

# The association between second Trimester Preeclampsia and mean platelet volume. A Cross-Sectional Statistical Retrospective Study.

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## ABSTRACT:

**Objective:** To find association between preeclampsia occurring during 2<sup>nd</sup> trimester of pregnancy and mean platelet volume.

**Methodology:** To conduct this retrospective case-control study 200 pregnant female patients were recruited from February 2024 to June 2024. We included 140 were normotensive patients and 40 patients. with the criteria of preeclampsia. We obtained a second trimester (14 weeks to 26 weeks) complete blood count for all the patients for mean platelet volume observation.

**Results:** The participants with raised MPV during second trimester of pregnancy had a higher incidence of Preeclampsia than the normal population with normal MPV, with a significant statistical value (P-value 0.0001).

**Conclusion:** The results of our research indicate that patients exhibiting elevated mean platelet volume during the second trimester are more likely to develop preeclampsia later compared to those with normal mean platelet volume.

**Keywords:** Preeclampsia, Platelet Parameters, Platelet Count, Mean Platelet Volume.

## Introduction:

Preeclampsia is a serious condition characterized by the involvement of multiple organ systems, typically manifesting after the 20<sup>th</sup> week of pregnancy with a sustained elevation of blood pressure. Uncontrolled hypertension during pregnancy can lead to a range of serious complications, including eclampsia, pulmonary oedema, cerebral haemorrhage, labor difficulties, miscarriages, and the formation of emboli. If not managed promptly, it may progress to the life-threatening HELLP syndrome (Haemolysis, Elevated Liver Enzyme and Low Platelets), which is characterized by thrombocytopenia, elevated liver enzymes, and haemolysis. Preeclampsia is associated with several severe maternal complications, such as stroke, myocardial infarction, acute renal failure, liver dysfunction, disseminated intravascular coagulation (DIC), and thrombocytopenia. Additionally, it poses risks to foetal health, resulting in outcomes such as low birth weight for gestational age, restricted foetal growth, and stillbirth.<sup>1</sup> In simple words preeclampsia may be define as raised blood pressure (exceeding 140/90) along with proteinuria in previously normotensive patient. Uncontrolled hypertension during pregnancy can lead to a range of serious complications, including eclampsia, pulmonary oedema, cerebral haemorrhage, labor difficulties, miscarriages, and the formation of emboli. Hypertension is classified into two distinct categories based on its aetiolo-

gy: placenta-related preeclampsia, which arises before 34 weeks of gestation due to placental abnormalities, and maternal-related preeclampsia, which occurs after 34 weeks and is linked to pre-existing maternal health issues. Histological examination of the placenta in cases of maternal-related preeclampsia often reveals extensive ischemic regions and partially occluded arteries.<sup>2</sup> Notable risk factors contributing to the onset of preeclampsia include deficiency of vitamin D and serum calcium, obesity, type 2 diabetes mellitus, hypertension, and malnutrition.<sup>3</sup> Uncontrolled hypertension during pregnancy can lead to a range of serious complications, including Eclampsia, pulmonary oedema, cerebral haemorrhage, labor difficulties, miscarriages, and the formation of emboli. If not managed promptly, it may progress to the life-threatening HELLP syndrome, which is characterized by thrombocytopenia, elevated liver enzymes, and haemolysis.<sup>4</sup> Preeclampsia is associated with several severe maternal complications, such as stroke, myocardial infarction, acute renal failure, liver dysfunction, disseminated intravascular coagulation (DIC), and thrombocytopenia.<sup>5</sup> Additionally, it poses risks to foetal health, resulting in outcomes such as low birth weight for gestational age, restricted foetal growth, and stillbirth.<sup>6</sup> The World Health Organization estimates that the global incidence of preeclampsia ranges from 2% to 10%, while studies conducted in various regions of Pakistan suggest that this rate is approximately 5%.<sup>7</sup> The primary factor contributing to the onset of preeclampsia is the placenta. The disruption of the endothelium severely impacts the production of nitric oxide, resulting in increased vasoconstriction and elevated peripheral resistance.<sup>8</sup> Impaired and dysfunctional endothelium results in a reduction of nitric oxide and prostacyclin synthesis. This decrease triggers the generation of activating signals for platelets. Upon activation, platelets exhibit a significant increase in p-selection molecules on their surface, which facilitates the activation of neutrophils and monocytes upon binding, initiating a cascade of inflammatory processes.<sup>9</sup> The inadequate invasion of trophoblastic cells into the uterine endometrium obstructs the remodelling of uterine blood vessels, resulting in their persistent constriction. This condition induces turbulent blood

