International Journal of Scientific Reports
*Passi R et al. Int J Sci Rep. 2022 Jan;8(1):23-28*
http://www.sci-rep.com
pISSN 2454-2156 | eISSN 2454-2164
DOI: https://dx.doi.org/10.18203/issn.2454-2156.IntJSciRep20214933

**Original Research Article**

# Role of platelet parameters and hematological profile in dengue positive cases

**Rashim Passi*, B. P. Baviskar, R. R. Karle**

Department of Pathology, Rural Medical College, Loni, Maharashtra, India

**Received:** 07 December 2021
**Revised:** 22 December 2021
**Accepted:** 23 December 2021

***Correspondence:**
Dr. Rashim Passi,
E-mail: passirashim@gmail.com

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** Dengue is an endemic in tropical and sub-tropical regions of the world and also in various parts of India. Recent evidence indicates that platelet indices can be used to assess the severity and prognosis of dengue. This study aimed to assess the role of the platelet indices-mean platelet volume (MPV), platelet distribution width (PDW), platelet to large cell ratio (P-LCR), plateletcrit (Pct) and hematological parameters like hemoglobin (Hb), hematocrit (Hct) with the platelet count in dengue NS1 antigen positive cases.
**Methods:** An observational cross-sectional study conducted on cases of dengue over a period of 3 months admitted with serological positivity (NS1 antigen) in a tertiary care hospital, Loni. The platelet indices like MPV, PDW, Pct, P-LCR and hematological parameters like Hb, Hct were noted using Sysmex XN-3100 Automated hematology analyzer and compared with platelet count.
**Results:** Relationship between various platelet indices like MPV, PDW, P-LCR and PCT and hematological parameters like Hb, TLC and Hct were related with platelet count. Dengue positive cases were inversely related to MPV, PDW, P-LCR, Hb and Hct and directly related to Pct. In the present study Pct, P-LCR, Hb and Hct were statistically significant in correlation with platelet count.
**Conclusions:** Pct, P-LCR, Hb and Hct along with platelet count can be used to assess the predictive outcomes in case of dengue infection.

**Keywords:** Dengue, Platelet indices, MPV, PDW

## INTRODUCTION

Dengue is a viral disease caused by dengue virus with four serotypes DEN-1 to DEN-4 of the Flavivirus family transmitted through *Aedes aegypti* mosquito.[1] A large number of cases remain undiagnosed or underreported and the incidence of dengue infection and its geographical distribution has seen an increasing trend in past few decades.[2] Approximately 50 million infections per year have been reported worldwide.[3] Severity is determined by risk factors such as age, secondary infections, pre-existing illness and infecting serotypes. A more severe form of disease is noted when there is a second infection with a different serotype than primary infection.[3] Dengue is characterized by sudden onset of fever of 3-5 days, intense headache, myalgia, joint pain, retro-orbital pain, anorexia, gastrointestinal disturbances and rash.[4]

Except for few hilly and dry regions where the environment is unfavourable for mosquito breeding, the outbreaks of the disease have been reported in almost entire India.[2] Dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) are life threatening reversible vascular complications of dengue fever (DF) and are associated with severe thrombocytopenia bleeding and increased vascular permeability. To predict the severity of the disease decreasing platelet counts are

used. So, there is a need to study platelets profile and understand its importance so that adverse outcomes of this rapidly spreading disease can be controlled to a great extent.[4] The most common laboratory findings in dengue is thrombocytopenia but the mechanism remains unclear. The mechanisms possibly leading to thrombocytopenia could be suppression of bone marrow by the virus; antidengue antibody-mediated platelet destruction, peripheral consumption of platelets and isolated viral replication in the platelet.[3] Thrombocytopenia leads to bleeding although the platelet count may not directly correlate with the bleeding manifestation.[5]

In most of the patients recovery is made following a non-severe clinical course, but a small proportion might progress to severe disease, which is characterized by plasma leakage with or without haemorrhage. As the initial symptoms of the infection are non-specific, early recognition is challenging as viremia may be below detectable levels and serological tests confirm dengue late in the course of illness.[5] Detection of IgM/IgG antibody specific to dengue has been the mainstay for diagnosis of infection is an indirect method and is prone to false positive as well as false negative results. Nonstructural protein1 (NS1) detection is available for diagnosis of DF in recent times. NS1 Ag detection is considered sensitive and highly specific. Platelet count is the only accessory laboratory test available in the peripheral areas that can support the diagnosis of DHF or DSS. The complex mechanism of thrombocytopenia remains unclear.[6]

