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Postpartum Depression in Mothers of NICU-Admitted Neonates: A Case-Control Study on Prevalence and Associated Factors

Dr. Harjinder Singh[1] Dr Ramit Gupta[2], Dr. Gurmeet Kaur Brar[3]

[1]Junior Resident - 3, Department of Psychiatry Adesh institute of medical sciences and research, Bathinda, Punjab, India
[2]Associate Professor, Department of Psychiatry Adesh institute of medical sciences and research, Bathinda, Punjab, India
[3]Professor, Department of Psychiatry Adesh institute of medical sciences and research, Bathinda, Punjab, India

Corresponding Author:

Dr. Harjinder Singh
Junior Resident - 3 (JR3)
Department of Psychiatry
Adesh institute of medical sciences and research, Bathinda, Punjab, India

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ABSTRACT

Objective: To determine the prevalence of postpartum depression (PPD) in mothers of NICU-admitted neonates compared with matched controls, and to identify associated sociodemographic and obstetric risk factors.
Methods: This matched case-control study enrolled 320 mothers (160 NICU cases, 160 matched controls) over twelve months (May 2024–April 2025) at a tertiary care teaching hospital in Punjab, India. PPD was assessed using the Edinburgh Postnatal Depression Scale (EPDS ≥10) at postpartum day 30. Pearson chi-square tests and binary logistic regression were applied; odds ratios (OR) with 95% confidence intervals (CI) were calculated.
Results: PPD was present in 59 NICU mothers (36.9%) versus 36 controls (22.5%) (χ^2=7.920, P=0.005; OR 2.01, 95% CI: 1.23–3.29). On binary logistic regression, five variables were independently associated with PPD: rural residence (aOR 5.57, 95% CI: 2.19–14.20), cesarean delivery (aOR 5.54, 95% CI: 1.60–19.10), female neonate sex (aOR 2.91, 95% CI: 1.32–6.43), joint family type (aOR 2.70, 95% CI: 1.20–6.04), and lower education level (aOR 0.33, 95% CI: 0.14–0.75, protective).
Conclusions: More than one in three NICU mothers screened positive for PPD — nearly double the rate observed in controls. Routine EPDS screening at NICU admission and discharge, with focused support for high-risk mothers, is recommended.

Keywords*: case-control study; Edinburgh Postnatal Depression Scale; NICU mothers; perinatal mental health; postpartum depression.*

INTRODUCTION

Postpartum depression (PPD) is a non-psychotic depressive episode beginning within four weeks of childbirth and lasting at least two weeks, with a global prevalence of 10–15% among new mothers (O'Hara & McCabe, 2016). In India, prevalence estimates range from 22% to 26%, with variation across regions and clinical settings (Upadhyay et al., 2017; Panolan & Thomas, 2024). Despite considerable prevalence daily mental health screening in postnatal wards regular mental health screening is uncommon, as a result of which most affected women go undetected and untreated (Panolan & Thomas, 2024; Rajeev et al., 2024).

Mothers whose neonates needed admission to neonatal intensive care unit (NICU) are at highest risk of depression. These mothers get separated from their newborn at this important period of bonding with ongoing uncertainty about the survival of their neonate, restricted physical contact, and additional challenge of postoperative recovery where delivery has been operative (Vigod et al., 2010; Yahya et al., 2021). Indian data on PPD specifically in NICU populations are limited, and risk factors in this subgroup have rarely been examined using a controlled study design. This study aimed to determine the prevalence of PPD in mothers of NICU-admitted neonates compared with matched controls, and to identify independent sociodemographic and obstetric predictors using binary logistic regression.

RESEARCH METHODOLOGY

Reporting guidelines

This study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Ethics

Ethics approval was obtained from the AIMSR Research Committee (Ref. No. AIMSR/RC/Estt/04/2K24/119, dated 03 April 2024) and the Ethics Committee of Biomedical and Health Research, Adesh University (Ref. No. AU/EC_BHR/2K24/559, dated 26 April 2024). The study was conducted in accordance with the Declaration of Helsinki (2000 revision). Written informed consent was obtained from all participants before enrolment.

