

Serum Ferritin as a Biomarker in Preeclampsia: A Comparative Cross-Sectional Study**Sowjanya G.¹, Y. Krishna Mohan², J. Madhavi Latha³**¹Senior Resident, Department of Biochemistry, Kurnool Medical College & Government General Hospital, Kurnool, Andhra Pradesh, India²Associate Professor, Department of Biochemistry, Kurnool Medical College & Government General Hospital, Kurnool, Andhra Pradesh, India³Professor, Department of Biochemistry, Guntur Medical College & Government General Hospital, Guntur, Andhra Pradesh, India

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Conflict of interest: Nil

Abstract**Background:** Preeclampsia is a leading cause of maternal and perinatal morbidity and mortality. Oxidative stress and inflammation are central to its pathogenesis, and serum ferritin—an acute-phase iron-storage protein—may reflect these processes. This study estimated serum ferritin in preeclamptic women and compared it with normotensive pregnant women.**Methods:** An analytical cross-sectional study was conducted over one year (September 2023–September 2024) in the Department of Biochemistry in collaboration with the Department of Obstetrics & Gynaecology, Government General Hospital, Kurnool. Using stratified random sampling, 120 pregnant women (>20 weeks gestation, 19–35 years) were enrolled—60 preeclamptic cases and 60 normotensive controls. Serum ferritin was measured by a solid-phase, two-site immunoenzymatic assay. Groups were compared using the independent samples t-test; correlation with blood pressure was assessed by Pearson's coefficient.**Results:** Mean serum ferritin was markedly higher in preeclamptic women (107.0 ± 51.7 ng/mL) than in controls (17.9 ± 12.4 ng/mL); the difference was highly significant ($t = -12.9$, $df = 118$, $p < 0.001$). Elevated ferritin was seen in 12.4% of cases and in none of the controls, while 48.3% of controls had low ferritin versus only 3.33% of cases. Serum ferritin correlated positively with systolic blood pressure ($r = 0.758$, $p < 0.001$).**Conclusion:** Serum ferritin is significantly elevated in preeclampsia and correlates with blood pressure severity, supporting its potential role as an inflammatory/oxidative-stress biomarker for risk stratification. Population-specific cut-offs and larger prospective studies are warranted.**Keywords:** Preeclampsia; Serum Ferritin; Oxidative Stress; Biomarker; Pregnancy Hypertension.**DOI:** 10.25258/ijcpr.18.8.109

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Introduction

Hypertensive disorders of pregnancy are among the foremost causes of maternal and perinatal death worldwide. Preeclampsia—new-onset hypertension (systolic ≥ 140 mmHg or diastolic ≥ 90 mmHg) developing after 20 weeks of gestation, usually with proteinuria or other evidence of end-organ dysfunction—complicates an estimated 2–8% of pregnancies globally. [9] In India, its prevalence ranges from about 3.8% to 10%, and it contributes to roughly 8–10% of maternal deaths.

Although the precise aetiology remains incompletely understood, defective trophoblastic invasion, poor placental perfusion, endothelial dysfunction, oxidative stress and a heightened systemic inflammatory response are recognised as

key mechanisms. Ferritin, the principal intracellular iron-storage protein, also behaves as a positive acute-phase reactant. In normal pregnancy, serum ferritin tends to fall with advancing gestation because of expanded plasma volume and increased fetal iron demand. In preeclampsia, however, iron released from oxidative tissue injury and the accompanying inflammatory state may raise circulating ferritin, and free iron can further amplify oxidative damage to the endothelium.

Several investigators have reported higher serum ferritin in preeclamptic women, proposing it as a marker of disease presence and severity, [1–4] though findings are not entirely uniform across populations. [8] The present study was therefore

undertaken to estimate serum ferritin in preeclamptic women and to compare it with normotensive pregnant women, and to examine its relationship with blood pressure.

Materials and Methods

Study design and setting: This analytical cross-sectional study was carried out over one year (September 2023–September 2024) in the 24-hour laboratory of the Department of Biochemistry, in collaboration with the Department of Obstetrics & Gynaecology, Government General Hospital, Kurnool. Ethical committee approval was obtained, and written informed consent was taken from every participant in her local language (Telugu).

