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Original Article

Pathology Section

Association of Complete Blood Count-derived Inflammatory Indices with Preeclampsia, Eclampsia and Normotensive Pregnancies: A Case-control Study

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ABSTRACT

Introduction: Preeclampsia (PE) and Eclampsia (E) are hypertensive disorders of pregnancy with significant global maternal and perinatal morbidity and mortality. Despite existing diagnostic criteria, early prediction remains challenging. Haematological parameters, Systemic Immune-Inflammation Index (SII), Systemic Inflammation Response Index (SIRI) and Pan-Immune-Inflammation Value (PIV) derived from Complete Blood Count (CBC) parameters have shown potential as minimally-invasive biomarkers of inflammation in various diseases but are underexplored in obstetric contexts.

Aim: To evaluate and compare CBC-derived inflammatory indices (SII, SIRI and PIV) in PE, eclampsia and normotensive pregnancies and to assess their diagnostic utility using Receiver Operating Characteristic (ROC) analysis.

Materials and Methods: A case-control study was conducted at Department of Pathology, Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka, India, from October 2024 to March 2025, involving 236 participants including 118 controls and 118 cases (59 PE and 59 eclampsia). Haematological parameters including absolute counts of neutrophils, lymphocytes, monocytes and platelet count were used to calculate SII, SIRI and PIV. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 16.0, inferential statistics like Analysis of Variance (ANOVA) (or Kruskal-Wallis test) was used and ROC curves were used to evaluate predictive performance.

Results: Absolute neutrophil/lymphocytes/monocytes count, neutrophil/monocyte percentage and platelet count showed significant association between normal subjects, PE and eclampsia cases. SII and SIRI levels were significantly elevated in the eclampsia group compared to controls ($p<0.001$ and $p=0.042$, respectively), while PIV showed borderline significance ($p=0.058$). Among PE patients, only PIV demonstrated statistically significant predictive ability (AUC=0.623, $p=0.008$). For predicting eclampsia, SII showed the highest AUC (0.668, $p=0.001$), followed by SIRI (AUC=0.628, $p=0.005$) and PIV (AUC=0.602, $p=0.027$), suggesting moderate discriminatory power.

Conclusion: The study underscores the association of haematological parameters and inflammatory markers with PE and eclampsia. These findings highlight the potential utility of these minimally-invasive and cost-effective parameters in early risk stratification and diagnosis of the disease.

Keywords: Haematological parameters, Hypertensive disorders, Perinatal morbidity

INTRODUCTION

Preeclampsia (PE) and eclampsia are the second most frequent aetiologic cause of maternal death and two of the high-risk pregnancy problems with increased mortality globally, representing 14% of maternal fatalities each year [1].

Eclampsia is defined as the occurrence of one or more generalised tonic-clonic convulsions unrelated to other medical conditions in women with hypertensive disorder of pregnancy. Although 10% of pregnancies are complicated by hypertensive disorders, eclampsia continues to occur in 0.8% of women with hypertensive disorders [2].

The PE is a multi-system disorder specific to pregnancy, characterised by the new onset of high blood pressure and often a significant amount of protein in the urine or by the new onset of high blood pressure along with significant end-organ damage, with or without the proteinuria. The rates of maternal and neonatal mortality and morbidity rise as a result of this condition, which often manifests after 20 weeks of pregnancy and impacts both the mother and the infant. PE and eclampsia is currently diagnosed based on clinical observation and laboratory evaluation and early identification still remains a challenge due to its insidious onset [3].

Identification of biomarkers of systemic inflammation as early indicators of PE and eclampsia is of great interest. Markers of systemic inflammation can be calculated from CBC. Analysis has been proposed as potential early predictors of PE. These biomarkers are haematological parameters, SII, SIRI and PIV. Elevated levels of these markers in the pregnancy have been associated with an increased risk of developing PE and eclampsia. Research has indicated that heightened vulnerability to PE and eclampsia is linked to maternal systemic inflammation [4].

