



Correlation of Serum Calcium Levels with Severity of Dengue in Children: A Cross-Sectional Observational Study.

Dr. K Praveen Kumar ¹, Dr. Ravula Chaitanya Jyothi ^{2*}, Dr Ramya Madhuri Yendamuri ³, Dr. V. Murali Krishna ⁴

¹Senior Resident, Department of Pediatrics, Government Medical College and Hospital, Vikarabad, Telangana, India

²Associate Professor, Department of Pediatrics, Government Medical College and Hospital, Gadwal, Telangana, India

³Associate Professor, Department of Pediatrics, Government Medical College and Hospital, Siddipet, Telangana, India

⁴Professor, Department of Pediatrics, Niloufer Hospital, Osmania Medical College, Hyderabad, Telangana, India

Page | 1

Abstract

Background:

Dengue fever is a significant pediatric health burden in tropical countries. Predicting severe cases early remains crucial to reducing morbidity and mortality. Hypocalcemia has been implicated in dengue pathogenesis, but its clinical utility as a prognostic marker in children requires further evaluation.

Objectives:

To estimate serum calcium levels in children with dengue and analyze their correlation with disease severity.

Methods:

This cross-sectional observational study was conducted over 24 months at Niloufer Hospital, Hyderabad, involving 100 children aged 1 month to 12 years with serologically confirmed dengue. Demographic data, clinical features, and laboratory findings were recorded. Serum total and ionized calcium levels were measured within 24 hours of admission. Statistical analysis was performed using SPSS v17.0. ANOVA, chi-square test, and Spearman's correlation were applied; $p < 0.05$ was considered significant.

Results:

The mean age of participants was 5.8 ± 3.6 years, with a male predominance (58%). Fever was universal, followed by myalgia (76%), vomiting (44%), and abdominal pain (33%). Severe dengue was identified in 7% of cases. Mean serum calcium and ionized calcium levels were significantly lower in severe dengue (7.2 ± 0.5 mg/dL and 0.96 ± 0.10 mmol/L, respectively) compared with dengue without warning signs (8.5 ± 0.4 mg/dL and 1.18 ± 0.06 mmol/L, $p = 0.01$). Strong negative correlations were observed between calcium levels and disease severity (Spearman's rho -0.651 for total calcium; -0.724 for ionized calcium). Mortality was 3%.

Conclusion:

Hypocalcemia, particularly low ionized calcium, correlates strongly with the severity of pediatric dengue and can be a sensitive early biomarker for risk stratification.

Recommendations:

Routine estimation of ionized calcium should be incorporated into the clinical evaluation of dengue in children. Early correction of hypocalcemia may prevent complications. Larger multicenter studies are warranted to validate calcium monitoring as a prognostic and therapeutic tool.

Keywords: Dengue fever; Hypocalcemia; Ionized calcium; Pediatric patients; Disease severity; Biomarker

Submitted: July 15, 2025 **Accepted:** August 29, 2025 **Published:** September 30, 2025

Corresponding Author: Dr. Ravula Chaitanya Jyothi

Email: chaitanyajyothi9985@gmail.com

Associate Professor, Department of Pediatrics, Government Medical College and Hospital, Gadwal, Telangana, India

Introduction

Dengue fever is one of the most prevalent mosquito-borne viral infections worldwide, transmitted primarily by *Aedes*



aegypti and *Aedes albopictus*. It remains a major global health threat, with an estimated 390 million infections annually, of which nearly 96 million present with clinical manifestations [1]. India contributes significantly to the global dengue burden, with seasonal epidemics and a rising proportion of pediatric cases reported in recent years [2]. Children are particularly vulnerable to severe forms such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS), which carry high morbidity and mortality [3].

The clinical spectrum of dengue ranges from mild febrile illness to severe, life-threatening disease characterized by plasma leakage, hemorrhage, and multiorgan dysfunction [4]. Early recognition of patients at risk of developing severe dengue remains a clinical challenge. Conventional hematological markers, including thrombocytopenia and hemoconcentration, are commonly used in monitoring, but these often reflect severity only after complications arise [5]. Consequently, there is increasing interest in identifying biochemical markers that could serve as early predictors of severity.

