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Platelet Indices and Erythrocyte Sedimentation Rate are useful Parameters in the Assessment of a Cohort of Nigerian Women with Preeclampsia

Les Indices Plaquettaires et la Vitesse de Sédimentation des Érythrocytes sont des Paramètres Utiles pour L'évaluation d'une Cohorte de Femmes Nigérianes Atteintes de Prééclampsie

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ABSTRACT

BACKGROUND: The study compared some haematological parameters in normotensive pregnant women with those of women with pre-eclampsia (PE) to identify those parameters that may reinforce the occurrence and severity of PE.

METHODS: The study was a case-control study involving 40 pre-eclamptic women as subjects and 40 normotensive pregnant women as controls. The subjects were classified into mild and severe based on their blood pressure of $\geq 140/90$ mmHg and $\geq 169/100$ mmHg, respectively. Full blood count (FBC) was done using a haematology autoanalyzer, D-dimer and fibrinogen were assessed by enzyme-linked immunosorbent assay (ELISA) method, while Prothrombin Time (PT) and activated plasma thromboplastin time (aPTT) were done manually.

RESULTS: The mean PCV was higher while the mean WBC was lower in PE but the differences were not statistically significant. The ESR was significantly higher (50.48 ± 2.90mm/hr vs 41.05 ± 3.74mm/hr, $p < 0.049$). The mean neutrophil ($59.38 \pm 7.77\%$ vs $64.95 \pm 6.68\%$; $p < 0.001$) and lymphocyte ($31.35 \pm 7.67\%$ vs $27.63 \pm 7.47\%$, $p = 0.031$) counts were significantly lower and higher, respectively, in PE. Although the mean platelet count in PE was lower, the plateletcrit, mean platelet volume (MPV), and platelet distribution width (PDW) were significantly higher in PE ($p = 0.01, 0.04, 0.001$, respectively). The D-dimer was significantly higher in the women with PE ($p < 0.001$), while the PT, aPTT and fibrinogen concentrations were not statistically different between the two groups.

CONCLUSION: It may be concluded that low platelet count, high MPV, PDW, PCT and ESR in PE women may reinforce the diagnosis while a high MPV may, in addition, discriminate between severe and mild Pre-eclampsia. **WAJM 2022; 39(12): 1273–1279.**

Keywords: Preeclampsia, Platelet count, Platelet indices, ESR, D-Dimer, Severity.

RÉSUMÉ

CONTEXTE: L'étude a comparé certains paramètres hématologiques chez des femmes enceintes normotendues à ceux de femmes atteintes de pré-éclampsie (PE) afin d'identifier les paramètres qui peuvent renforcer l'occurrence et la gravité de la PE.

MÉTHODES: Il s'agissait d'une étude cas-témoins impliquant 40 femmes pré-éclamptiques comme sujets et 40 femmes enceintes normotendues comme témoins. Les sujets ont été classés en légers et sévères sur la base de leur pression artérielle de $\geq 140/90$ mmHg et $\geq 169/100$ mmHg respectivement. La formule sanguine complète (FBC) a été réalisée à l'aide d'un auto-analyseur d'hématologie, les D-dimères et le fibrinogène ont été évalués par la méthode ELISA (enzyme-linked immunosorbent assay), tandis que le temps de prothrombine (PT) et le temps de thromboplastine plasmatique activé (aPTT) ont été réalisés manuellement.

RÉSULTATS: Le VPC moyen était plus élevé tandis que le nombre moyen de globules blancs était plus faible dans l'EP, mais les différences n'étaient pas statistiquement significatives. L'ESR était significativement plus élevé (50.48 ± 2.90mm/hr vs 41.05 ± 3.74mm/hr, $p < 0.049$). Les numérations moyennes des neutrophiles ($59,38 \pm 7,77\%$ contre $64,95 \pm 6,68\%$; $p < 0,001$) et des lymphocytes ($31,35 \pm 7,67\%$ contre $27,63 \pm 7,47\%$, $p = 0,031$) étaient respectivement plus faibles et plus élevées de manière statistiquement significative dans l'EP. Bien que la numération plaquettaire moyenne dans l'EP soit plus faible, le critère plaquettaire, le volume plaquettaire moyen (VPM) et la largeur de distribution plaquettaire (LDP) étaient significativement plus élevés dans l'EP ($p = 0,01, 0,04, 0,001$ respectivement). Le D-dimère était significativement plus élevé chez les femmes atteintes d'EP ($p < 0,001$), tandis que les concentrations de PT, aPTT et fibrinogène n'étaient pas statistiquement différentes entre les deux groupes.

