

## A Cross-Sectional Statistical Study of Postpartum Depression among Mothers and Fathers

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### Abstract

Postpartum depression is an important mental health concern affecting both mothers and fathers during the postnatal period. While maternal depression has been widely studied, comparative statistical analyses involving both parents remain limited. This study presents a cross-sectional statistical investigation of postpartum depression using survey data covering emotional, cognitive, functional, and social dimensions. Standard statistical and multivariate methods are applied to examine symptom patterns and psychosocial associations, with particular emphasis on parenting-related isolation. The study aims to identify key symptom domains, clarify gender-based differences, and provide a statistical framework to support early screening and targeted postnatal mental health interventions.

**Keywords:** Postpartum depression; Mothers and fathers; Cross-sectional study; Psychosocial factors; Statistical analysis.

### 1. Introduction

Postpartum depression (PPD) is a significant mental health condition affecting parents during the postnatal period, with potential adverse consequences for family functioning and child development. Early research on postpartum depression primarily focused on mothers, emphasizing biological, psychological, and social changes associated with childbirth as key contributing factors [1,2]. Subsequent studies established that maternal postpartum depression negatively influences maternal well-being, parent–infant bonding, and early childhood development [3].

In recent years, research attention has expanded to include paternal postpartum depression, recognizing that fathers may also experience psychological distress

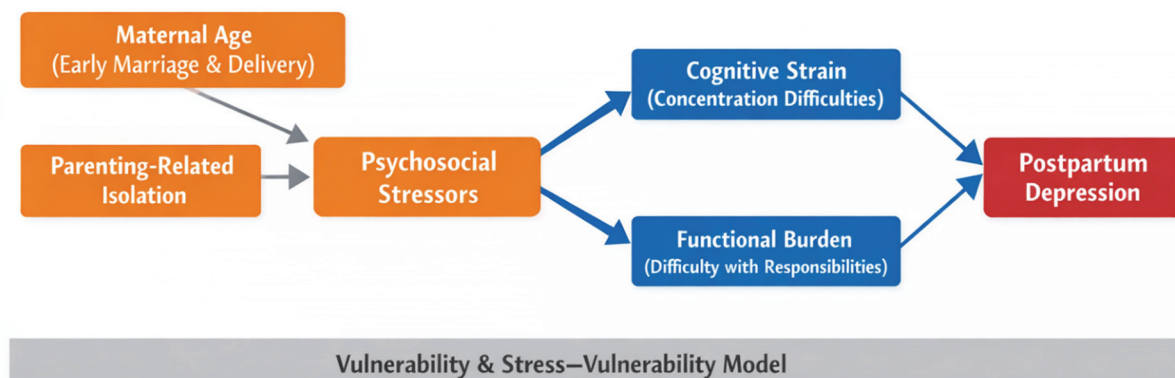
following childbirth. Empirical studies have reported that paternal postpartum depression often coexists with maternal depression and is associated with factors such as financial stress, role transition, caregiving responsibility, and limited emotional support [4,5]. Despite this evidence, paternal mental health remains under-screened, particularly in low- and middle-income countries, where sociocultural expectations may discourage emotional expression among fathers.

Psychosocial determinants have consistently emerged as strong predictors of postpartum depression among both parents. Reduced social support, marital dissatisfaction, sleep disruption, and parenting-related isolation have been shown to significantly increase depressive symptom severity [6,7]. In the Indian context, extended family dynamics, economic pressures, and limited access to mental health services further exacerbate postpartum psychological vulnerability [8].

Maternal demographic factors, particularly age at marriage and age at delivery, have also been shown to play a critical role in maternal and child health outcomes in rural India. A recent study conducted in Tirunelveli District reported that early age at marriage and delivery were associated with increased health risks for mothers and children, emphasizing the importance of age-related and contextual factors in maternal well-being [11]. These findings highlight the relevance of incorporating maternal age variables and rural demographic context when examining postpartum mental health outcomes.

From a methodological perspective, recent literature emphasizes that postpartum depression is a multidimensional construct rather than a single homogeneous condition. Studies employing multivariate and factor-analytic techniques have identified distinct but interrelated emotional, cognitive, functional, and social symptom domains [9,10]. Such approaches allow for a more nuanced understanding of symptom clustering and underlying latent structures, which is essential for effective screening and intervention.

