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**Study of Coagulation Markers in Pregnant Women at University of Port Harcourt Teaching Hospital**Moore-Igwe, Beatrice W.<sup>1\*</sup> and Wenah-Emmanuel, Justina E.<sup>2</sup>Department of Medical Laboratory Science, Rivers State University, Port-Harcourt, Nigeria<sup>1</sup>, Department of Haematology and Blood Transfusion, University of Port Harcourt Teaching Hospital (UPTH)<sup>2</sup>Author for Correspondence \*: beatrice.moore-igwe1@ust.edu.ng/Orcid ID: 0000-0002-3660-7002. <https://dx.doi.org/10.4314/sokjmls.v10i1.24>**Abstract**

Pregnancy is a complex physiological condition that causes significant changes in the haematological profile of women, including changes in platelet indices and fibrinogen levels. The aim of this study was to investigate coagulation markers in pregnant women at University of Port Harcourt Teaching Hospital. This study included 100 participants between the ages of 18 and 45 including 43 non-pregnant Port Harcourt residents and 57 healthy pregnant women who were visiting the University of Port Harcourt Teaching Hospital antenatal clinic. The Sicuro Hemia 5D Haematology Analyzer was used to collect and analyze blood samples for platelet markers and Clauss method for fibrinogen marker. Figures collected were statistically analyzed using t-tests and ANOVA. Results deduced Platelet count (PLT) as statistically significantly lower in pregnant women ( $206.80 \pm 63.04 \times 10^9 /L$ ) compared to non-pregnant controls ( $270.20 \pm 76.38 \times 10^9 /L$ ,  $p = 0.00$ ). Plateletcrit (PCT) and platelet large cell count (P\_LCC) were also significantly reduced in pregnant women ( $p = 0.00$ ). Mean platelet volume (MPV), platelet distribution width (PDW\_CV and PDW\_SD), and platelet large cell ratio (P\_LCR) showed no statistical significance differences between the groups ( $p > 0.05$ ). Also, fibrinogen values were comparable between pregnant and non-pregnant women, with no statistically significant differences ( $p = 0.44$  and  $p = 0.98$ ), respectively. In gestational age analysis, Platelet count showed a non-significant inclination, lower in the first trimester ( $184.58 \pm 58.26 \times 10^9 /L$ ), peaked in the second

trimester ( $227.31 \pm 67.25 \times 10^9 /L$ ), and declined in the third trimester ( $202.07 \pm 59.77 \times 10^9 /L$ ). Fibrinogen levels increased across trimesters (first -  $461.99 \pm 109.55$  mg/dL third -  $534.68 \pm 161.72$  mg/dL), but the differences were not statistically significant ( $p > 0.05$ ). Pregnant women demonstrated significantly reduced platelet counts and related indices compared to non-pregnant women, Fibrinogen levels showed negligible statistically insignificant increases across trimesters. Platelet count decreases during pregnancy, possibly due to haemodilution. Haemodilution is supported by fibrinogen levels. Antenatal treatment should include platelet count evaluations for early thrombocytopenia management. Larger sample sizes may help detect subtle trends.

**Keywords:** Coagulation, markers, Platelet, Indices, Fibrinogen and Antenatal

**Introduction**

Pregnancy is a complex physiological condition that causes significant changes in the haematological profile of women, including changes in platelet indices and fibrinogen levels. Fibrinogen, a key acute-phase reactant, involved in clot formation and wound healing, and its levels are known to increase during pregnancy, serving as a critical factor in assessing the risk of thrombotic events (Papageorgiou *et al.*, 2017). Monitoring platelet indices and fibrinogen levels is crucial for identifying potential complications like preeclampsia, gestational hypertension, and thrombocytopenia in pregnancy, especially in antenatal care.

Abnormal fibrinogen levels and platelet activity may be associated with these diseases, which may affect the outcomes of both the mother and the foetus. As one of top medical facilities, the University of Port Harcourt Teaching Hospital (UPTH) in Rivers State, enabled the assessment of these haematological markers in prenatal attendance in order to determine how to apply same in this locality with possible suitable clinical therapy. Prior research has shown how crucial it is to monitor platelet markers throughout pregnancy, and results indicate that elevated MPV may be linked to pregnancy-related hypertension diseases (Alvarado *et al.*, 2018). It has also been shown that higher fibrinogen levels are associated with a higher risk of thrombotic events (Ashworth *et al.*, 2016).