CONCLUSION: On peut conclure qu'une faible numération plaquettaire, un VPM élevé, un PDW, un PCT et un ESR chez les femmes atteintes d'EP peuvent renforcer le diagnostic, tandis qu'un VPM élevé peut, en outre, faire la distinction entre une pré-éclampsie grave et une pré-éclampsie légère. **WAJM 2022; 39(12): 1273–1279.**

Mots clés: Prééclampsie, Numération plaquettaire, Indices plaquettaires, ESR, D-Dimères, Gravité.

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Abbreviations: MPV, Mean Platelet Volume; PDW, Platelet Distribution Width; PCT, Plateletcrit; ESR, Erythrocyte Sedimentation Rate.

INTRODUCTION

Preeclampsia (PE) is a disorder of pregnancy that is associated with new-onset hypertension and which occurs most often after 20 weeks of gestation and frequently near term.[1] It is characterised by blood pressure of 140/90mmHg or above on two occasions about 4–6 hours apart with preceding normal blood pressure. The increase in blood pressure is also associated with significant proteinuria (≥300mg in 24 hours). Preeclampsia is associated with poor pregnancy outcomes such as an increased rate of maternal mortality, preterm birth, small for gestational age newborns, stillbirth and neonatal death.[2] If left untreated, it can progress to eclampsia which is still one of the leading causes of maternal mortality in Nigeria.

Although haematological or coagulation parameters are not specific for the pathology of preeclampsia, studies have shown derangements in some haematological and coagulation parameters in PE; some of which might be used as biomarkers in identifying a worsening clinical state of the pregnant woman with preeclampsia.[3–8] Hence early detection and institution of measures to correct these derangements may help in reducing maternal and foetal morbidity and mortality. The aim of this study, therefore, was to evaluate some haematological and coagulation parameters that may be used to predict the onset and severity of preeclampsia to help with early intervention; thereby preventing complications that may arise from it without any warning.

SUBJECTS AND METHODS
Subjects

This was a prospective case-control study involving consenting women with preeclampsia recruited consecutively at the Department of Obstetrics and Gynaecology, Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife, Osun State. The study population consisted of two groups viz: pregnant women with preeclampsia and normotensive pregnant women (with a gestational age of more than 20 weeks) as subjects and controls, respectively.

The sample size was determined using the Kish Leslie formula[9] for single proportions:

$$N = \frac{Z^2 p(1-p)}{d^2}$$

where N is the desired sample size; Z is the standard deviation set at 1.96 which corresponds to a 95% confidence level; P is the prevalence of PE in Nigeria (which is about 2%);[10] d is the degree of accuracy desired at p is set at less than 5%. Therefore, $N = 1.96^2 \times 0.02\,(1 - 0.02)/(0.05)^2$ is 30. However, to take into consideration the attrition rate of 10%, the sample size was put at 40.

Ethical approval was obtained from the Ethics and Research Committee of the Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife (ERC/2016/09/20). Written informed consent was also obtained from the subjects after they were informed about the study and the procedures involved in the study. Included were pregnant women with preeclampsia (new-onset hypertension with systolic BP ≥140mmHg or diastolic BP ≥90mmHg and proteinuria of at least 2+ on deep stick testing after 20 weeks of gestation). They were categorized into two groups according to the American College of Obstetricians and Gynaecologists (ACOG) Practice bulletin;[11] mild preeclampsia with a blood pressure of ≥ 140/90 mmHg and severe pre-eclampsia with a blood pressure of ≥160/110 mmHg. The test subjects were singleton women with preeclampsia attending the antenatal clinic and seen at the Labour ward of the hospital. They were newly diagnosed and samples were taken before the commencement of medications. The control subjects were normotensive singleton women attending the antenatal clinic. All cases with pre-existing hypertensive disorders other than preeclampsia, multi-foetal pregnant women, women with comorbidity such as diabetes mellitus, renal failure, haemoglobinopathy, patients currently on aspirin usage or other anticoagulant therapy, and pregnant women who declined consent were excluded.

