(RESEARCH ARTICLE)

Assessing the relationship between hematocrit and platelet count in dengue fever: A prospective observational study

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Abstract

Background: Globally, dengue fever, a virus spread by mosquitoes, is a serious public health concern. Changes in hematocrit level and platelet count, in particular, are important markers of the severity of the disease.

Objective: The purpose of this prospective observational study was to clarify the connection between dengue fever patients' hematocrit level and platelet count and investigate the potential consequences for managing and predicting the illness.

Methods: A total 80 dengue patients were gathered from a tertiary care hospital. Statistical models were used to analyze and correlate the hematological parameters, such as hematocrit level and platelet count, with dengue severity.

Results: In dengue patients, the study found a statistically significant correlation between platelet count and hematocrit level. Its prognostic value was highlighted by the noteworthy correlation between NS1Ag positivity and thrombocytopenia as well as PCV changes.

Conclusion: This study emphasizes how crucial it is to track platelet count and hematocrit level in order to identify severe dengue early. The results have important ramifications for clinical practice, emphasizing the necessity of prompt action and effective patient care to reduce dengue fever-related morbidity and mortality.

Keywords: Dengue Fever; Hematocrit; Platelet Count; Thrombocytopenia; Dengue Severity

1. Introduction

Dengue fever, a viral infection transmitted by mosquitoes, constitutes a serious public health hazard the world over, but mostly in tropical and subtropical areas. Dengue is endemic in almost all the states in India and is one of the leading causes of hospitalization.

This disease manifest with a wide spectrum of clinical symptoms ranging from mild febrile illness to severe forms of dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS). Timely recognition of the patients at risk of progressing to severe forms of the disease is an indispensable part of the management of dengue, and depends on reliable clinical and laboratory markers.[1]

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1.1. Rationale for Topic Selection

The present study based upon this topic of research originated from the urgent requirement to improve the prognosis tools in dengue management. Hematocrit level and platelet count are the parameters of measurement in the clinical settings. Thrombocytopenia (decrease in platelet count) is a well-known characteristic of dengue infection, but the accompanying changes in hematocrit levels and the combined prognostic significance have not been deeply explored. The insight gained from this form of understanding would lead to closer comprehension of the disease course and early identification of the patients at risk for severe complications.

The evidence from different studies into the hypothesis states a strong correlation existing between hematocrit levels as well as platelet counts in dengue fever events. An increasing level of hematocrit is indicative of plasma leakage developing in DHF patients, while a reduced level of this parameter implies hemostatic loss. A different study has shown an increase in hematocrit, along with a decrease in platelet count below 40,000/mL, predicts possible shock with relative risks from 4.8 to 10.9. [2] The data suggests both hematocrit levels and platelet counts may provide important clues in assessing disease progression and severity in dengue patients. [3]

1.2. Purpose of the Study

This study will prospectively observe patients to explain the interrelationship of hematocrit levels with platelet counts in dengue-fever patients. Monitoring syllogistically both variables through the course of the illness will allow the study to determine whether certain patterns or cutoffs can be used as early warning signs for the severity of the disease. Such determination will be useful in making clinical decisions on when to intervene and where resources should go.

1.3. Epidemiological Background of Dengue

A complex pattern of epidemiology has been observed for dengue fever in India for several decades. The first-known outbreak occurred during 1963-1964 by the eastern coast; then it spread to other parts, with Delhi being invaded in 1967 and Kanpur in 1968. Initially limited to urban areas, dengue has now found its way into peri-urban and rural regions, with widespread endemicity.[4] The increasing incidence and geographical expansion only serve to underscore the urgent need for better diagnostic and prognostic methods to manage and control the disease effectively.[1]

1.4. Importance of Investigating Hematocrit and Platelet Relationship

Monitoring hematocrit level and platelet counts is an important aspect of clinically managing dengue patients. Considerable drops in platelet counts are commonly seen, with studies showing thrombocytopenia in around 77% of the patients.

