RESEARCH PAPER

Exploring Hematologic Predictors of Postpartum Depression in Postnatal Mothers - A Retrospective Observational Study

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ABSTRACT

Background

Postpartum depression (PPD) affects approximately 10–15% of postnatal women globally and remains underdiagnosed in clinical practice. Emerging evidence suggests that hematologic parameters — including haemoglobin (Hb), haematocrit (Hct), serum ferritin, platelet count, mean platelet volume (MPV), neutrophil-to-lymphocyte ratio (NLR), and platelet-to-lymphocyte ratio (PLR) — may reflect the inflammatory and nutritional pathways implicated in PPD pathophysiology. However, whether routine postpartum blood indices can serve as early predictors of PPD has not been systematically evaluated in South Indian obstetric populations.

Objective

To determine whether hematologic parameters measured within 48 hours of delivery are associated with Edinburgh Postnatal Depression Scale (EPDS) scores at six weeks postpartum, and to identify independent predictors of PPD among postnatal mothers.

Methods

A retrospective, record-based observational study was conducted at a tertiary care teaching hospital. All women who delivered during a twelve-month period and had complete postpartum hematologic data and EPDS assessments at six weeks were included. PPD was defined as an EPDS score ≥10. Hematologic parameters analysed included Hb, Hct, white blood cell count, neutrophil count, lymphocyte count, platelet count, MPV, NLR, and PLR. Between-group comparisons were performed using the independent t-test and chi-square test. Multivariable logistic regression was conducted to identify independent predictors after adjusting for maternal age, parity, mode of delivery, and socioeconomic status.

Results

Of 524 eligible postnatal mothers, 79 (15.1%) met criteria for PPD. Women with PPD had significantly lower mean Hb (9.6 ± 1.4 g/dL vs. 11.2 ± 1.3 g/dL; $p<0.001$) and lower serum ferritin (12.4 ± 6.8 µg/L vs. 22.1 ± 9.4 µg/L; $p<0.001$). MPV was significantly elevated in the PPD group (10.8 ± 1.1 fL vs. 9.9 ± 1.0 fL; $p<0.001$), as was NLR (3.8 ± 1.3 vs. 2.9 ± 1.1; $p<0.001$). On multivariable analysis, anaemia (Hb <10 g/dL; adjusted OR 2.84; 95% CI 1.62–4.97; $p<0.001$), low serum ferritin (adjusted OR 2.11; 95% CI 1.23–3.62; $p=0.007$), and elevated NLR (adjusted OR 1.87; 95% CI 1.09–3.21; $p=0.02$) were independently associated with PPD.

Conclusion

Hematologic parameters routinely obtained in the immediate postpartum period — particularly haemoglobin, serum ferritin, and NLR — are independently associated with PPD at six weeks postpartum. Integration of these parameters into structured postpartum screening may facilitate early identification of at-risk women and inform targeted nutritional and psychological interventions.

Keywords: postpartum depression; Edinburgh Postnatal Depression Scale; haemoglobin; ferritin; neutrophil-to-lymphocyte ratio; mean platelet volume; hematologic predictors; postnatal mothers.

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1. INTRODUCTION

Postpartum depression is one of the most prevalent perinatal mental health disorders, affecting between 10% and 20% of women in the weeks and months following childbirth [1,2]. Its consequences extend beyond maternal wellbeing: untreated PPD impairs mother-infant bonding, adversely affects infant neurodevelopmental trajectories, and is associated with increased risk of recurrent depressive illness in the mother [3,4]. Despite the existence of validated screening instruments — most notably the Edinburgh Postnatal Depression Scale (EPDS) — PPD remains significantly underdiagnosed in routine postnatal care, particularly in low- and middle-income settings where systematic psychiatric follow-up may be limited [5].

