Mad, Sad, or Sleepy? Relationships between Postpartum Maternal Anger, Depression, and Sleep: A Cross-Sectional Survey Study

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Abstract

**Background:** Although some women experience anger as a mood problem after childbirth, postpartum anger has been neglected by researchers. Poor maternal and infant sleep quality during the postpartum period has been associated with depressive symptoms; however, links between sleep quality and postpartum anger are unclear. This study aimed to determine the proportions of women with significant anger, depressive symptoms, and comorbid anger and depressive symptoms, and to examine maternal and infant sleep quality as correlates of postpartum anger.

**Methods:** This cross-sectional survey study was advertised as an examination of mothers’ and babies’ sleep. Women, with healthy infants between 6 and 12 months of age, were recruited using social media. The survey contained validated measures of maternal and infant sleep quality, and maternal fatigue, social support, anger, depressive symptoms, and cognitions about infant sleep.

**Results:** 278 women participated in the study. Thirty-one percent of women (n = 85) reported high anger levels (≥ 90th percentile on State Anger Scale) while 26% (n = 73) of mothers indicated probable depression (>12 on Edinburgh Postnatal Depression Scale). Women reported a mean of 6.2 hours of sleep (SD = 1.2 hours, range = 4 – 9 hours); over half of the participants rated their sleep as poor (n = 144, 51.8 %). Using robust regression analysis, income (b = -0.74, p < 0.05), parity (b = 2.05, p < 0.01), depressive symptoms (b = 0.59, p < 0.01), maternal sleep quality (b = 0.98, p < 0.05), and maternal anger about infant sleep (b = 0.50, p < 0.01) were significant predictors of maternal anger.

**Conclusions:** Maternal sleep quality and anger about infant sleep are associated with maternal state anger. Clinicians should educate families about sleep pattern changes during the perinatal time frame and assess women's mood and perceptions of maternal and infant sleep quality in the first postpartum year. They can also offer evidence-based strategies for improving parent-infant sleep. Such health promotion initiatives could reduce maternal anger and support healthy maternal-infant sleep.

**Background**

Perinatal mood and anxiety disorders (PMADs) are amongst the most common comorbidities of childbearing [1]. A global meta-analysis of postpartum mood disturbances drawing on 291 studies indicated a pooled prevalence of 17.7% [2] for depressive symptoms and 20.7% for anxiety [3] in the first postpartum year. In contrast, persistent and intense maternal anger as a postpartum mood problem has been neglected; it is unclear how many women experience postpartum anger. The transition to parenthood can be stressful because women have to navigate physical changes and meet around-the-clock infant-care demands, while experiencing decrements to their sleep, personal autonomy, and time for self and others [7, 8]. For mothers, lack of sleep, fatigue, and carrying the majority of infant care responsibilities, mixed with the reduced capacity to meet their own needs, can present conditions that contribute to their experiences of anger [6].

Growing evidence suggests that persistent and intense anger is an important and overlooked PMAD [5, 6, 9]. In the postpartum time frame, there are significant costs to neglecting anger because evidence suggests that high levels of anger are associated with chronic and recurring symptoms of postpartum depression [9–11]. Depressive symptoms have been associated with poorer child socioemotional development [12] and worse partner mental health [13]. Anger in the context of postpartum depression has also been implicated in less positive maternal-infant interactions. Field and colleagues [14] compared a sample of depressed mothers with high and low anger levels and found that mothers with high anger levels showed fewer positive behaviors towards infants (less smiling, gameplaying, and imitative behaviors). Moreover, the infants of mothers with depression and high anger levels displayed more negative affect (less smiling and vocalizing, and more distress behaviors). Despite emerging evidence that postpartum women experience persistent and intense anger and even rage [15], and that anger is associated with deleterious effects on maternal-child relationships, the proportions of women who experience anger after childbirth are not known.

Insomnia and poor sleep quality are associated with new onset mental illness [16] and worse mental health in adults [17]. There are documented decrements in sleep quality after childbirth; postpartum maternal sleep is characterized by fragmented sleep from waking to feed and tend to infants at night which in turn lowers sleep efficiency (the percentage of time spent in actual sleep) and reduces sleep duration [18–20]. In a meta-analysis of 28 studies, Yang et al. [21] found that the prevalence of poor sleep quality for women during the postpartum period was 67.2% (95% CI [57.6 – 75.5%]). In the context of poor postpartum sleep quality, Wilson, Lee, and Bei [22] indicated that up to 60% of women experience elevated fatigue. Most studies have examined maternal sleep outcomes in the first half of the postpartum year [21, 22]. In contrast, the second half of the postpartum year, the time when infant sleep patterns are
consolidating, has been largely neglected in research [22, 23]. Despite infant sleep problems being known to persist well into the first and even second and third postpartum years [24], research about ongoing parental sleep quality is sparse.