Despite these advances, there remains a lack of Indian studies that simultaneously examine maternal and paternal postpartum depression within a unified statistical framework that integrates psychosocial factors and multivariate symptom structure. The present study seeks to address this gap by conducting a cross-sectional statistical analysis of postpartum depression among mothers and fathers, with particular emphasis on symptom dimensions and parenting-related isolation.



**Figure 1:** Conceptual Framework of Postpartum Depression.

The conceptual framework illustrating the relationships among demographic, psychosocial, cognitive, and functional factors influencing postpartum depression is presented in Figure 1.

## 2. Materials and Methods

This study adopted a cross-sectional descriptive design based on primary data. The study population comprised 1080 households in the Murugankurichi region of Palayamkottai, Tirunelveli District. From this population, 133 eligible mothers and fathers were selected using stratified random sampling. Data were collected through structured interviews and mailed questionnaires. All symptom variables were measured on ordinal scales and standardized prior to analysis. Descriptive statistics summarized symptom severity, while paired Wilcoxon signed-rank tests compared maternal and paternal symptoms. Binary logistic regression assessed the association between parenting-related isolation and elevated maternal depression. Principal Component Analysis and Pearson correlation analysis were used to examine latent symptom dimensions and interrelationships. All analyses were performed using R software.

## 3. Results

### 3.1 Descriptive Statistics

The mean maternal sadness score was 1.76, compared with 1.26 among fathers. Maternal irritability averaged 1.71, while the corresponding paternal mean was 1.47. Mean scores for maternal concentration difficulties and responsibility-related strain were 1.51 and 1.85, respectively, compared with 1.13 and 1.29 among fathers. Parenting-related isolation showed a higher mean among mothers (1.75) than fathers (0.92). These descriptive differences indicate a consistently higher symptom burden among mothers across domains.

Table 1. Summary statistics of postpartum depression symptoms

Symptom Domain	Mother (Mean $\pm$ SD)	Father (Mean $\pm$ SD)
Sadness / Depression	1.76 $\pm$ 1.19	1.26 $\pm$ 1.20
Irritability / Anger	1.71 $\pm$ 1.16	1.47 $\pm$ 1.25
Concentration Difficulty	1.51 $\pm$ 1.22	1.13 $\pm$ 1.19
Responsibility Strain	1.85 $\pm$ 1.26	1.29 $\pm$ 1.36
Parenting Isolation	1.75 $\pm$ 0.87	0.92 $\pm$ 1.27

### 3.2 Comparison of Maternal and Paternal Symptoms

Let  $d_i = X_{Mi} - X_{Fi}$  denote the paired difference between maternal and paternal symptom scores. The Wilcoxon signed-rank test statistic is given by

$$W = \sum_{i=1}^n \text{sign}(d_i) R_i,$$

where  $R_i$  represents the rank of  $|d_i|$ . The test assesses whether the median difference between paired observations is zero. Paired Wilcoxon signed-rank test results comparing maternal and paternal symptoms are summarized in Table 2.

**Table 2.** Comparison of Postpartum Depression Symptoms Between Mothers and Fathers

Symptom	Test	Test Statistic (V)	p-value
Sadness/Depression	Wilcoxon signed-rank	1039	< 0.001
Irritability/Anger	Wilcoxon signed-rank	977	0.038

Statistically significant differences were observed for sadness/depression and irritability/anger, with mothers reporting higher symptom levels. The distributional differences between mothers and fathers are illustrated in Figure 2.