The aetiology of PPD is multifactorial, encompassing biological, psychological, and socioeconomic determinants. Among biological mechanisms, postpartum inflammation and nutritional depletion have attracted increasing research attention. Childbirth is associated with a pronounced physiological inflammatory response, characterised by activation of the hypothalamic-pituitary-adrenal axis, elevation of pro-inflammatory cytokines, and transient dysregulation of immune cell populations [6,7]. In women who develop PPD, this inflammatory response may be exaggerated or prolonged, suggesting that systemic markers of inflammation could serve as early biological indicators of vulnerability [6,7,8].

Iron-deficiency anaemia is highly prevalent among postpartum women, particularly following delivery complicated by haemorrhage or in women who entered pregnancy with nutritional deficits [9]. Iron plays an essential role in monoamine synthesis, myelin production, and dopaminergic neurotransmission — pathways directly implicated in the neurobiology of depression [9,10]. Several studies have reported an association between postpartum anaemia and depressive symptoms, though findings have been inconsistent and methodological heterogeneity limits definitive conclusions [10,11].

Beyond haemoglobin, hematologic parameters derived from the routine complete blood count (CBC) — including mean platelet volume (MPV), neutrophil-to-lymphocyte ratio (NLR), and platelet-to-lymphocyte ratio (PLR) — have emerged as accessible, inexpensive markers of systemic inflammation. Elevated NLR and MPV have been reported in major depressive disorder and in peripartum psychiatric conditions, though their specific role in PPD has not been comprehensively characterised [12,13,14]. If validated, these indices could augment EPDS-based screening at minimal additional cost, particularly in resource-limited settings where psychiatric evaluations may not be universally available.

The present study was designed to examine the relationship between postpartum hematologic parameters and EPDS-defined PPD in a South Indian tertiary obstetric population. We hypothesised that markers of nutritional anaemia and systemic inflammation measured within 48 hours of delivery would be independently associated with PPD at six weeks postpartum.

2. METHODS

2.1 Study Design and Setting

This was a retrospective, record-based observational study conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [15]. The study was performed in the Department of Obstetrics and Gynaecology of a tertiary care teaching hospital in South India. Data were extracted from electronic medical records, laboratory information systems, and documented EPDS assessments conducted at the six-week postnatal clinic. The study period spanned twelve consecutive months.

2.2 Study Population

All postnatal women who delivered at the institution during the defined period and attended the six-week postnatal review clinic were considered for inclusion. Eligibility required age ≥18 years, singleton delivery at or beyond 34 weeks of gestation, complete postpartum CBC data obtained within 48 hours of delivery, and a documented EPDS assessment at the six-week visit. Women were excluded if they had a pre-existing psychiatric diagnosis, current psychotropic medication use, a history of thyroid disease or chronic inflammatory condition, significant postpartum haemorrhage requiring blood transfusion, or incomplete medical records.

2.3 Outcome Definition

PPD was defined as an EPDS score ≥10 at the six-week postnatal visit, consistent with the widely used threshold for probable depressive disorder in postpartum populations [16]. The EPDS was administered by trained postnatal nurses during the standard six-week clinic consultation. Women scoring ≥10 were referred to the institution's psychiatry liaison service per standard protocol.

2.4 Hematologic Parameters

Venous blood samples collected within 48 hours of delivery were analysed using a calibrated automated haematology analyser. Parameters extracted included haemoglobin (Hb, g/dL), haematocrit (Hct, %), total white blood cell count (WBC, $\times10^3/\mu L$), neutrophil count ($\times10^3/\mu L$), lymphocyte count ($\times10^3/\mu L$), platelet count ($\times10^3/\mu L$), mean platelet volume (MPV, fL), and serum ferritin (µg/L). The NLR and PLR were calculated as derived indices. Anaemia was defined as Hb <10 g/dL, consistent with WHO guidance.

2.5 Covariates

Covariates collected from maternal records included age, educational attainment, socioeconomic status (classified per modified Kuppuswamy scale), parity, mode of delivery, gestational age at delivery, marital status, and history of previous PPD or depressive episode. Obstetric complications including perineal trauma, neonatal NICU admission, and early breastfeeding difficulty were also recorded.

