

# Association Between Mean Platelet Volume and Hypertension Incidence

Dr. Shrinivas Kalyanrao Panchal<sup>1</sup>, Dr. Savita Madhav Sonawane<sup>2</sup>,  
Mr. Ravindra Balaji Naktile<sup>3</sup>

<sup>1</sup>Assistant Professor, Pathology, BSP Medical College

<sup>2</sup>Assistant Professor, Pathology, BSP Medical College

<sup>3</sup>Molecularbiologist, Molecular, Detect Diagnostic

## Abstract

**Background:** Hypertension is a major cardiovascular risk factor, and early identification of high-risk individuals is crucial. Mean platelet volume (MPV), a marker of platelet activation, has been associated with vascular dysfunction and hypertension.

**Objective:** To investigate the association between MPV and hypertension incidence among adult participants attending a tertiary care hospital.

**Methods:** A cross-sectional study was conducted on 900 adults aged 18–65 years. Blood pressure was measured according to American Heart Association guidelines, and participants were classified as hypertensive or normotensive. Venous blood samples were analyzed for MPV using an automated hematology analyzer. Demographic and clinical data were recorded. Statistical analysis included descriptive statistics, independent t-tests, and logistic regression to assess the association between MPV and hypertension ( $p < 0.05$ ).

**Results:** Of 900 participants, 310 (34.4%) were hypertensive and 590 (65.6%) normotensive. Hypertensive participants had significantly higher MPV ( $10.2 \pm 1.1$  fL) than normotensives ( $9.1 \pm 0.9$  fL,  $p < 0.001$ ). Elevated MPV ( $>10$  fL) was present in 54.8% of hypertensives versus 10.2% of normotensives. Higher MPV correlated with increased systolic and diastolic blood pressure, supporting platelet activation as a contributor to hypertension.

**Conclusion:** MPV is significantly associated with hypertension and may serve as a simple, cost-effective hematological marker for identifying individuals at increased cardiovascular risk.

**Keywords:** Mean platelet volume, MPV, Hypertension, Platelet activation, Cardiovascular risk

## Introduction

Hypertension is a major public health concern worldwide and a leading risk factor for cardiovascular morbidity and mortality. Early detection of individuals at risk is essential to prevent target organ damage and cardiovascular complications. Platelets play a central role not only in hemostasis but also in the pathophysiology of hypertension and associated vascular damage. Mean platelet volume (MPV), a marker of platelet size and activity, has emerged as a potential indicator of platelet activation and cardiovascular risk.

Recent studies have shown that elevated MPV is associated with increased incidence of hypertension, su-

ggesting that platelet activation may contribute to the development and progression of elevated blood pressure. Gang et al. (2017) reported a significant association between MPV and hypertension incidence, indicating that higher MPV values may predict future hypertensive events [1]. Similarly, Varol et al. (2010) observed that patients with prehypertension and hypertension had significantly higher MPV levels compared to normotensive controls, highlighting MPV as a potential early marker for blood pressure elevation [2].

Furthermore, resistant hypertension, which poses significant therapeutic challenges, has been linked to increased MPV. Akın et al. (2022) demonstrated that patients with resistant hypertension exhibited higher MPV compared to controlled hypertensive and normotensive subjects, suggesting a role for platelet activation in treatment-resistant forms of hypertension [3]. Surgit et al. (2015) confirmed these findings by comparing MPV across resistant, controlled, and normotensive groups, further emphasizing its relevance in hypertension stratification [4]. In addition, MPV has been associated with other cardiovascular risk factors, reinforcing its potential as a simple and cost-effective biomarker in routine clinical practice (Sansanayudh et al., 2016) [5].

Despite these findings, the relationship between MPV and hypertension is not fully elucidated, and population-based data from diverse cohorts are limited. Understanding this association could provide insights into the pathophysiology of hypertension and aid in early identification of individuals at increased cardiovascular risk. Therefore, the present study aimed to investigate the association between MPV and hypertension incidence in adult participants attending a tertiary care hospital, with the goal of assessing MPV as a potential hematological marker for hypertension risk.