Hematocrit levels may change simultaneously in some patients; others may develop hemoconcentration because of plasma leakage. This presents a clear indication of severe dengue. Understanding the dynamic changes and correlation between the two parameters can lend predictive values regarding the disease progression. Early identification may lead to prompt, targeted therapeutic interventions, thus reducing morbidity and mortality associated with the dengue disease on the severe end.[5]

In summary, this study aims to fill the gap of knowledge in understanding the relationship between hematocrit levels, platelet counts and other blood factors in dengue fever patient's. It is anticipated that the acquired insights will better the clinical assessment protocols and patient management strategies in areas affected by this disease.

2. Methodology

A prospective observational study was conducted from August 2024 to February 2025 in the department of general medicine at Tertiary care hospital, Rajahmundry. Prior permission from the hospital and consent from the patients were taken before the clinical examination and data collection. Inclusion criteria were participants aged between 15 to 65 years, who were presented with dengue fever & willing to participate in the study. Patients with fever not caused by dengue, those with pre-existing blood, liver, or kidney disorders, and those who had dropped out the treatment were excluded from the study.

For this study, a total of 80 patients were included, ensuring a sample size that enhances the reliability of the findings. The sampling technique employed was simple random sampling, which is crucial for minimizing bias and ensuring that every individual within the defined study population had an equal chance of selection.

To facilitate the data collection process, an Excel sheet was created, including age, gender, chief complaints, hematologic parameters (HB, RBC, WBC, PCV, platelets), and dengue serology [NS1 Ag, IgM Ab, IgG Ab], which were collected from medical records and compiled in an Excel sheet. This study aims to evaluate hematological changes in dengue and their clinical significance.

After data collection, the information was recorded in a Microsoft Excel sheet and analyzed using SPSS (Statistical Package for the Social Sciences). For the test, a P-value of <0.05 is to be considered statistically significant.

The analysis included the application of the Chi-square test to determine any significant associations between categorical variables, such as dengue biomarkers and laboratory parameters like hematocrit severity and platelets severity. This statistical approach helped in understanding the relationships and patterns within the collected data, contributing to the overall findings of the study.
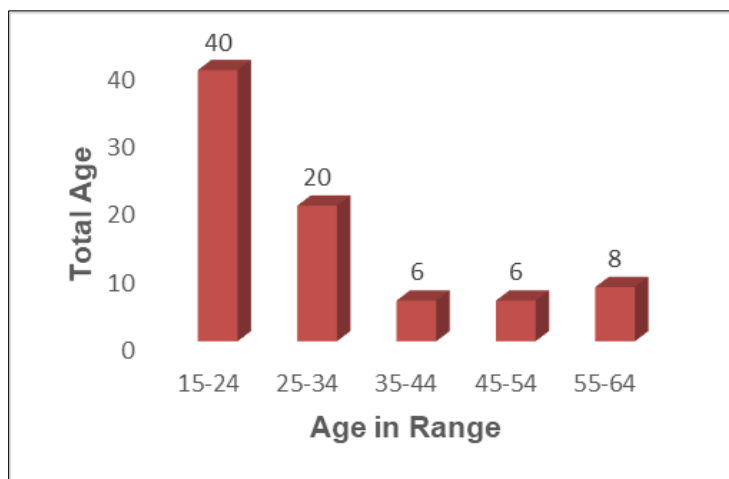
3. Result

Figure 1 Age wise Distribution

In our study, the graph shows the age distribution of males and females. It divides the population into age ranges (15-24, 25-34, 35-44, 45-54, 55-64). The graph indicates that the 15-24 age group has the highest value, followed by a general decline in subsequent age groups, with a slight increase in the oldest age group.
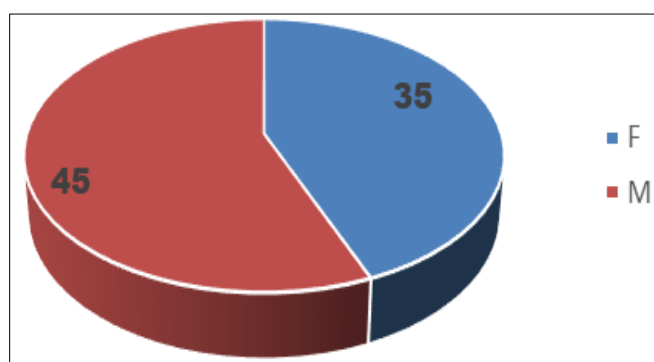