The hematology tests of importance are platelet counts, total leucocyte count (TLC) and Hct. However changes in platelet count and Hct occur in later stages of infection, after 3rd-4th day. The earliest hematological abnormality is progressive decline in white cell counts. Leucopenia is defined as a prominent and supposedly the second most common feature in dengue and provide clue for diagnosis of dengue and helps in differentiation from other febrile illnesses thus reducing its morbidity and mortality. Some studies have observed that TLC/leucopenia could serve as a prognostic factor for dengue severity while others dispute it. Few studies noted a progressive decline in white cell counts with sudden platelet drop which precedes plasma leakage and hence could be the earliest prognosticator of severe dengue.[7]

In order to provide specific care early diagnosis of dengue is important which can ensure marked reduction in the morbidity.[8] In India the first case of dengue was reported in Chennai in 1780 and the first outbreak in Kolkata in 1963; subsequent outbreaks have been reported in different parts of India. Since 1956, in various parts of the country four serotypes (one to four) have been reported. There has been a change in geographical range of the disease as in early 2000s, dengue was endemic in a few southern (Maharashtra, Karnataka, Tamil Nadu and Pondicherry) and northern states (Delhi, Rajasthan, Haryana, Punjab and Chandigarh) but now has spread to many other states, union territories and rural regions. This trend might be related to unplanned urbanization, environmental factors, host-pathogen interactions and immunological factors.[9]

Favourable conditions for the transmission of dengue virus have been created due to poor vector control measures. The main vectors for dengue virus in India are *A. aegypti* and *Aedes albopictus*. There has been a 30 fold global increase in the cases of dengue over past five decades. Dengue is endemic in more than 100 countries and causes an estimated 50 million infections annually.[9]

***Platelet indices***

Recently, platelet indices such as MPV, PDW, Pct and platelet large cell ratio (PLCR) have been investigated as prospective platelet activation markers.[3] There is a direct impact of platelet function on severe dengue infection such as DHF and DSS which have hemorrhagic manifestations.[1] Platelet count has been reported as a predictive factor for severe dengue and a prognosticator of recovery.[5] Automation has helped researchers to measure the newer parameters such as platelet indices besides the platelet count. Platelet indices provide additional facts about the morphology and maturity of the platelets. The platelet indices namely Pct, MPV and PDW are being explored in a wide range of clinical disorders.[2]

MPV is a marker of platelet function and activity. When platelet production is reduced, newer platelets become larger and more active and MPV levels rise.[4] It is a calculated and expressed in femtoliter (fl). Due to hypoproduction of platelets, immature platelets become activated and due to pseudopod formation there is increase in size leading to increased MPV. Normal range of MPV is between 7.4 and 11.5 fl. High MPV with thrombocytopenia represents peripheral destruction. Low MPV indicates underproduction/bone marrow suppression. MPV is inversely related to platelet counts. When marrow suppression is the cause of thrombocytopenia, a rising trend in MPV indicates platelet recovery and platelet transfusions may be put on hold.[1]

Pct measures total platelet mass. It helps to detect quantitative abnormalities of platelet and its volume occupied by platelets in the blood as a percentage. The normal range for PCT is 0.22-0.24%.4 PCT is the platelet equivalent of HCT. The normal range for PCT is 0.22-0.24%. PCT parallels the platelet count.[1]

PDW represents the variability in the volume of platelet size and the presence of platelet anisocytosis. Reference interval ranges from 10 to 14 fL. Measures the variability in the platelet size, suggests the heterogeneity in platelet morphology and changes occurring with platelet activation. There is a direct relation between MPV and PDW. A high PDW is related with a high MPV.[4]

P-LCR is expressed in percentage and is an indicator of circulating larger platelets >12 fl. Normal range is 15-30%. It is used to monitor the activity of platelets. Related inversely to the platelet count and directly related to the PDW and MPV. It is increased in thrombocytopenia and decreased in thrombocytosis.[1]

The aim of the study was to assess the role of platelet indices and hematological parameters in dengue infection in the tertiary care setup. Objective was to study the role of platelet parameters like platelet count, PDW and MPV and hematological parameters like Hb, Hct, TLC in dengue positive infection.