### **Methodology:**

This cross-sectional study aimed to investigate the association between mean platelet volume (MPV) and hypertension incidence among adult participants. The study population consisted of individuals aged 18–65 years attending the outpatient department of a tertiary care hospital. The sample size was calculated using the standard formula for estimating a proportion in cross-sectional studies:

$$n = [Z^2 \cdot P \cdot (1-P)] / d^2$$

where  $n$  is the required sample size,  $Z$  is the standard normal deviate corresponding to a 95% confidence interval (1.96),  $P$  is the anticipated prevalence of hypertension in the target population (assumed 25% based on prior studies), and  $d$  is the absolute precision or margin of error (5%). Substituting the values, the minimum sample size was calculated to be 288. Considering potential non-response and incomplete data, a final sample size of 900 participants was targeted to enhance the study's statistical power and reliability.

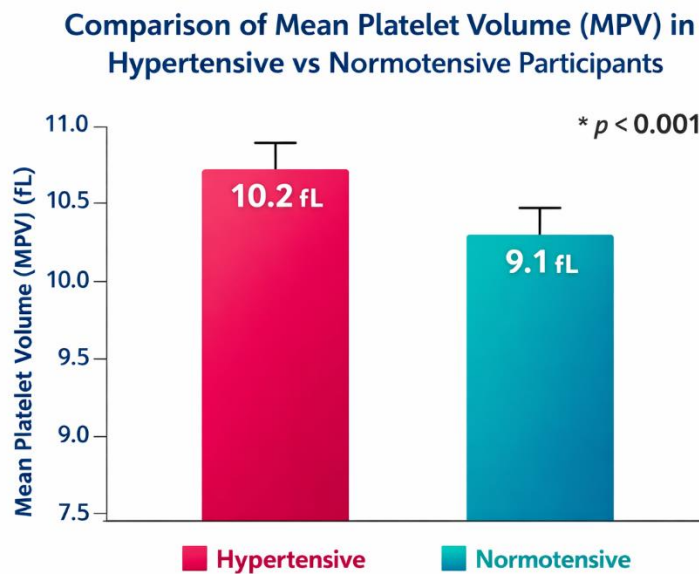
Participants were recruited using convenience sampling, and written informed consent was obtained prior to enrollment. Blood pressure was measured according to the American Heart Association guidelines using a calibrated sphygmomanometer, and participants were classified as hypertensive (systolic BP  $\geq 140$  mmHg or diastolic BP  $\geq 90$  mmHg) or normotensive. Venous blood samples were collected under standardized conditions and analyzed for MPV using an automated hematology analyzer. Demographic data, clinical history, and laboratory results were recorded in a structured proforma. Data analysis included descriptive statistics, independent t-tests to compare MPV between hypertensive and normotensive groups, and logistic regression to assess the association between MPV and hypertension incidence, with a significance level set at  $p < 0.05$ . Ethical approval was obtained from the institutional ethics committee prior to study commencement.

**Results:**

A total of **900 participants** were enrolled, with a mean age of **45.2 ± 12.1 years**; 480 (53.3%) were male and 420 (46.7%) were female. Among them, **310 (34.4%) were hypertensive** and 590 (65.6%) were normotensive. Hypertensive participants showed significantly higher mean **systolic (148.5 ± 9.8 mmHg) and diastolic (92.3 ± 6.5 mmHg) blood pressure** compared to normotensive participants (118.7 ± 7.6 mmHg and 76.4 ± 5.2 mmHg, respectively;  $p < 0.001$ ). The **mean platelet volume (MPV)** was also significantly elevated in the hypertensive group (**10.2 ± 1.1 fL**) versus the normotensive group (**9.1 ± 0.9 fL**,  $p < 0.001$ ), suggesting increased platelet activation in hypertension. The distribution of MPV across hypertensive and normotensive participants is presented in **Table 1**, while **Figure 1** illustrates the comparative mean MPV levels, highlighting a clear increase in hypertensive individuals. Higher MPV (>10 fL) was noted in **54.8% of hypertensive participants** compared to only **10.2% in normotensive participants**, demonstrating a strong association between elevated MPV and hypertension ( $\chi^2=192.4$ ,  $p < 0.001$ ).