Calcium homeostasis plays a critical role in cellular signaling, endothelial integrity, and coagulation pathways. Emerging evidence suggests that serum calcium levels, especially ionized calcium, decline significantly during dengue infection and correlate with disease severity [6]. Monitoring calcium levels in children may therefore aid in early risk stratification and timely intervention.

Despite these observations, the role of hypocalcemia as a prognostic marker in pediatric dengue remains underexplored in the Indian context. The present study was therefore undertaken to estimate serum total and ionized calcium levels in children with dengue and to determine their correlation with disease severity. Identifying such associations may provide a simple, cost-effective tool for early recognition of severe disease and guide appropriate management strategies.

Materials and Methods

Study Design and Setting:

This was a cross-sectional observational study conducted in the Department of Pediatrics at Niloufer Hospital, Osmania Medical College, Hyderabad, a tertiary-care referral center, during the period from September 2021 to August 2023.

Study Population:

Children aged 1 month to 12 years admitted with serologically confirmed dengue infection were included.

Diagnosis was established by a positive NS1 antigen and/or IgM ELISA test.

Inclusion Criteria:

Children aged 1 month to 12 years with confirmed dengue infection (NS1Ag or IgM ELISA positive).

Exclusion Criteria:

Children with no serological evidence of dengue.

Children with known endocrine, hepatic, or renal disorders.

Children with clinically diagnosed rickets.

Sample Size:

The sample size of 100 children was determined based on the annual dengue admission load at Niloufer Hospital and feasibility within the 24-month study period. Previous pediatric dengue studies conducted in similar tertiary-care settings have reported sample sizes ranging from 80 to 150, indicating that a cohort of 100 provides adequate power to detect clinically meaningful differences in serum calcium levels across severity categories. All eligible consecutive cases during the study period were included to maximize precision and minimize selection bias.

Data Collection:

After obtaining informed consent from parents/guardians, detailed demographic and clinical data were recorded using a structured proforma. Clinical evaluation included presenting symptoms, vital parameters, and systemic examination findings. Laboratory investigations performed included complete blood count, hematocrit, liver function tests, renal function tests, electrolytes, total serum calcium, ionized calcium, and dengue serology.

Measurement of Calcium Levels:

Total serum calcium was measured using a colorimetric method, and ionized calcium was measured with an ion-selective electrode analyzer. All measurements were performed within 24 hours of admission.

Classification of Severity:

Patients were categorized as per the WHO 2009 classification into:

Dengue without warning signs

Dengue with warning signs

Severe dengue

Bias

Several measures were taken to minimize potential sources of bias. All eligible children with serologically confirmed



dengue were enrolled consecutively to reduce selection bias. Clinical assessments and laboratory measurements, including serum total and ionized calcium levels, were performed within the first 24 hours of admission using standardized protocols to limit measurement bias. Classification of dengue severity followed the WHO 2009 criteria to ensure uniform outcome assessment and reduce misclassification bias. Data collection was carried out using a structured proforma, and cross-checking of entries was performed to minimize information bias.

Statistical Analysis:

Data were entered into Microsoft Excel and analyzed using SPSS version 17.0. Continuous variables were presented as mean $\pm$ standard deviation, and categorical variables as frequencies and percentages. Differences in serum total calcium and ionized calcium levels across the three dengue severity groups were assessed using one-way ANOVA, and the corresponding p-values have been reported in the Results section. The relationship between calcium levels and disease severity was evaluated using Spearman's rank correlation

coefficient. A p-value <0.05 was considered statistically significant.

Ethical Considerations:

The study was approved by the Institutional Ethics Committee of Osmania Medical College, Hyderabad. Written informed consent was obtained from parents or guardians of all participants.