Improving maternal and foetal health outcomes during pregnancy requires an understanding of the role of platelet indices and fibrinogen, particularly in underdeveloped nations where early detection and suitable management might avert negative results. Better prenatal care practices and the early detection of dangers would result from this study's insightful findings about the clinical significance of these biomarkers in the Nigerian antenatal population. Fibrinogen is an acute-phase reactant, essential for coagulation, and implicated in the pathophysiology of pregnancy-related conditions like intrauterine growth restriction (IUGR), gestational hypertension, and preeclampsia. Increased fibrinogen levels and other pregnancy-induced hypercoagulability are a normal reaction that help limit excessive bleeding during labor and delivery (Wang *et al.*, 2019). However, pregnant women may be at risk for thromboembolic problems such as deep vein thrombosis (DVT) and pulmonary embolism (PE) if their fibrinogen levels rise excessively, particularly when other risk factors are present (Bertino *et al.*, 2020). Thus, tracking fibrinogen levels in conjunction with platelet indices can offer important information about the haemostatic balance during pregnancy and assist in identifying any aberrations that might point to possible problems.

The mean platelet volume (MPV) and other platelet indices are becoming more widely accepted as indicators of inflammation and

platelet activity. Increased thrombosis risk and unfavorable pregnancy outcomes, including preeclampsia and gestational diabetes mellitus (GD), have been linked to elevated MPV levels (Ozdemir *et al.*, 2021). Vascular issues may result from platelets with bigger volumes since they are often more reactive and more likely to agglomerate. On the other hand, thrombocytopenia, or a drop in platelet count, may indicate conditions like disseminated intravascular coagulation (DIC), HELLP syndrome (hemolysis, increased liver enzymes, and low platelet count), or even pregnant thrombocytopenia (Kara *et al.*, 2018).

The variation in platelet size within the circulation is reflected by platelet distribution width (PDW), another significant platelet metric that is frequently employed as an indicator of platelet heterogeneity. Alterations in PDW during pregnancy may indicate changes in bone marrow activity or platelet function (Jafari *et al.*, 2020). Pregnancy-related issues continue to be common in Nigeria, and results can be greatly enhanced by early detection and prompt care. This study aims to close this knowledge gap by concentrating on antenatal attendees at the University of Port Harcourt Teaching Hospital (UPTH). Additionally, the study will assess the correlation between these biomarkers and common pregnancy-related complications to gain a better understanding of their diagnostic value.

## Materials and methods

### Study Design

Study comprised of 100 participants between the ages of 18 and 45 including 43 non-pregnant Port Harcourt residents and 57 healthy pregnant women who were visiting the University of Port Harcourt Teaching Hospital antenatal clinic.

### Study Area

This study was basically carried out on pregnant women attending antenatal care at University of Port Harcourt Teaching Hospital, Port Harcourt, Rivers State Nigeria. The hospital was established in April 1980 and was officially commissioned by the federal government in 1985, it is a major tertiary-care teaching and research facility in Rivers State. It is managed through a three-tier managerial system

consisting - the Board of Management, Hospital Management Committee (HMC) and the Departments. Nearly 200,000 patients are seen annually on both outpatient and inpatient settings, as well as over 3000 surgical operations a year.

### Study Population

The study enrolled 57 pregnant women as test subjects and 43 non-pregnant women as control. The women were between the ages of 18 and 45, attending the antenatal clinic University of Port Harcourt Teaching Hospital. After proper sensitization about the study, interested subjects gave their consent, and each subject provided pertinent demographic data using a well-designed questionnaire.

### Collection of Blood Samples, Storage and Transportation

A total of (5.0 ml) was withdrawn from each participant as described by Cheesebrough (2010) using the S-Monovette vacutainer blood collection system with minimal stasis from the antecubital vein. Two milliliters (2ml) was placed into tubes containing the anticoagulant Ethylene Diamine Tetraacetic Acid (EDTA) for full blood count while 3ml was collected into sodium citrate anticoagulated tube for Fibrinogen determination. Specimen were labelled appropriately, using each subject's unique identifiers (age and identification number). The EDTA samples were kept at room temperature until processing, which occurred within 4 hours of collection, each blood sample

was mixed well. Plasma was separated using an unused transfer pipette after centrifugation for 10 minutes at 3500 rpm into sterile cryovials and then refrigerated overnight at 2 to 8 degrees Celsius. The plasma was then re-spun for 10 minutes at 3500 rpm to make it sufficiently clear for the assessment of fibrinogen and stored at -86°C.