Methods

At the obstetrics emergency unit, informed consent in the language best understood by the pre-eclamptic patient was obtained. A study Pro-forma and serial number were given to them. Information obtained from these patients included age, parity, gestational age, religion and level of education.

Blood samples were obtained after diagnosis and before the patients were delivered of their pregnancies. Eight and a half millilitres of venous blood were taken from each subject and control by the standard sterile procedure. Four and a half millilitres out of the whole blood was put into five-millilitre plastic tubes containing half millilitres of 3.8% sodium citrate, while four millilitres was dispensed into a bottle containing ethylene diamine tetra acetic acid (EDTA). Both bottles were gently mixed to allow a proper mixture of the blood sample with the anticoagulant.

The sample in the citrate bottle was centrifuged for 20 minutes at 3500g to obtain a platelet-poor supernatant, and the supernatant plasma was stored at −80°C until assayed. The blood in the EDTA bottle was used for the estimation of full blood count (FBC), reticulocyte count, and erythrocyte sedimentation rate (ESR) within two hours of collection. The same method of blood collection and storage was done for the controls. Each subject was then labelled on the study proforma as mild or severe pre-eclampsia using the criteria in the American College of Obstetricians and Gynaecologists (ACOG) Practice Bulletin.[11]

PCV, WBC, platelet count, and platelet indices were done by using Sysmex Automated machine model Kx21N™ (Sysmex Europe GmbH; Hamburg), while the neutrophil-lymphocyte ratio was calculated from the results obtained. The ESR was carried out manually using the Westergren method.

The prothrombin time (PT) was carried out manually using commercially prepared calcified tissue thromboplastin reagent and the PT ratios were calculated using the results of test and control samples. The activated partial thromboplastin time (aPTT) was also manually carried out by initially pre-incubating the plasma with kaolin before being re-calcified. Both the D-dimer (Eagle Bioscience, Amherst NH 03031) and fibrinogen (*Technoclone Herstellung*

von Diagnostika und Arzneimitteln GmbH, Austria) assays were carried out manually using a quantitative sandwich enzyme immunoassay technique.

The data collected on the proforma were transferred into a master sheet using numerical codes. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) IBM® version 20.0 (*IBM corporation, Virginia, USA*) 2011 for the Windows software package. Data were presented as means ± standard deviation. The difference between means was tested using the student t-test. Probability values less than 0.05 (p < 0.05) were considered as significant. Results were presented in tables and charts.

RESULTS
Haematological Parameters
Table 1 compares the haematological parameters of women with preeclampsia with those of normotensive women. The mean (± SD) of PCV among women with preeclampsia was 33.12 ± 2.53%. Though higher than that of the normotensive women (32.07 ± 2.63%), the difference was not statistically significant (t = 1.82, p = 0.073). On the other hand, the mean (± SD) values of WBC (6907 ± 266.23/cmm vs 7545.00 ± 295.76/cmm), platelet count (203050.00 ± 34827.74/cmm vs 207075.00 ± 38209.54/cmm) and fibrinogen estimation (2.18 ± 1.02g/L vs 2.50 ± 1.19g/L) among preeclamptic women were lower than what was obtained in the normotensive women; the differences were, however, not statistically significant (t = 1.602, p = 0.113; t = 0.852, p = 0.397; t = 0.492, p = 0.624; t = 1.309, p = 0.194, respectively. The mean (±SD) ESR in women with pre-eclampsia was found to be 50.48 ± 2.90mm/hr. It was significantly higher (t = 1.99, p = 0.049) than that of the normotensive women with mean of 41.05 ± 3.74mm/hr. The mean (± SD) values for plateletcrit (PCT), mean platelet volume (MPV) and platelet distribution width (PDW) among the women with pre-eclampsia were found to be 0.25 ± 0.06%, 10.87 ± 0.82fl and 15.12 ± 0.36fL, respectively. They were significantly higher than what was found in normotensive women who had a mean ± SD values of 0.22 ± 04 % (t = 2.65, p = 0.01), 10.50 ± 0.76fL (t = 2.075, p = 0.04) and 14.78fl ± 0.36 (t = 4.168, p = 0.001),