**Table 1: Demographics and MPV Distribution**

Parameter	Total (n=900)	Hypertensive (n=310)	Normotensive (n=590)	p-value
Age (years, mean ± SD)	45.2 ± 12.1	50.1 ± 10.2	42.3 ± 11.8	<0.001
Male, n (%)	480 (53.3%)	180 (58.1%)	300 (50.8%)	0.04
Female, n (%)	420 (46.7%)	130 (41.9%)	290 (49.2%)	0.04
SBP (mmHg, mean ± SD)	129.8 ± 17.5	148.5 ± 9.8	118.7 ± 7.6	<0.001
DBP (mmHg, mean ± SD)	82.9 ± 12.1	92.3 ± 6.5	76.4 ± 5.2	<0.001
MPV (fL, mean ± SD)	9.6 ± 1.1	10.2 ± 1.1	9.1 ± 0.9	<0.001



**Figure 1: Comparison of Mean Platelet Volume (MPV) in Hypertensive vs Normotensive Participants**

Bar graph showing mean MPV: Hypertensive = 10.2 fL, Normotensive = 9.1 fL, error bars = SD.

## Discussion

This cross-sectional study evaluated the association between mean platelet volume (MPV) and hypertension in a cohort of 900 adult participants. Our results demonstrate that MPV is significantly higher in hypertensive individuals ( $10.2 \pm 1.1$  fL) compared to normotensive controls ( $9.1 \pm 0.9$  fL,  $p < 0.001$ ), suggesting that platelet activation may play a role in the pathogenesis and progression of hypertension. Additionally, more than half of hypertensive participants had MPV values exceeding 10 fL, compared to only 10.2% in normotensive participants, reinforcing the potential clinical relevance of MPV as a hematological marker for cardiovascular risk.

**Pathophysiological Basis:** Platelets contribute to vascular homeostasis and endothelial function, and their activation is a key factor in thromboinflammatory processes. Elevated MPV reflects larger, metabolically and enzymatically more active platelets with increased prothrombotic potential, which may promote endothelial dysfunction, vascular inflammation, and microvascular remodeling in hypertension. Gang et al. (2017) reported that elevated MPV was associated with increased incidence of hypertension, indicating that platelet hyperactivity may precede or accompany elevated blood pressure [1]. Varol et al. (2010) similarly observed higher MPV in prehypertensive and hypertensive individuals, suggesting that platelet activation begins early in the hypertensive continuum [2].

**Comparison with Previous Studies:** Our findings align with prior studies demonstrating that resistant hypertension is associated with increased MPV. Akin et al. (2022) showed that MPV was higher in patients with resistant hypertension compared to controlled hypertensive and normotensive subjects, implying that platelet activation may contribute to treatment-resistant hypertension [3]. Surgit et al. (2015) reported consistent findings across resistant, controlled, and normotensive groups, highlighting the potential utility of MPV in stratifying hypertensive patients [4]. Sansanayudh et al. (2016) further emphasized that elevated MPV correlates with other cardiovascular risk factors, including obesity, dyslipidemia, and diabetes, underscoring its role as a marker of systemic vascular risk [5].

Yarlioglues et al. (2011) demonstrated a significant association between MPV and subclinical target organ damage in newly diagnosed hypertensive patients, supporting the hypothesis that platelet activation contributes to early vascular injury [6]. Ntaios et al. (2011) observed that hypertension independently predicted elevated MPV in patients with acute ischemic stroke, linking MPV to thrombotic and vascular complications [7]. Karabacak et al. (2014) reported increased MPV in patients experiencing hypertensive crises, suggesting that platelet hyperactivity may exacerbate acute blood pressure elevations and related complications [8]. More recent studies, including Shakeri Shamsi et al. (2024), corroborate these observations by showing a positive correlation between MPV and hypertension in large population cohorts, confirming its reliability as a marker in diverse populations [9]. Elevated MPV has also been reported in patients experiencing hypertensive crises, indicating that platelet activation may exacerbate acute blood pressure elevations and related vascular complications (Karabacak et al., 2014)[10]. Xu and Guo (2023) applied Mendelian randomization analysis and highlighted a potential causal relationship between platelet indices, including MPV, and blood pressure regulation [11].

**Clinical Implications:** The significant elevation of MPV in hypertensive participants suggests that MPV can serve as a simple, inexpensive, and readily available marker to identify individuals at higher cardiovascular risk. Monitoring MPV may help clinicians detect early vascular changes and implement timely preventive strategies. Furthermore, the correlation between MPV and blood pressure supports the inclusion of platelet indices in the routine assessment of hypertensive patients, particularly those with resistant hypertension or target organ involvement.