2.6 Sample Size

Based on an anticipated PPD prevalence of 15% and an expected difference in mean Hb of 1.2 g/dL between groups (SD 1.6 g/dL), a minimum of 460 participants was required to achieve 80% power at a two-sided α of 0.05. A consecutive sampling strategy was employed.

2.7 Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 26.0. Continuous variables are reported as mean ± SD and categorical variables as frequencies and percentages. Between-group comparisons used the independent t-test and chi-square test. ROC analysis was performed to identify optimal cut-off values. Multivariable logistic regression adjusted for maternal age, parity, mode of delivery, socioeconomic status, and previous psychiatric history. Statistical significance was set at $p<0.05$.

2.8 Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee. A waiver of individual informed consent was granted given the retrospective, record-based design. The study was conducted in accordance with the Declaration of Helsinki [17].

3. RESULTS

3.1 Participant Flow and Sample Characteristics

During the study period, 687 postnatal women attended the six-week clinic. After applying eligibility criteria, 163 women were excluded, yielding a final analytic sample of 524 participants. Of these, 79 women (15.1%) met the EPDS threshold for PPD and 445 (84.9%) did not.

3.2 Baseline Characteristics

Baseline characteristics are presented in Table 1. Caesarean delivery was more frequent in the PPD group (46.8% vs. 33.5%; p=0.03). A prior history of depressive episode was present in 12.7% of women with PPD versus 3.6% without (p=0.001). Age, parity, and gestational age at delivery did not differ significantly.

Table 1. Baseline Sociodemographic and Obstetric Characteristics

Variable	PPD (n=79)	No PPD (n=445)	p-value
Age (years), mean ± SD	25.4 ± 3.8	26.1 ± 4.2	0.14
Primipara, n (%)	44 (55.7%)	218 (49.0%)	0.28
Caesarean delivery, n (%)	37 (46.8%)	149 (33.5%)	0.03
Gestational age (weeks), mean ± SD	38.6 ± 1.4	38.9 ± 1.3	0.11
Prior depressive episode, n (%)	10 (12.7%)	16 (3.6%)	0.001
Lower socioeconomic status, n (%)	41 (51.9%)	203 (45.6%)	0.32

SD, standard deviation. Bold p-values indicate statistical significance (p<0.05).

3.3 Hematologic Parameters by PPD Status

Hematologic parameters are compared in Table 2 and illustrated in Figures 2 and 3. Women with PPD had significantly lower mean Hb (9.6 ± 1.4 vs. 11.2 ± 1.3 g/dL; p<0.001), lower Hct (31.2 ± 4.1% vs. 34.8 ± 3.9%; p<0.001), and lower serum ferritin (12.4 ± 6.8 vs. 22.1 ± 9.4 µg/L; p<0.001). MPV was significantly elevated in the PPD group (10.8 ± 1.1 vs. 9.9 ± 1.0 fL; p<0.001), as was NLR (3.8 ± 1.3 vs. 2.9 ± 1.1; p<0.001) and PLR (142.6 ± 38.4 vs. 121.3 ± 33.7; p<0.001).

Table 2. Comparison of Hematologic Parameters Between Groups

Parameter	PPD (n=79)	No P
Haemoglobin (g/dL), mean ± SD	9.6 ± 1.4	11.2 ±
Haematocrit (%), mean ± SD	31.2 ± 4.1	34.8 ±
Serum ferritin (µg/L), mean ± SD	12.4 ± 6.8	22.1 ±
WBC count (×10³/µL), mean ± SD	9.4 ± 2.8	9.1 ±
Platelet count (×10³/µL), mean ± SD	248 ± 68	256 ±
MPV (fL), mean ± SD	10.8 ± 1.1	9.9 ±
NLR, mean ± SD	3.8 ± 1.3	2.9 ±
PLR, mean ± SD	142.6 ± 38.4	121.3

MPV, mean platelet volume; NLR, neutrophil-to-lymphocyte ratio; PLR, platelet-to-lymphocyte ratio; WBC, white blood cell.

