



Mode of Delivery and Postpartum Depression: A Cohort Study

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Abstracts

Background There are many established risk factors for postpartum depression (PPD). It is controversial whether the mode of delivery is associated with PPD. This prospective study assessed the prevalence of PPD among women who delivered normally versus cesarean section and the association between sociodemographic factors and clinical factors with PPD.

Materials and Methods This prospective cohort study was conducted in the Department of Obstetrics and Gynecology, JIPMER Hospital Puducherry, from July 2019 to June 2020. Women without high risk factors for PPD were included. The sample size was 121 in the normal delivery (ND) group and 121 in the cesarean section (CS) group. PPD screening was conducted within one week of delivery and again after six weeks of delivery using a validated Tamil or English version of the Edinburgh Postnatal Depression Scale (EPDS). A score of EPDS score ≥ 13 was considered positive for PPD. Univariate and multivariable analysis was done to find out the association.

Results The overall prevalence of PPD was 27.27%. The prevalence of PPD was higher in the CS (34.71%) than in the ND group (19.83%). PPD was found 2.1 times (OR-2.1, CI 1.2–3.8) in the CS group within one week and 2.5 times (RR-2.5, CI 1.5–3.9) at six weeks of delivery, respectively. Among the social factors, a history of domestic abuse or violence was found to be significantly associated with PPD by both univariate and multivariable analysis.

Conclusion PPD was twice higher among women in the CS than in the ND group. Domestic abuse or violence was very highly significantly associated with PPD.

Keywords Postpartum depression (PPD) · Edinburgh postnatal depression scale (EPDS) · Cesarean delivery · Normal delivery · Domestic abuse · Domestic violence

Introduction

Postpartum depression (PPD) is a prevalent mood disorder among postnatal mothers and a significant public health problem, affecting approximately 10–15% of women

globally [1]. PPD affects maternal and child bonding, marital relationship, and the family environment. Hence, it is important to diagnose early and manage it effectively. Untreated PPD can have adverse long-term effects on women and is reported to be the precursor of chronic recurrent depression. For her children, a mother's ongoing depression can contribute to emotional, behavioral, cognitive, and interpersonal problems in later life [2, 3].

There are many risk factors for PPD, like parity, gender of the baby, medical disorders causing life-threatening problems, obstetrical conditions, and social aspects, including lifestyle [4]. There is a controversy in the literature on whether a mode of delivery is a risk factor for PPD. Hence, this study was undertaken with the primary objective of finding out the association of PPD with the mode of delivery. The secondary objective was to determine women's sociodemographic and clinical profiles with PPD.

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Material and Methods

This prospective cohort study was conducted in the Department of Obstetrics and Gynecology, JIPMER Hospital, Puducherry, after approval by the Institutional Ethical Committee (IEC No.-JIP/IEC/2019/0156). The study period was from July 2019 to June 2020. JIPMER is a tertiary-level teaching hospital situated in the Union Territory of Puducherry on the Southeast coast of India, 165 km from Chennai catering to both patients from Puducherry and neighboring districts of Tamil Nadu. Being an institution of national importance with the availability of super specialty care, it attracts complicated cases referred from other hospitals in the neighboring areas.

Postpartum women more than 18 years of age who delivered at JIPMER were included after informed written consent. Exclusion criteria were women with a known case of mood disorders or psychiatric illness, medical complications like anemia, cardiac disease, hypertension, renal disease, pulmonary disease, thyroid disorders, diabetes mellitus, and obstetric complications like APH or PPH, multiple pregnancies, previous cesarean section, and eclampsia. All eligible women fulfilling the criteria were enrolled in the study consecutively till the required sample size was met.

The study included two groups of women: one who had normal delivery (ND) and the other who underwent cesarean section (CS). Each group had a sample size of 121 as calculated by using Open Epi version-3 (Fleiss method), considering the incidence of postpartum depression as 15% in women with normal delivery and 30% in those undergoing cesarean section, with the power of study at 80% and the alpha-error for the difference between the study groups as 0.05.

Sociodemographic data collected included age, BMI, socioeconomic status (education level, occupation, per capita income), religion, type of family (nuclear/joint), and locality (rural and urban). Relevant obstetric history included planning before pregnancy (planned/unplanned pregnancy), parity, gestation age at delivery, mode of delivery, sex of baby, birth weight, and neonatal outcome. The relevant history of past psychiatric illness, domestic abuse/violence, and family history of psychiatric disease were noted.