The SII, SIRI and PIV have been extensively studied as inflammatory biomarkers in various malignancies. They have demonstrated significant clinical utility in predicting prognosis, disease progression and therapeutic outcomes in several types of cancer, including carcinoma of the cervix, oral squamous cell carcinoma and breast carcinoma, among others. These indices, derived from routine blood parameters, reflect the balance between host immune response and systemic inflammation, which play a crucial role in tumour development and progression [5].

Despite their growing relevance in oncology, the application and interpretation of SII, SIRI and PIV in the context of obstetric conditions particularly PE and eclampsia remain largely unexplored. PE and eclampsia are hypertensive disorders of pregnancy characterised by systemic inflammation, endothelial dysfunction and immune dysregulation. Given the pathophysiological overlap involving immune and inflammatory pathways, it is plausible that these indices could serve as valuable biomarkers for early detection, risk stratification and management of PE and eclampsia [6,7].

Therefore, the present research aimed to investigate and establish the clinical significance of haematological parameters such as White Blood Cell (WBC) count, neutrophil percentage, absolute neutrophil count, lymphocyte percentage, absolute lymphocyte count, monocyte percentage, absolute monocyte count and platelets including SII, SIRI and PIV in patients diagnosed with PE and eclampsia. By examining their association with disease severity and potential predictive value, this study seeks to contribute to the evolving understanding of inflammation-based markers in obstetric care and potentially aid in the development of more effective diagnostic and prognostic tools for hypertensive disorders of pregnancy.

To estimate haematological parameters such as WBC count, neutrophil %, absolute neutrophil count, lymphocyte percentage, absolute lymphocyte count, monocyte percentage, absolute monocyte count and platelets and derived inflammatory indices like SII, SIRI and PIV in PE patients, eclampsia patients and in normal subjects and to determine the association of haematological parameters, SII, SIRI and PIV scores between PE and eclampsia patients and in normal subjects.

MATERIALS AND METHODS

A case-control study was conducted with a total of 236 subjects at the Department of Pathology, Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka, India, from October 2024 to March 2025. The cases comprised women diagnosed with PE and eclampsia, identified through case file records obtained from the Department of Obstetrics. The control group included normotensive pregnant women attending the same institution during the study period. All data collection and laboratory analyses were performed at the Central Diagnostic Laboratory Services, a tertiary health care centre attached to our institution. Ethical clearance was obtained from the Central Ethics Committee, Sri Devaraj Urs Academy of Higher Education and Research, under approval number SDUAHER/R&D/CEC/SDUMC-PG/27/NF/-2025-26.

Sample size calculation: In the study done by Ozkan S et al., SII showed a sensitivity of 81% and specificity of 67% for predicting PE [1]. Using the sensitivity value (81%) for sample size estimation, the calculation was performed for a single proportion (sensitivity) with a Type I error (α) of 5%, absolute precision (marginal error) of 10% and a power of 80%.

The sample size was calculated using the formula: $n=(Z(1-\alpha/2)^2 \times Se \times (1-Se)) / d^2$,

Where:

- n=required sample size
- Z=standard normal variate at 95% confidence level (1.96)
- Se=expected sensitivity (0.81)
- d=absolute precision (0.10)

Based on this calculation, the total estimated sample size was 236 participants, comprising 118 normotensive pregnant women (controls) and 118 cases, further divided equally into 59 women with PE and 59 women with eclampsia.

Inclusion criteria:

Case group:

- Cases diagnosed with PE and eclampsia according to criteria given by American College of Obstetricians and Gynaecologists (ACOG) (2020) [3], between the period of gestation from 26-41 week based on last menstrual period in primigravida and multigravida. According to ACOG criteria [3], PE is defined as a new-onset elevation of blood pressure after 20 weeks of gestation in a previously normotensive woman, characterised by systolic pressure ≥140 mmHg or diastolic pressure ≥90 mmHg on two occasions, with either proteinuria (≥300 mg/24 h or protein/creatinine ratio ≥0.3) or, in the absence of proteinuria, new-onset maternal end-organ dysfunction such as thrombocytopenia, elevated liver enzymes, renal insufficiency, pulmonary oedema, or cerebral or visual symptoms. Eclampsia is defined as the occurrence of new-onset generalised tonic-clonic seizures in a woman with PE that cannot be attributed to other neurologic causes and represents the severe end of the disease spectrum;
- Age between 18 and 45 years;
- Gestational age between 26 and 41 weeks (when symptoms of PE and eclampsia become prominent and evident), based on the last menstrual period, in both primigravida and multigravida women.