### Methodology

#### Determination of full blood count for platelet indices

The haematology analyzer was set up, blood samples were mixed, placed in serial order and aspirated and samples were analyzed.

#### Determination of Fibrinogen

One hundred microliters (100ul) of patient plasma were pipetted into test tube also known as coagulometer cuvette. The plasma was incubated at 37°C for 2 minutes after which 100 µL of thrombin reagent was added to the sample, and the measurement of clotting time was taken.

#### Statistical Analysis

T-tests and ANOVA were used as statistical tools for information analysis.

#### Ethical Consideration

Ethical authorization for the study was got from the Ethics and Research Committee of the University of Port Harcourt Teaching Hospital.

### Results

**Table 1: Socio-demographic variables of Pregnant Women**

| Variables                | Frequency (%) |
|--------------------------|---------------|
| <b>Age group (years)</b> |               |
| < 25                     | 7(12.3)       |
| 26 – 30                  | 14(24.6)      |
| 31 – 35                  | 14(24.6)      |
| 36 – 40                  | 18(31.4)      |
| 41 – 45                  | 4(7.0)        |
| <b>Mean age</b>          | 32.75 ±5.93   |
| <b>Parity</b>            |               |
| None                     | 20(35.1)      |
| Single                   | 18(31.6)      |
| Double                   | 11(19.2)      |
| Multiple                 | 8(14.1)       |

|                           |           |
|---------------------------|-----------|
| <b>Educational Status</b> |           |
| SSCE                      | 11(19.3)  |
| HND                       | 6(10.5)   |
| Bachelor's                | 35(61.4)  |
| Master's                  | 2(3.5)    |
| PhD                       | 3(5.3)    |
| <b>Occupation</b>         |           |
| Students                  | 3(5.3)    |
| Health Workers            | 10(17.5)  |
| Business                  | 27(47.4)  |
| Teachers                  | 5(8.8)    |
| Civil Servant             | 12(21.0)  |
| <b>Marital Status</b>     |           |
| Married                   | 56(98.0)  |
| Single                    | 1(2.0)    |
| <b>Gestational Age</b>    |           |
| First Trimester           | 11(19.3)  |
| Second Trimester          | 19(33.3)  |
| Third Trimester           | 27(47.4)  |
| Total                     | 57(100.0) |

**Table 2: Mean difference between platelet indices and fibrinogen levels among pregnant and non-pregnant women.**

| Parameters                 | Pregnant women<br>N = 57<br>Mean ±SD | Non-Pregnant<br>women N=43<br>Mean ±SD | <i>p-value</i> | Remark |
|----------------------------|--------------------------------------|--|----------------|--------|
| PLT (10 <sup>9</sup> /L)   | 206.80±63.04                         | 270.20±76.38                           | 0.00           | S      |
| MPV (fL)                   | 10.38±0.88                           | 10.04±0.93                             | 0.07           | NS     |
| PDW-CV                     | 0.13±0.01                            | 0.13±0.00                              | 0.11           | NS     |
| PDW SD (fL)                | 16.06±2.95                           | 15.30±2.89                             | 0.20           | NS     |
| PCT (mL/L)                 | 2.14±0.65                            | 2.68±0.70                              | 0.00           | S      |
| P-LCC (10 <sup>9</sup> /L) | 65.70±20.76                          | 79.50±24.47                            | 0.00           | S      |
| P-LCR                      | 0.33±0.08                            | 0.30±0.07                              | 0.07           | NS     |
| Fibrinogen (Seconds)       | 9.15±2.24                            | 9.48±1.96                              | 0.44           | NS     |
| Fibrinogen(mg/dl)          | 502.07±150.27                        | 501.28±178.25                          | 0.98           | NS     |

P 0.05 = Not Significant, P 0.05 = Significant,

**Key=** Y-PLT-Platelet count, MPV-Mean Platelet Volume, PDW-CV-Platelet Distribution Width-PDW-SD-Platelet Distribution Width, PCT-Plateletcrit, P-LCC-Platelet Large Cell Count, P-LCR-Platelet Large Cell Ratio, NS-Not significant, S-Significant