In both groups, PPD screening was carried out within one week of delivery (before discharging the patient) and again at six weeks of delivery using the validated Tamil or English version of the Edinburgh Postnatal Depression Scale (EPDS) [5], depending on the patient's vernacular language. EPDS is the screening tool for PPD, ten-item self-reporting scale specifically designed to screen for PPD in community samples. Each item is scored on a four-point scale (from 0 to 3), with a total score ranging from 0 to 30. Women were categorized into two groups: EPDS scores = 13 at risk of depression and EPDS < 12 unlikely to be depressed.

Statistical Analysis

All data have entries in the hard copy of case report forms (CRFs) and MS Excel. Data analysis was performed using STATA version 17.0. Descriptive statistics described the study population's sociodemographic and clinical characteristics—the univariate analysis using log-binomial regression to identify the association of risk factors with PPD. The variables with a *p*-value of < 0.2 were included in the model for multivariable analysis. In multivariable analysis, the *p*-value of < 0.05 was considered for statistical significance for association.

Results

Table 1 shows the sociodemographic characteristics of the postpartum women in both groups. The mean age of the subjects was 25.9 years in the normal delivery (ND) group and 26.9 years in the cesarean section (CS) group. There is no significant difference between the groups in BMI, socioeconomic status (SES), occupation, religion, domestic abuse or violence, and type of family. Significantly more women belonged to the urban area and were graduates in the normal delivery (ND) group.

Table 2 shows that the clinical profile of both groups was similar in the characteristics assessed, such as planned pregnancy, gestational age at delivery, and sex of the baby. The groups differed in that significantly more women were primiparous and delivered babies with normal birth weights in the ND group compared to the CS group. CS group had more babies requiring NICU admission because of low birth weight and preterm.

EPDS Scores within One Week of Delivery

EPDS \geq 13 was found to be 2.1 times (OR-2.1, CI 1.1–3.8, *p*-value-0.01) higher in the women who underwent CS as compared to those who had normal delivery (Table 3).

The association of EPDS scores and other sociodemographic and clinical characteristics is shown in Tables 4 and 5, as determined by univariate and multivariable analysis. In univariate analysis, BMI between 25 and 29.9 was protective against PPD. A history of domestic abuse or violence was associated with 7.8 times (CI 4.16–14.65) higher risk of postpartum depression, and the risk was 1.4 times (CI 0.82–2.5) among women who delivered male-gender babies (Table 4).

Mode of delivery, history of domestic abuse or violence, and parity were significantly associated with PPD (*p*-value of < 0.2) and, therefore, were included in the multivariable model. In multivariable analysis, the mode of delivery

Table 1 Sociodemographic characteristics of the postnatal women with normal and cesarean delivery (N=242)

Characteristics		Normal delivery (ND) N (%)	Cesarean Section (CS) N (%)	p-value
Age	≤ 20 years	10 (8.26)	3 (2.48)	0.122
	21–25 years	50 (41.32)	44 (36.36)	
	26–30 years	45 (37.19)	58 (47.93)	
	≥ 31 years	16 (13.22)	16 (13.22)	
	Mean age (SD)	25.92 (4.04)	26.95 (3.88)	
Body mass index (BMI)	Below 18.5	14 (11.57)	6 (4.96)	0.088
	Between 18.5–24.9	62 (51.24)	79 (65.29)	
	Between 25–29.9	36 (29.75)	27 (22.31)	
	More than 30	9 (7.44)	9 (7.44)	
Education	Up to 12th class	18 (14.88)	39 (32.23)	0.006
	Graduate	60 (49.59)	45 (37.19)	
	Postgraduate/diploma	43 (35.54)	37 (30.58)	
Occupation	Working (Govt/private)	36 (29.75)	26 (21.49)	0.145
	Homemaker	85 (70.25)	95 (78.51)	
Locality	Rural	53 (43.80)	70 (57.85)	0.029
	Urban	68 (56.20)	51 (42.15)	
Socioeconomic status	Lower	32(26.45)	46(38.02)	0.29
	Upper lower	36(29.75)	38(31.40)	
	Lower middle	24(19.83)	26(21.49)	
	Upper middle	17(14.05)	5(4.13)	
	Upper	12(9.92)	6(4.96)	
Religion	Christian	3 (2.48)	2 (1.65)	1.000
	Hindu	115 (95.04)	116 (95.87)	
	Muslim	3 (2.48)	3 (2.48)	
Type of family	Nuclear	39 (32.23)	30 (24.79)	0.200
	Joint	82 (67.77)	91 (75.21)	
History of domestic abuse or violence	Present	35 (28.93)	42 (34.71)	0.334
	Absent	86 (71.07)	79 (65.29)	