Control group:

- No history of PE and eclampsia, or any other obstetric complications.
- Age reference between 18 and 45 years
- Gestational age of 26-41 weeks in primigravida and multigravida.

Exclusion criteria: Women with chronic hypertension history of coronavirus infections and other acute infections, as well as women with autoimmune diseases, diabetes mellitus, cardiovascular diseases, liver and kidney diseases, women taking medication (corticosteroids or immunosuppressants) or other factors, including smoking, that may alter inflammatory status or blood count and missing data were excluded from the study.

Following ethical clearance from central ethics committee of academy and informed consent by the patients, sociodemographic data, Clinical parameters and laboratory investigation values was captured.

A 3-5 mL of blood was collected from each patient and normal subjects in K2 Ethylenediaminetetraacetic Acid (EDTA) vacutainer.

Study Procedure

An automated Sysmex haematology analyser (Sysmex 551) was used to perform CBCs on venous blood samples. The analyser directly reported total leukocyte count, absolute neutrophil count, absolute lymphocyte count, absolute monocyte count and platelet count, which were used for the calculation of SIRI, SII and PIV as follows [8,9].

SIRI: Neutrophil x Monocytes

Lymphocyte

SII: Neutrophil x Platelet

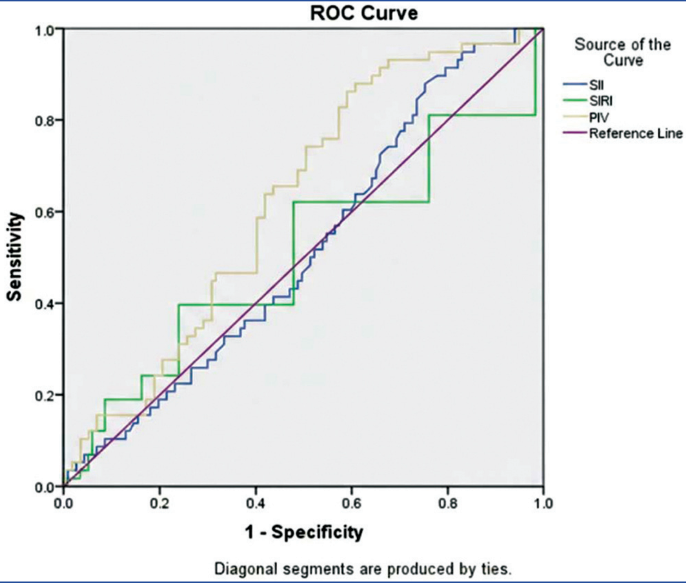
Lymphocyte

PIV: Neutrophil x Platelet x Monocytes

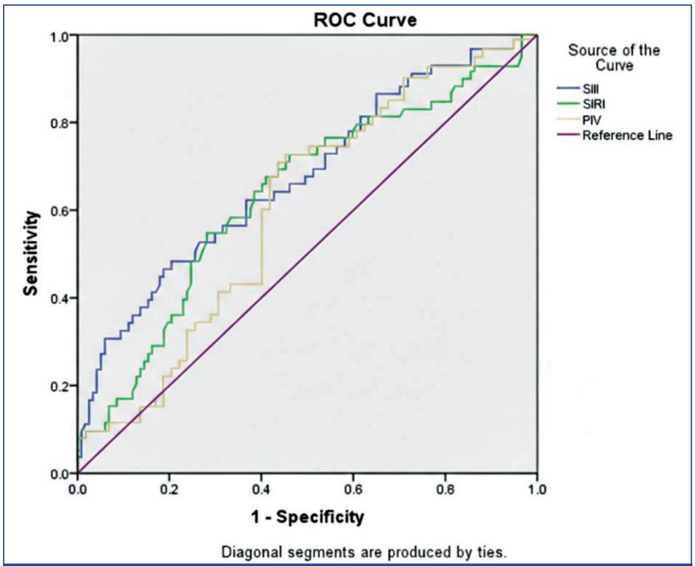
Lymphocyte

SIRI, SII and PIV are dimensionless inflammatory indices derived from absolute haematological parameters