Sleep is a vital component of postpartum wellbeing. Weinberg, Noble, and Hammond [25] theorized that compromised sleep quality affects mothers’ abilities to manage stress and emotions, leading to diminished wellbeing. There are robust associations between poor maternal sleep quality, fatigue, and postpartum depressive symptoms [13, 22, 26, 27]. Outside of the perinatal time frame, Krizan and Hisler [28] found that adults’ sleep restriction was associated with anger. Anger may be the result of increased sensitivity to negative stimuli from restricted sleep [29] and reduced capacity to regulate emotions [30].

It is important to note that PMADs also have psychosocial correlates, such as socioeconomic disadvantage [2, 31], poor social support, and stressful life events [31, 32]. Anger has been specifically linked with socioeconomic status; financial hardships have been associated with higher levels of anger [33, 34]. Inadequate social support could also be associated with anger because anger has been linked to unfulfilled expectations of others [6, 35]. For example, mothers may have expectations of support from partners or family members and, when support does not materialize, women feel distressed and angry.

Our study was designed to address the gap in the investigation of relationships between maternal sleep quality, infant sleep quality, psychosocial factors, depressive symptoms, and maternal state anger. The purpose of this study was to 1) determine the proportion of women who experience anger, depressive symptoms, and poor perceived sleep quality, and 2) examine the relationships among maternal and infant sleep quality, fatigue, maternal cognitions about infant sleep, depressive symptoms, social support, demographic variables, and maternal anger. We hypothesized that women who have 1) higher anger levels were more likely to have depressive symptoms above the cut-off on the EPDS, 2) women with worse sleep quality were more likely to experience anger, and that 3) socioeconomic status indicators, maternal sleep quality, cognitions about infant sleep, and social support would be associated with maternal anger.

**Conceptual Framework**

Relational autonomy is a philosophical perspective about autonomy that conceptualizes autonomy as a relational rather than individualistic practice [36]. A relational theory of autonomy served as a theoretical framework for examining maternal anger and the causes of maternal anger during the postpartum period. Underpinning relational autonomy is the assumption that social relations, norms, and structures are simultaneously a precondition of, and an influence on, an individual’s ability to have and exercise autonomy [36–38]. Becoming a mother involves learning to manage both maternal needs and an infant’s needs, a process that is made easier with social and structural support [38]. Using the framework of a relational theory of autonomy, we examined indicators of socioeconomic status (i.e., income, immigration) and perceived availability of social support as variables that contributed to explanations of the presence or absence of anger.

**Methods**

The data presented here are from the quantitative portion of a mixed methods study about maternal anger in the latter half of the first postpartum year. A cross-sectional survey study of Canadian mothers was undertaken after receiving ethical approval from our university-based behavioral research ethics board (H18-03761). Biological mothers of healthy singleton infants between six and twelve months of age living in Canada were invited to participate in the survey study. Women completing a screening survey were ineligible if they had a history of diagnosed depression (during pregnancy or prior to pregnancy), had a chronic health or developmental condition that affected their sleep, were prescribed medication for sleep, were employed working night shifts, or had a baby that was delivered prematurely. Eligible participants were recruited via social media (Facebook and Twitter), internet community boards, and study posters at community centers. Women who viewed the study advertisement (online and in-person) and who were interested in participating were provided with the link to the screening survey to determine eligibility. Those who were eligible were emailed a link to the survey study. Data were collected between April and July of 2019. A list of Canadian resources to support mental health was made available for all participants at the end of the survey. This was particularly important for participants who may have been distressed following the survey due to the sensitive nature of the questions about anger and depressive symptoms.

**Measures**
The survey contained measures of maternal and infant sleep quality, maternal mood, social support, and demographic variables. The study variables were operationalized with the following measures:

The State Anger Scale (SAS), from the State-Trait Anger-Expression Inventory, was used to measure maternal anger levels. The SAS assessed current feelings of anger with items such as “I am furious”, and “I feel like yelling at somebody”. The SAS has 15 items with each item being rated on a four-point Likert-like scale with a scoring range between 15 and 60. A score of 27 (equivalent to the 90th percentile on norms established for non-psychiatric women by Spielberger, 1999 [39]) was used as the cut-off for indicating high anger levels.

Studies that have used the SAS for women during the postpartum period have indicated good internal consistency with Cronbach’s α of 0.91 to 0.92 [10, 40]. For this study, the Cronbach's alpha for the SAS was 0.92, indicating excellent internal consistency.