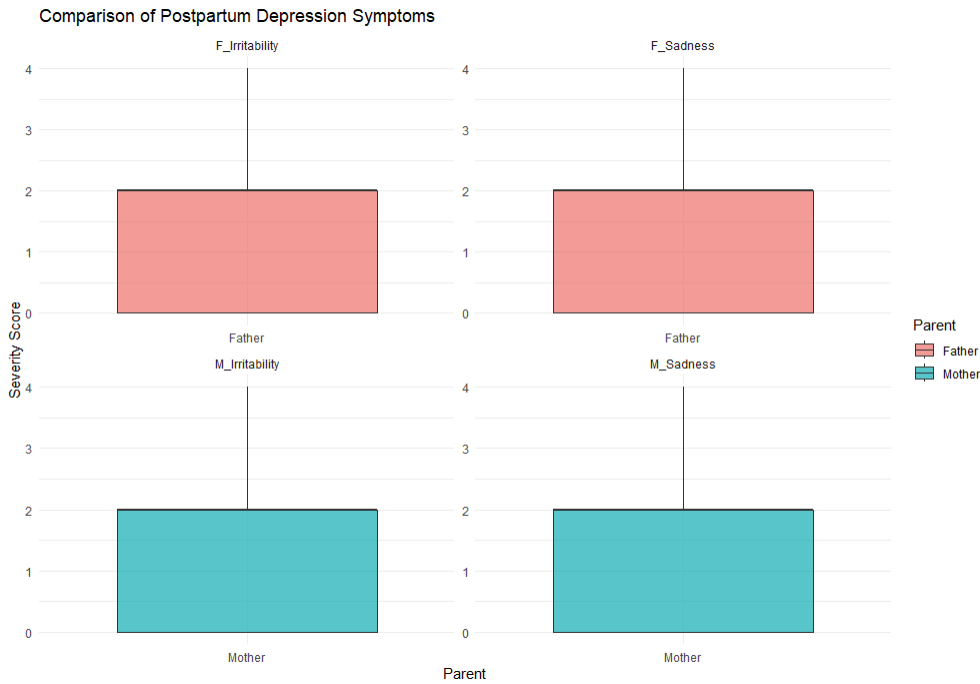


Figure 2. Comparison of postpartum depression symptoms between mothers and fathers

### 3.3 Association between Parenting Isolation and Maternal Depression

The association between parenting-related isolation and elevated maternal depressive symptoms was examined using a binary logistic regression model:

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k,$$

where  $p$  denotes the probability of elevated maternal depression and  $X_k$  represent predictor variables.

Results of the crude logistic regression analysis examining the association between parenting-related isolation and elevated maternal sadness are presented in Table 3. Higher levels of parenting isolation were associated with increased odds of elevated maternal depressive symptoms. The adjusted logistic regression model, controlling for maternal age, concentration difficulties, and responsibility strain, is presented in Table 4. After adjustment, psychosocial and cognitive factors remained influential, while demographic variables showed limited association.

Table 3. Parenting Isolation and Elevated Maternal Sadness

Predictor	Odds Ratio (OR)	95% CI	p-value
Isolation Level 2 vs 1	1.00	0.35 – 2.84	0.993
Isolation Level 3 vs 1	<b>5.78</b>	<b>1.18 – 28.87</b>	<b>0.027</b>
Isolation Level 4 vs 1	3.85	0.85 – 16.46	0.068

### 3.4 Principal Component Analysis

Principal Component Analysis was performed by decomposing the standardized covariance matrix **S** as

$$\mathbf{S} = \mathbf{P}\mathbf{\Lambda}\mathbf{P}^T,$$

where **Λ** contains eigenvalues and **P** contains eigenvectors defining the principal components. The PCA results for maternal symptoms are summarized in Table 5. Three principal components were retained based on eigenvalues and scree plot inspection (Figure 4).

Table 4. Adjusted logistic regression

Symptom	Component 1(Emotional–Functional)	Component 2(Isolation)	Component 3(Cognitive–Role)
Sadness/Depression	<b>0.510</b>	−0.191	−0.480
Irritability/Anger	<b>0.516</b>	−0.291	−0.356
Concentration Difficulties	<b>0.479</b>	0.182	0.373
Responsibility Difficulty	<b>0.440</b>	−0.101	<b>0.676</b>
Parenting Isolation	0.224	<b>0.914</b>	−0.213

The first component represented emotional-functional distress, the second captured parenting-related isolation, and the third reflected cognitive-responsibility strain. The PCA biplot illustrating variable loadings is shown in Figure 2.