**Table 3: Comparison of The Platelet Count, Platelet Indices and Fibrinogen According to Gestational Age.**

| Gestational Age  | PLT (10 <sup>9</sup> /L) | MPV (fL) | PDW-CV   | PDW-SD (fL) | PCT (mL/L) | P-LCC (10 <sup>9</sup> /L) | P-LCR    | Fibrinogen n (secs) | Fibrinogen (mg/dl) |
|------------------|--------------------------|----------|----------|-------------|------------|----------------------------|----------|---------------------|--------------------|
| First Trimester  | 184.58±58.               | 10.74±1. | 0.13±0.0 | 17.22±3.2   | 1.97±0.5   | 63.91±22.                  | 0.35±0.0 | 9.55±1.1            | 461.99±10          |
| Second Trimester | 227.31±67.               | 10.29±0. | 0.13±0.0 | 15.20±2.8   | 2.37±0.7   | 71.31±23.                  | 0.31±0.0 | 9.54±2.4            | 482.75±15          |
| Third Trimester  | 202.07±59.               | 10.28±0. | 0.14±0.0 | 16.15±2.7   | 2.05±0.5   | 62.42±17.                  | 0.33±0.1 | 8.69±2.4            | 534.68±16          |
| P- value         | 0.16                     | 0.29     | 0.09     | 0.17        | 0.14       | 0.39                       | 0.45     | 0.36                | 0.30               |
| Remarks          | NS                       | NS       | NS       | NS          | NS         | NS                         | NS       | NS                  | NS                 |

Key= Y-PLT-Platelet count, MPV-Mean Platelet Volume, PDW-CV-Platelet Distribution Width-PDW-SD-Platelet Distribution Width, PCT-Plateletcrit, P-LCC-Platelet Large Cell Count, P-LCR-Platelet Large Cell Ratio, NS-Not significant

**Table 4: Correlation table showing relationship between fibrinogen level and platelet indices of antenatal attendees in University of Port Harcourt Teaching hospital.**

| Parameters                 | N  | R     | p-value | Decision |
|----------------------------|----|-------|---------|----------|
| PLT (10 <sup>9</sup> /L)   |    | 0.13  | 0.32    | NS       |
| MPV (fL)                   |    | -0.08 | 0.54    | NS       |
| PDW-CV                     | 57 | -0.02 | 0.88    | NS       |
| PDW-SD (fL)                |    | -0.03 | 0.82    | NS       |
| PCT (mL/L)                 |    | -0.11 | 0.41    | NS       |
| P-LCC (10 <sup>9</sup> /L) |    | 0.08  | 0.52    | NS       |
| P-LCR                      |    | -0.06 | 0.61    | NS       |

Key=PLT-Platelet count, MPV-Mean Platelet Volume, PDW-CV-Platelet Distribution Width-PDW-SD-Platelet Distribution Width, PCT-Plateletcrit, P-LCC-Platelet Large Cell Count, P-LCR-Platelet Large Cell Ratio, NS-Not significant

**Table 5: Correlation table showing relationship between Gestational Age and Platelet indices with Fibrinogen levels of antenatal attendees in University of Port Harcourt Teaching hospital**

| Parameters                 | N  | R     | p-value | Decision |
|----------------------------|----|-------|---------|----------|
| PLT(10 <sup>9</sup> /L)    |    | 0.06  | 0.70    | N/S      |
| MPV (fL)                   |    | -0.17 | 0.18    | N/S      |
| PDW-CV                     |    | 0.10  | 0.51    | N/S      |
| PDW-SD (fL)                |    | 0.15  | 0.25    | N/S      |
| PCT (mL/L)                 | 57 | 0.00  | 0.94    | N/S      |
| P-LCC (10 <sup>9</sup> /L) |    | -0.06 | 0.61    | N/S      |
| P-LCR                      |    | -0.06 | 0.91    | N/S      |
| Fibrinogen (Seconds)       |    | 0.17  | 0.20    | N/S      |
| Fibrinogen(mg/dl)          |    | 0.20  | 0.14    | N/S      |

