs was the most common clinical category, a substantial proportion of patients had warning signs or severe disease. Hospital stay differed significantly across severity categories, demonstrating the relevance of clinical severity to inpatient resource utilization. The mortality model, however, showed inadequate predictive performance and failed to identify deaths accurately.

Overall, the findings reinforce the importance of seasonal preparedness, early recognition of warning signs, repeated clinical assessment, and serial laboratory monitoring. Larger prospective studies with comprehensive clinical data and validated statistical models are needed to identify reliable predictors of severe dengue and mortality.

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