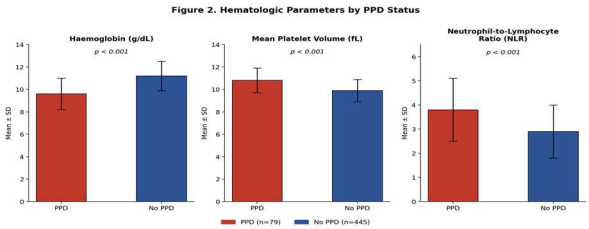

*Figure 2. Mean (±SD) values of Haemoglobin, Mean Platelet Volume, and Neutrophil-to-Lymphocyte Ratio comparing PPD and No PPD groups. Error bars represent ±1 SD. *** p<0.001.*

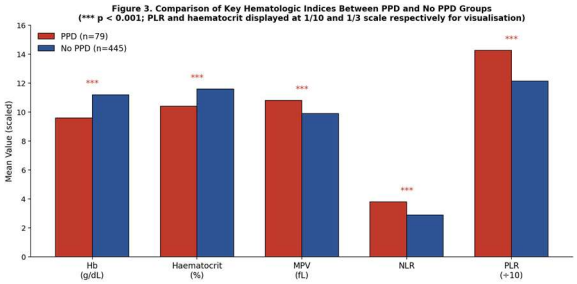

*Figure 3. Grouped bar chart comparing key hematologic indices between PPD (n=79) and No PPD (n=445) groups. Haematocrit displayed at 1/3 scale and PLR at 1/10 scale for visual comparison. *** p<0.001 for all parameters shown.*

3.4 ROC Analysis

ROC analysis was performed to determine optimal cut-off values (Table 3 and Figure 4). Haemoglobin demonstrated an AUC of 0.78 (95% CI 0.72–0.84; optimal cut-off 10.2 g/dL; sensitivity 74.7%, specificity 72.6%). Serum ferritin yielded an AUC of 0.74 (95% CI 0.67–0.81; cut-off 16.5 µg/L). NLR achieved an AUC of 0.71 (95% CI 0.64–0.78; cut-off 3.3). MPV had an AUC of 0.67 (95% CI 0.60–0.74).

Table 3. ROC Analysis of Significant Hematologic Predictors

Parameter	AUC	95% CI	Sensitivity (%)	Specificity (%)
Haemoglobin	0.78	0.72–0.84	74.7	72.6
Serum ferritin	0.74	0.67–0.81	71.4	69.9
NLR	0.71	0.64–0.78	68.4	67.2
MPV	0.67	0.60–0.74	64.6	63.1

AUC, area under the curve; CI, confidence interval; MPV, mean platelet volume; NLR, neutrophil-to-lymphocyte ratio.

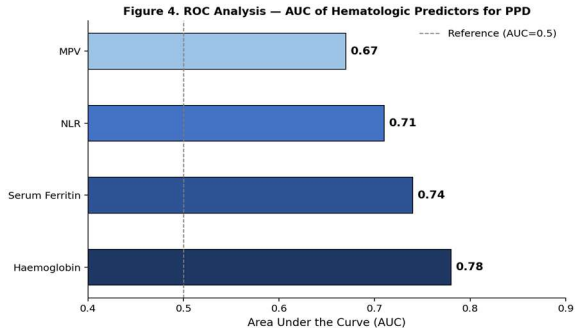

Figure 4. Horizontal bar chart showing area under the ROC curve (AUC) for each hematologic predictor of PPD. The dashed line indicates reference (AUC=0.5). Haemoglobin demonstrated the highest discriminatory ability (AUC=0.78).