Results

Participant Flow

During the 24-month study period, 124 children were admitted with suspected dengue infection. Of these, 24 were excluded—15 had negative serology (NS1Ag and IgM ELISA negative), 5 had pre-existing renal or endocrine disorders, and 4 had incomplete laboratory data. Thus, a total of 100 children met the eligibility criteria and were enrolled for final analysis. All enrolled patients had complete clinical and biochemical data, including serum calcium measurements (Figure 1).

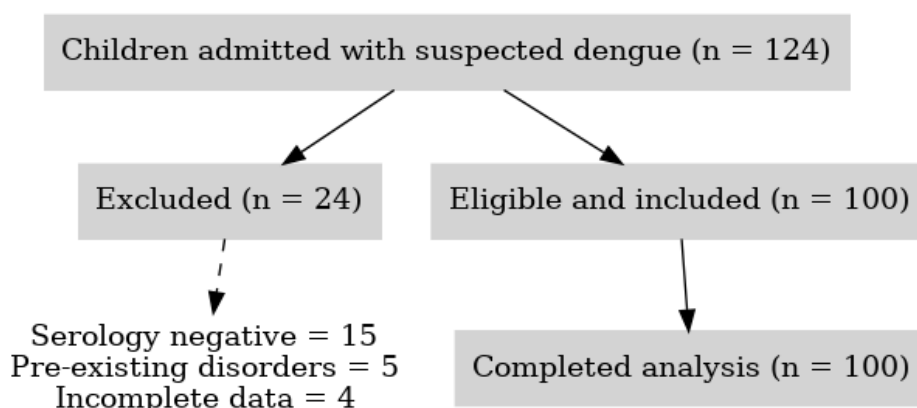


Figure 1. Participant Flow Diagram

The mean age was 5.8 ± 3.6 years, with the majority belonging to the 5–10 year age group (42%). There was a slight male preponderance (58%), and most participants belonged to lower and upper-lower socioeconomic strata (55%) (Table 1).

Table 1. Demographic Profile of Children with Dengue (n=100)

Variable	Category	n (%)
Age (years)	<1	14 (14.0)
	1–5	22 (22.0)
	5–10	42 (42.0)
	10–12	22 (22.0)
Gender	Male	58 (58.0)
	Female	42 (42.0)



Socioeconomic status	Lower + Upper lower	55 (55.0)
	Lower middle + Upper middle	45 (45.0)
Mean age $\pm$ SD	5.8 $\pm$ 3.6 years	

Clinical Profile

Page | 4

All patients presented with intermittent fever. The most frequent associated symptoms were joint pain/myalgia (76%), vomiting (44%), abdominal pain (33%), refusal to

feed (32%), and bleeding manifestations (23%). Neurological and renal symptoms such as altered sensorium (7%) and reduced urine output (12%) were less common (Table 2).

Table 2. Clinical Symptoms at Presentation

Symptom	n (%)
Fever (intermittent)	100 (100.0)
Vomiting	44 (44.0)
Abdominal pain	33 (33.0)
Joint pain/myalgia	76 (76.0)
Bleeding manifestations	23 (23.0)
Refusal to feeds	32 (32.0)
Altered sensorium	7 (7.0)
Reduced urine output	12 (12.0)

Vital Signs and Examination Findings

At admission, tachycardia was present in 25% of cases, tachypnea in 16%, hypotension in 17%, and abnormal

capillary refill in 14%. On examination, pallor was documented in 24%, tender hepatomegaly in 38%, and abdominal distension in 13% of patients (Table 3).

Table 3. Vital Signs and Examination Findings

Finding	n (%)
Tachycardia	25 (25.0)
Tachypnea	16 (16.0)
Hypotension	17 (17.0)
Abnormal capillary refill	14 (14.0)
Pallor	24 (24.0)
Tender hepatomegaly	38 (38.0)
Distended abdomen	13 (13.0)

Laboratory Findings

The mean hemoglobin was 11.5 ± 1.8 g/dL, hematocrit $36.2 \pm 5.6\%$, and total leukocyte count $7236 \pm 3046/\text{mm}^3$. The mean platelet count was $97,220 \pm 68,089/\text{mm}^3$. Liver

enzymes were elevated, with a mean SGOT of 166 IU/L and SGPT of 98 IU/L. Abnormal renal function was observed in 8% of patients. Dengue serology was positive for NS1Ag in 56% and IgM in 44% (Table 4).