Key= PLT-Platelet count, MPV-Mean Platelet Volume, PDW-CV-Platelet Distribution Width-PDW-SD-Platelet Distribution Width, PCT-Plateletcrit, PLCC-Platelet Large Cell Count, PLCR-Platelet Large Cell Ratio, NS-Not significant

**Table 6: Correlation table showing relationship between Parity and Platelet indices with fibrinogen levels of antenatal attendees in University of Port Harcourt Teaching hospital**

| Variables            | N  | R    | p-value | Decision |
|----------------------|----|------|---------|----------|
| PLT ( $10^9/L$ )     |    | 0.07 | 0.63    | N/S      |
| MPV (fL)             |    | 0.00 | 0.92    | N/S      |
| PDW-CV               |    | 0.00 | 0.91    | N/S      |
| PDW-SD (fL)          |    | 0.00 | 0.93    | N/S      |
| PCT (mL/L)           | 57 | 0.00 | 0.84    | N/S      |
| P-LCC ( $10^9/L$ )   |    | 0.03 | 0.82    | N/S      |
| P-LCR                |    | 0.08 | 0.52    | N/S      |
| Fibrinogen (Seconds) |    | 0.07 | 0.59    | N/S      |
| Fibrinogen(mg/dl)    |    | 0.00 | 0.90    | N/S      |

Key= PLT-Platelet count, MPV-Mean Platelet Volume, PDW-CV-Platelet Distribution Width-PDW-SD-Platelet Distribution Width, PCT-Plateletcrit, P-LCC-Platelet Large Cell Count, P-LCR-Platelet Large Cell Ratio, NS-Not significant

**Discussion**

Gestational thrombocytopenia, a condition that affects roughly 7–10% of pregnancies, is consistent with the significantly reduced platelet count in pregnant women when compared to non-pregnant women (Carter *et al.*, 2021). Higher plasma volume, haemodilution, and improved platelet turnover as a result of higher peripheral destruction could be responsible for this decrease (Bussel *et al.*, 2020; James *et al.*, 2023). Ajibola *et al.* (2023) found that platelet count tends to decrease progressively from the first to third trimester, which contrasts with our findings which indicated the highest platelet count occurs in the second trimester. Similar to this, a study by Gupta *et al.* (2022) found that haemodilution and increased platelet consumption were the main causes of the slight drop in platelet count at the third trimester. This discrepancy may be due to variations in sample size, population characteristics, or measurement methods.

Though not statistically significant, MPV was somewhat higher in pregnant women than in non-pregnant women. Due to the hypercoagulable state of pregnancy, a slight increase in MPV may be a sign of enhanced platelet activation (Tantawy *et al.*, 2019). The study demonstrated no significant fluctuation in MPV or PDW across trimesters, which is consistent with Sultana *et al.* (2021) findings that MPV did not significantly vary throughout pregnancy. Our finding is at variance with a previous report by Khan *et al.* (2022) which indicated that MPV rises in the latter stages of

pregnancy as a result of elevated platelet activation. Variability in platelet turnover rates or differences in study subjects could be the cause for lack of relevance. Nonetheless, it is commonly known that the hypercoagulable state during pregnancy causes fibrinogen levels to gradually increase (Pavord *et al.*, 2021). The sample size and inter-individual differences may have contributed to lack of statistical significance in the fibrinogen levels.

Likewise, there was no significant difference in PDW values between the two groups indicating that the range of platelet activation fluctuation is within a medically acceptable range. Pregnant women showed non-significant increases in PLCR, substantial decreases in PCT, and a non-significant increase in P\_LCC. This decrease is supported by (Arias *et al.*, 2022). The two groups demonstrated almost same values in fibrinogen level (mg/dL), suggesting that pregnancy has no discernible impact on fibrinogen levels. However, studies by McLean *et al.* (2021), have shown that pregnancy causes a pro-thrombotic state, with the body producing more fibrinogen as a defense against possible hemorrhagic risks. Because estrogen affects coagulation factors to prepare for childbirth and prevent excessive bleeding, the increase in fibrinogen levels during pregnancy is expected (Pavord *et al.*, 2021). Sample size limitations or differences in individual coagulation responses could be the cause of the lack of statistical significance.