Participants: A total of 120 singleton pregnant women aged 19–35 years and beyond 20 weeks of gestation were recruited by stratified random sampling into two equal strata: 60 preeclamptic cases (SBP ≥ 140 and/or DBP ≥ 90 mmHg on two occasions six hours apart, with or without proteinuria) and 60 normotensive controls. Women with chronic or secondary hypertension, chronic liver or kidney disease, diabetes mellitus, gout or other metabolic disorders were excluded. The sample size of 120 was derived from $n = Z^2p(1-p)/d^2$ ($Z = 1.96$, $p = 0.5$, $d = 0.09$).

Laboratory analysis: Serum ferritin was estimated using a solid-phase, two-site immunoenzymatic (chemiluminescent) assay in which ferritin binds immobilised monoclonal anti-ferritin while a goat anti-ferritin–alkaline phosphatase conjugate binds a second antigenic site; luminescence is proportional to ferritin concentration. Blood pressure was recorded by standardised sphygmomanometry.

Statistical analysis: Data were expressed as mean $\pm$ standard deviation. Group means were compared using the independent samples t-test, and the association between serum ferritin and blood pressure was assessed using Pearson's correlation coefficient. A p-value < 0.05 was considered statistically significant.

Results

The two groups were comparable in gestational age. A full comparison of the clinical and biochemical parameters is presented in Table 1.

Systolic and diastolic blood pressure, urine protein-to-creatinine ratio (UPCR), uric acid, triglycerides, VLDL-cholesterol and serum ferritin were all significantly higher in preeclamptic women ($p < 0.05$ for each), whereas HDL-cholesterol did not differ between the groups.

Table 1: Comparison of clinical and biochemical parameters (mean $\pm$ SD) between normotensive and preeclamptic women (independent samples t-test, $df = 118$).

Parameter	Normal (n=60)	Preeclampsia (n=60)	p-value
Age (years)	23.2 $\pm$ 2.7	24.6 $\pm$ 4.0	0.029
Gestational age (weeks)	33.1 $\pm$ 3.2	34.1 $\pm$ 2.6	0.056
SBP (mmHg)	111.3 $\pm$ 7.7	159.0 $\pm$ 18.5	<0.001
DBP (mmHg)	74.3 $\pm$ 5.3	103.2 $\pm$ 15.0	<0.001
UPCR	0.17 $\pm$ 0.07	0.69 $\pm$ 0.47	<0.001
Uric acid (mg/dL)	3.44 $\pm$ 0.73	7.21 $\pm$ 2.20	<0.001
Total cholesterol (mg/dL)	193.5 $\pm$ 34.7	223.1 $\pm$ 62.1	0.002
Triglycerides (mg/dL)	197.9 $\pm$ 76.0	263.8 $\pm$ 80.5	<0.001
LDL-C (mg/dL)	99.0 $\pm$ 26.9	112.4 $\pm$ 47.7	0.059
HDL-C (mg/dL)	55.8 $\pm$ 9.1	55.6 $\pm$ 14.5	0.934
VLDL-C (mg/dL)	39.7 $\pm$ 15.2	55.9 $\pm$ 25.0	<0.001
Serum ferritin (ng/mL)	17.9 $\pm$ 12.4	106.6 $\pm$ 51.7	<0.001

Serum ferritin showed the most striking difference. Categorically, elevated ferritin was confined to the case group (12.4%), while low ferritin predominated among controls (48.3%), consistent with the physiological iron depletion of normal pregnancy (Figure 1). On quantitative comparison (Figure 2), mean serum ferritin in preeclamptic

women (106.6 $\pm$ 51.7 ng/mL) was approximately six-fold higher than in controls (17.9 $\pm$ 12.4 ng/mL); the difference was highly significant ($t = -12.9$, $p < 0.001$). Serum ferritin also correlated positively with systolic blood pressure (Pearson's $r = 0.758$, $p < 0.001$), indicating that it rose in parallel with the severity of hypertension.