Figure 1 Gender wise Distribution

The graph depicts gender distribution, showing more males (45) than females (35), likely representing a higher proportion of males affected with dengue.
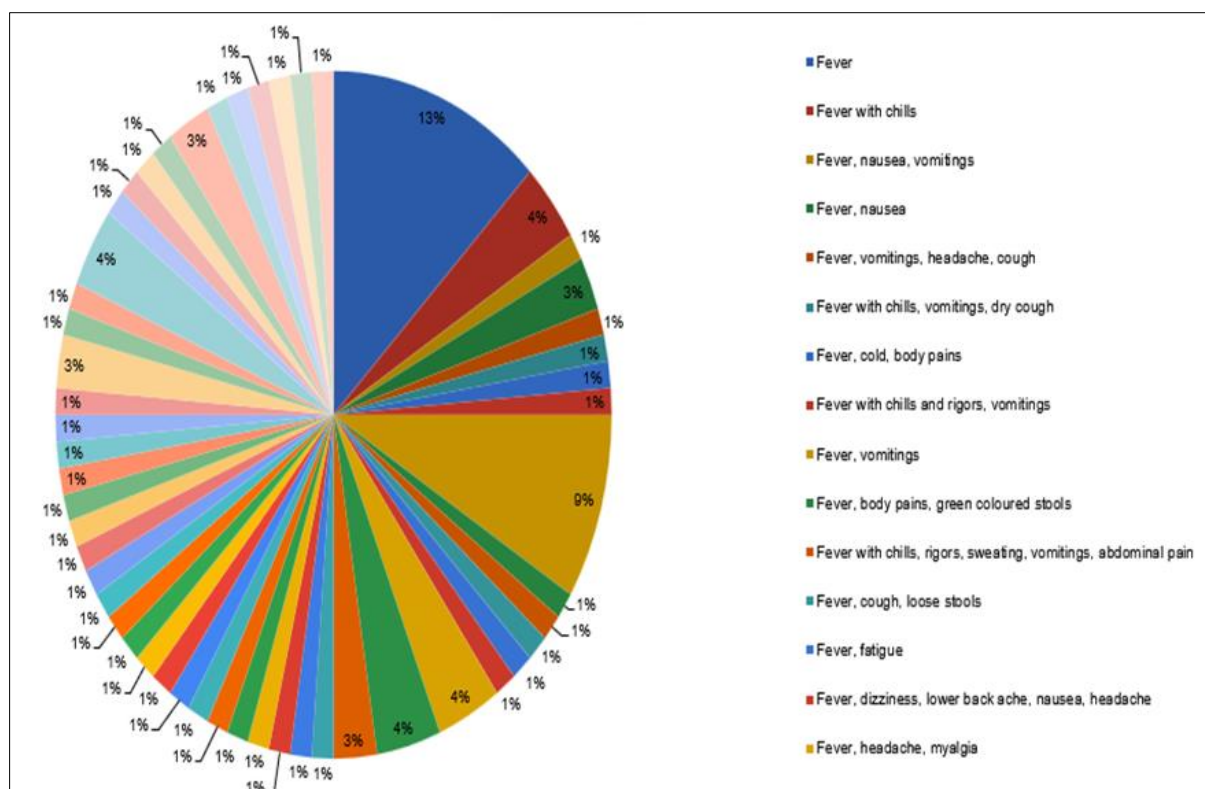
Figure 2 Chief complaints

This pie chart shows patient complaints, with "Fever" being the most common. Many patients report fever combined with other symptoms like chills, nausea, vomiting, cough, and body pain. "Fever" alone accounts for the largest portion, but the variety of combined symptoms suggests diverse presentations of illness.