Table 4. Laboratory Parameters

Parameter	Mean $\pm$ SD
Hemoglobin (g/dL)	11.5 ± 1.8
Hematocrit (%)	36.2 ± 5.6
TLC (/mm ³)	7236 ± 3046
Platelet count (/mm ³)	$97,220 \pm 68,089$
SGOT (IU/L)	166 ± 847
SGPT (IU/L)	98 ± 289



Abnormal renal function	8 (8.0%)
Dengue serology – NS1Ag	56 (56.0%)
Dengue serology – IgM	44 (44.0%)

Correlation of Serum Calcium with Dengue Severity

Based on WHO criteria, 51% of cases were classified as dengue without warning signs, 42% as dengue with warning signs, and 7% as severe dengue. A significant decline in both

total serum calcium and ionized calcium levels was observed with increasing severity. Severe dengue cases had the lowest calcium values (7.2 ± 0.5 mg/dL and 0.96 ± 0.10 mmol/L, respectively), with a significant association ($p = 0.01$) (Table 5).

Table 5. Dengue Severity and Serum Calcium Levels

Diagnosis	Total Calcium (mg/dL) Mean $\pm$ SD	Ionized Calcium (mmol/L) Mean $\pm$ SD
Dengue without warning signs (n=51)	8.5 ± 0.4	1.18 ± 0.06
Dengue with warning signs (n=42)	7.9 ± 0.5	1.06 ± 0.07
Severe dengue (n=7)	7.2 ± 0.5	0.96 ± 0.10
p-value	0.01*	0.01*

Outcomes and Correlation Analysis

The mean hospital stay was six days, with 70% requiring admission for 5–10 days. Most patients were discharged in stable condition (97%), while 3% succumbed to illness.

Platelet counts were lowest in severe dengue ($40,143 \pm 26,105/\text{mm}^3$). Spearman's correlation revealed a strong negative association between disease severity and both total calcium ($r = -0.651$, $p < 0.05$) and ionized calcium ($r = -0.724$, $p < 0.05$) (Table 6).

Table 6. Clinical Outcomes and Correlations

Variable	Observation
Hospital stay (5–10 days)	70 (70.0%)
Outcome – Discharged	97 (97.0%)
Outcome – Death	3 (3.0%)
Platelet count is lowest in severe dengue	$40,143 \pm 26,105/\text{mm}^3$
Spearman's rho correlation	Total calcium: -0.651 ($p < 0.05$) Ionized calcium: -0.724 ($p < 0.05$)

Discussion

Dengue fever continues to impose a considerable pediatric health burden in India, with children forming a large proportion of admissions during seasonal outbreaks. The mean age of affected participants in this study was 5.8 years, with the highest concentration in the 5–10 year group, a pattern similar to findings reported in earlier Indian pediatric cohorts [1,2]. A slight male predominance was noted, which aligns with observations that boys may have greater outdoor exposure to mosquito breeding environments [3].

Clinical Profile

Fever was universal among the children included in this study. Musculoskeletal symptoms, particularly myalgia and

arthralgia, were frequent and consistent with classical descriptions of dengue infection [4]. Gastrointestinal symptoms such as vomiting and abdominal pain were also prominent, and abdominal pain remains recognized as an important warning sign under the WHO classification [5]. Nearly one-fourth of the children exhibited bleeding manifestations, reflecting trends reported in other Asian pediatric studies [6].

Calcium and Disease Severity

A central observation in this study was the progressive decline in both total and ionized calcium levels with increasing dengue severity. Ionized calcium showed the most pronounced reduction, and correlation analysis



demonstrated a strong negative association with disease severity. These findings correspond with earlier reports that highlighted the role of calcium in endothelial stability and the tendency of calcium levels to fall more markedly in severe dengue [7]. The broader pediatric evidence also substantiates hypocalcemia as a sensitive indicator of escalating severity [8], and several clinical datasets have described hypocalcemia as a common biochemical abnormality in moderate to severe dengue [9].