respectively. The neutrophil percentage (64.95 ± 6.68% vs 59.38 ± 7.77%) and the neutrophil-lymphocyte ratio (2.63 ± 1.13 vs 2.04 ± 1.13) were significantly higher among the normotensive women compared to women with preeclampsia (t = 3.441, p 0.001; t = 2.801, p = 0.006, respectively). However, the lymphocyte percentage found in pre-eclamptic women (31.35 ± 7.67%) was significantly higher (t = 2.20, p = 0.031) than what was found in normotensive women (27.63 ± 7.47%). The sensitivity, specificity, positive predictive value and negative predictive value of the platelet indices are shown

on Table 2 revealing that MPV is the most sensitive and has high negative predictive value.

The Clotting Profile
Table 3 compares the coagulation profiles of the pre-eclamptic women with those of normotensive women. The mean (± SD) D-dimer values among the women with pre-eclampsia (1822.76 ± 233.68ng/ml) was found to be significantly higher (t = 3.608, p = 0.0001) than that of the normotensive women (829.77 ± 145.36ng/ml). On the contrary, though the PT (14.45 ± 1.06 sec vs 13.20 ± 1.15 sec), aPTT (34.50

Table 1: Haematological Parameters of Women with Preeclampsia and Normotensive Pregnant Women

Variable	Pregnant Women	Mean (± SD)	t-value	p-value
WBC(/cmm)	PE	6907.50±266.23	1.602	0.113
	NP	7545.00±295.76		
PCV(%)	PE	33.12±2.53	1.820	0.073
	NP	32.07±2.63		
ESR(mm/hr)	PE	50.48±2.90	1.993	0.049*
	NP	41.05±3.74		
Neutrophil(%)	PE	59.38±7.77	3.441	0.001*
	NP	64.95±6.68		
Lymphocyte(%)	PE	31.35±7.67	2.200	0.031
	NP	27.63±7.47		
Fibrinogen(g/l)	PE	2.18±1.02	1.309	0.194
	NP	2.50±1.19		
Platelet(/cmm)	PE	203050±34827.74	0.492	0.624
	NP	207075±38209.54		
PCT(%)	PE	0.25±0.06	2.654	0.010*
	NP	0.22±0.04		
MPV(fL)	PE	10.87±0.82	2.075	0.041*
	NP	10.50±0.76		
PDW(fL)	PE	15.12±0.36	4.168	0.000*
	NP	14.78±0.36		
N: L Ratio	PE	2.04±0.68	2.801	0.006*
	NP	2.63±1.13		

PE, Preeclampsia; NP, Normotensive Pregnant Women; WBC, White Blood Cell; PCV, Packed Cell Volume; ESR, Erythrocyte Sedimentation Rate; PCT, Plateletcrit; MPV, Mean Platelet Volume; PDW, Platelet Distribution Width; N: L, Neutrophil-Lymphocyte Ratio.

Table 2: Sensitivity, Specificity, Positive Predictive Value and Negative Predictive Value of the Platelet Indices