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flow, which contributes to elevated vascular resistance, placental ischemia, and changes in blood vessel permeability, ultimately harming the endothelial lining of several sensitive organs. Consequently, platelets are drawn to the injured endothelium and are depleted, leading to a reduction in platelet count. This triggers the production of new, highly active, and larger platelets, resulting in an increased mean platelet volume.<sup>10</sup> MPV serves as an effective, non-invasive, and cost-efficient biomarker for the early detection and assessment of the onset and severity of pregnancy-induced hypertension and preeclampsia.<sup>11</sup> During the second to eight weeks of gestation, the platelets become activated and begin to accumulate inside the placenta which causes development of preeclampsia.<sup>12</sup> Platelets serve as an essential cellular element within the blood, playing a crucial role in haemostasis by forming a platelet plug at the location of vascular damage. Typically, blood contains both large and small platelets; however, during instances of vascular injury, these platelets are drawn to the affected area and subsequently consumed. This process stimulates increased production of thrombocytes in the bone marrow, leading to the release of larger platelets characterized by a higher mean platelet volume (MPV). These larger platelets exhibit greater reactivity and are more effective pro-coagulants compared to their smaller counterparts.<sup>13</sup> Studies revealed that there is a potential decrease in the concentration of platelet activating factor (PAF) inhibitors resulting in activation of platelets and secretion of thromboxane in blood. Thromboxane stimulates vasoconstriction and enhances platelets clumping and destruction this causes generation of a positive drive for platelets production which would be larger and more reactive.<sup>14</sup>

#### Objective:

To investigate any relationship between mean platelet volume and occurrence of preeclampsia.

#### Methodology:

This retrospective comparative study conducted at Muhammad medical college Hospital (MMCH) Mirpurkhas from February 2024 to June 2024 with a beforehand approval from institute's ethical committee via letter no: MMC/361. Data of 220 pregnant females, aged between 20 to 35 years were retrieved from MMCH gynaecology department from their antenatal records. During study period 60 female subjects were diagnosed as having pre-eclampsia (BP more than 140/90mmHg measured on 2 occasions at least 4 hours apart and protein in urine more than 300 milligram per day after 20 weeks of gestation in previously normotensive patients) whereas 140 female subjects were having normal blood pressure and urine output with protein of normal physiological limit were considered as control. Second trimester complete blood count was performed and haemoglobin, platelet count and mean platelet volume was recorded. For CBC at MMCH we used Mindray BC 6800 plus auto analyser (Mindray Bio-Medical Electronics Co), that uses laser and impedance measurement technique for automatic blood counting.

#### Results:

The average age of participants in the control group was  $27.72 \pm 5.468$  years, while the case group had an average age of  $27.93 \pm 5.230$  years, showing statistically no difference ( $p=0.8131$ ) between the groups as shown in table no 1. The mean Body Mass Index (BMI) among subjects from

control group was  $21.62 \pm 3.035$ , and it was  $20.98 \pm 3.098$  in the case group ( $p=0.2432$ ). However, the systolic blood pressure was significantly higher in the case group, with an average of  $146.5 \pm 6.345$  mmHg when compared to  $102.8 \pm 8.628$  mmHg in the control group and the difference was statistically highly significant ( $p < 0.0001$ ). Similarly, the diastolic blood pressure was also elevated in the case group, averaging  $97.95 \pm 8.800$  mmHg when compared to  $72.10 \pm 5.368$  mmHg in the control group ( $p < 0.0001$ ). Additionally, the Mean Platelet Volume (MPV) was significantly higher in the case group, with an average of  $11.83 \pm 2.139$  as compared to  $9.560 \pm 1.490$  in the control group ( $p < 0.0001$ ). These findings suggest significant differences in blood pressure and MPV between the case and control groups.