Sample size

Sample size was estimated using a two-proportion z-test with 80% power and a two-sided alpha of 0.05, based on an anticipated PPD prevalence of 35% in NICU mothers and 20% in controls from prior Indian literature. This gave a minimum of 146 participants per group. A sample of 160 per group (320 total) was enrolled to account for possible incomplete responses.

Study design and setting

This was a matched case-control study conducted over twelve months (May 2024 to April 2025) in the NICU and postnatal wards of a tertiary care teaching hospital in northern India.

Participants

Cases were 160 mothers aged 18–30 years whose neonates were admitted to the NICU due to preterm birth (gestational age <37 weeks) or low birthweight (<2.5 kg). Controls were 160 mothers of healthy term neonates (≥37 weeks gestation, birthweight ≥2.5 kg). Each case was matched 1:1 to a control on maternal age (±2 years) and socioeconomic status. Mothers with a pre-existing psychiatric diagnosis, major obstetric complications (eclampsia, placenta praevia), or unwillingness to participate were excluded. All assessments were conducted at the routine postpartum day 30 follow-up visit.

Measures

A structured interviewer-administered proforma was used to collect sociodemographic data (age, education, occupation, domicile, family type, socioeconomic status, marital relationship, history of domestic violence) and obstetric data (pregnancy planning, abortion history, sex of neonate, mode of delivery). PPD was assessed using the Edinburgh Postnatal Depression Scale (EPDS), a validated 10-item self-report questionnaire with scores ranging from 0 to 30, developed by Cox et al. (1987). A cutoff score of ≥10 was used to identify probable PPD, consistent with Indian validation studies and published NICU-based research.

Statistical analysis

Data were analysed using standard statistical methods. Categorical variables are presented as frequencies and percentages. Between-group differences were examined using the Pearson chi-square (χ^2) test. Odds ratios (OR) with 95% confidence intervals (CI) were calculated for the primary case-control comparison. Binary logistic regression was performed to identify independent predictors of PPD within the NICU group, with all variables significant on bivariate analysis ($P<0.05$) entered simultaneously. Results are reported as adjusted odds ratios (aOR) with 95% CI. Overall model fit was evaluated using the likelihood ratio chi-square test and Nagelkerke R^2 (a measure of the proportion of variance in the outcome explained by the model). $P<0.05$ was taken as the level of statistical significance.

RESULTS

Participant characteristics

A total of 320 mothers were enrolled: 160 NICU cases and 160 matched controls. Among cases, mean (SD) age was 23.2 (2.7) years (range 18–30); 106 (66.25%) were in the 18–24-year group. Controls were comparable in age [mean (SD) 23.4 (2.2) years; P=0.181]. Most mothers in both groups were homemakers [NICU: 144 (90%); controls: 149 (93.12%)]. Approximately 65% of NICU mothers were from rural areas and 58.12% lived in joint family households; neither proportion differed significantly between groups (Table I).

Two variables showed significant between-group differences. Domestic violence was reported by 16 NICU mothers (10%) compared with three controls (1.87%; $\chi^2=9.456$, P=0.002). Cesarean delivery was recorded in 134 NICU mothers (83.75%) versus 68 controls (42.5%; $\chi^2=58.480$, $P<0.001$), reflecting the preponderance of emergency and operative deliveries in the NICU cohort.

