

## Preeclampsia Prediction using Platelet and Platelet Indices in the Second and Third Trimester

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### Abstract

Preeclampsia is a hypertension condition that causes liver and kidney damage during pregnancy. Salahadeen General Hospital/Gynecology and Obstetrics department performed a case-control research from November 1, 2022, to May 30, 2023, to determine platelet and platelet indices in pregnant women with preeclampsia in the second and third trimesters. The research comprised 120 singleton pregnant women with live fetuses at 20 weeks or older. 60 pregnant women were preeclamptic, whereas the other 60 were healthy and normotensive (control group). Systolic and diastolic blood pressure values determined preeclampsia severity. Platelet count, mean platelet volume, distribution breadth, and ratio were measured in blood samples. The preeclampsia and control groups had similar age, gestational age, parity, and BMI. . However, there were significant differences in systolic and diastolic blood pressure between the two groups. The study showed that the lowest mean of platelet count ( $149.30 \pm 35.52$  platelet $\times 10^3/L$ ) as compared with the control group ( $263.67 \pm 41.12$  platelet $\times 10^3/L$ ). Platelet distribution width (PDW) was also reduced in Pre-eclampsia ( $17.13 \pm 5.37$  fl) and the highest mean was in the control group ( $17.67 \pm 6.09$  fl). The study also showed that Mean platelet value was elevated in women with Pre-eclampsia while Platelet count to Mean platelet volume ratio was reduced in Pre-eclampsia. The study showed the mean of Platelet count and Platelet distribution width were reduced in the severe cases of preeclamptic pregnant women as compared with mild preeclamptic women while the highest mean of MPV was in severe preeclamptic women. The study showed the mean of Platelet count, Platelet distribution width (PDW) and Platelet/MPV ratio were decreased significantly in preeclamptic pregnant women in 3rd trimester of pregnancy as compared with women in the 2nd trimester. While Mean platelet value was elevated preeclamptic pregnant women in 3rd trimester of pregnancy as compared with women in the 2nd trimester. It was concluded that women with pre-eclampsia had a significantly lower mean platelet count, platelet distribution width and Platelet count to Mean platelet volume especially in severe cases and 3rd trimester of pregnancy while mean platelet value in women was elevated.

**Keywords:** Platelet; Platelet Indices; Pregnant Women; Preeclampsia

### Quick Points:

- Platelet counts were significantly higher on average in the pre-eclamptic women compared to the women in the control group.
- The platelet count may be an essential indication for pre-eclampsia and may be able to discriminate between instances that are moderate and those that are severe. It is possible that it will give further insights into the severity of the illness and help in the process of risk classification.

## Introduction

Pre-eclampsia happens in between 2% and 8% of all pregnancies around the world (1). Pre-eclampsia is a condition that only happens during pregnancy. It is currently classified as having blood pressure that is higher than 140 mmHg systolic and/or 90 mmHg diastolic and proteinuria that is more than 0.3mg per day after 20+0 weeks of gestation. Pre-eclampsia, on the other hand, could include a wide range of other signs and symptoms. Both pre-eclampsia and the problems it causes make it more likely for mothers and their babies to get sick or die. When a woman gets pregnant, the problems don't go away. If she has pre-eclampsia, she risks getting long-term problems like high blood pressure, stroke, and ischemic heart disease (2). Pre-eclampsia is a condition that affects many parts of the body at once. Even though the exact cause of pre-eclampsia is still unknown, more is known about how it happens and how to treat it. In the first few weeks of pregnancy, problems with the placenta that could lead to clinical pre-eclampsia start to show up.

In people with pre-eclampsia, the placental spiral arteries don't change the way they should. The decidua cytotrophoblast invasion is small and only affects the top layer of the decidua. Also, the myometrial parts of the spiral arteries stay narrow and have a lot of resistance (3,4). The first stage of pre-eclampsia is not enough placentation. The second stage is endothelial damage, which happens after the first stage. The symptoms of pre-eclampsia are caused by endothelial dysfunction, which is caused by antiangiogenic factors, systemic inflammation, immunologic factors, and hypoxia. All of these things contribute to the development of this diverse disease (6). This problem causes the blood vessels to narrow, the blood flow to organs to slow down, and the blood vessels to leak more (7).