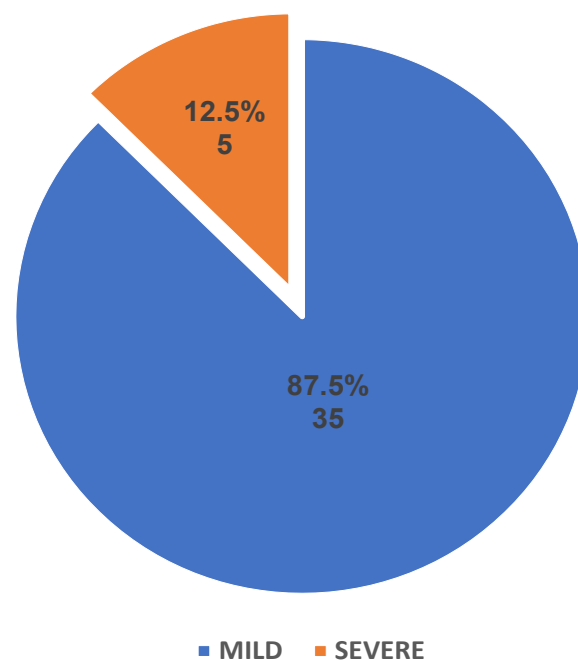| Variables	SEN (%)	SPEC (%)	PPV (%)	NPV (%)
PCT	75.0	47.5	58.8	65.5
MPV	92.5	17.5	52.9	79.0
PDW	100	–	50	0

SEN, Sensitivity; SPE, Specificity; PPV, Positive Predictive Value; NPV, Negative.

± 1.06 sec vs 33.73 ± 1.15 sec) and fibrinogen concentration (2.18 ± 1.02g/L vs 2.16 ± 0.92g/L) were also higher among the pre-eclamptic women, the values were not statistically significant (t = 1.355, p = 0.090; t = 0.918, p = 0.253 and t = 0.083, p = 0.934, respectively).

The Severity of Preeclampsia

Table 4 compares the haemato-logical parameters, clotting profile, D-dimer and fibrinogen concentration in the mild and the severe groups of women with pre-eclampsia. Thirty-five (87.5%) of the subjects were classified as mild pre-eclampsia and 5 (12.5%) had severe preeclampsia (Figure). The mean leukocyte count, ESR and aPTT values were found to be higher in severe preeclampsia but did not reach significant levels. The MPV is the only parameter that was found to be significantly higher with a p-value of 0.046.

WBC, White Blood Cell; PCV, Packed Cell Volume; ESR, Erythrocyte Sedimentation Rate; PCT, Plateletcrit; MPV, Mean Platelet Volume; PDW, Platelet Distribution Width; PT, Prothrombin Time; aPTT, Activated Partial Thromboplastin Time.

Fig. Severity of Clinical Presentation of Pre-eclampsia.

DISCUSSION

Pre-eclampsia is a major cause of maternal and perinatal mortality and morbidity worldwide, particularly in developing countries including Nigeria. Unfortunately, its aetiology remains unresolved. The majority of women investigated in this study were between the ages of 18 and 35 years, had up to tertiary education and were either civil servants or self-employed. This might be a result of the study setting being a tertiary referral facility and a semi-urban city.

The mean haematocrit in women with preeclampsia was higher than in normotensive pregnant women. Also, that of women with severe preeclampsia was higher than those with mild preeclampsia though the difference was not statistically significant. In a study to examine the association between the haematocrit value and severity of preeclampsia, Basak et al[6] found haematocrit values that were significantly higher in women with preeclampsia than the normotensive pregnant women and they also found a strong association between increased haematocrit and occurrence of pre-eclampsia. In another study by Pakniat et al[12] to determine the association and predictive value of first-trimester haemoglobin and haematocrit in women with preeclampsia, they also found a significantly higher haematocrit level in severe preeclampsia compared to mild; while the haematocrit level in mild eclampsia was similarly higher than that of normal pregnant women studied. Silver et al[13] in their studies found that the increase in intravascular volume that normally occurs during normal pregnancy is minimal or completely absent in women with preeclampsia and that the reduced plasma volume may contribute to haemoconcentration, hence, the increase in haematocrit observed in these studies including the present one.

In this study, the total WBC and neutrophil percentages were found to be higher in normotensive pregnant women compared to preeclamptic women contrary to expectation as several authors have reported significantly elevated leukocyte and neutrophil counts

Table 3: Comparison between Clotting Profile, D-Dimer and Fibrinogen Assay of Preeclamptic Women and Normotensive Pregnant Women

Parameter	Subject	Mean ± SD	t-value	p-value
PT(sec)	PE	14.45±1.06	1.355	0.090
	NoP	13.20±0.99		
aPTT(sec)	PE	34.50±1.06	0.918	0.253
	NoP	33.73±1.15		
D-Dimer(ng/ml)	PE	1822.76±233.68	3.608	0.000*
	NoP	829.77±145.36		
Fibrinogen(g/l)	PENoP	2.18±1.022.16±0.92	0.083	0.934

PT, Prothrombin Time; aPTT, Activated Partial Thromboplastin Time.