Table 1 Distribution of case according to Hemoglobin and Hematocrit level

Hemoglobin level			Hematocrit level		
Hb(gm/dl)	No. of cases	Percentage	PCV%	No. of cases	Percentage
9-11.9	20	25	27-36	29	36.25
12-14.9	39	48.75	37-46	23	28.75
15-17.9	21	26.25	47-56	18	22.5

Table shows a significant proportion of cases (25%) had low hemoglobin levels, suggesting possible anemia, with a correlation between low hemoglobin and packed cell volume.

Table 2 Distribution of case according to Total Leukocyte count and Platelet count

Total Leukocyte count			Platelet count		
TLC (cells/cumm)	No. of cases	Percentage	PLT (cells/cumm)	No. of cases	Percentage
>1.5 lakhs	27	33.75	>11,000	16	19.75
20,000-50,000	25	31.25	1,500-4,000	21	26.25
50,000-1.4 lakhs	27	33.75	4,000-11,000	43	53.75

Table indicate that approximately 33.75% of cases had elevated total leukocyte counts, suggesting an underlying inflammatory or infectious process, and a significant proportion had low platelet counts, with over 25% having severely low counts, posing a high risk of bleeding complications.

Table 3 Changes in the hematological factors by relating with different dengue subjects

Blood Parameter	Dengue Marker	Mean Difference	t-Statistic	Two-Tailed p-value	Significant Difference
PCV (40.78)	IgG Ab (0.175)	40.6	50.3	9.15E-62	Yes
	NS1 Ag (0.825)	39.95	50.27	9.57E-62	Yes
	IgM Ab (0.0875)	40.7	50.37	8.31E-62	Yes
WBC (7565.75)	IgG Ab (0.175)	7565.58	13.41	4.72E-22	Yes
	NS1 Ag (0.825)	7564.93	13.41	4.74E-22	Yes
	IgM Ab (0.0875)	7565.66	13.41	4.71E-22	Yes
PLT (115750)	IgG Ab (0.175)	115749.83	12.32	4.50E-20	Yes
	NS1 Ag (0.825)	115749.18	12.32	4.50E-20	Yes
	IgM Ab (0.0875)	115749.91	12.32	4.50E-20	Yes
HB (13.415)	IgG Ab (0.175)	13.24	51.4	1.76E-62	Yes
	NS1 Ag (0.825)	12.59	50.02	1.40E-61	Yes
	IgM Ab (0.0875)	13.33	50.87	3.88E-62	Yes

This table summarizes the results of paired t-tests examining the changes in four hematological factors (PCV, WBC, PLT, and HB) in relation to the presence of different Dengue markers (IgG Ab, NS1 Ag, and IgM Ab). The t-statistics indicate the strength of these differences, with PCV and HB showing the strongest effects.

Table 4 Dengue Diagnostic Test Results

Dengue Result	NS1 Ag (N=80)	IgM Ab (N=80)	IgG Ab (N=80)
Positive	66	7	14
Negative	14	73	66

Table reveals that there are a lot of active dengue infections present, as indicated by the high number of positive NS1 antigen tests while, IgM and IgG antibodies provided evidence of recent and possible prior exposure.
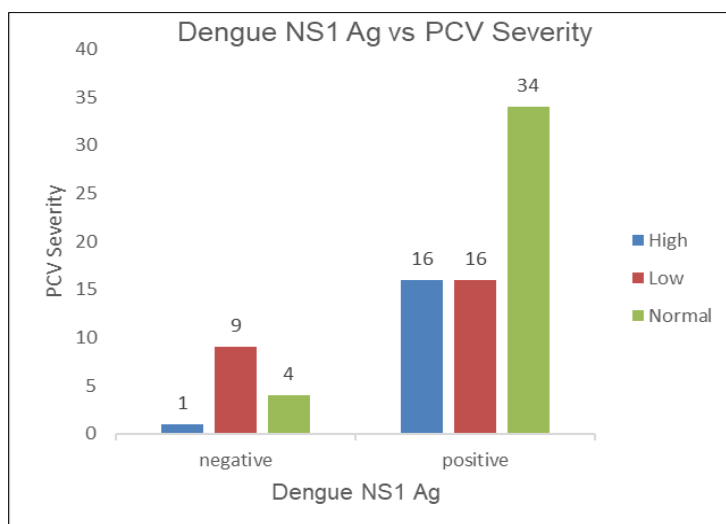
Figure 3 Dengue NS1 Ag vs PCV Severity