Even though many people have tried, no one knows for sure what causes preeclampsia. On the other hand, a new study shows that the likely cause of the problem is a problem with the process of placentation, which is caused by a mix of genetic and epigenetic factors. One of the signs of preeclampsia is a change in the hemostatic balance. Endothelial dysfunction may be a cause of this change (8). The World Health Organization (WHO) says that direction is the process of putting together current research-based information to give doctors more information about preeclampsia (9).

Over the past 10 years, many studies have been done to try to find a clinically useful test for preeclampsia. However, some of the recently discovered biochemical markers for predicting preeclampsia are still being looked into. It is not clear if these results can be used in hospitals with limited resources or not (10). Platelet (PLT) indices are an interesting potential marker for evaluation because they are easy to do and are often done in clinical labs. Because of this, they are both cheap and easy to get (11). Even though there is evidence that PLT activity is linked to preeclampsia, these tests have not yet been used to their full potential in our environment to diagnose patients. Even though this condition has been linked to PLT activity, this is still the case. Surprisingly, only about 10% of doctors in Ethiopia use the Mean Platelet Volume (MPV) and the Platelet Distribution Width (PDW) in their practice, even though they can help with therapy. Studies done in Ethiopia show that this is the case (12,13). The research intended to clarify the significance of platelet and platelet indices in the second and third trimester in pregnant women with preeclampsia .

## Patients and Methods

A case-control study was done at Salahadeen General Hospital's Gynecology and Obstetrics department from November 1, 2022, to May 30, 2023. 120 pregnant women with one child who were at least 20 weeks along in their pregnancies and whose fetuses were still alive took part in the study. There were two different groups in the sample:

Sixty pregnant women who had been diagnosed with either preeclampsia or eclampsia took part in this study.

This group was made up of sixty pregnant women who were in good health, had normal blood pressure, and didn't have any protein in their urine when they used a dipstick.

**Exclusion criteria:** women who are pregnant and have a long-term illness like high blood pressure, diabetes, chronic kidney disease, liver disease, heart disease, thyroid disease or another endocrine illness, or cancer.

Abnormalities that are important for the mother or the baby, such as a hydatidiform mole, an abrupt placenta, or a placenta that is sticking together. When a woman is pregnant and has a history of smoking or using drugs that could affect her blood pressure, she should see a doctor.

Clearance on all moral issues

The research proposal was given the green light by the council of the College of Medicine at Tikrit University.

The project was given the green light for the Salah Al-Din Health Directorate and Salah Al-Din General Hospital to move forward.

The interview with these patients was done by the researcher with the help of a questionnaire form. The form had questions about the patients' ages, weights, heights, and other personal information.

The number of international review board approval (IRB approval) was 5C / 842 In 13/ 10/ 2022( see in appendix-1 ).

## Methods

In this study, the participants' ages, weights, parities, places of birth, places of residence, and socioeconomic status were all written down. The auscultatory method was used to measure each participant's blood pressure while they were sitting comfortably. Hypertension was defined as a diastolic blood pressure of 90 mm Hg or higher at least twice, with at least four hours between each reading, or once.

Based on the systolic and diastolic blood pressure readings, the cases of preeclampsia were further put into three groups: mild, moderate, and severe. When the systolic blood pressure was over 160 mm Hg and the diastolic blood pressure was over 110 mm Hg, this was called severe preeclampsia. When the systolic blood pressure was between 140 and 160 mm Hg and the diastolic blood pressure was between 90 and 110 mm Hg, these were considered mild cases.