The mean scores of SII, SIRI and PIV were tested for association between eclampsia, PE and normal subjects. SII, SIRI and PIV are composite inflammatory indices derived from peripheral blood cell counts and are not standalone laboratory parameters. These indices are influenced by physiological status, inflammatory burden, gestational age and underlying pathology. At present, universally accepted reference ranges have not been established for SII, SIRI, or PIV, particularly in pregnant populations, as values vary widely across different study populations and clinical settings. Hence, there is no defined reference range for these three indices. The cut-off values for the three indices were derived by ROC [Table/Fig-1,2].



[Table/Fig-1]: ROC curve analysis for CBC-derived inflammatory indices in order to predict preeclampsia.
ROC curve showing AUC for SII, SIRI and PIV for Preeclampsia (PE) cases.



[Table/Fig-2]: ROC curve analysis for CBC-derived inflammatory indices in order to predict eclampsia.
ROC curve showing AUC for SII, SIRI and PIV for eclampsia cases.

STATISTICAL ANALYSIS

Data entry was done using Microsoft Excel and statistically analysed using Statistical Package for social sciences (SPSS Version 16). Descriptive statistical analysis like percentages, mean, median, standard deviation and interquartile range was done to explore the distribution of several categorical and quantitative variables. Normality of continuous variables was assessed using the Shapiro-Wilk test and graphical methods including histograms and Q-Q plots. The association of haematological parameters, SII, SIRI and PIV with PE, eclampsia and normotensive pregnancies was analysed using One-way Analysis of Variance (ANOVA) for normally distributed variables and the Kruskal-Wallis test for non normally distributed variables. ROC curve analysis was carried out to evaluate the discriminatory ability of the inflammatory indices in distinguishing between the study groups. The Area Under the Curve (AUC) was calculated for each parameter along with the corresponding sensitivity and specificity values at the optimal cut-off point, thereby assessing their diagnostic performance. A p-value <0.05 was considered statistically significant.

RESULTS

The control group (n=118) had a mean age of 29.36±4.17 years, the PE group (n=59) had a mean age of 28.73±5.11 years and the eclampsia group (n=59) had a mean age of 33.76±7.63 years, with a p-value of 0.183. There was no statistically significant difference in the mean age distribution among the three groups. The mean gestation weeks was comparable among the three groups (35.4±3.0 weeks in controls, 34.9±3.2 weeks in PE and 35.6±2.8 weeks in eclampsia; p=0.42) [Table/Fig-3].

Considering haematological parameters, between PE, eclampsia and normal subjects before the delivery only. WBC, neutrophil percentage, neutrophil absolute count, lymphocyte absolute count, monocyte percentage, monocyte absolute count and platelet count showed statistically significant association between these groups [Table/Fig-4].

Variables	Control group (n=118)	Preeclampsia cases (n=59)	Eclampsia cases (n=59)	p-value
Age (years)	29.36± 4.171	28.73± 5.109	33.76±7.63	0.183
Gestational weeks	35.4± 3.0	34.9± 3.2	35.6± 2.8	0.420

[Table/Fig-3]: Mean distribution of age and gestational weeks among the study population (N=236).
Shapiro-Wilk test showed non-significant p-value, thus for parametric distribution One-way ANOVA is used. Values presented as mean±SD

Variables	Control (n=118)	Preeclampsia (n=59)	Eclampsia (n=59)	p-value
WBC (/μL)	9065 (6703-11220)	10510 (8954-13577)	9856 (7670-12856)	0.12
Neutrophil %	0.670 (0.550-0.740)	0.760 (0.722-0.800)	0.720 (0.577-0.795)	<0.001
Absolute neutrophil count (/μL)	5390 (4030-7569)	8732 (5906-11059)	6971 (4584-9620)	0.003
Lymphocyte %	0.180 (0.120-0.231)	0.180 (0.140-0.200)	0.180 (0.147-0.200)	0.310
Absolute lymphocyte count (/μL)	1562 (971-2307)	1844 (1283-2566)	1743 (1391-2198)	0.001
Monocyte %	0.0755 (0.0612-0.0950)	0.0700 (0.0565-0.0875)	0.0680 (0.0515-0.0825)	0.009
Absolute monocyte count (/μL)	640 (491-838)	710 (561-961)	609 (473-923)	0.013
Platelets (/μL)	251,500 (198,000-315,000)	165,000 (158,000-169,862)	165,895 (156,709-177,176)	<0.001