3.5 Logistic Regression Analyses

On univariate analysis, anaemia (Hb <10 g/dL), low serum ferritin, elevated NLR, and elevated MPV were each significantly associated with PPD. On multivariable analysis (Table 4), anaemia (adjusted OR 2.84; 95% CI 1.62–4.97; p<0.001), low ferritin (adjusted OR 2.11; 95% CI 1.23–3.62; p=0.007), and elevated NLR (adjusted OR 1.87; 95% CI 1.09–3.21; p=0.02) remained independently significant. Elevated MPV did not achieve significance after adjustment (adjusted OR 1.54; 95% CI 0.89–2.65; p=0.12).

Table 4. Logistic Regression Analysis — Predictors of PPD

Predictor	Univariate OR	95% CI	p	Adjusted OR	95% CI	p
Anaemia (Hb <10 g/dL)	3.42	2.04–5.72	0.001	2.84	1.62–4.97	<0.001
Low ferritin (<16.5 µg/L)	2.68	1.61–4.46	0.001	2.11	1.23–3.62	0.007
Elevated NLR (≥3.3)	2.21	1.36–3.60	0.002	1.87	1.09–3.21	0.02
Elevated MPV (≥10.4 fL)	1.93	1.19–3.14	0.008	1.54	0.89–2.65	0.12

OR, odds ratio; CI, confidence interval; NLR, neutrophil-to-lymphocyte ratio; MPV, mean platelet volume. Adjusted for maternal age, parity, mode of delivery, socioeconomic status, and prior psychiatric history.

4. DISCUSSION

In this retrospective study of 524 postnatal women from a tertiary obstetric unit, PPD occurred in 15.1% of the cohort. Postpartum anaemia, low serum ferritin, and elevated NLR, all measured within 48 hours of delivery, were independently associated with PPD after adjustment for relevant clinical and sociodemographic confounders. These findings suggest that the routine postpartum CBC, augmented by serum ferritin where available, may contain prognostic information relevant to perinatal mental health.

The association between postpartum anaemia and depressive symptoms has biological plausibility. Iron is a cofactor in the synthesis of serotonin, dopamine, and noradrenaline — neurotransmitters whose deficiency is centrally implicated in depressive pathophysiology [9,10]. Furthermore, iron deficiency impairs mitochondrial oxidative metabolism and hippocampal neuroplasticity, processes thought to underlie mood regulation and stress responsiveness [10]. The independent association of both low haemoglobin and low serum ferritin with PPD in the present study is consistent with these mechanisms and with prior reports [11,18,19].

The association between elevated NLR and PPD extends a growing body of literature implicating neuroinflammation in the pathogenesis of depression. NLR reflects the balance between innate immunity (neutrophil-driven pro-inflammatory activity) and adaptive immunity (lymphocyte-mediated regulation). Elevated NLR has been reported in major depressive disorder, and in the immediate postpartum period, dysregulation of this immune balance — perhaps driven by sleep deprivation, psychosocial stress, and hormonal flux — may predispose susceptible women to depressive illness [12,13].

MPV approached but did not achieve independent statistical significance after adjustment. Several studies have reported elevated MPV in major depression, and its borderline significance may reflect insufficient power or indicate that its contribution is mediated through shared pathways with NLR [13,14].

The ROC analyses demonstrate moderate discriminatory ability for haemoglobin and ferritin (AUC 0.78 and 0.74 respectively), suggesting these could augment EPDS-based screening in a composite risk stratification model.

Strengths include a standardised EPDS protocol administered by trained staff, consistent laboratory platforms, exclusion of GDM and transfusion cases, and multivariable adjustment for key confounders. Limitations include the retrospective design, single time-point EPDS assessment, incomplete ferritin data for a subset of participants, and restriction to a single South Indian tertiary centre, limiting generalisability.