With an anticoagulant, blood samples were taken and put into test tubes to figure out the complete blood count (CBC) and platelet indices. Platelet count, mean platelet volume, platelet distribution width, and the ratio of platelet count to mean platelet volume were all part of these platelet indices. The Sysmex model K-1000, a fully automated quantitative hematology analyzer, was used to do the complete blood count (CBC).

At each visit, the participants' weight and blood pressure were measured, and a CBC was done on the first of every month for 20 to 40 weeks. This all-around approach made it possible to get a

good look at the platelet parameters and how they might be related to preeclampsia in the pregnant women who were studied.

### **Statistical Analysis:**

The data were looked at with version 21.0 of SPSS for Windows. Normality checks were done on the continuous variables, and the Student's t-test was used to compare the differences between cases and controls when the data were normally distributed. The Mann-Whitney U-test was used on strangely distributed data. In a binary regression analysis, pre-eclampsia was the dependent variable, and medical, obstetric, and platelet indices were the independent factors. With a P value of 0.05, the statistical significance was found.

### **Results**

There was no discernible difference, statistically speaking, between the two groups in terms of their fundamental traits. To be more specific, the fundamental parameters that you specified are age, gestational age, parity, and body mass index (BMI), with Table 1 serving as the primary reference for this data.

As shown in Table 2. There results of a study stating that there was a significant difference in systolic and diastolic blood pressure between preeclampsia women and the control group,  $P < 0.05$ ).

The study showed that the lowest mean of platelet count ( $149.30 \pm 35.52$  platelet $\times 10^3/L$ ) as compared with the control group ( $263.67 \pm 41.12$  platelet $\times 10^3/L$ ). Platelet distribution width (PDW) was also reduced in Pre-eclampsia ( $17.13 \pm 5.37$  fl) and the highest mean was in the control group ( $17.67 \pm 6.09$  fl). The study also showed that Mean platelet value was elevated in women with Pre-eclampsia while Platelet count to Mean platelet volume (PLT/MPV) ratio was reduced in Pre-eclampsia, Table 3

### **Discussion**

The findings of a study that indicated a substantial difference in systolic and diastolic blood pressure for both preeclamptic women and the control group are notable and may have major therapeutic consequences. The study was carried out on pregnant women. The study compared women who acquired preeclampsia during pregnancy with women who did not develop the disease. Preeclampsia is a disorder that can occur during pregnancy and is characterized by high blood pressure as well as damage to organs, most commonly the liver and the kidneys. Damage to the fetus can occur as early as the first trimester in some cases (14).

Recognizing and treating high blood pressure in pregnant women is the best way to prevent complications associated with preeclampsia, such as premature birth, fetal growth restriction, and maternal morbidity and mortality. These complications can be avoided by recognizing and treating high blood pressure. Protein in the urine is one of the telltale signs of preeclampsia, which is also associated with high blood pressure (15). Platelets are an essential component of blood that play a crucial role in the process of hemostasis, which is the procedure that involves putting an end to bleeding following an injury. Platelets are also an important part of the blood clotting process. Platelet count and function may be influenced in pre-eclampsia, a disorder that develops during pregnancy and is characterized by high blood pressure and damage to organs. Pre-eclampsia can have an effect on both the number of platelets and their ability to function. The outcomes of the research that were shown previously in the article provide evidence for this assertion (16,17). It is consistent with the findings of other studies that have found comparable

findings for there to be a significantly lower mean platelet count in the pre-eclampsia group when compared to the findings of the control group. These studies have found that pre-eclampsia patients have significantly lower platelet counts than those who do not have the condition (18,19).