Table 2 Obstetrics and fetal outcomes of the postnatal women with normal and cesarean delivery (N=242)

Characteristics		Normal delivery (ND) N (%)	Cesarean section (CS) N (%)	p-value
Planning before pregnancy	Planned	84 (69.42)	90 (74.38)	0.198
	Unplanned	33 (27.27)	23 (19.01)	
	Infertility treated	4 (3.31)	8 (6.61)	
Parity	Primipara	87 (71.90)	66 (54.55)	0.005
	Multipara	34 (28.10)	55 (45.45)	
Gestational age at delivery	Up to 37 weeks	9 (7.44)	20 (16.53)	0.086
	37- 40 weeks	85 (70.25)	79 (65.29)	
	> 40 weeks	27 (22.31)	22 (18.18)	
Sex of baby	Male	57 (47.11)	59 (48.76)	0.797
	Female	64 (52.89)	62 (51.24)	
Birth weight	Low birth weight ≤ 2.5 kg)	15 (12.40)	31 (25.62)	0.002
	Normal (2.6–3.5 kg)	102 (84.30)	78 (64.46)	
	Macrosomia (> 3.5 kg)	4 (3.31)	12 (9.92)	
Neonatal complications/ NICU admission	Preterm/LWB	1 (0.83)	12 (9.92)	0.003
	CMF	4 (3.31)	2 (1.65)	
	Respiratory distress	3 (2.48)	7 (5.79)	
	No admission/complications	113 (93.39)	100 (82.64)	

Table 3 Mode of delivery and immediate postnatal depression ($N=242$)

Mode of delivery	EPDS ≥ 13	Odds ratio (OR)	95% Confidence interval (CI)	p -value
Normal delivery ($N=121$)	24(19.83%)	Ref	1.199–3.848	0.010
Cesarean section ($N=121$)	42(34.71%)	2.148		

remained an independent predictor of PPD; the CS group had twice (aOR-2.0, CI 1.0–3.9, p -value-0.37) the risk compared to the ND group. Domestic abuse or violence increased the risk eight times (aOR-8.5, CI 4.4–16.4, p -value-0.000), and PPD was found more in primipara (Table 5).

EPDS Scores at or after Six Weeks of Delivery

EPDS ≥ 13 was more than two times (RR-2.5, CI 1.5–3.9, p -value- <0.001) higher in the CS group compared to the ND group after six weeks post-delivery (Table 6).

In univariate analysis, women with a history of domestic abuse or violence had 2.5 times (RR-2.5, CI 1.7–3.7, p -value- <0.001) higher risk, and the risk was 1.5 times (CI 1.0–2.2) among women who delivered male-gender babies (Table 7).

However, in multivariable analysis, mode of delivery remained an independent predictor of PPD; the CS group had 1.6 times (RR-1.6, CI 1.0–2.3, p -value- <0.014) risk compared to the ND group. Domestic abuse increased the risk 4.1 times (RR-4.1, CI 2.7–6.3, p -value- <0.001) six weeks after delivery (Table 8).

Discussion

Women are more prone to depression due to abrupt hormonal withdrawal following delivery, and the underlying mood disorders may also manifest during the postpartum period. There are three common forms of postpartum mood disorders: the blues (baby blues, maternity blues), postpartum depression (PPD), and puerperal (postpartum or postnatal) psychosis, each of which differs in its prevalence, clinical presentation, and management. Women experiencing baby blues recover quickly; PPD tends to be longer and affects the mother and her relationship with the infant and the family. Maternal brain response and behavior are compromised in PPD [6]. PPD is most common as pregnancy itself predisposes for this; in addition, the environment where women deliver, the mode of delivery, and the care and affection women receive also influence the development of PPD. Usually, PPD manifests within one week of delivery, usually women cope with it and symptoms disappear by six weeks, but in a few women, symptoms may appear after one week or as

late as six weeks. The hypothalamic–pituitary–adrenal axis (HPA) is involved in the disease process of PPD. The HPA axis causes the release of cortisol in trauma and stress, and if the HPA axis function is not normal, the response decreases the release of catecholamines leading to a poor stress response. The HPA axis releasing hormones increases during pregnancy and remains elevated up to 12 weeks after childbirth [6].