The Edinburgh Postnatal Depression Screen (EPDS), developed for the purpose of screening women for possible postpartum depression [41] (Cox, Holden, & Sagovsky,1987), contains ten self-report questions that measure the presence of depressive and anxiety symptoms in the previous 7 days. The screen is amongst the most established and frequently used measures for detecting PMADs [42, 43]. Scores can range between 0 and 30. Cox et al. (1987) [41] recommended a cut-off of >12 for detecting probable depression. For this study, the Cronbach's alpha was 0.84, indicating good internal consistency.

The Pittsburgh Sleep Quality Index (PSQI) is a generic measure of sleep quality that can discriminate between ‘good’ and ‘poor’ adult sleepers [44] and is comprised of 19 items divided into seven components (sleep duration, latency, quality, efficiency, disturbance, use of sleep medications, and daytime dysfunction) that provide a summary of self-reported sleep characteristics. The measure yields a total score (PSQI global score) ranging from 0 (best sleep) to 21 (worst sleep). A score of > 5 indicates problematic sleep [44]. The PSQI has been used widely for women during the perinatal period [21, 45]. The PSQI item on perception of sleep quality has been used by researchers as a single-item to assess subjective sleep quality [46]. Mollayeva et al. [47] found, across 37 studies, that the PSQI demonstrated strong validity but only fair internal consistency (Cronbach's alpha ranging from 0.64 to 0.83) given the heterogeneity of the scale dimensions. For this study, the Cronbach's alpha was 0.63, indicating poor internal reliability.

The Brief Infant Sleep Questionnaire (BISQ), developed as a screening tool for infant sleep problems [48], assessed infant sleep patterns (e.g., sleep onset time, latency, and duration, and night wakes). The measure has been validated for web surveys across cultures [49]. All items were used to report on infant sleep characteristics. For this study, infant sleep quality was assessed using a single item regarding parents’ perceptions of the presence and degree of infant sleep problems (“no problem”, “small-to-moderate problem”, and “serious problem”).

The Multidimensional Assessment of Fatigue (MAF) is a measure used to assess maternal fatigue. The MAF comprises 16 items assessing fatigue severity, distress about fatigue, and interference with activities of daily living. A global fatigue index is calculated from items and ranges from 1 (no fatigue) to 50 (severe fatigue). The MAF has been validated for use with women during the perinatal period. Cronbach's alpha has ranged from 0.94 to 0.95 [50, 51]. For this study, the Cronbach's alpha was 0.93, indicating excellent internal consistency.

The Maternal Cognitions about Infant Sleep Questionnaire (MCISQ) is a 20-item survey that assesses the presence of aversive parental thoughts about managing infant sleep; it is comprised of 5 subscales including limit setting, anger about infant sleep, doubts about sleep management, nighttime feeding necessity, and infant safety [52]. Higher scores indicate a greater degree of difficulty in managing infant sleep. The anger about infant sleep subscale was of particular interest as a potential correlate with overall maternal anger. Morrell [52] found the measure’s overall internal consistency was 0.82. For this study, Cronbach's alpha for the whole MCISQ was 0.82 and 0.59 for the 5-item anger subscale.

The Family Support Scale (FSS) is an 18-item scale used to examine the availability and frequency of support (e.g., from partners, kin, health care providers, and community agencies) for parents of young children [53]. Each available source of support is ranked on a Likert scale between 1 (not at all helpful) and 5 (extremely helpful). Although originally developed for parents of children with special needs, the FSS has been used in the context of perinatal depression [54] and parental stress after childbirth [55], with Cronbach's alpha being 0.70, and 0.72 for each study respectively. For this study, Cronbach's alpha was 0.69, indicating poor to fair internal consistency.

Data Analysis
Data analyses were conducted using R (RStudio, version 1.2.5033), an open-source statistical program. Data analysis was performed on 278 surveys. After checks for data integrity and data screening and cleaning, univariate and bivariate descriptive statistics for participants’ demographic, sleep, and mood characteristics were calculated. Anger levels were dichotomized as high and low based on normed percentiles (with 90th percentile and above indicating high anger levels) on the SAS for non-psychiatric women (Spielberger, 1999). The presence of probable depression was determined using the EPDS cut-off score of >12. Bivariate relationships between variables of interest were examined using a correlation table and a series of chi-square and t-tests to identify significant associations. Correlations between characteristics were examined and variables that were moderately-to-highly correlated with anger were used for multivariate regression model building with anger as the outcome variable. Robust regression technique (using robustbase package version .93-6) was used to correct for heteroscedasticity in the linear regression models [56, 57].