Table 4: Comparison of Haematological Parameters, Clotting Profile, D-Dimer and Fibrinogen Concentration between Mild and Severe Groups of Pre-eclampsia

Parameter	Mild N = 35	Severe N = 5	T value	P value
WBC (/cmm)	6602.86±1476.58	7840.0±2580.31	1.589	0.120
PCV (%)	32.73±2.36	35.58±2.47	1.514	0.066
Neut (%)	58.66±9.69	55.20±8.58	0.755	0.455
Lymph (%)	31.97±9.13	35.0±8.86	0.696	0.491
ESR (mm/hr)	51.49±18.59	52.0±17.30	0.058	0.954
Platelet (/cmm)	207057.14±34460.0	159979.0±1134.51	0.586	0.561
PCT (%)	0.25±0.06	0.23±0.01	0.693	0.492
MPV (fL)	10.94±0.82	12.44±0.77	2.674	0.042*
PDW (fL)	15.13±0.33	14.86±0.48	1.603	0.117
PT (sec)	14.40±0.98	14.20±0.84	0.435	0.666
aPTT (sec)	34.54±0.98	34.80±0.84	0.557	0.581
Fibrinogen (g/l)	2.27±1.15	1.73±0.25	1.033	0.308
D-dimer (ng/ml)	1829.78±262.10	1559.79±507.37	0.318	0.752

in preeclampsia as against normal pregnancy[14,15] Pregnancy is said to impose an inflammatory response in the mother and the leukocytosis is considered to be evidence of an increased inflammatory response during normal pregnancy.[16] This increase in leucocyte count has been attributed to mainly an increase in neutrophil count as an increase in the cortisol level in pregnancy triggers the mobilization of the leukocyte pool from the bone marrow, likewise, an increase in the concentration of GM-CSF may also contribute to the increase in white cell count.[17] The reasons for the low mean leukocyte count and neutrophil differential in the preeclamptic women compared to the normal pregnant women in this study are not clear. However, because of the ease of access to over-the-counter drugs in our environment, the majority of them might have been exposed to several courses of antibiotics at the slightest indication without seeking appropriate medical advice, for fear of not jeopardizing their pregnancies.[18,19] Similarly, the neutrophil-lymphocyte ratio in preeclamptic women was also found to be lower than what was found in the normal pregnant women in this study. Several studies have reported significantly elevated neutrophils and neutrophil/lymphocyte ratio.[20,21] Activation of neutrophils has been implicated in the pathophysiology of preeclampsia and studies have been conducted to examine the role of neutrophils in its pathogenesis[22,23] In a study conducted by Aly et al,[22] they found that syncytiotrophoblast microvillous membranes stimulate maternal neutrophils to produce superoxide radicals in women with preeclampsia which might be the cause of endothelial dysfunction in them. The observation of Aly et al[22] was further corroborated by the study of Tsukimori et al[23] in which neutrophils from women with preeclampsia, when pre-treated with NG-nitro-L-arginine methyl ester, caused reduced neutrophil-mediated endothelial injury in preeclampsia, indicating a role for peroxynitrite (a reactive oxygen radical produced by neutrophils) formation as a mechanism of endothelial cell injury in preeclampsia. The reasons for the reduced NLR in preeclamptic

women in the present study may also be related to the use of antibiotics, either prophylactically or to treat accompanying infections in them. However, some studies have suggested some maternal factors such as urinary tract and respiratory tract infections and sepsis as reasons to institute antibiotic therapy and which may contribute to the reduced leukocyte numbers.[18,19,24] In a study conducted by Toptas et al. to determine if NLR and platelet/lymphocyte ratio (PLR) can predict severity of pre-eclampsia, only PLR ratio was found to be associated with severity and not NLR.[25] Similarly, because of the significant morbidity and mortality associated with preeclampsia, Mannaerts et al investigated the role of NLR, PLR, and mean platelet volume (MPV) as possible predictors of preeclampsia in pregnant women and they found only the MPV to be significantly elevated in women who later developed pre-eclampsia.[26] In this present study, only MPV and PCT were observed to have high predictive values for the occurrence of preeclampsia.