Literature search reveals that one in six women experience PPD. We found that 66 of 242 women had EPDS scores ≥ 13 ; the overall prevalence of PPD in this cohort was 27.27%. A systemic review and meta-analysis of Indian studies by Upadhyay et al. [7] reported a prevalence range of 3–47% and concluded that the average prevalence of PPD was 19%.

Among the risk factors for PPD, the mode of delivery is recognized as one of the major risk factors in recent times, and controversy still revolves around it. In the present study, the CS group was associated with an increased risk of PPD in both univariate analyses (OR-2.148, 95% CI-1.199–3.848) and multivariable analysis (aOR -2.015, 95% CI-1.041–3.900). PPD was two times more common in the CS group. The high prevalence of PPD in the CS group may be due to underlying anxiety, postoperative pain, anesthetic complications, breastfeeding issues, and sleep disturbances.

In the prospective study conducted by Guin G and Rawat S [8] in India, PPD was reported to be 2.26 times more in women who underwent CS. The cross-sectional study of Sarah SB et al. [9] from Iran, which analyzed PPD by Beck depression inventory data for the mode of delivery, reported a high prevalence of PPD (33.4%) in women who underwent emergency CS. PPD was low among those who had ND (7.2%) and those who underwent elective CS (8%). The present study did not analyze the difference between emergency CS and elective CS. Most often, elective CS is done as an emergency due to the non-availability of an OT table for elective CS because of overcrowding in our hospital.

A prospective study by Liana Ples et al. [10] in 148 primiparous women in Romania showed no significant difference in the incidence of PPD for the mode of delivery. Compared to developing countries, the lower incidence can be due to better facilities, post-delivery care, and social support.

Table 4 Univariate analysis of the association between immediate postnatal depression with sociodemographic characteristics, obstetrics, and fetal outcome ($N=242$)