Table I. Sociodemographic and Obstetric Profile of Cases and Controls

Variable	Cases n (%) n=160	Controls n (%) n=160	Chi-square	P value

Age (years)				
18–24 years	106 (66.25)	117 (73.12)	1.790	0.181 NS
25–30 years	54 (33.75)	43 (26.88)	—	—
Religion				
Hindu	49 (30.63)	41 (25.62)	0.989	0.320 NS
Sikh	111 (69.38)	119 (74.38)	—	—
Education				
Primary school	26 (16.25)	36 (22.50)	2.012	0.365 NS
Secondary school	115 (71.88)	107 (66.88)	—	—
Graduate or above	19 (11.88)	17 (10.62)	—	—
Domicile				
Rural	104 (65.00)	97 (60.62)	0.656	0.418 NS
Urban	56 (35.00)	63 (39.38)	—	—
Family type				
Joint family	93 (58.12)	98 (61.25)	0.325	0.569 NS
Nuclear family	67 (41.88)	62 (38.75)	—	—
Socioeconomic status				
Lower	69 (43.12)	54 (33.75)	2.971	0.085 NS
Middle	91 (56.88)	106 (66.25)	—	—
Occupation				
Homemaker	144 (90.00)	149 (93.12)	1.011	0.315 NS
Employed	16 (10.00)	11 (6.88)	—	—
Marital relationship				
Cordial	149 (93.12)	154 (96.25)	1.553	0.213 NS
Discordant	11 (6.88)	6 (3.75)	—	—
Domestic violence				
Present	16 (10.00)	3 (1.87)	9.456	0.002 S*
Absent	144 (90.00)	157 (98.12)	—	—
Pregnancy planning				
Planned	108 (67.50)	120 (75.00)	2.197	0.138 NS
Unplanned	52 (32.50)	40 (25.00)	—	—
Previous abortion history				
Present	49 (30.63)	61 (38.12)	1.995	0.158 NS
Absent	111 (69.38)	99 (61.88)	—	—
Sex of neonate				
Male	88 (55.00)	87 (54.37)	0.000	1.000 NS
Female	72 (45.00)	73 (45.62)	—	—
Mode of delivery				
Normal vaginal delivery	26 (16.25)	92 (57.50)	58.480	<0.001 S*

Cesarean section	134 (83.75)	68 (42.50)	—	—

NS: not significant; S: statistically significant (P<0.05); χ^2: chi-square; NICU: neonatal intensive care unit.*

Prevalence of postpartum depression

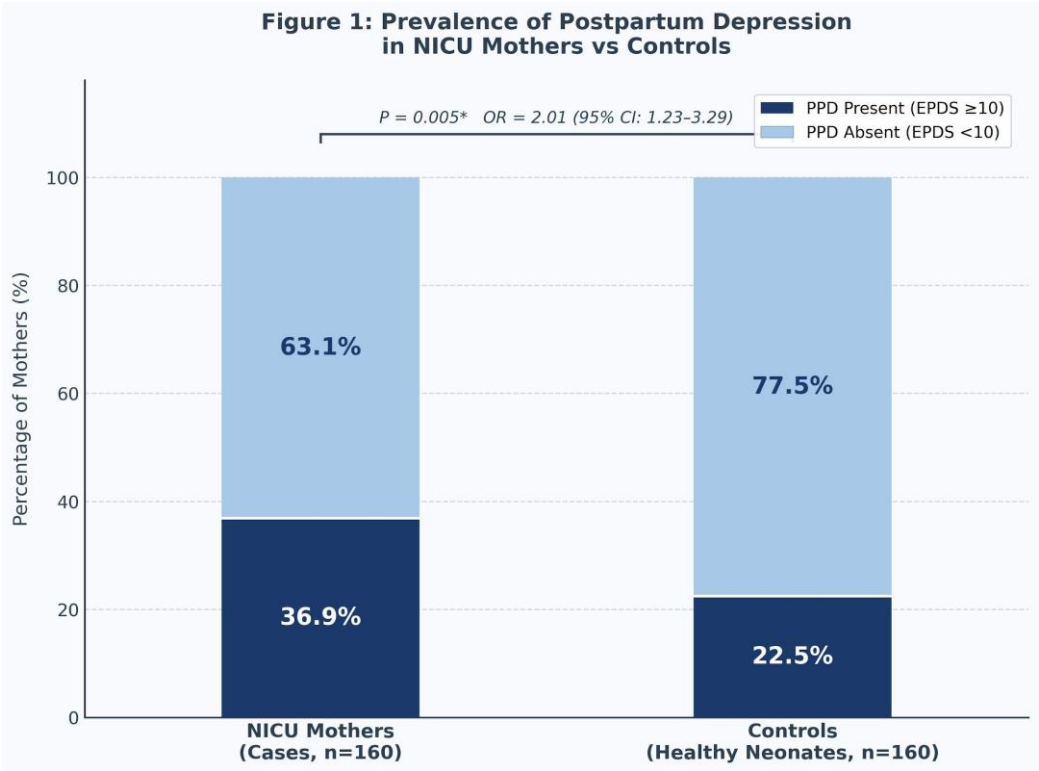
At the day-30 EPDS assessment, 59 NICU mothers (36.9%) scored ≥10 compared with 36 controls (22.5%; χ^2=7.920, P=0.005; Table II). NICU mothers were twice as likely to screen positive for PPD (OR 2.01, 95% CI: 1.23–3.29). The 22.5% control-group rate is consistent with the national Indian estimate reported by Upadhyay et al. (2017). Among NICU mothers who screened positive, the most commonly reported symptoms were persistent low mood, loss of interest in daily activities, and difficulty coping with routine tasks.