## METHODS

An observational cross-sectional study conducted on clinically suspected cases of dengue admitted in the month of 15 July 2021 to 15 October 2021 and with serological positivity (NS1 antigen) in a tertiary care hospital, Loni. All the samples received in the department of pathology diagnosed as dengue NS1 were included in the study. Sample size was decided considering 4-5% prevalence and 95% confidence limit (CI).

Ethical approval of the study was not required.

### *Inclusion criteria*

All patients admitted to the hospital with clinical features of dengue fever and NS1 antigen positivity were included in the study.

Exclusion criteria

Patients serologically negative for dengue infection; patients with sepsis or other active infections; and patients on antiplatelet drugs or NSAIDS were excluded.

The blood sample for dengue were collected in plain bulb and done by dengue day 1 rapid visualization test by immunochromatography method, after the serum separates, 70 µl was transferred to the well and result was read after 20 minutes.

The blood samples were collected in EDTA-anticoagulant bulbs and were run on automated analyser (SYSMEX XN-3100) within 2 hours of collection to prevent artefactual EDTA-induced swelling of platelets. The platelet count was compared with histograms and also confirmed with peripheral smears.

### *Statistical analysis*

Statistical product and service solutions (SPSS) version 21 for Windows (Armonk, NY:IBM corp software was used to analyse the data. Statistical analysis was done by using tools of descriptive statistics such as mean, standard deviation (SD) and standard error (SE) for representing quantitative data. Categorical data was expressed in percentage/proportions. Probability $p<0.05$, considered as significant as alpha error set at 5% with confidence interval of 95% set in the study. Power of the study was set at 80% with beta error set at 20%. Shapiro Wilk test was used to check the normality of data. Pearson 'r' correlation coefficient was used to find correlation between platelet count with various other platelet indices and haematological parameters.

## RESULTS

A total of 71 cases of dengue NS1 positive were evaluated. Among the total 39 (55%) were female and 32 (45%) were male. Of the total 71 patients, age wise distribution shows maximum patients in the age group 17-45 years (52.1%), 22 cases (30.9%) in the age group <16 years and least in the age group >45 years (17%). Platelet parameters like platelet count, MPV, Pct, P-LCR, PDW and haematological parameters like Hb, Hct and TLC were evaluated in dengue NS1 positive cases.

Out of 71 cases, 23 cases (32.3%) were anaemic and 48 cases (67.7%) had Hb >12 g/dl and an inverse relation was noted of Hb level with platelet count and was statistically significant (p=0.036). TLC <4,500 /cumm was observed in 28 cases (39.4%), 37 cases (52.1%) had TLC in the normal range 4,500-11,000 /cumm and 6 cases (8.5%) showed TLC >11,000 /cumm. Hct was below the normal range in 35 cases (49.2%) and values were normal in 36 cases (50.8%) and has an inverse relation with platelet count (p=0.019).

Out of 71 cases, 56 cases had thrombocytopenia. 15 cases (21.1%) showed platelet count <20,000 /cumm, 22 cases (31%) had platelet count between 20,000 to 60,000 /cumm, 19 cases (26.8%) had platelet count between 60,000 to 1,50,000 /cumm and 15 cases (21.1%) had platelet count >1,50,000 /cumm (Table 1).

Low MPV was found in 1 case (1.4%), 53 cases (74.6%) had MPV in normal range and 17 cases had increased MPV (24%) and an inverse relation was observed between MPV and platelet count but had no significant correlation (p=0.208). PDW was high in 20 cases (28.2%), was in normal range in 44 cases (61.9%) and decreased in 7 cases (9.9%) and inverse relation was observed but was of no statistical significance (p=0.106).

P-LCR was high in 30 cases (55%), was in normal range in 32 cases (45%) and inverse relation was observed and was statistically significant (p=0.027) (Table 2). Pct was high in 6 cases (8.5%), was in normal range in 5 cases (7%) and decreased in 60 cases (84.5%) and positive correlation was observed and was statistically significant (p=0.001) (Table 3).