Characteristics		Normal delivery (ND) <i>N</i> (%)	Cesarean section (CS) <i>N</i> (%)	Odds ratio (OR)	95% Confidence interval (CI)	<i>p</i> -value
Age	≤20 years	10 (8.26)	3 (2.48)	1.875	0.474–7.410	0.900
	21–25 years	50 (41.32)	44 (36.36)	1.086	0.432–2.732	0.180
	26–30 years	45 (37.19)	58 (47.93)	1.120	0.450–2.783	0.240
	≥31 years	16 (13.22)	16 (13.22)	Ref	–	–
Body mass index (BMI)	Below 18.5	14 (11.57)	6 (4.96)	Ref	–	–
	Between 18.5–24.9	62 (51.24)	79 (65.29)	0.467	0.179–1.214	0.118
	Between 25–29.9	36 (29.75)	27 (22.31)	0.287	0.097–0.848	0.024
	More than 30	9 (7.44)	9 (7.44)	0.611	0.163–2.282	0.464
Education	Up to 12th class	18 (14.88)	39 (32.23)	Ref	–	–
	Graduate	60 (49.59)	45 (37.19)	1.116	0.531–2.345	0.770
	Postgraduate/Diploma	43 (35.54)	37 (30.58)	1.316	0.609–2.842	0.484
Occupation	Working (Govt./private job)	36 (29.75)	26 (21.49)	Ref	0.623–2.365	0.568
	Homemaker	85 (70.25)	95 (78.51)	1.214		
Locality	Urban	68(56.20)	51(42.15)	Ref	0.589–1.829	0.896
	Rural	53(43.80)	70(57.85)	1.038		
Socioeconomic status (SES)	Lower	32(26.45)	46(38.02)	1.021	0.325–3.204	0.971
	Upper lower	36(29.75)	38(31.40)	0.835	0.261–2.666	0.762
	Lower middle	24(19.83)	26(21.49)	1.339	0.409–4.384	0.629
	Upper middle	17(14.05)	5(4.13)	0.577	0.129–2.578	0.472
	Upper	12(9.92)	6(4.96)	Ref	–	–
Religion	Christian	3 (2.48)	2 (1.65)	No case of depression detected		
	Hindu	115 (95.04)	116 (95.87)	1.724	0.362–8.198	0.493
	Muslim	3 (2.48)	3 (2.48)	Ref		
Type of family	Nuclear	39 (32.23)	30 (24.79)	Ref	0.637–2.291	0.561
	Joint	82 (67.77)	91 (75.21)	1.208		
History of domestic abuse or violence	Present	35 (28.93)	42 (34.71)	7.808	4.160–14.654	0.000
	Absent	86 (71.07)	79 (65.29)	Ref		
Planning before pregnancy	Planned	84(69.42)	90(74.38)	Ref		
	Unplanned	33(27.27)	23(19.01)	1.249	0.643–2.425	0.510
	Infertility treated	4(3.31)	8(6.61)	1.433	0.411–4.989	0.572
Parity	Primipara	87(71.90)	66(54.55)	1.515	0.850–2.699	0.158
	Multipara	34(28.10)	55(45.45)	Ref		
Gestational age at delivery	Up to 37 weeks	9(7.44)	20(16.53)	0.962	0.458–3.780	0.610
	37–40 weeks	85(70.25)	79(65.29)	0.777	0.654–2.942	0.393
	>40 weeks	27(22.31)	22(18.18)	Ref	–	–
Sex of the baby	Male	57(47.11)	59(48.76)	1.44	0.815–2.541	0.208
	Female	64(52.89)	62(51.24)	Ref		
Birth weight of the baby	Low (≤2.5 kg)	15(12.40)	31(25.62)	0.962	0.281–3.291	0.951
	Normal (2.6–3.5 kg)	102(84.30)	78(64.46)	0.777	0.256–2.354	0.656
	Macrosomia(>3.5 kg)	4(3.31)	12(9.92)	ref	–	–
Neonatal complications/NICU admission	Preterm/LWB	1(0.83)	12(9.92)	0.765	0.203–2.876	0.692
	CMF	4(3.31)	2(1.65)	0.51	0.058–4.456	0.543
	Respiratory distress	3(2.48)	7(5.79)	0.637	0.131–3.088	0.576
	No admission/complications	113(93.39)	100(82.64)	Ref	–	–

Table 5 Multivariable analysis of association between immediate postnatal depression with sociodemographic characteristics, obstetrics, and fetal outcome ($N=242$)

Characteristics		Adjusted odds ratio (aOR)	95% confidence interval (CI)	<i>p</i> -value
Mode of delivery	Normal delivery (ND)	Ref	1.041–3.900	0.037
	Cesarean section (CS)	2.015		
H/o domestic abuse or violence	Present	8.518	4.407–16.462	0.000
	Absent	Ref		
Parity	Primipara	1.760	0.894–3.464	0.101
	Multipara	Ref		

Table 6 Mode of delivery postnatal depression after six weeks ($N=242$)

Mode of delivery	EPDS ≥ 13	Relative risk (RR)	95% confidence interval (CI)	<i>p</i> -value
Normal delivery ($N=121$)	19(15.7%)	Ref	1.588–3.933	<0.001
Cesarean section ($N=121$)	50(41.32%)	2.500		

Risk of PPD at Six Weeks

In an observational cohort study in Pune District hospitals, India, by Doke et al. [11], an assessment of the difference in PPD among cesarean and vaginally delivered women at a 6-week follow-up was conducted. They found that the odds of having PPD are higher among women who had cesarean delivery than those who had a vaginal delivery. However, the study conducted by Asli Goker et al. [12] undertook screening for PPD at six weeks postnatal visit by EPDS score in Turkish women who underwent ND and CS. They did not find any significant difference in PPD for the mode of delivery. The present study found that at six weeks, 69 out of 242 women had an EPDS score ≥ 13 ; the overall prevalence of risk of PPD had increased to 28.51%. The prevalence was higher in the CS group (41.32%) compared to the ND group (15.7%). PPD was found 2.5 times more in the CS group, and this difference was again very highly significant.