**Limitations and Future Directions:** Being a cross-sectional study, causality cannot be established. MPV measurements may be influenced by pre-analytical variables, such as time to sample processing. Future prospective studies should explore the longitudinal relationship between MPV and incident hypertension, evaluate its predictive value for cardiovascular outcomes, and investigate potential interventions targeting platelet activation in hypertensive populations.

### Conclusion:

This study demonstrates a strong association between elevated MPV and hypertension, reinforcing the role of platelet activation in the pathophysiology of elevated blood pressure. MPV may serve as a cost-effective marker for identifying high-risk individuals, guiding early preventive interventions, and informing clinical decision-making in hypertension management.

### Reference's

1. Gang L, Yanyan Z, Zhongwei Z, Juan D. Association between mean platelet volume and hypertension incidence. *Hypertens Res.* 2017 Aug;40(8):779-784. doi: 10.1038/hr.2017.30. Epub 2017 Mar 9. PMID: 28275234.
2. Varol E, Akcay S, Icli A, Yucel H, Ozkan E, Erdogan D, Ozaydin M. Mean platelet volume in patients with prehypertension and hypertension. *Clin Hemorheol Microcirc.* 2010;45(1):67-72. doi: 10.3233/CH-2010-1327. PMID: 20571231.
3. Akın H, Bilge Ö, Yavuz B, Özkan S, Işık F. The relationship between mean platelet volume and resistant hypertension. *Clin Exp Hypertens.* 2022 Apr 3;44(3):228-232. doi: 10.1080/10641963.2021.2022686. Epub 2022 Jan 3. PMID: 34974786.
4. Surgit O, Pusuroglu H, Erturk M, Akgul O, Buturak A, Akkaya E, Gul M, Uygur B, Yazan S, Eksik A. Assessment of Mean Platelet Volume in Patients with Resistant Hypertension, Controlled Hypertension and Normotensives. *Eurasian J Med.* 2015 Jun;47(2):79-84. doi: 10.5152/eurasianjmed.2015.43. PMID: 26180490; PMCID: PMC4494555.
5. Sansanayudh N, Muntham D, Yamwong S, Sritara P, Akrawichien T, Thakkinstian A. The association between mean platelet volume and cardiovascular risk factors. *Eur J Intern Med.* 2016 May;30:37-42. doi: 10.1016/j.ejim.2015.11.028. Epub 2016 Jan 6. PMID: 26777606.
6. Yarlioglues M, Kaya MG, Ardic I, Dogdu O, Kasapkara HA, Gunturk E, Akpek M, Kalay N, Dogan A, Ozdogru I, Oguzhan A. Relationship between mean platelet volume levels and subclinical target organ damage in newly diagnosed hypertensive patients. *Blood Press.* 2011 Apr;20(2):92-7. doi: 10.3109/08037051.2010.532317. Epub 2010 Nov 24. PMID: 21105760.
7. Ntaios G, Gurer O, Faouzi M, Aubert C, Michel P. Hypertension is an independent predictor of mean platelet volume in patients with acute ischaemic stroke. *Intern Med J.* 2011 Sep;41(9):691-5. doi: 10.1111/j.1445-5994.2009.02162.x. PMID: 21899682.
8. Karabacak M, Dogan A, Turkdogan AK, Kapci M, Duman A, Akpinar O. Mean platelet volume is increased in patients with hypertensive crises. *Platelets.* 2014;25(6):423-6. doi: 10.3109/09537104.2013.830181. Epub 2013 Oct 8. PMID: 24102343.
9. Shakeri Shamsi F, Taheri Soodejani M. Platelet Indices and Hypertension: Results from Shahedieh Cohort Study, Yazd, Iran. *Int J Hypertens.* 2024 Feb 13;2024:3705771. doi: 10.1155/2024/3705771. PMID: 39220598; PMCID: PMC11364473.

10. Karabacak M, Dogan A, Turkdogan AK, Kapci M, Duman A, Akpinar O. Mean platelet volume is increased in patients with hypertensive crises. *Platelets*. 2014;25(6):423-6. doi: 10.3109/09537104.2013.830181. Epub 2013 Oct 8. PMID: 24102343.
11. Xu Y, Guo Y. Platelet indices and blood pressure: a multivariable mendelian randomization study. *Thromb J*. 2023 Mar 20;21(1):31. doi: 10.1186/s12959-023-00475-6. PMID: 36941692; PMCID: PMC10026509.