There is no associable connection between fibrinogen levels and platelet indices (PLT, MPV, PDW-CV, PDW-SD, PCT, P-LCC, and P-LCR) among the pregnant subjects. In line with our findings, a study by Gupta *et al.* (2021) discovered that fibrinogen levels rose with gestational age, while platelet indices such as MPV and PDW were not substantially impacted. However, a study by Adekanbi *et al.* (2023), found fibrinogen and MPV, negatively correlated. This suggests that higher fibrinogen levels could cause platelet aggregation, which could lower the number of big platelets in circulation. Individual differences in platelet turnover and consumption may impact how they interact with fibrinogen. During pregnancy, the body keeps a careful equilibrium between procoagulant and anticoagulant substances (Pavord *et al.*, 2021). Because of regulatory processes, platelet parameters may remain steady even as fibrinogen rises in preparation for delivery. Correlations found in other research were not observed in this study, which could be explained by variations in genetics, diet, and access to healthcare (Ajibola *et al.*, 2023).

There was no statistically significant relationship between gestational age and fibrinogen levels or platelet indices. Some researchers have looked at the relationship between gestational age and platelet indices and fibrinogen levels during pregnancy; some have shown slight or no link, while others have reported considerable alterations. Platelet count (PLT) tends to decline with increasing gestational age, which is typically attributed to increased platelet consumption and hemodilution, according to a study by Khan *et al.* (2022).

PLT did, however, show a positive association ( $r = 0.06$ ,  $p = 0.70$ ) in this study, which is not statistically significant and raises the possibility that the anticipated drop in platelet count may not be as noticeable in this study. This is consistent with research by Gupta *et al.* (2021), which found no significant relationship between PLT and gestational age.

Although not statistically significant, there was a slight positive connection between fibrinogen levels and gestational age ( $r = 0.20$ ,  $p = 0.14$ ). This aligns with the physiological rise in fibrinogen during pregnancy as a result of the hypercoagulable state

(James *et al.*, 2023). The lack of statistical significance in the study, however, raises the possibility that not all pregnant people will have a consistent decrease in fibrinogen levels. As gestation advances, elevated fibrinogen levels result from the hypercoagulable state that pregnancy causes (Pavord *et al.*, 2021). The absence of statistical significance, however, points to individual differences in fibrinogen synthesis. Individual variations in platelet turnover rates or compensating mechanisms that preserve platelet count could be the cause of this (Ajibola *et al.*, 2023).

There is no statistically significant correlation between parity, platelet indices and fibrinogen levels. The results of this study are corroborated by Gupta *et al.* (2021), who found no significant correlation between parity and MPV, PLT, or PDW. They advocated that pregnancy-related physiological haemostatic alterations take place apart from parity. On the other hand, a study by Khan *et al.* (2022) found that PLT decreased somewhat as parity increased, indicating that multiparous women may have increased platelet demand due to parity. Pavord *et al.* (2021) discovered that while fibrinogen level increased with gestational age, parity does not seem to have a major impact on it. Fibrinogen levels did not significantly correlate with parity, which is consistent with this study. Research has shown that platelet indices and fibrinogen levels can differ between populations, and that while multiparous women may have higher platelet consumption due to repeated pregnancies, the bone marrow compensates by maintaining platelet production, resulting in stable platelet indices across parity groups (Ajibola *et al.*, 2023). Pregnancy causes variations in coagulation factors and platelet function, but these changes may be primarily driven by gestational age rather than parity (James *et al.*, 2023).

## Conclusion

Platelet count and indices reduce sharply during pregnancy, which suggests that haemodilution is likely a contributing factor to the drop in platelet concentration. Further evidence for haemodilution rather than a consumptive process comes from the stable levels of fibrinogen. Platelet count evaluations should be part of routine prenatal treatment in order to manage thrombocytopenia early. The lack of strong statistical associations in this study suggests that a larger sample size may be required to detect subtle haematological trends as well as investigation of the clinical implications.