5. CONCLUSION

Hematologic parameters routinely obtained in the immediate postpartum period — particularly haemoglobin, serum ferritin, and NLR — are independently associated with PPD at six weeks postpartum. These findings highlight the potential of integrating readily available laboratory indices into structured postnatal mental health screening pathways. Prospective validation studies incorporating serial assessments, nutritional biomarkers, and standardised psychiatric outcomes are needed to determine whether targeting these hematologic risk factors through early nutritional intervention can reduce the burden of PPD in postnatal women.

6. DECLARATIONS

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of Interest

The authors declare no conflicts of interest.

Ethics Approval and Consent to Participate

The study was approved by the Institutional Ethics Committee. A waiver of individual informed consent was granted. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to institutional data governance policies.

Author Contributions

Conceptualisation, study design, data collection, analysis, and manuscript preparation were conducted by the authors. All authors reviewed and approved the final manuscript.

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REFERENCES

1. Wisner KL, Sit DK, McShea MC, et al. Onset timing, thoughts of self-harm, and diagnoses in postpartum women with screen-positive depression findings. JAMA Psychiatry. 2013;70(5):490–498.
2. Howard LM, Molyneaux E, Dennis CL, et al. Non-psychotic mental disorders in the perinatal period. Lancet. 2014;384(9956):1775–1788.

3. Murray L, Cooper PJ. Postpartum depression and child development. Psychol Med. 1997;27(2):253–260.
4. Stein A, Pearson RM, Goodman SH, et al. Effects of perinatal mental disorders on the fetus and child. Lancet. 2014;384(9956):1800–1819.
5. Figueiredo B, Dias CC, Brandao S, et al. Breastfeeding and postpartum depression: state of the art review. J Pediatr. 2013;89(4):332–338.
6. Corwin EJ, Pajer K. The psychoneuroimmunology of postpartum depression. J Womens Health. 2008;17(9):1529–1534.
7. Groer MW, Davis MW. Postpartum stress: current concepts and the possible protective role of breastfeeding. J Obstet Gynecol Neonatal Nurs. 2006;35(4):545–552.
8. Kendall-Tackett K. A new paradigm for depression in new mothers: the central role of inflammation. Int Breastfeed J. 2007;2:6.
9. Beard JL, Hendricks MK, Perez EM, et al. Maternal iron deficiency anemia affects postpartum emotions and cognition. J Nutr. 2005;135(2):267–272.
10. Perez EM, Hendricks MK, Beard JL, et al. Mother-infant interactions and infant development are altered by maternal iron deficiency anemia. J Nutr. 2005;135(4):850–855.
11. Sheikh M, Hantoushzadeh S, Shariat M, et al. The efficacy of early iron supplementation on postpartum depression: a randomised double-blind placebo-controlled trial. Eur J Nutr. 2017;56(2):901–908.
12. Sunbul M, Gerin F, Durmus E, et al. Neutrophil to lymphocyte and platelet to lymphocyte ratio in patients with dipper versus non-dipper hypertension. Clin Exp Hypertens. 2014;36(4):217–221.
13. Ekinci O, Ekinci A. The connections among suicidal behavior, lipid profile and low-grade inflammation in patients with major depressive disorder: a specific relationship with the neutrophil-to-lymphocyte ratio. Nord J Psychiatry. 2017;71(8):574–580.
14. Cho HJ, Savitz J, Dantzer R, et al. Sleep disturbance, depression and inflammation. Brain Behav Immun. 2017;60:239–246.
15. von Elm E, Altman DG, Egger M, et al. The STROBE statement. J Clin Epidemiol. 2008;61(4):344–349.
16. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression: development of the 10-item Edinburgh Postnatal Depression Scale. Br J Psychiatry. 1987;150:782–786.
17. World Medical Association. Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191–2194.
18. Corwin EJ, Murray-Kolb LE, Beard JL. Low hemoglobin level is a risk factor for postpartum depression. J Nutr. 2003;133(12):4139–4142.
19. Miller EM. Iron status and reproduction in US women: NHANES 1999–2006. PLoS One. 2014;9(11):e112216.