The chi-square test showed that the p-value of 0.023 is generally considered statistically significant (typically $p<0.05$). There is a statistically significant association between dengue infection (positive NS1 Ag) and PCV levels. Dengue-positive individuals are more likely to have normal PCV levels, but a considerable proportion also exhibit high or low PCV, suggesting that dengue can impact PCV in various ways.
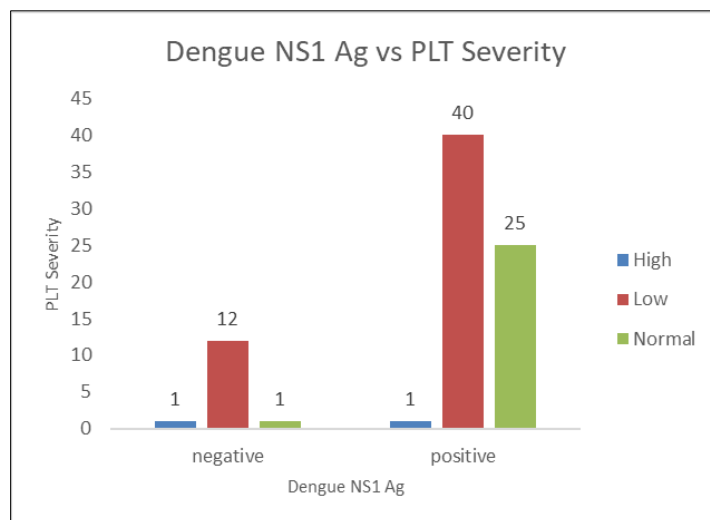

Figure 4 Dengue NS1 Ag vs PLT Severity

The chi-square test showed that the p-value of 0.018 is generally considered statistically significant (typically $p<0.05$). There is a statistically significant association between dengue infection (positive NS1 Ag) and lower platelet counts. Dengue-positive individuals are much more likely to have low platelet counts, which is consistent with the known effects of dengue on platelet levels.

4. Discussion

Our study, it offers significant insights into evaluating the correlation between platelet count and hemoglobin in patient's with dengue fever. A fever onset due to Dengue virus; a virus spreading from infected Aedes mosquito bite is one of the growing health concerns in tropical countries like India.[6] Hence, it is very important to diagnose dengue and course of disease must be done very finely. In Dengue fever amount of platelet and hematocrit levels are often used as the markers of the severity of conditions.[7] So, we conducted this prospective observational study in tertiary care hospital, over a 6 months period of time to investigate the relationship between hematocrit level and platelet count in patients with dengue fever.

In our study we found that, the age group of 15–24 years had the most dengue cases (40), followed by the 25–34 age group (20). Fewer cases were observed in the 55-64 (8), 35-44 (6), and 45-54 (6) age groups. (Figure1) Overall, the majority of cases occurred in patients aged 15-45. A finding consistent with the study on, "Clinical and hematological profile of dengue among adult patients at a tertiary care hospital in Pokhara" by Dhungana D, Banstola B and Banjara M. [8]

In our study comparable patterns were discovered. Rajbhandari A, Shrestha M, Shah P, and Adhikari S's work on the subject of "Hematologic parameters in thrombocytopenic patients with dengue fever"[9] was earlier research, which indicated a higher prevalence of dengue fever in males compared to females, where our findings showed a similar trend with 35 female patients and 45 male patients (Figure 2) were diagnosed with the illness. The higher incidence of dengue fever observed in young males in our study may be explained by their increased exposure to the outdoors and, consequently, to potential mosquito breeding grounds and infection sites.[10]