**Table 1: Distribution of study population based on platelet count.**

| PC | Frequency (N) | Percentage (%) |
|---|---|---|
| **<20000 (severe)** | 15 | 21.1 |
| **20000-60000 (moderate)** | 22 | 31 |
| **>60000-150000 (mild)** | 19 | 26.8 |
| **>150000** | 15 | 21.1 |
| **Total** | 71 | 100 |

**Table 2: Distribution of study population based on P-LCR values.**

| P-LCR | Frequency (N) | Percentage (%) |
|---|---|---|
| **<15% (low)** | 0 | 0 |
| **15-30 (normal)** | 32 | 45 |
| **>30 (high)** | 39 | 55 |
| **Total** | 71 | 100 |

**Table 3: Distribution of study population based on PCT values.**

| PCT | Frequency (N) | Percentage (%) |
|---|---|---|
| **<0.22 (low)** | 60 | 84.5 |
| **0.22-0.24 (normal)** | 5 | 7 |
| **>0.24 (high)** | 6 | 8.5 |
| **Total** | 71 | 100 |

**Table 4: Descriptive statistics of hemopathological lab investigation parameters in study population.**

| Variables | Mean | SD | SE | Minimum | Maximum |
|---|---|---|---|---|---|
| **Hb levels** | 12.66 | 2.26 | 0.26 | 8.0 | 17.7 |
| **TLC** | 6.43 | 4.57 | 0.54 | 1.1 | 29.7 |
| **Platelet count** | 88.64 | 80.64 | 9.57 | 7.0 | 350.0 |
| **MPV** | 10.33 | 1.41 | 0.16 | 7.3 | 13.5 |
| **PDW** | 12.57 | 2.81 | 0.33 | 8.8 | 22 |
| **PCT** | 0.12 | 0.08 | 0.01 | 0.01 | 0.35 |
| **PLCR** | 31.87 | 8.9 | 1.05 | 17.0 | 51.8 |
| **Hematocrit** | 38.23 | 6.27 | 0.74 | 24.7 | 51.7 |

**Table 5: Correlation of platelet count with other parameters.**

| Parameters | | Pearson 'r' correlation coefficient value | P value, significance |
|---|---|---|---|
| **PC versus** | Hb | r=-0.249 (moderate negative correlation) | P=0.036* |
| | TLC | r=-0.04 (weak negative correlation) | P=0.739 |
| | MPV | r=-0.151 (weak negative correlation) | P=0.208 |
| | PDW | r=-0.193 (weak negative correlation) | P=0.106 |
| | PCT | r=0.653 (strong positive correlation) | P<0.001** |
| | PLCR | r=-0.262 (moderate negative correlation) | P=0.027* |
| | HCT | r=-0.279 (moderate negative correlation) | P=0.019* |

## DISCUSSION

In tropical countries like India, dengue fever is a growing public health concern. 50-100 million cases occured world-wide annually.[4] The geographical distribution of the virus and the mosquito vector had been expanding which might be the cause of the increase in the number of epidemics and the emergence of complications like DHF and DSS. This might be due to poor control of the mosquito vector or climatic change.[10] In India the epidemics have become very frequent.[11] DF was a self-limited febrile illness.[6] The most major concern of DF was thrombocytopenia and it had been observed that many a times patients were subjected to unnecessary platelet transfusions exposing them to the risk of adverse reactions related to transfusion.[3]

For the study, 71 cases of dengue NS1 positivity were taken of various age groups and there various hematological and platelet parameters were evaluated. It was observed that most number of cases, 37 (52.1%) belonged to age group 17-45 years which was similar to the study conducted by Nehara et al.[5] Out of the total 71 cases, 45% cases were males and 55% cases were females. Thrombocytopenia can be due to increased peripheral destruction, abnormal pooling or increased destruction of platelets.[6] It can also be due to suppression of bone marrow thrombopoiesis or destruction of platelets by anti-NS1 antibodies.[12] Among the 71 cases, 56 cases had thrombocytopenia. The maximum cases 22 (31%) had platelet count between 20,000 to 60,000 /cumm. The mean platelet count was found to 88.64.

MPV indicated increase in platelet diameter and can be used as a marker of platelet activation and production rate. During the process of activation, platelets changed shape from biconcave to disc and with pseudopod formation that leads to increase MPV.[4] Increase in MPV with thrombocytopenia represented peripheral destruction and increased meagakaryocytic activity. Low MPV indicated underproduction/bone marrow suppression. MPV was inversely related to platelet count.[1] Thus MPV was surrogate marker of bone marrow activity.[3] In the present study the mean MPV was 10.33 and 53 cases (74.6%) had MPV in normal range and 17 cases had increased MPV (24%) and it was observed that MPV had a negative correlation with platelet count and was in accordance with Mukker et al and Nehara et al.[4,5]