Multiple mechanisms have been proposed to explain calcium disturbances in dengue. These include increased intracellular calcium flux during viral replication, plasma leakage due to endothelial dysfunction, and dysregulation of parathyroid hormone or vitamin D homeostasis [7,10]. Given that ionized calcium represents the physiologically active component, its stronger association with severity is biologically plausible.

Hematological and Biomarker Correlation

Beyond calcium disturbances, severe dengue is frequently accompanied by pronounced thrombocytopenia and altered leukocyte patterns, and similar trends were observed in this study. These hematological abnormalities remain key indicators of disease progression. Emerging pediatric evidence further supports the use of biochemical and inflammatory markers for early risk prediction. Early biomarker panels have shown utility in anticipating progression to severe disease [11], and elevated ferritin levels have been associated with adverse outcomes in severe pediatric dengue [12]. Serial monitoring of cardiovascular and inflammatory biomarkers has also demonstrated dynamic changes during dengue shock syndrome [13]. Collectively, these findings reinforce the role of biochemical markers, including calcium, in refining early risk stratification.

Generalizability

The findings of this study, conducted in a single tertiary care center in South India, provide important insights into the correlation of serum calcium with dengue severity in children. While the results strongly suggest the utility of ionized calcium as an early biomarker, their generalizability may be limited by regional epidemiological variations, single-center design, and absence of serial calcium monitoring. However, given the biological plausibility and consistency with prior studies, these results are likely applicable to similar pediatric populations in endemic regions.

Conclusion

This study demonstrates a significant association between hypocalcemia and the severity of dengue in children, with ionized calcium emerging as a more sensitive predictor than total serum calcium. Severe dengue cases consistently exhibited markedly reduced calcium levels, along with lower platelet counts and prolonged hospitalization. The strong negative correlation highlights the potential of ionized calcium as a simple, cost-effective biomarker for early risk stratification in pediatric dengue. Incorporating routine estimation of serum calcium, particularly ionized calcium, into clinical evaluation can facilitate timely intervention, minimize complications, and improve outcomes. Multicenter prospective studies are warranted to validate its prognostic and therapeutic implications.

Limitations

This study was limited by its single-center design and modest sample size. Serum calcium was assessed only at admission without serial monitoring during illness. Other determinants of calcium homeostasis, such as phosphate, magnesium, vitamin D, and parathyroid hormone, were not evaluated, potentially influencing observed associations.

Recommendations

Routine monitoring of serum calcium, particularly ionized calcium, should be incorporated into the standard evaluation of pediatric dengue cases, as it may serve as a simple and reliable biomarker of disease severity. Early recognition and correction of hypocalcemia could help prevent complications such as shock, myocardial dysfunction, and seizures. Clinicians should consider calcium levels alongside conventional hematological parameters for more comprehensive risk stratification. Multicenter, prospective studies with larger cohorts are recommended to validate these findings and explore the therapeutic role of calcium supplementation in severe dengue. Integration into national dengue management protocols may improve pediatric outcomes.

Acknowledgements

The author expresses sincere gratitude to the faculty and staff of the Department of Pediatrics, Niloufer Hospital, Osmania Medical College, Hyderabad, for their guidance, encouragement, and continuous support throughout the study. Special thanks are due to Dr. V. Murali Krishna for his mentorship and valuable suggestions. Appreciation is also extended to colleagues, fellow postgraduates, and laboratory staff for their cooperation. Above all, heartfelt



thanks are offered to the children and their families who participated in this research.

Abbreviations

aPTT – Activated Partial Thromboplastin Time
CHF – Congestive Heart Failure
CNS – Central Nervous System
DF – Dengue Fever
DHF – Dengue Hemorrhagic Fever
DSS – Dengue Shock Syndrome
DIC – Disseminated Intravascular Coagulation
HCT – Hematocrit
HUVEC – Human Umbilical Vein Endothelial Cells
IgG – Immunoglobulin G
IgM – Immunoglobulin M
IL – Interleukin
PAF – Platelet-Activating Factor
prM – Precursor Membrane Protein
RNA – Ribonucleic Acid
TNF – Tumor Necrosis Factor
WHO – World Health Organization

Source of funding:

The study had no funding.