In our prospective observation, (Figure3) we found fever of varying intensity to be the primary clinical sign, which is consistent with existing literature describing fever as the first clinical sign of illness, typically appearing during the acute febrile stage and often accompanied by body aches, headaches, and vomiting.[11] Table1 highlights the potential for dengue to impact red blood cell production or survival, warranting further investigation into the underlying causes of anemia in these patients. This may be connected to abnormalities in megakaryocytes and platelet destruction brought on by bone marrow suppression during the acute phase of dengue virus infection.[12] Table 2 reveals that patients with

dengue fever have elevated leukocyte counts, which indicate inflammatory/infectious processes, and significantly low platelet counts, which indicate a high risk of bleeding. In dengue, leukocytosis is rare and usually linked to complications such as sepsis or bacterial superinfections.[13]

In our study we found that, Table 3 presents strong evidence that the presence of various Dengue markers is substantially correlated with the levels of PCV, WBC, PLT, and HB. This implies that the pathophysiology or clinical presentation of dengue fever may be influenced by these hematological variables. In regions where dengue is endemic, routinely employed hematological parameters can help with diagnosis, enhancing early detection and treatment start.[14] Thrombocytopenia (platelet count <150,000/μL), a WHO-recognized indicator of severity and bleeding risk, is often caused by dengue infection. [12]

In our study we found that, out of 80 samples, 66 had positive NS1 antigen results from dengue diagnostic testing, suggesting a substantial amount of active dengue infection. 7 samples had IgM antibodies, whereas 14 samples had IgG antibodies. IgM antibodies were negative in 73 samples, IgG antibodies were negative in 66 samples, and NS1 antigen was negative in 14 samples. Many people who are currently infected may be in the early stages of the infection, as indicated by the high NS1 positive results. (Table 4) In primary cases, the virus stays in the bloodstream and body fluids for longer, and non-structural protein (NS1) stays there for longer as well. [15] The secretory form of NS1 is the most popular biomarker used to diagnose DENV infection by blood tests.[16]

In our study we found that, dengue NS1Ag shows a statistically significant association with both PCV levels and lower platelet counts whereas no significant association was found with IgM antibodies and only weak significance was observed with IgG antibodies. NS1Ag-positive dengue exhibits both normal and modified PCV, indicating a strong correlation with PCV levels. (Figure4) The association between NS1Ag and these hematological alterations was confirmed by secondary dengue in NS1-positive patients, which displayed decreased platelets and increased hematocrit. [17]

In our study, we observed reduced platelet counts in dengue fever patients. (Figure5) The association between NS1Ag and thrombocytopenia is shown by both of our study and study by Gitanjali K. Badave, P. Sai Swaroop and P. Nageswara Rao on topic "Importance of NS1 antigen detection and its association with platelet count for early diagnosis of dengue virus infection" [18], confirming the clinical significance of NS1Ag in predicting dengue severity, which is linked with the study on topic "Outcomes among children and adults at risk of severe dengue in Sri Lanka: Opportunity for outpatient case management in countries with high disease burden" by Bodinayake CK, Nagahawatte A DeS, Devasiri V, et al [19], who reported thrombocytopenia in dengue patients.

These findings, especially in settings with limited resources, have important clinical significance for the management of dengue fever. Regular platelet counts and PCV monitoring in patients with NS1Ag can help identify severe dengue early and direct the right treatment. From the viewpoint of public health, our study highlights the necessity of targeted interventions and greater awareness among young males, who are more susceptible to dengue infection. Prevention of dengue outbreaks in endemic areas requires improved mosquito control strategies and public awareness campaigns.

5. Conclusion

This study highlights the predictive value of NS1Ag and validates the significant correlation between dengue severity, platelet counts, and hematocrit. For the early detection of severe dengue, it is essential to monitor these parameters. The results highlight how crucial the use of hematological markers is for prompt clinical intervention and better patient outcomes. The strong correlation between NS1Ag positivity and thrombocytopenia and PCV alterations supports its use as a crucial prognostic marker. By improving clinical assessment procedures and management techniques in dengue-endemic areas, this research eventually lowers morbidity and mortality.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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