Table II. Prevalence of Postpartum Depression in Cases and Controls

Group	Total (n)	EPDS ≥ 10 (n)	Prevalence (%)	OR (95% CI)	P value
NICU mothers (cases)	160	59	36.9	2.01 (1.23–3.29)	0.005*
Controls (healthy neonates)	160	36	22.5	Reference	—

*EPDS: Edinburgh Postnatal Depression Scale; OR: odds ratio; CI: confidence interval. *P<0.05.*

Figure 1. Prevalence of postpartum depression (EPDS ≥ 10) in NICU mothers versus controls at postpartum day 30 (OR 2.01, 95% CI: 1.23–3.29; P = 0.005).



EPDS: Edinburgh Postnatal Depression Scale; NICU: neonatal intensive care unit; OR: odds ratio; CI: confidence interval.

Factors associated with postpartum depression among NICU mothers

Within-case analysis comparing the 59 depressed and 101 non-depressed NICU mothers identified five factors that reached statistical significance (Table III). Rural domicile showed the strongest association: 50 of 104 rural NICU mothers (48.1%) were depressed versus 9 of 56 urban mothers (16.1%; χ^2=16.018, P<0.001). Depression rates were significantly higher in joint families (48.4%) compared with nuclear families (20.9%; χ^2=12.645, P<0.001). An inverse gradient was observed with education level, with rates of 61.5% among mothers with only primary schooling, 34.8% among those with secondary education, and 15.8% among graduates (χ^2=10.640, df=2, P=0.005).

Female neonate sex was associated with higher depression rates compared with male neonate sex (45.8% vs 29.5%; χ^2=4.513, P=0.034). Cesarean delivery was associated with depression in 40.3% of cases compared with 19.2% after normal vaginal delivery (χ^2=4.152, P=0.042). Maternal age, socioeconomic status, occupation, pregnancy planning, and prior abortion history did not reach statistical significance within the NICU group.

Table III. Factors Associated with Postpartum Depression Among NICU Mothers (Depressed n=59 vs Non-depressed n=101)

Variable / Category	Depressed n=59 (%)	Non-depressed n=101 (%)	Chi-square	P value
Domicile				
Rural (n=104)	50 (48.1)	54 (51.9)	16.018	<0.001 S*
Urban (n=56)	9 (16.1)	47 (83.9)	—	—
Family type				
Joint family (n=93)	45 (48.4)	48 (51.6)	12.645	<0.001 S*
Nuclear family (n=67)	14 (20.9)	53 (79.1)	—	—
Education				
Primary (n=26)	16 (61.5)	10 (38.5)	10.640 (df=2)	0.005 S*
Secondary (n=115)	40 (34.8)	75 (65.2)	—	—
Graduate or above (n=19)	3 (15.8)	16 (84.2)	—	—
Sex of neonate				
Female (n=72)	33 (45.8)	39 (54.2)	4.513	0.034 S*
Male (n=88)	26 (29.5)	62 (70.5)	—	—
Mode of delivery				
Cesarean (n=134)	54 (40.3)	80 (59.7)	4.152	0.042 S*
Normal vaginal delivery (n=26)	5 (19.2)	21 (80.8)	—	—
Maternal age group				
18–24 years (n=106)	35 (33.0)	71 (67.0)	2.006	0.157 NS
25–30 years (n=54)	24 (44.4)	30 (55.6)	—	—
Socioeconomic status				
Lower (n=69)	25 (36.2)	44 (63.8)	0.185	0.667 NS
Middle (n=91)	30 (33.0)	61 (67.0)	—	—
Pregnancy planning				
Planned (n=108)	45 (41.7)	63 (58.3)	3.278	0.070 NS
Unplanned (n=52)	14 (26.9)	38 (73.1)	—	—
Prior abortion history				
Present (n=49)	20 (40.8)	29 (59.2)	0.471	0.492 NS
Absent (n=111)	39 (35.1)	72 (64.9)	—	—
Occupation				
Homemaker (n=144)	50 (34.7)	94 (65.3)	2.867	0.090 NS
Employed (n=16)	9 (56.3)	7 (43.7)	—	—