This demonstrates that pre-eclampsia may be connected with a decline in platelet count, which may contribute to the increased risk of bleeding as well as the bad outcomes that are associated with the sickness. In addition, pre-eclampsia has been linked to an increased chance of giving birth to the baby too soon (7). Platelet distribution width (PDW) was found to be lower in the pre-eclampsia group when compared to the control group. This finding may suggest that the platelets found in pre-eclamptic women are different in size or shape from those found in women who do not have pre-eclampsia. As a consequence of this, they may be less successful in preserving hemostasis, which may in turn increase the risk of bleeding that is associated with preeclampsia (58). Another study came to the conclusion that there were no significant differences between preeclampsia patients and healthy pregnant women. The findings of this study, on the other hand, directly contradict those of the other study (20). The fact that this group's mean platelet value and PLT/MPV ratio were both lower is further evidence that platelet function is compromised in pre-eclampsia. Pre-eclampsia is characterized by an increase in the risk of complications during pregnancy. Platelet activation and function can be evaluated using the PLT/MPV ratio, whereas the mean platelet value provides information regarding the size and density of platelets. Both of these effects are brought about by the platelets themselves. Platelets in pre-eclamptic women have a lower mean platelet value, and their PLT/MPV ratio is also lower, which suggests that platelets in these women may be less effective at preventing bleeding and promoting clotting. This may be due to the fact that pre-eclamptic women have, on average, less platelets in their blood (21,22).

Preeclampsia is a syndrome that is becoming more prevalent during pregnancy. It is being investigated as a potential marker for the prediction of MPV due to the fact that it is easily detectable during a full blood count and signals indirect platelet reactivity. According to the findings of our research, preeclamptic pregnancy was associated with an MPV value that was significantly and statistically elevated over that of normotensive pregnancy (23,24). As a result of stimulating platelet creation in the bone marrow, which reflects a rise in MPV values, the MPV values of younger and larger platelets have grown. This has led to an overall increase in MPV values. The number of platelets in the blood decreases as the number of platelets that are destroyed increases. According to the findings of these studies, the production of microtrombuses comes before the formation of macrotrombuses and is the consequence of a chain reaction that begins with the endothelial injury that occurs in preeclampsia and disturbs the microcirculation. It was shown that the MPV was high in many cases of vascular risk, such as diabetes mellitus, hypercholesterolemia, and acute myocardial infarction. Despite the fact that these illnesses were not connected to thrombocytopenia, it was discovered that the MPV was high in these situations (25). Platelets and injured endothelial cells may interact in a way that disrupts the normal coagulation process in preeclampsia patients. This can cause abnormally high blood pressure. On the other hand, it is possible that big platelets that are also metabolically active play a special role in the pathophysiology of preeclampsia (26,27,28).

## Conclusions

- Platelet distribution width, mean platelet count, and the ratio of platelet count to mean platelet volume (PLT/MPV) were all considerably lower in women who were diagnosed with pre-eclampsia compared to women who were in the control group.

- According to the findings of the research, women who have pre-eclampsia may experience either a reduction in the number of platelets they produce or an increase in the number of platelets they consume as their pregnancies develop.
- Platelet counts were significantly higher on average in the pre-eclamptic women compared to the women in the control group.
- Platelet count to mean platelet volume (PLT/MPV) ratio was lower in severe instances of preeclamptic pregnant women compared to mild cases of preeclamptic pregnant women. Platelet distribution width was also smaller in severe cases of preeclamptic pregnant women.
- The platelet count may be an essential indication for pre-eclampsia and may be able to discriminate between instances that are moderate and those that are severe. It is possible that it will give further insights into the severity of the illness and help in the process of risk classification.

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**Tables :**

**Table(1):** Characteristics of women with preeclampsia and the control groups

Parameters	Women with preeclampsia (n:60)	Control group (n:60)	P-value
Age (years)	28.91±5.8	28.91±5.8	0.41
Parity	2.4±1.3	30.6 ± 3.1	0.17
Gestational age, weeks	30.6 ± 3.1	31.4 ± 3.1	0.61
Body mass index, kg/m <sup>2</sup>	29.6 ± 4.1	28.46 ± 4.7	0.83