Conflict of interest:

The authors declare no conflict of interest.

Author contributions:

KPK -Concept and design of the study, results interpretation, review of literature, and preparation of the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. **RCJ**-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript, revision of the manuscript. **RMV** - Concept and design of the study, results interpretation, review of literature, and preparation of the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. **VMK**-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript, revision of the manuscript.

Data availability:

Data available on request

Author Biography

Dr. K. Praveen Kumar is currently serving as a Senior Resident in the Department of Pediatrics at Government Medical College, Vikarabad, Telangana. He obtained his

MBBS (Bachelor of Medicine and Bachelor of Surgery) degree from Xiamen University, China (2018), followed by internship training at Christian Medical College and Hospital, Vellore. He pursued an MD in Pediatrics at Niloufer Hospital, Osmania Medical College (2022–2025). His academic interests include pediatric critical care and infectious diseases, and he is actively involved in clinical care, research, and teaching. **ORCID iD:** <https://orcid.org/0009-0009-1505-8786>

Dr. Ravula Chaitanya Jyothi is an Associate Professor in Pediatrics at Government Medical College, Jogulamba Gadwal, Telangana. She earned her MBBS (Bachelor of Medicine and Bachelor of Surgery) degree from Kakatiya Medical College, Warangal (2009) and completed her MD in Pediatrics from Niloufer Hospital, Osmania Medical College, Hyderabad (2013). Her areas of expertise include pediatric critical care and infectious diseases, with a strong academic interest in improving child health outcomes through evidence-based practices. She has contributed several publications to reputed national journals and is actively involved in clinical teaching, mentorship, and collaborative research aimed at strengthening pediatric healthcare delivery. **ORCID iD:** <http://orcid.org/0009-0008-8473-201X>

Dr. Ramya Madhuri Yendamuri is an Associate Professor in the Department of Pediatrics at Government Medical College & Hospital, Siddipet, Telangana. She earned her MBBS (Bachelor of Medicine and Bachelor of Surgery) degree from Siddhartha Medical College (graduated in 2009) and subsequently pursued her MD in Pediatrics at Chalmeda Anand Rao Institute of Medical Sciences, completing it in 2016.

With an academic and clinical career grounded in evidence-based child health care, Dr. Ramya Madhuri is engaged in teaching, mentorship, and clinical supervision of undergraduate and postgraduate students. Her interests span neonatal care, growth and development, immunization strategies, and pediatric preventive medicine. **ORCID iD:** <http://orcid.org/0009-0002-8316-0757>

Dr. V. Murali Krishna is an accomplished pediatrician and academican with extensive clinical and teaching experience at Niloufer Hospital, one of the largest pediatric tertiary care centers in South India. He has been actively involved in undergraduate and postgraduate medical education, pediatric clinical services, and multidisciplinary research. His academic interests span neonatal and child health, infectious diseases, and preventive pediatrics. He has contributed to peer-reviewed publications, mentored postgraduate students, and continues to play a vital role in advancing pediatric healthcare and training in India.