Pct is the volume of platelets as percentage of the total blood volume and found to be consistent with platelet count. Reduction of platelet count and Pct signified exclusive consumption of platelets.[12] The mean Pct in present study was 0.12% and showed significant positive correlation which was in accordance with study conducted by Wayez et al and Nehara et al.[3,5] During the course of platelet activation, PDW and P-LCR differed with increase in size and number of pseudopodia.[12] In the present study the mean PDW was found to be 12.57. On comparing platelet count with PDW a negative correlation was seen and was observed that low platelet count was associated with high PDW. This was in accordance with study by Navya et al and Mukker et al.[4,6]

P-LCR is used to monitor the platelet activity and is an indicator of circulating large platelets. The mean P-LCR was 31.87%. In the present study an inverse relation was seen with platelet count which was in accordance with Mukker et al and Mennon et al.[4,12] An inverse relation of PDW and P-LCR in the present study signified increased activation of platelets with low platelet count which was in accordance with Mukker et al and Mennon et al.[4,12]

The value of mean Hb was 12.6 g/dl and out of 71 cases, 23 cases (32.3%) were anaemic and 48 cases (67.7%) had Hb >12 g/dl. Whereas in a study by Wyas et al 84.9% cases were anaemic.[3] The Hb had an inverse relation with platelet count. The mean Hct in the present study was 38.23 which was in accordance with study conducted by Shekhar et al.[12] The maximum subjects had the hct in the normal range.

In the present study Pct, P-LCR, Hb and Hct were statistically significant in correlation with platelet count in accordance with study by Mukker et al, Wyas et al and Shekhar et al.[3,4,12]

PDW and MPV were also found to be statistically significant in studies conducted by Mukker et al and Wyas et al.[3,4]

### *Limitations*

Most of these studies were conducted in a small study population. Hence, large epidemiological, randomized, control studies were needed to establish utility of these parameters in dengue.

## CONCLUSION

PDW, P-LCR, MPV, Hb and Hct had an inverse relation with platelet count and Pct was directly proportional to platelet count. Pct, P-LCR, Hb and Hct along with platelet count can be used to assess the predictive outcomes in case of dengue infection.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: Not required*

## REFERENCES

1. Mukker P, Kiran S. Platelet indices evaluation in patients with dengue fever. Int J Res Med Sci. 2018;6(6):2054-9.
2. Khatri S, Sabeena S, Arunkumar G, Mathew M. Utility of platelet parameters in serologically proven dengue cases with thrombocytopenia. Indian J Hematol Blood Transfus. 2018;34(4):703-6.
3. Wayez A, Zafar L, Aijaz M, Afroz N. Study of platelet indices in dengue fever with thrombocytopenia and correlation of immature platelet fraction (IPF) with platelet recovery. Arch Hematol Case Rep Rev. 2020;5(1):1-5.
4. Kantharaj A. Role of platelet and red cell indices as a predictive tool for transfusions in dengue. Glob J Transfus Med. 2018;3:103-8.
5. Nehara H, Meena SL, Parmar S, Gupta BK. Evaluation of platelet indices in patients with dengue infections. Int J Scientif Res. 2016;5(7).
6. Navya BN, Patil S, Kariappa TM. Role of platelet parameters in dengue positive cases-an observational study. Int J Health Sci Res. 2016;6(6):74-8.
7. Joshi AA, Gayathri BR, Gowda RY. The total leucocyte count: its utility in dengue. Int J Adv Med. 2017;5(5):1621-6.

8. Jameel T, Mehmood K, Mujtaba G, Choudhry N, Afzal N, Paul RF. Changing haematological parameters in dengue viral infections. J Ayub Med Coll Abbottabad. 2012;24(1):3-6.
9. Mutheneni SR, Morse AP, Caminade C, Upadhyayula SM. Dengue burden in India: recent trends and importance of climatic parameters. Emerging Microbe Infect. 2017.
10. Chatterjee N, Mukhopadhyay M, Ghosh S, Mondol M, Das C, Patar K. An observational study of dengue fever in a tertiary care hospital of Eastern India. J Assoc Physicians India. 2014;62(3):224-7.
11. Sharma K, Yadav A. Association of mean platelet volume with severity, serology & treatment outcome in dengue fever: prognostic utility. J Clin Diagn Res. 2015;9(11):1-3.
12. Menon D, Sekhar G, Siddharth AR, Sridevi M. Analysis of platelet indices and its correlation with platelet count in dengue. Int J Res Pharm Sci. 2020:284-289.

**Cite this article as:** Passi R, Baviskar BP, Karle RR. Role of platelet parameters and hematological profile in dengue positive cases. Int J Sci Rep 2022;8(1):23-8.