Row percentages used throughout. S: statistically significant (P<0.05); NS: not significant; df: degrees of freedom.*

Binary logistic regression

Binary logistic regression was performed with all five bivariately significant variables entered simultaneously. All five remained independently significant after mutual adjustment (Table IV). The overall model was statistically significant (χ^2=47.255, df=5, P<0.001) and explained approximately 34.9% of the variance in PPD among NICU mothers (Nagelkerke R^2=0.349). Rural residence conferred the highest adjusted risk (aOR 5.57, 95% CI: 2.19–14.20, P<0.001), followed by cesarean delivery (aOR 5.54, 95% CI: 1.60–19.10, P=0.007), female neonate sex (aOR 2.91, 95% CI: 1.32–6.43, P=0.008), and joint family type (aOR 2.70, 95% CI: 1.20–6.04, P=0.016). Higher education was independently protective (aOR 0.33 per one-level increase, 95% CI: 0.14–0.75, P=0.008).

Table IV. Binary Logistic Regression — Independent Predictors of PPD Among NICU Mothers (n=160)

Variable	β	SE	Wald χ^2	df	P value	aOR	95% CI
Rural residence	1.718	0.477	12.966	1	<0.001*	5.57	2.19–14.20
Joint family type	0.992	0.411	5.812	1	0.016*	2.70	1.20–6.04
Education level†	−1.112	0.419	7.055	1	0.008*	0.33	0.14–0.75
Female neonate sex	1.069	0.404	7.016	1	0.008*	2.91	1.32–6.43
Cesarean delivery	1.711	0.632	7.336	1	0.007*	5.54	1.60–19.10

**P<0.05. †Education coded as ordinal (0=primary, 1=secondary, 2=graduate or above); aOR per one-level increase; aOR<1 indicates higher education is protective. Model χ^2=47.255 (df=5, P<0.001); Nagelkerke R^2=0.349. aOR: adjusted odds ratio; CI: confidence interval; SE: standard error; df: degrees of freedom.*

DISCUSSION

In this matched case-control study, 36.9% of NICU mothers screened positive for PPD at one month postpartum, compared with 22.5% of matched controls (OR 2.01, 95% CI: 1.23–3.29; P=0.005). This figure exceeds the national Indian baseline of approximately 22% (Upadhyay et al., 2017; Panolan & Thomas, 2024), and falls within the wide range of 12.1–68% reported by Vigod et al. (2010) in their systematic review of mothers of preterm and low-birthweight infants. US-based NICU studies have reported rates of 26–36% (Cherry et al., 2016; Moreyra et al., 2021); our results sit at the upper end of this range, which may reflect the higher socioeconomic adversity and obstetric risk profile of the present tertiary care cohort.

The NICU environment leads to substantial psychological stress on mothers. Emergency delivery, postoperative pain, hormonal changes, disrupted sleep, and separation from the newborn during the earliest days of life all contribute to this burden (Vigod et al., 2010; Yahya et al., 2021). Hofheimer et al. (2024) reported that depression risk in NICU mothers does not improve at discharge but persists even beyond it. Gateau et al. (2021) found that maternal depression following discharge from the NICU independently predicts poorer developmental outcomes in the neonates. When left untreated, PPD can also reduce breastfeeding, decrease engagement in kangaroo care, and affect neurodevelopment of child. (O'Hara & McCabe, 2016; Upadhyay et al., 2017).

Rural residence was the major independent predictor of PPD (aOR 5.57), with rural NICU mothers had nearly three times the crude depression rate of their urban counterparts (48.1% vs 16.1%). Rural women travelling to a tertiary care NICU often leave behind other children and all the domestic responsibilities, have limited access to health related information, and receive less social support during recovery (Rajeev et al., 2024; Panolan & Thomas, 2024). Chandran et al. (2002) identified social isolation as a key pathway between psychosocial adversity and postpartum depression in rural Tamil Nadu women, and a similar dynamic is likely at work in the present cohort.