References

1. Constantine GR, Rajapakse S, Ranasinghe P, Parththipan B, Wijewickrama A, Jayawardana P. Hypocalcemia is associated with disease severity in patients with dengue. *J Infect Dev Ctries*. 2014 Sep 12;8(9):1205-9. <https://doi.org/10.3855/jidc.4974>
2. Dahanayaka NJ, Agampodi SB, Kodithuwakku Arachchi UP, Vithange SP, Rajapakse R, Ranathunga K, Siribaddana S. Dengue fever and ionized calcium levels: significance of detecting hypocalcaemia to predict severity of dengue. *Ceylon Med J*. 2017 Mar 31;62(1):67-69. <https://doi.org/10.4038/cmj.v62i1.8438>
3. Alam R, Fathema K, Yasmin A, Roy U, Hossen K, Rukunuzzaman M. Prediction of severity of dengue infection in children based on hepatic involvement. *JGH Open*. 2024 Mar 14;8(3):e13049. <https://doi.org/10.1002/jgh3.13049>
4. Singh AR, Dnyanesh DK. The prevalence of hypocalcemia in children with dengue infection: A 1-year cross-sectional study. *Indian J Health Sci Biomed Res*. 2019;12(2):166-73. https://doi.org/10.4103/kleuhsj.kleuhsj_308_18
5. Manjunath VG, Balla S, Kumar JK. Serum ionic calcium levels and hypocalcemia in dengue fever in children and its correlation with its severity: case control study. *Int J Contemp Pediatr* 2019;6:1289-93. <https://doi.org/10.18203/2349-3291.ijcp20192030>
6. Haq FU, Imran M, Aslam Z, Mukhtar F, Jabeen K, Chaudhry M, Rahman SU, Muhammad N. Severity of Dengue Viral Infection Based on Clinical and Hematological Parameters among Pakistani Patients. *Am J Trop Med Hyg*. 2023 Oct 23;109(6):1284-1289. <https://doi.org/10.4269/ajtmh.23-0309>
7. Shivanthan MC, Rajapakse S. Dengue and calcium. *Int J Crit Illn Inj Sci*. 2014 Oct-Dec;4(4):314-6. <https://doi.org/10.4103/2229-5151.147538>
8. Domingo KG, Duque CN, Blanco MC. Significance of hypocalcemia in predicting dengue severity in the pediatric population: A systematic review and meta-analysis. *Health Sci J*. 2021;10(1):55-62.
9. Joshi A, Sahu MC, Arun G. Prevalence, severity, and clinical impact of hypocalcemia in dengue fever patients. *Int J Mosq Res*. 2024;11(4):102-7. <https://doi.org/10.22271/23487941.2024.v11.i4b.791>
10. S R R, Kem AK, Sharma R. Role of Serum Calcium Levels as a Biomarker for Dengue Severity and Prognosis: Insights from a Cross-Sectional Analytic Study. *Natl J Med Res [Internet]*. 2024 Apr. 1 [cited 2025 Oct. 1];14(02):56-60. <https://doi.org/10.55489/njmr.14022024978>
11. Moallemi S, Lloyd AR, Rodrigo C. Early biomarkers for prediction of severe manifestations of dengue fever: a systematic review and a meta-analysis. *Sci Rep*. 2023 Oct 14;13(1):17485. <https://doi.org/10.1038/s41598-023-44559-9>
12. Jha NP, Gupta T, Krupanandan R, Sadasivam K, Kapalavai SK, Ramachandran B. Serum Ferritin Level in Children with Severe Dengue Infection and Its Association with Outcome: A Single-center Prospective Cohort Study. *Indian J Crit Care Med*. 2025 May;29(5):458-462. <https://doi.org/10.5005/jp-journals-10071-24972>
13. Ho QC, Huynh TT, Tran KH, Vuong HNT, Vu NTH, Moncada A, et al. Kinetics of cardiovascular and inflammatory biomarkers in paediatric dengue shock syndrome. *Oxford Open Immunol*. 2024;5(1):iqae005. <https://doi.org/10.1093/oxfimm/iqae005>



Student's Journal of Health Research Africa

e-ISSN: 2709-9997, p-ISSN: 3006-1059

Vol.6 No. 9 (2025): September 2025 Issue

<https://doi.org/10.51168/sjhrafrica.v6i9.2152>

Original Article

PUBLISHER DETAILS:

Student's Journal of Health Research (SJHR)

(ISSN 2709-9997) Online

(ISSN 3006-1059) Print

Category: Non-Governmental & Non-profit Organization

Email: studentsjournal2020@gmail.com

WhatsApp: +256 775 434 261

Location: Scholar's Summit Nakigalala, P. O. Box 701432,
Entebbe Uganda, East Africa