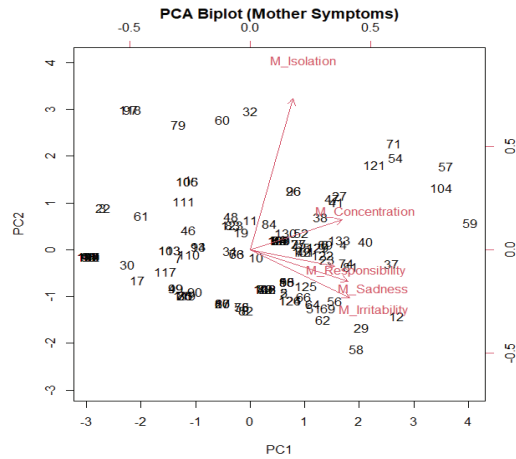


Figure 3. PCA biplot of maternal postpartum depression symptoms

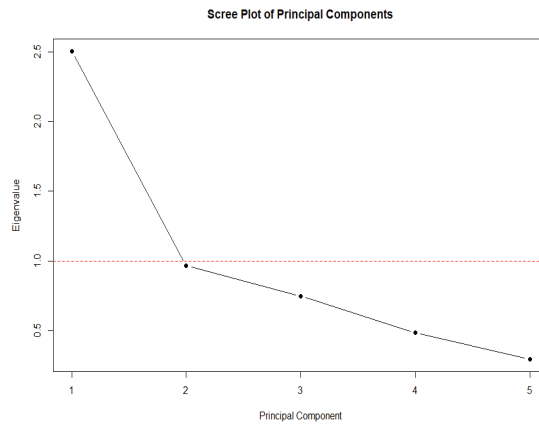


Figure 4. Scree plot of principal components

### 3.5 Correlation Analysis

The correlation structure among maternal symptoms is illustrated in Figure 5.

Table 5. Correlation Matrix of Maternal Postpartum Depression Symptoms

Variable	Sadness	Irritability	Concentration	Responsibility	Isolation
Sadness	1.00	0.70	0.43	0.37	0.18
Irritability	0.70	1.00	0.44	0.42	0.11
Concentration	0.43	0.44	1.00	0.48	0.28
Responsibility	0.37	0.42	0.48	1.00	0.12
Isolation	0.18	0.11	0.28	0.12	1.00

Moderate to strong positive correlations were observed among emotional and functional symptoms, with sadness showing the strongest association with irritability. Sadness was strongly correlated with irritability ( $r = 0.70$ ) and moderately correlated with concentration difficulties ( $r = 0.43$ ) and difficulty managing responsibilities ( $r = 0.37$ ). Parenting isolation showed weaker but positive correlations with emotional and cognitive symptoms, suggesting that isolation may function as an indirect psychosocial amplifier of distress rather than a primary emotional symptom.

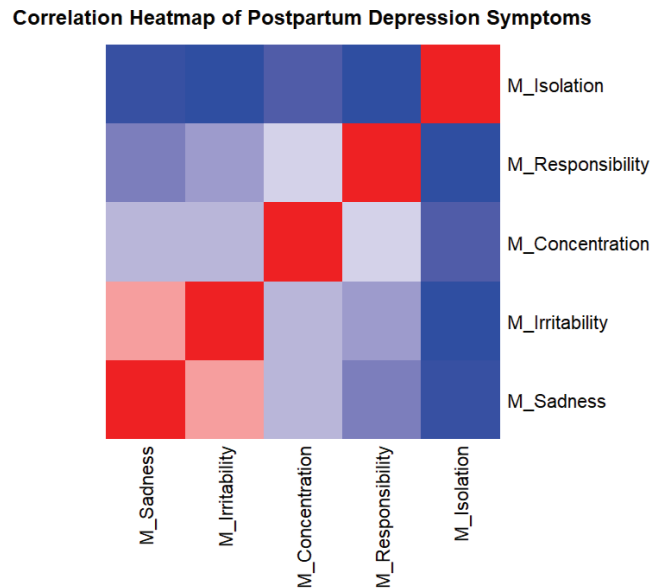


Figure 5. Correlation Heatmap of Maternal Postpartum Depression Symptoms

Figure 5 presents the Pearson correlation heatmap illustrating the interrelationships among maternal postpartum depression symptoms. Blue shades indicate weaker correlations, while red shades represent stronger positive associations.

#### 4. Discussion

The findings demonstrate that mothers experience significantly higher postpartum depressive symptoms than fathers, particularly in emotional and functional domains, consistent with earlier studies [1,3]. Parenting-related isolation emerged as an important psychosocial risk factor, supporting previous evidence highlighting the protective role of social support [6,7].

The multivariable analysis suggests that cognitive strain and psychosocial factors may play a more prominent role in postpartum depression than demographic characteristics such as age. PCA results confirm the multidimensional nature of postpartum depression, aligning with recent psychometric research advocating dimensional assessment approaches [9,10].

#### 5. Conclusion

Postpartum depression is a multifactorial condition affecting both mothers and fathers, with mothers experiencing greater symptom severity. Strengthening social support systems, reducing parenting-related isolation, and implementing routine mental health screening during the postnatal period are essential. Inclusive postnatal mental health policies addressing both maternal and paternal well-being are strongly recommended.

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