The link between joint family residence and higher depression rates (48.4% vs 20.9%) requires careful interpretation. In traditional Indian culture, joint families are often assumed to be supportive. However, when a neonate is sick, preterm, or female, the mother in a joint household may face severe criticism from in-laws, which heightened pressure to fulfil gender-role expectations, and diminished attention from her spouse (Chandran et al., 2002; Kale et al., 2019). Kale et al. (2019) reported a comparable finding in a Mumbai tertiary centre, where joint family membership did not protect against PPD.

Looking at education, depression rates fell steadily as education level rose — from 61.5% in mothers with only primary schooling down to 15.8% in graduates. This pattern is consistent with what others have reported. Better-educated women generally understand their symptoms earlier, know where to seek help, and feel less hesitant about doing so (Upadhyay et al., 2017; Panolan & Thomas, 2024).

The higher depression rate among mothers of female neonates (45.8% vs 29.5%) is well known in the context of son preference prevalent in northern India. When a female birth accompanied by prematurity or illness, the mother may face

negative reactions from family members, concerns over future dowry obligations, and social disapproval (Upadhyay et al., 2017; Rajeev et al., 2024). A similar pattern was reported by Sheela and Venkatesh (2016) in a southern Indian hospital setting.

PPD was present in 40.3% of mothers who delivered by cesarean, compared to 19.2% in those who had a normal vaginal delivery. Ning et al. (2024) in their meta-analysis of 18 studies involving 844,328 women showed that cesarean delivery independently increases PPD risk (aOR 1.12, 95% CI: 1.04–1.20), with emergency cesarean carrying the highest risk (OR 1.20). In our study, 83.75% of NICU mothers had cesarean delivery, most of them emergency procedures. Pain after surgery, difficulty in moving around, and not being able to hold the baby immediately after birth likely all play a role here (Agarwal et al., 2023).

Domestic violence was significantly more prevalent among NICU mothers (10% vs 1.87%; P=0.002). While it did not reach independent significance in the logistic regression within the NICU group — likely due to small cell numbers — it remains a well-documented risk factor for PPD in the broader literature (Upadhyay et al., 2017; Panolan & Thomas, 2024) and warrants prospective evaluation in larger multicentre studies.

Interestingly, several factors that usually predict PPD in routine postnatal settings — such as maternal age, occupation, socioeconomic status, pregnancy planning, and abortion history — did not show any significant association within our NICU group. Gateau et al. (2021) found something similar, noting that distress in NICU mothers cut across economic lines. This probably happens because the stress of having a critically ill newborn is so overwhelming that factors like a stable income or steady job simply stop being protective in that situation.

These results carry clear implications for clinical practice. Ahlqvist-Björkroth et al. (2019) demonstrated that a structured health related programme delivered by NICU nursing staff significantly decreased maternal depression scores at two months postpartum, confirming that the risk is modifiable. Cherry et al. (2016) and Moreyra et al. (2021) have shown that embedding EPDS screening into routine NICU workflows is feasible and substantially improves detection rates. Based on the present findings, we recommend integrating EPDS screening at NICU admission and discharge, with targeted follow-up for mothers from rural areas, joint family households, those with low educational attainment, mothers of female neonates, and those who have undergone cesarean section.

Limitations

This study has some limitations worth mentioning. Since data were collected from one centre only, findings may not generalise to other hospitals or regions. Mothers were assessed at day 30 alone, so what happened to their symptoms after NICU discharge remains unknown. The EPDS identifies probable cases but is not a diagnostic tool - a structured interview like the MINI or SCID would be needed to confirm depression formally. Future studies should include multiple centres, longer follow-up, and formal diagnostic assessment.

CONCLUSION

To conclude, more than one in three NICU mothers in our study had probable PPD at one month after delivery, with nearly double the odds seen in controls. Rural residence, joint family type, low education, female baby sex, and cesarean section came out as independent risk factors on regression analysis. We suggest that EPDS screening should be made routine at NICU admission and discharge, with extra attention given to mothers who fall into these high-risk groups.

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