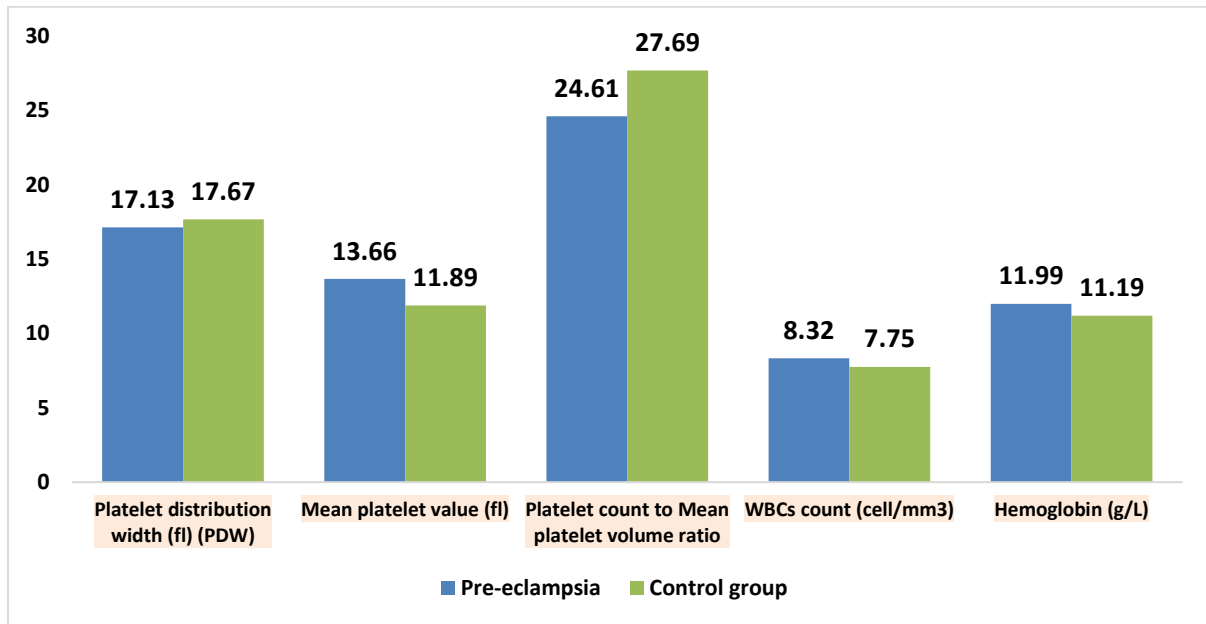
**Table(2):** Differences in the blood pressure levels in the studied groups

Parameters (Mean±SD)	Pre-eclampsia	Control group	P-value
Mean 24 h SBP, mm Hg	149.5±11.4*	109.1±9.15	0.001
Mean 24 h DBP, mm Hg	95.44±11.6*	70.15±7.66	0.001
Maximal SBP, mm Hg	179.3±22.3*	118.4±8.27	0.001
Maximal DBP, mm Hg	118.5±12.5*	76.7±13.3	0.001

**Table(3):** Differences between cases and control reading platelets indices and hematological parameters

Variable Mean±SD	Pre-eclampsia	Control group	P-value
Platelet count (platelet×10 <sup>3</sup> /L)	149.30±35.52	263.67±41.12	0.001
Platelet distribution width (fl) (PDW)	17.13±5.37	17.67±6.09	0.034
Mean platelet value (fl)	13.66±4.21	11.89±3.73	0.011
Platelet count to Mean platelet volume ratio	24.61±10.13	27.69±9.23	0.013
WBCs count (cell/mm <sup>3</sup> )	8.32±2.5	7.75±2.1	0.087
Hemoglobin (g/L)	11.99±1.12	11.19±1.7	0.13





**Figure 1:** Differences between cases and control reading platelets indices and hematological parameters

**Appendix-1** : international review board approval

Republic Of Iraq  
Ministry of Higher Education and  
Scientific Research  
Tikrit University  
College of Medicine  
Graduate Studies Division