[Table/Fig-4]: Basic haematological parameters in control group, preeclampsia and eclampsia cases (N=236).
Shapiro-Wilk test showed significant p-value, thus for non-parametric distribution Kruskalwallis test is used. Values are mentioned in median and interquartile ranges

Median SII increased from 706 (640-788) in controls to 737 (557-829) in PE and 852 (656-1136) in eclampsia (p<0.001) group which was statistically significant. The median SIRI showed a significant elevation particularly in eclampsia {3.22 (2.06-4.68), p=0.016} compared to other groups and was statistically significant PIV also was found to be high among eclampsia group compared to other two groups, however the difference was not statistically significant (p=0.051) [Table/Fig-5].

For PE group, SII yielded an AUC of 0.518 (95% CI: 0.430-0.606; p=0.692), indicating no discrimination. The optimal cut-off of ≥627.04 had high sensitivity (87.9%) but poor specificity (24.8%). SIRI also showed poor discrimination, with an AUC of 0.505 (95% CI: 0.408-0.602; p=0.914) at a cut-off value of ≥1.42 (sensitivity 65.5%, specificity 23.9%). In contrast, PIV demonstrated modest predictive ability, achieving an AUC of 0.623 (95% CI: 0.540-0.707; p=0.008) at a cut-off of ≥320.99, with sensitivity of 87.9% and specificity of 39.3% [Table/Fig-1,2,6].

When predicting eclampsia, SII performed best among the three indices, with an AUC of 0.668 (95% CI: 0.581-0.755; p=0.001). A threshold of ≥848.86 yielded sensitivity of 49.2% and specificity of 79.5%. SIRI showed an AUC of 0.628 (95% CI: 0.538-0.719; p=0.005) at a cut-off of ≥1.97, corresponding to 74.6% sensitivity and 40.2% specificity. PIV showed the least discriminative power for eclampsia, with an AUC of 0.602 (95% CI: 0.515-0.689; p=0.027) at a cut-off of ≥432.3, achieving 71.2% sensitivity and 54.7% specificity [Table/Fig-1,2,6].

Variables	Control group (n=118)	Preeclampsia cases (n=59)	Eclampsia cases (n=59)	p-value
SII	706 (640-788)	737 (557-829)	852 (656-1136)	<0.001
SIRI	2.40 (1.54-3.32)	2.63 (1.25-3.91)	3.22 (2.06-4.68)	0.016
PIV	417.8 (206.4-664.7)	499.1 (339.2-775.4)	509.7 (366.4-816.5)	0.051

[Table/Fig-5]: Distribution of inflammatory parameters among the study population.
Shapiro-Wilk test showed significant p-value, thus for non-parametric distribution Kruskalwallis test is used. Values are mentioned in median and interquartile ranges (N=236).

Variables	AUC (95% CI)	p-value	Cut-off value	Sensitivity	Specificity
Preeclampsia (PE)					
SII	0.518 (0.430 - 0.606)	0.692	≥627.04	87.9%	24.8%
SIRI	0.505 (0.408 - 0.602)	0.914	≥ 1.42	65.5%	23.9%
PIV	0.623 (0.540 - 0.707)	0.008	≥320. 99	87.9%	39.3%
Eclampsia					
SII	0.668 (0.581 - 0.755)	0.001	≥848.86	49.2%	79.5%
SIRI	0.628 (0.538 - 0.719)	0.005	≥1.97	74.6%	40.2%
PIV	0.602 (0.515 - 0.689)	0.027	≥432. 32	71.2%	54.7%

[Table/Fig-6]: ROC curve analysis for CBC-derived inflammatory indices in order to predict preeclampsia and eclampsia.
Values are expressed as Area Under the receiver operating Characteristic Curve (AUC) with 95% confidence intervals. Optimal cut-off values were determined using the Youden index. Sensitivity and specificity are presented as percentages

DISCUSSION

The study addresses a specific gap in current knowledge by focusing on the clinical significance of haematological parameters SII, SIRI and PIV index in PE and eclampsia, as their role has not been well interpreted in this context previously. It employs a case-control study design, which is suitable for investigating associations between potential markers and conditions like PE and eclampsia. The study utilised standard, readily available laboratory data from CBC analysis to calculate the inflammatory indices, making the method potentially accessible and non-invasive. ROC curve analysis was performed to find the discriminatory power of inflammatory indices.