The current study demonstrated a reduced but non-significant decrease in platelet count in women with pre-eclampsia. This is similar to what was observed by some other researchers in their different studies.[27,28] However, Plateletcrit and mean platelet volume were found to be significantly higher in women with preeclampsia in this study. Activation of platelets can cause changes in size, count and distribution.[29] Mean platelet volume (MPV), Plateletcrit (PCT), Platelet distribution width (PDW), and Platelet-large cell ratio (P-LCR) are volume-measuring platelet indices that increase during platelet activation[30] which are now being used to measure platelet function in preeclampsia.[31,32] PCT is the volume occupied by platelets in the blood as a percentage and is the least investigated parameter of all the red cell indices.[33] In this study, the PCT was significantly higher in the preeclamptic group than in the normotensive pregnant women. This is in contrast to what was reported by Freitas et al[27] and Kurtoglu et al[29] in their separate studies. Kurtoglu et al[29] observed no difference in PCT values between the preeclamptic women

and normal pregnant women while Freitas et al[27] observed a decrease in PCT value in preeclamptic women when compared with normal pregnant women. The increase in PCT in this study might reflect an increase in bone marrow activity in response to peripheral destruction of the platelets. Similarly, the mean platelet volume and the platelet distribution width were significantly higher in the pre-eclamptic group compared to the normal pregnant group in this study. The same observation has been reported by other researchers in their various studies.[34,35,36] In a study by Nirmala et al,[30] only MPV was found to be statistically significant out of all the platelet indices. There were no significant differences in the values of MPV and PDW between normal pregnant women and preeclamptic women in studies carried out by Alsheeha et al.[37]

In this study, the PCT, MPV and PDW were significantly higher in women with preeclampsia and may be suitable markers of the disease. However, the MPV is the only index that was found to be considered as a marker of the severity of preeclampsia in this study. It was the only one out of all the studied platelet indices that showed a statistically significant difference when they were compared between the mild and severe groups of preeclampsia. In addition to the MPV, Kumar et al[38] and Hale et al[39] also reported PDW as a marker of severity in their studies. The MPV, apart from being a marker of severity, was also reported by other researchers as a predictor of preeclampsia.[40] This is because the value of MPV was observed to be raised even before the diagnosis of preeclampsia.[41]

The erythrocyte sedimentation rate (ESR) is one of the measurements of the acute-phase response. In this study, the ESR was found to be significantly raised in preeclamptic women as against their normotensive counterparts; however, it did not define the severity of the disease. With pregnancy being a hypercoagulable state, it is expected that the PT and the aPTT time may be shortened.[42] In this study, the values of these two clotting tests were found to be prolonged and greater than the values in the normotensive pregnant women, though this was not statistically significant. Similarly,

prolonged and significant values were found in some other studies.[35,36] In addition to the prolongation of both the PT and aPTT in women with preeclampsia as against the normotensive pregnant women, this study also showed a statistically significant increase in the plasma D-dimer but a non-significant increase in plasma fibrinogen levels. These findings, as previously reported in other studies,[36,43] in addition to the reduced platelet count, may contribute to the increased risk of postpartum haemorrhage associated with preeclampsia.

It may be concluded from this study that haematological findings such as high haemoglobin levels, leukocytosis, high ESR, reduced platelet count, high PCT, MPV and PDW, prolonged PT and aPTT could differentiate a normal pregnancy from preeclampsia. Also, high haemoglobin level, high MPV, and PDW, prolonged PT and aPTT could discriminate between severe and mild preeclampsia. Limitation of the study: The study is limited by being a cross-sectional study. A longitudinal study investigating the same patients in the three trimesters would have confirmed if the higher values obtained in the preeclampsia patients returned to normal after delivery.

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Conflict of Interest
None.

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