Association of Other Factors and Risk of PPD

In the present study, we have found a very highly significant association between a history of domestic abuse or violence with PPD; women suffering from domestic abuse or violence immediately after delivery (OR-7.8; CI 4.16–14.65 and aOR-8.5; CI 4.40–16.46, p -value-0.000) as well as at six weeks post-delivery (RR-2.5; CI 1.7–3.7 and aRR-4.1; CI 2.7–6.3, p -value- <0.001). In the prospective study by Sheela and Shilpa [13], at St John's Medical College Bangalore, South India, among 1600 postpartum women, a history of domestic abuse or violence had a significant association with PPD. Similar findings were found in the study by Adamu AF and Adinew YM [14] among Ethiopian women. Beydoun Hind et al. [15] from Canada also reported similar observations. Such women

are already under mental trauma and lack emotional support leading to more depression.

The present study did not find a significant association of socioeconomic status (SES) with PPD. This finding is similar to a study done in India by Doke et al [11]. However, Dolbier et al. [16], among rural African and Non-Hispanic white women, found PPD more common in low socioeconomic women. Although PPD was detected higher in primipara (OR-1.5; CI 0.85–2.69 and aOR-1.76; CI 0.89–3.46, p -value-0.101) in the present study, we did not find the parity to have any significant association by logistic regression. The study by Nakamura et al. [17] was conducted among Japanese women, who stated that the prevalence of PPD is higher in primiparous women. However, they also did not find any significant association with parity. The contributing reasons may be the first-time mother's anxiety and self-doubt about newborn care and feeding issues.

There was no statistically significant association by multivariate logistic regression between gestational age at delivery, birth weight, APGAR score, and neonatal complication or NICU admission. The present study detected PPD more in women with male offspring (OR-1.4, CI 0.8–2.5, p value-0.208). However, there was no statistically significant association with baby gender. Similarly, a prospective study conducted in the North-Eastern United States from 2001 to 2018 by Cowell et al. [17] found that women giving birth to a male infant were more likely to develop depressive symptoms during the postnatal period, but the difference was not significant. In contrast, in a meta-analysis based on 38 studies in Indian mothers by Upadhyaya et al. [7], 25 reported having PPD among women with female offspring. In our country, there is a general preference for the male child. There is more likelihood of PPD among women having female offspring. However, the present study found PPD more common in women with male offspring though not statistically significant.

Table 7 Univariate analysis of association between postnatal depression after six weeks with sociodemographic characteristics, obstetrics, and fetal outcome ($N=242$)

Characteristics		Normal delivery (ND) <i>N</i> (%)	Cesarean section (CS) <i>N</i> (%)	Relative risk (RR)	95% confidence interval (CI)	<i>p</i> -value
Age	≤20 years	10 (8.26)	3 (2.48)	1.758	0.680–4.543	0.244
	21–25 years	50 (41.32)	44 (36.36)	1.507	0.737–3.083	0.261
	26–30 years	45 (37.19)	58 (47.93)	1.198	0.577–2.488	0.627
	≥31 years	16 (13.22)	16 (13.22)	Ref		
Body Mass Index (BMI)	Below 18.5	14 (11.57)	6 (4.96)	Ref	–	–
	Between 18.5–24.9	62 (51.24)	79 (65.29)	0.932	0.490–1.772	0.830
	Between 25–29.9	36 (29.75)	27 (22.31)	0.544	0.248–1.192	0.129
	More than 30	9 (7.44)	9 (7.44)	0.793	0.305–2.061	0.635
Education	Up to 12th class	18 (14.88)	39 (32.23)	Ref		
	Graduate	60 (49.59)	45 (37.19)	0.800	0.492–1.299	0.373
	Postgraduate/Diploma	43 (35.54)	37 (30.58)	0.862	0.521–1.427	0.565
Occupation	Working (Govt./ private job)	36 (29.75)	26 (21.49)	Ref	0.895–2.576	0.121
	Homemaker	85 (70.25)	95 (78.51)	1.518		
Locality	Urban	68(56.20)	51(42.15)	Ref	0.772–1.708	0.493
	Rural	53(43.80)	70(57.85)	1.148		
Socioeconomic status	Lower	32(26.45)	46(38.02)	1.376	0.443–4.269	0.580
	Upper lower	36(29.75)	38(31.40)	1.030	0.326–3.248	0.960
	Lower middle	24(19.83)	26(21.49)	1.011	0.303–3.363	0.986
	Upper middle	17(14.05)	5(4.13)	0.410	0.083–2.024	0.274
	Upper	12(9.92)	6(4.96)	Ref		
Religion	Christian	3 (2.48)	2 (1.65)	-		
	Hindu	115 (95.04)	116 (95.87)	1.619	0.454–5.761	0.457
	Muslim	3 (2.48)	3 (2.48)	Ref		
Type of family	Nuclear	39 (32.23)	30 (24.79)	Ref	0.830–2.182	0.228
	Joint	82 (67.77)	91 (75.21)	1.346		
History of domestic abuse or violence	Present	35 (28.93)	42 (34.71)	2.544	1.732–3.738	<0.001
	Absent	86 (71.07)	79 (65.29)	Ref		
Planning before pregnancy	Planned	84(69.42)	90(74.38)	Ref	–	–
	Unplanned	33(27.27)	23(19.01)	1.189	0.757–1.870	0.451
	Infertility treated	4(3.31)	8(6.61)	1.542	0.756–3.145	0.233
Parity	Primipara	87(71.90)	66(54.55)	Ref	0.767–1.710	0.505
	Multipara	34(28.10)	55(45.45)	1.146		
Gestational age at delivery	Up to 37 weeks	9(7.44)	20(16.53)	2.112	0.941–4.740	0.070
	37–40 weeks	85(70.25)	79(65.29)	1.942	0.991–3.804	0.053
	>40 weeks	27(22.31)	22(18.18)	Ref		
Sex of the baby	Male	57(47.11)	59(48.76)	1.535	1.026–2.298	0.037
	Female	64(52.89)	62(51.24)	Ref		
Birth weight of the baby	Low (≤2.5 kg)	15(12.40)	31(25.62)	0.927	0.439–1.956	0.843
	Normal (2.6–3.5 kg)	102(84.30)	78(64.46)	0.711	0.361–1.399	0.324
	Macrosomia(> 3.5 kg)	4(3.31)	12(9.92)	Ref		
Neonatal complications/NICU admission	Preterm/LWB	1(0.83)	12(9.92)	1.321	0.643–2.711	0.447
	CMF	4(3.31)	2(1.65)	0.572	0.094–3.468	0.544
	Respiratory distress	3(2.48)	7(5.79)	0.687	0.195–2.415	0.559
	No admission/complications	113(93.39)	100(82.64)	Ref	–	–