The present study compared the haematology parameters and inflammatory indices like SII, SIRI and PIV among the three groups of pregnant women i.e., normotensive controls, patients with PE and patients with eclampsia. In the present study, the mean age of women in the control group was 29.36±4.17 years. In the PE group, the mean age was slightly lower at 28.73±5.11 years and in eclampsia group 33.76±7.63 years. However, age was not found as a confounding factor in the subsequent comparisons of haematology parameters and inflammatory indices. Similar age distributions have been reported by Ozkan S et al., who found no significant difference between control and PE patients in their first-trimester screening study (mean ages 28.9 versus 29.4 years; p=0.264) and by Akdulum MFC et al., whose mean ages for the PE and control groups were 30.1 years and 29.3 years, respectively (p=0.421) [1,10].

The present study found that absolute neutrophil count and absolute monocyte count were progressively higher from the control group to the PE group and significantly higher in the eclampsia group. Neutrophil percentages and absolute neutrophil counts increased progressively (64.8±12.8% and 5,956±3,123/μL in controls vs. 68.8±13.8% and 7,507±3,742/μL in PE vs. 74.8±9.1% and 22,935±8,732/μL in eclampsia; p<0.001 for percentages, p=0.003 for absolute counts). The mean WBC count observed was 9,192.8±4,053.9/μL in controls, 10,644.7±3,939.0/μL in PE and 10,934.0±3675.0/μL in eclampsia patients (p=0.13). Although lymphocyte percentages remained statistically similar across groups (p=0.310), absolute lymphocyte counts were significantly higher in the eclampsia group (4,601±9,525/μL) compared to controls (1,746±1,062/μL; p=0.001). Monocyte percentages were slightly reduced in PE group versus controls (p=0.009), while absolute monocyte counts were markedly elevated in eclampsia (2,687±8,791/μL vs. 710±341/μL in controls; p=0.013). Significant difference was also observed in absolute lymphocyte count across the groups, with the eclampsia group showing a notably higher mean value. This aligns with the understanding of PE and eclampsia as inflammatory conditions often associated with increased leukocyte activation and counts. Comparable leukocytosis and neutrophilia trends have been documented by Kapci M et al., where their study reported mean WBC of 8,900±3,200/μl in controls and 11,200±4,100/μl in PE patients [11], Seyhanli Z et al., who noted a significant increase in neutrophil count in early-onset PE patients versus matched controls (6,500 versus 5,400 cells/μL; p=0.02) [4]. Another similar study done by Bektaş O et al., observed higher absolute lymphocyte counts in severe PE patients (3,200 versus 2,100 cells/μL; p=0.004) but no significant difference in lymphocyte percentage was noted [12]. Increased monocyte counts in severe hypertensive disorders of pregnancy was reported by Maziashvili G et al., who found monocyte counts of 2,400±900 cells/μL in eclampsia versus 800±300 cells/μL in controls (p<0.001) [13].

Platelet counts were significantly lower in both PE and eclampsia groups in present study, averaging 162,902±10,764/μL in PE and 172,081±36,990/μL in eclampsia versus 267,463±92,278/μL in controls (p<0.001). Platelet dysfunction and consumption are well-established features of PE, especially severe forms, contributing to thrombocytopenia. This is often linked to endothelial damage and activation of the coagulation system. These results are concordant with findings of Çendek BD et al., who documented platelet counts of 170,000±12,000/μL in PE compared to 260,000±15,000/μl in controls (p<0.001) [9], Ozkan S et al., reported that first-trimester platelet count analysis showed lower platelet counts in women who later developed PE (210,000 versus 240,000 cells/μL; in control's p=0.03) [1].