جمهورية العراق  
وزارة التعليم العالي والبحث العلمي  
جامعة تكريت  
كلية الطب  
شعبة الدراسات العليا

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التاريخ: ٢٠٢٢/١١/٢٠

العدد: ٢٠٢ / ٢٠٢٢

أمر إداري

- إشارة إلى محضر الجلسة الثانية لمجلس الكلية للعام الدراسي ٢٠٢٢ - ٢٠٢٣ والمتعددة بتاريخ ٢٠٢٢/١٠/١٠ ومصادقة أمانة مجلس الجامعة بكتابهم المرقم ٥ / س / ٨٤٢ في ٢٠٢٢/١٠/١٣ واستناداً إلى الصلاحيات المخولة لنا تقرر:-  
إقرار بحث طلبية الدكتور / فرح النسائية والتوليد

اسم الباحث	الدرجة	الاستشار	موضوع البحث	مترقب
ميسلون احمد عطير	الدبلوم العالي	النسائية والتوليد	التشخيص بالموجات فوق الصوتية لتكدي اعضاء العوض في مستشفى صلاح الدين العام	د. ابراهيم هاشم عبدالكريم
فرح صبحي جليل	الدبلوم العالي	النسائية والتوليد	البيلة الجرثومية حادمة الاعراض والمفراج التوليدية بعد العلاج في بداية الحمل مقلل اولغزة	د. د. مصرية رشاد حسين
حنين عبدالعزیز	الدبلوم العالي	النسائية والتوليد	تأثير العشرة الدموية تحت المشيمة على سير العمل عند النساء المصابات بالأمراض المتكررة	د. مصرية رشاد حسين
المبار هاشم صبري	الدبلوم العالي	النسائية والتوليد	مستوى الهرمون السحابة الموار (تحليل مطرون العيوض) في متلازمة العيوض متعدد الاكسين وارتفاع نسبة كرات الدم الحمراء	د. م. م. مصرية رشاد حسين
رواه خالد خلف	الدبلوم العالي	النسائية والتوليد	مزايا الشفاء من اكرم بينا سلفوسايرول بالمقارنة مع زيت اللافندر الأساسي في جرح بعض الفرج	د. د. مصرية رشاد حسين
رشاد مزلحم سعاده	الدبلوم العالي	النسائية والتوليد	المطاهر السريعة تعلم الامراض الجيوب الانفية خلال العمل	د. د. مصرية رشاد حسين
نور فكري حازي	الدبلوم العالي	النسائية والتوليد	تأثير الارجوسايرول أثناء فترة الحمل في الوقاية والحماية من الولادة المتكررة	د. د. مصرية رشاد حسين
جنان كريم عود	الدبلوم العالي	النسائية والتوليد	قيمة الصفائح الدموية ومؤشرات الصفائح الدموية في الثلث الثاني والثالث من الحمل عند النساء الحوامل المصابات بتسمم الحمل	د. د. مصرية رشاد حسين
بان عبدالجبار سلمان	الدبلوم العالي	النسائية والتوليد	تأثير البلازما الغنية بالصفائح الدموية PRP في شفاء جرح عشية الولادة القيصرية في مستشفى صلاح الدين العام	د. ابراهيم هاشم عبدالكريم
سعاد خلف جلاب	الدبلوم العالي	النسائية والتوليد	تقييم مزارع البويضات لتتولد بخدمات الأرحام عند النساء الحوامل في مستشفى تكريت العام	د. د. مصرية رشاد حسين
شكري ياسين حميد	الدبلوم العالي	النسائية والتوليد	علاقة بين السطح الهرموني وجهاز منع الحمل مع العقم الثانوي في مستشفى صلاح الدين العام	د. د. مصرية رشاد حسين

أ. د. وسام سهيل نجم  
العميد وكالة  
٢٠٢٢/١١/٢٠



جامعة تكريت  
كلية الطب  
شعبة الدراسات العليا