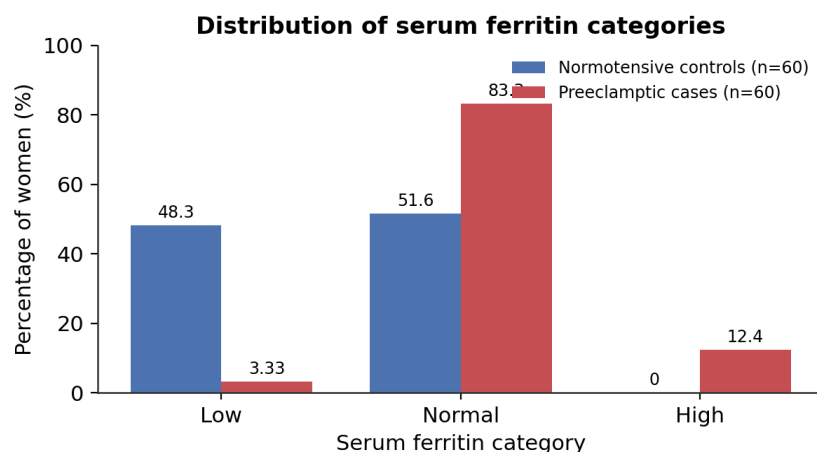


Figure 1: Distribution of serum ferritin categories (%) among controls and preeclamptic cases.

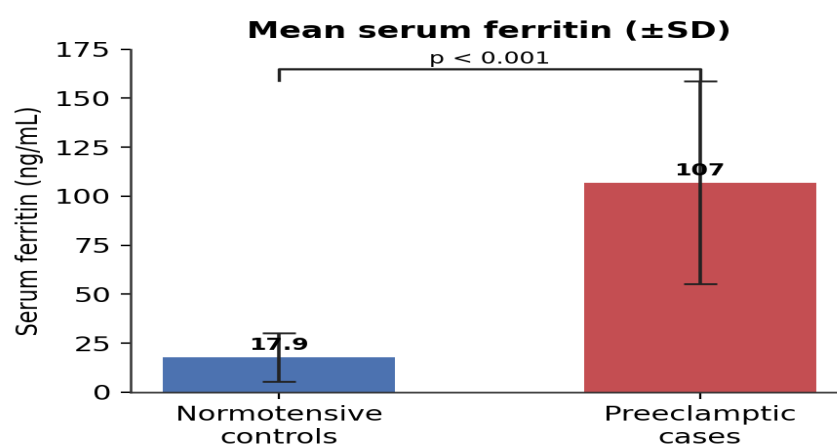


Figure 2: Mean serum ferritin (±SD) in the two groups; the difference was significant ($p < 0.001$).

Discussion

This study demonstrates a substantial and statistically significant elevation of serum ferritin in preeclamptic women compared with normotensive pregnant controls. The near six-fold difference in mean values, together with the confinement of elevated ferritin to the case group and its strong positive correlation with systolic blood pressure, supports the view that ferritin reflects the oxidative-inflammatory milieu of preeclampsia.

The findings are concordant with the wider literature. Taheripanah et al. (2007) reported higher ferritin in preeclampsia than controls, [1] and Siddiqui et al. (2011) proposed raised serum iron and ferritin as potential markers of the disease. [2] Fatima et al. (2013) and Mandal et al. (2020) similarly documented significantly higher—and potentially predictive—ferritin levels, [3,4] while more recent work by Fang et al. (2023), Wang et al. (2023) and Akhter et al. (2024) confirmed elevated ferritin and its correlation with disease severity and adverse outcomes such as preterm birth. [5–7] The physiological fall in ferritin expected in normal pregnancy explains the high proportion of controls with low values in the present study, making the elevation among cases more striking.

Mechanistically, endothelial and placental oxidative injury in preeclampsia releases iron and ferritin, while the acute-phase inflammatory response further raises circulating ferritin; liberated free iron catalyses further reactive-oxygen-species generation, perpetuating endothelial damage and hypertension. It should be noted that a minority of reports (e.g., Ahmed et al., 2023) found no significant difference in iron status, [8] underscoring the influence of population iron stores and assay methodology, and the need for context-specific reference values. The cross-sectional design and single-centre setting limit inference of causality, and ferritin's non-specificity as an acute-phase reactant means it is best interpreted alongside clinical and other biochemical markers.

Conclusion

Serum ferritin is significantly elevated in preeclampsia and rises with the severity of hypertension, reinforcing its potential as a biomarker of the oxidative stress and inflammation that characterise the disorder. Measuring serum ferritin may aid risk stratification when integrated with clinical assessment and other laboratory parameters. Larger, multi-centre prospective studies with population-specific cut-off values are

recommended to define its predictive and clinical utility.

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