In the present study, the median SII was 706 (640 - 788) in controls, 737 (557-829) in the PE group and 852 (656 - 1136) in the eclampsia group (p<0.001). Similar to the present study results, Ozkan S et al., evaluating first-trimester samples in their study, found significant differences in SII across control, PE and eclampsia groups, with mean SII values increasing with severity (Control: 499, PE: 892, PE-SF: 905, p<0.001) [13]. Akdulum MFC et al., reported significantly higher SII levels in the PE group compared to controls when measured in the first trimester. This supports the belief that elevated SII is associated with PE [10]. However, Kapci M et al., compared PE patients to controls at the time of presentation, found significantly lower mean SII in the PE group (944.23 vs 1600.37, p=0.018) in control group [11]. Seyhanli Z et al., found no significant difference in SII levels in the first trimester among control, mild PE and severe PE groups [4].

The median SIRI in the present study was 2.40 (1.54-3.32) in controls, 2.63 (1.25-3.91) in the PE group and 3.22 (2.06-4.68) in the eclampsia group (p=0.042). Seyhanli Z et al., evaluating first-trimester samples, found significantly elevated SIRI in the mild PE group compared to controls, but not in the severe PE group [4]. Ozkan S et al., also reported that first-trimester samples, showed significant differences in SIRI across control, PE and eclampsia groups and importantly, between PE and PE-SF groups, with SIRI being highest in PE and eclampsia (Control: 0.81, PE: 0.79, PE-eclampsia: 1.26, p<0.001, PE vs PE-eclampsia p<0.001) [1]. Genc SO and Erdal H, however, found significantly decreased SIRI in PE compared to controls when measured at delivery [14].

The median PIV in the present study was 417.8 (206.4-664.7) in controls, 499.1 (339.2-775.4) in the PE group and 509.7 (366.4-816.5) in the eclampsia group (p=0.051). Seyhanli Z et al., reported that in first-trimester samples, their study found significantly elevated PIV in the mild PE group compared to controls [4]. Ozkan S et al., also reported that in first-trimester samples, found significant differences in PIV across control, PE and PE groups, with PIV increasing with severity (Control: 143, PE: 217, PE-SF: 409, p<0.001) [1]. Another study by Genc SO and Erdal H at delivery, found significantly decreased PIV in PE compared to controls [14].

By ROC analysis, for predicting PE, only PIV demonstrated statistically significant predictive ability, though with moderate AUC and low specificity at the determined cut-off. For predicting eclampsia, all three indices (SII, SIRI and PIV) demonstrated statistically significant predictive ability, with AUC values ranging from 0.602 to 0.668. The predictive performance (AUC) was generally higher for predicting eclampsia than for predicting PE.

For PE, SII achieved an AUC of 0.518 with a p-value of 0.692. The optimal cut-off was 627.04, which corresponded to a sensitivity of 87.9 percent and a specificity of 24.8 percent. Similar to the present study findings, Ozkan S et al., reported a SII cut-off of 620.59 (AUC 0.801) for prediction of PE, highlighting that early elevation of SII may precede clinical onset of hypertension [1]. In comparison, Kapci M et al. identified an SII cut-off of 758.39 yielding an AUC of 0.705, sensitivity of 77.5 percent and specificity of 67.5 percent in an emergency department population [11]. Cendek BD et al., reported that in first-trimester SII threshold of 710.0 (AUC 0.650; sensitivity 65%, specificity 60%) in a community-based sample, suggesting that SII cut-offs may need to be adjusted downward for earlier gestational assessments [9]. Genc SO and Erdal H in their study observed SII cut-off of 800.5 (AUC 0.680; sensitivity 70%, specificity 62%) in their PE cohort [14].

For PE, SIRI had an AUC of 0.505 and a p value of 0.914, with an optimal cut-off of 1.42 yielding 65.5 percent sensitivity and 23.9 percent specificity in the present study. Seyhanli Z et al., reported an early-pregnancy SIRI AUC of 0.590 at a cut-off of 1.50, suggesting modest but significant discrimination when assessed prior to clinical disease onset [4]. Bektas O et al., established a higher SIRI cut-off of 2.00 (AUC 0.620; sensitivity 60%, specificity 55%), indicating that severity stratification may require steeper thresholds when late-gestation sampling is used [12].