**Table 1 Demographic data of participants.**

Parameters	Control (n=140)	Cases (n=40)	p value (t-test)
Age (years)	$27.72 \pm 5.468$ (0.4621)	$27.93 \pm 5.230$ (0.8269)	0.8131
BMI (kg/m <sup>2</sup> )	$21.62 \pm 3.035$ (0.2565)	$20.98 \pm 3.098$ (0.4898)	0.2432
Systolic BP mmHg	$102.8 \pm 8.628$ (0.7292)	$146.5 \pm 6.345$ (1.003)	< 0.0001
Diastolic BP mmHg	$72.10 \pm 5.368$ (0.4536)	$97.95 \pm 8.800$ (1.391)	< 0.0001
Mean Platelet volume	$9.560 \pm 1.490$ (0.1259)	$11.83 \pm 2.139$ (0.3382)	< 0.0001

During current study, patients in both control and cases groups shows raised MPV as well as normal MPV. Among 220 study participants, 140 showed normal MPV value while raised MPV was observed in 80 patients. Among those who showed evidence of preeclampsia 33.33% (n=20) were having normal MPV while 66.67% (n=40) were having raised MPV. On the other hand, those who did not showed any evidence of eclampsia (n=140), 75% (n=120) were having MPV within normal limit and 25% (n=40) showed raised MPV as shown in table no 2.

**Table 2: MPV in pre-eclamptic and normotensive patients.**

Participants	Normal level of MPV (<12.0 fl)	Raised MPV (>10.0fl)	p value
Participants with pre-eclampsia	20(33.33%)	40 (66.67%)	0.0001
Participants without pre-eclampsia	120(75.00%)	40 (25.00%)	
Total	140	80	

#### Discussion:

The results of the research indicate that the participant group comprised 220 individuals. Among these, 20 individuals displayed a normal mean platelet volume (MPV) in conjunction with pre-eclampsia, while 40 individuals showed an increased MPV alongside pre-eclampsia. Furthermore, 120 participants did not experience any episodes of pre-eclampsia, and an additional 40 individuals

with elevated MPV also did not develop pre-eclampsia, difference was statistically significant ( $p=0.0001$ ); this finding is in agreement with published studies. Several studies reinforce these conclusions, including those conducted by Jasim Alhusaynei et al.<sup>15</sup> and Tünde Montgomery et al.<sup>16</sup>, reported a significant association between elevated MPV and the incidence of pre-eclampsia, with a P-value of less than 0.05. In their research, Ali El-Shabrawy Ali and colleagues revealed that participants in the study group who experienced an episode of preeclampsia had a notably higher mean platelet volume (MPV) compared to those in the control group, with a mean difference of approximately 1.2 fL ( $P < 0.05$ ). Additionally, the odds ratio of 2.45 suggested that the probability of developing pre-eclampsia was 2.45 times higher in the study group. Furthermore, it has also been shown that MPV values may serve as an early predictor of pre-eclampsia, demonstrating a specificity of 65% and sensitivity of 75%, while also highlighting a significant correlation between the severity of pre-eclampsia and elevated MPV levels.<sup>18</sup> P. I. and colleagues have also indicated that mean platelet volume (MPV) serves as a crucial marker for the early detection of pre-eclampsia, demonstrating a sensitivity of 78% and a specificity of 60%.<sup>19</sup> Ciobanu AM and colleagues identified variations in platelet counts during pregnancies affected by conditions such as pre-eclampsia, reporting that the mean platelet volume (MPV) in these patients rose to 11.1 fL, with a P-value of 0.004.<sup>20</sup> Similarly, Sachan, Rekha, and others noted that patients exhibiting elevated MPV levels were more likely to have pre-eclampsia compared to the control group.<sup>21</sup> However, contrasting findings were reported by another research group. Papiahmadi et al. observed no significant correlation between MPV levels and pre-eclampsia, with a P-value of 0.75.<sup>22</sup> Additionally, Hayuningsih et al. found no significant association between these two factors, reporting a P-value of 0.80.<sup>23</sup> Furthermore, Selçuk, S. and associates demonstrated that MPV values were comparable between preeclamptic mothers and the control group, with a P-value of 0.08, indicating that MPV is not a reliable marker for the early detection of preeclampsia.<sup>24</sup>

#### Conclusion:

The raised MPV during pregnancy particularly during 2<sup>nd</sup> trimester is risk factor for the preeclampsia. The current study also warrant, further studies to identify cut off value of MPV in predicting preeclampsia.

#### Limitations:

There are certain limitations to this study. First, it was a cross sectional study, Secondly, the sample size was small, Thirdly, this study was conducted in one hospital, so the results cannot be applied to the whole population and Fourthly, the presence of confounding variables.

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