## References

- Agarwal, M., Kumar, V., & Tiwari, P. (2014). Platelet indices in pregnancy: A review of the literature. *International Journal of Hematology and Oncology*; **24(4)**: 112-117.
- Ajibola, S. O., Akinbami, A., Rabi, K., Adewunmi, A., Dosunmu, A., Adewumi, A. & Ismail, K. (2023). Gestational thrombocytopenia among pregnant women in Lagos, Nigeria. *Nigerian Medical Journal: Journal of the Nigeria Medical Association*; **55(2)**: 139-142.
- Akinbami, A. A., Ajibola, S. O., Rabi, K. A., Adewunmi, A. A., Dosunmu, A. O., Adediran, A., Osunkalu, V. O., Osikemaiya, B. I. & Ismail, K. A. (2023). Haematological profile of normal pregnant women in Lagos: Nigeria. *International Journal of Women Health*; **5(3)**: 227-232
- Alvarado, M., Pino, S., & Leiva, A. (2018). Platelet indices and their role in hypertensive disorders of pregnancy. *Journal of Pregnancy and Hypertension*; **10(1)**: 56-60.
- Arias, C. F., Martínez, L. R., & Torres, R. P. (2022). Hematological changes during pregnancy and their clinical implications. *Journal of Obstetric Hematology*; **17(3)**: 245-260.
- Ashworth, M., Kesson, C. M., & MacLennan, C. (2016). Elevated fibrinogen in pregnancy: Association with adverse maternal and fetal outcomes. *Thrombosis Research*; **146**: 43-50.
- Bertino, E., Tedesco, F., & Meschia, G. (2020). The role of fibrinogen in pregnancy-related thromboembolic complications. *Clinical Hemorheology and Microcirculation*; **74(4)**: 429-438.
- Jafari, S., Kamali, S., & Movahedi, M. (2020). The role of platelet distribution width (PDW) in predicting pregnancy complications: A systematic review. *Blood Coagulation & Fibrinolysis*; **31(2)**: 143-150.
- Kara, O., Mert, D., & Ozdemir, I. (2018). Thrombocytopenia in pregnancy: A comprehensive review of the causes and clinical outcomes. *Obstetrics & Gynecology*; **132(4)**: 946-953.
- Ozdemir, I., Basar, O., & Yildirim, O. (2021). Platelet indices as predictors of preeclampsia and gestational diabetes mellitus. *Clinical and Applied Thrombosis/Hemostasis*; **27**: 1076029621995417.
- Wang, X., Li, L., & Zhang, W. (2019). Hypercoagulability in pregnancy: Pathophysiology, clinical implications, and management. *Thrombosis Research*; **177**: 97-104.
- Bussel, J. B., Primiani, A., & Lee, C. S. (2020). Thrombocytopenia in pregnancy: Mechanisms and management. *American Journal of Hematology*; **95(1)**: 122-130.
- Carter, R. J., Green, S. A., & Patel, K. L. (2021). The impact of pregnancy on platelet function and coagulation. *International Journal of Obstetric Hematology*; **28(4)**: 112-130.
- Gupta, R., Sharma, N., & Mehta, S. (2021). Thrombocytopenia and coagulation factors in normal pregnancy and preeclampsia. *Indian Journal of Hematology*; **16(3)**: 112-118.
- James, A. H., Nelson-Piercy, C., & Greer, I. A. (2023). Hematological changes in pregnancy: Normal ranges and clinical implications. *American Journal of Obstetrics & Gynecology*; **229(1)**: 15-24.
- Khan, M. R., Yasmin, R., & Haque, S. (2022). Platelet activation and indices in normal pregnancy: A trimester-wise analysis. *Blood Coagulation & Fibrinolysis*; **33(3)**: 211-219.
- McLean, K. C., Smith, J. P., & Harris, D. W. (2021). Fibrinogen metabolism and coagulation dynamics in pregnancy. *Journal of Thrombosis and Hemostasis*; **19(7)**: 1345-1360.
- Papageorgiou, M., Siokos, A., & Mandal, D. (2017). The role of fibrinogen as an acute-phase reactant in pregnancy. *European Journal of Obstetrics & Gynecology and Reproductive Biology*; **212**: 73-78.
- Pavord, S., Thachil, J., & Hunt, B. J. (2021). The hemostatic adaptations of pregnancy: A review of physiological changes and clinical implications. *Journal of Thrombosis and Haemostasis*; **19(4)**: 879-888.
- Sultana, R., Alam, M., & Rahman, A. (2021). Platelet indices and coagulation factors in pregnancy: A comparative analysis. *Obstetric Hematology Journal*; **14(2)**: 112-120.
- Tantawy, A. A., El-Toukhy, S. E., & Mansour, M. O. (2019). Platelet activation markers in normal and complicated pregnancies. *Hematology Reports*; **14(2)**: 67-75.

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