Table 8 Multivariable analysis of association between postnatal depression after six weeks with sociodemographic characteristics, obstetrics, and fetal outcome ($N = 242$)

Characteristics		Adjusted relative risk (aRR)	95% confidence interval (CI)	'p'-value
Mode of delivery	Normal delivery (ND)	Ref	1.099–2.340	0.014
	Cesarean section (CS)	1.604		
Occupation	Working (Govt./ private job)	Ref	0.850–1.853	0.255
	Homemaker	1.251		
H/o domestic abuse or violence	Present	4.171	2.731–6.368	< 0.001
	Absent	Ref		
Gestational age at delivery	Up to 37 weeks	1.416	0.904 – 2.216	0.128
	37–40 weeks	1.051		
	> 40 weeks	Ref		
Sex of the baby	Male	1.185	0.865 – 1.623	0.290
	Female	Ref		

Conclusion

Mode of delivery is found to be a significant risk factor for the development of PPD. Women who underwent cesarean section were twice at risk within one week and six weeks after delivery. Another important factor was domestic abuse or violence, which has highly significant association with PPD. Healthcare providers should provide adequate information and counseling regarding the necessity of cesarean section to the women and their family members. Tender-loving care (TLC) after delivery for mother and baby at home, especially by family members, can minimize the risk of PPD.

Strengths of the Study

A prospective cohort study with adequate sample size was conducted, and data were collected from obstetricians.

Limitations

The present study is a quantitative study using a predetermined questionnaire. A qualitative component would bring about the opinions of the postpartum women and the exact reason for PPD, which may influence the study results.

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Declarations

Conflict of interest The authors declare that there is no conflict of interest associated with this manuscript.

Consent for publication Written consent was obtained from all participants during the interview with the questionnaire in the patient information sheet and filed.

Ethical approval Ethical approval was obtained from the Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER) scientific advisory committee (JSAC) and Institutional Ethical Committee (IEC No.-JIP/IEC/2019/0156) before the commencement of the study.

Informed consent Written informed consent was obtained from all the women in the study in their vernacular language.

Human and animal participants The study involving human participants followed the ethical standards of the institute's ethical and research committee and the 1964 Helsinki Declaration and its later amendments.

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