In the present study, for PE the PIV yielded an AUC of 0.623 with a p-value of 0.008. Its cut-off value of 320.997 corresponded to a sensitivity of 87.9 percent and a specificity of 39.3 percent. Ozkan S et al., reported a PIV cut-off of 190.62 with an AUC of 0.774, sensitivity of 74 percent and specificity of 72 percent, underscoring the enhanced predictive power of PIV in early pregnancy cohorts [1]. Esercan A and Cindoglu C validated a cut-off of 350.0 (AUC 0.700; sensitivity 68%, specificity 70%) in second-trimester samples, suggesting that PIV thresholds may vary with gestational age and clinical setting [15].

For eclampsia prediction, the SII had an AUC of 0.668 and a p-value of 0.001. The cut-off value of 848.86 was associated with 49.2 percent sensitivity and 79.5 percent specificity in the current study. Maziashvili G et al., noted an SII cut-off of 900±300 in their eclampsia subgroup, hinting at similar discrimination potential when severe disease is the target outcome [13]. Genc SO and Erdal H also reported an SII threshold of 820.2 (AUC 0.690; sensitivity 55%, specificity 75%) for eclampsia, reinforcing the consistency of SII performance under severe hypertensive conditions [14].

The SIRI in the present study produced an area under the Area Under Curve (AUC) curve of 0.628 (p value 0.005), with a cut-off of 1.97 yielding 74.6 percent sensitivity and 40.2 percent specificity. The PIV value had an AUC of 0.602 (p-value 0.027) and a cut-off of 432.32 corresponding to 71.2 percent sensitivity and 54.7 percent specificity. Seyhanli Z et al., showed a PIV cut-off of 400.0 for eclampsia prediction (AUC 0.610; sensitivity 60%, specificity 58%), further illustrating that PIV thresholds may shift upward with disease severity [4].

In the present study, findings of significant predictive ability for eclampsia across all three indices, albeit with moderate AUCs, suggests they might serve as useful adjunctive markers in the assessment of women presenting with hypertensive symptoms, helping to stratify risk for progression to eclampsia, especially in settings where more sophisticated biomarkers are unavailable.

Limitation(s)

The study has certain limitations. Its retrospective, single-centre design may introduce selection bias and limit generalisability of the findings. The relatively modest sample size may reduce statistical power. In addition, the case-control design allows assessment of associations but does not permit causal inferences between haematological inflammatory indices and the development of PE or eclampsia.

Future research should ideally involve large, prospective, multicentre studies with standardised protocols for patient recruitment, disease classification and timing of blood collection. Investigating these indices in combination with established risk factors and other biomarkers in well-defined patient cohorts (e.g., stratified by gestational age of onset, severity) is crucial for determining their optimal clinical application. Longitudinal studies tracking marker levels throughout pregnancy in high-risk women could also provide insights into their evolution and predictive potential at different gestational time periods.

CONCLUSION(S)

Among the haematological parameters WBC count, absolute neutrophil count, neutrophil percentage, absolute lymphocyte count, absolute monocyte count, monocyte percentage and platelet count showed statistically significant association between normal subjects, PE and eclampsia cases. The inflammatory biomarker PIV demonstrated statistically significant predictive ability for PE, while SII and SIRI did not. However, for the prediction of eclampsia, all three indices (SII, SIRI and PIV) showed significant predictive value. These findings support the premise that systemic inflammation plays a role in PE and eclampsia thereby suggesting that CBC-derived inflammatory indices could potentially serve as accessible markers, although their clinical utility for prediction warrants further investigation and validation. These haematological indices may enhance early risk stratification, allowing for improved surveillance, timely diagnosis and proactive management thereby potentially mitigating adverse maternal and foetal outcomes associated with PE and eclampsia. Looking ahead, integrative modeling approaches incorporating these and other clinical parameters could offer deeper insights into their translational relevance, marking a significant step toward optimised antenatal care and the prevention of pregnancy-related complications.

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