**Results**

Six hundred and twelve women received an invitation to the survey after completing an online screening survey, with 331 participants starting the actual survey. Forty-four participants dropped out of the survey; their responses were not retained for this analysis because those respondents did not complete the anger measure (the outcome variable of interest). A further 9 cases were excluded because of evidence of participant ineligibility (e.g., having an infant with health problems or premature delivery). Participants who were excluded because they withdrew or were ineligible did not differ significantly from other participants with respect to maternal age, infant age, parity, education, or income; however, excluded participants tended to be employed, and this bordered on significance (χ² (1, \[N= 326]\) = 3.719, p = 0.054).

**Univariate Analyses**

*Sample Characteristics.* The final sample consisted of 278 women between the ages of 23 to 44 years of age (M = 32.6, SD = 3.77) living across Canada, with the majority (77%, n = 220) being 30 years of age and over (Table 1). The sample represented high socioeconomic backgrounds with 73.0% (n = 203) holding a university degree or higher and 69.8% (n = 194) having household incomes of ≥ $90,000 CAD. All but 3 participants were partnered and just over half (53.8%, n = 149) were first-time mothers.

*Research Question 1.* To answer the question about the proportions of women who experienced intense anger, depressive symptoms, and poor sleep quality: 30.6% of women (n = 85) reported high levels of anger; 26% of women (n = 73) indicated probable depression (depressive symptoms above cut-off on the EPDS); and 73.3% of women (n = 204) reported global PSQI scores above cut-off, indicating problematic sleep. Of the 85 women who had high anger levels, almost 50% (n = 39) experienced probable depression, however, it is noteworthy that a large proportion of women (n = 46) had high levels of anger but did not have depressive symptoms above cut-off. When responding to a single question about sleep quality (using the PSQI item on perception of sleep quality), 52% of women (n = 144) felt their sleep quality was poor (either fairly bad or very bad).

**Bivariate Analyses**

In support of our hypothesis that depressive symptoms (EPDS scores >12) would be associated with higher anger levels, a chi-square test demonstrated that women who had depressive symptoms were nearly 4 times more likely to experience high levels of anger relative to those who did not have symptoms above cut-off (OR = 3.96, 95% CI [2.25 – 6.98], p < 0.001) (Figure 1). Contrary to our hypothesis, women who had a PSQI score >5 had lower odds of having high anger levels (OR = 0.49, 95% CI [0.26 – 0.92], p = 0.036). In support of our hypothesis that perceived sleep quality would be associated with anger, women who perceived their sleep as poor (fairly good or very good), were 2.9 times more likely to have high levels of anger compared to mothers who perceived their sleep as good (fairly good or very good) (OR = 2.88, 95% CI [1.68 – 4.96], p < 0.001) (Figure 1).

Participiants who had high anger levels (n = 85, M = 33 ± 6.3) had more children, t(152.8) = 2.8, p < 0.01, and had higher scores on depressive symptoms, t(160.1) = 6.3, p < 0.01, fatigue t(212.2) = 6.01, p < 0.01, perceptions of infant sleep problems, χ² (1, n = 278) = 11.9, p < 0.01, cognitions about infant sleep, t(168.1) = 3.76, p < 0.01, and anger about infant sleep t(144.1) = 6.03, p < 0.01. They also reported lower education levels, χ² (3, n = 278) = 12.9, p < 0.01, income, χ² (3, n = 277) = 11.18, p = 0.01, and perceived sleep quality, χ² (1, n = 278) = 14.2, p < 0.01 (Table 1).
Table 2 delineates the bivariate correlations between anger scores and demographic variables, maternal-infant sleep quality, fatigue, depressive symptoms, angry cognitions about infant sleep, and social support.

Table 1

Sample Characteristics.
| Characteristic          | All Participants | Anger Level<sup>a</sup> |  |  |
|-------------------------|------------------|-------------------------|---|---|
|                         | N = 278          | Low N = 193; n (%)      | High N = 85; n (%) | P value |
|                         | Mean, SD / n (%) | 32.6 ± 3.8              | 32.7 ± 4.1          | 0.97    |
| Age                     | Range 23-44 years| 32.6 ± 3.8              | 32.7 ± 4.1          | 0.97    |
| Infant age              | Range 6-12 months| 8.6 ± 1.9               | 8.7 ± 1.9           | 0.43    |
| Infant sex              | Male             | 148 (53.4)              | 105 (54.4)          | 0.72    |
| Partnered               | Yes              | 275 (98.9)              | 192 (99.5)          | 0.46    |
| Parity                  | Primiparous      | 149 (53.6)              | 1.5 (0.73)          | <0.01   |
|                         | Multiparous      | 128 (45.0)              | 1.8 (0.76)          |         |
|                         | Unknown          | 1 (<1)                  | 0.72                |         |
| Employment              | Yes              | 50 (18.0)               | 31 (16.1)           | 0.28    |
| Immigrant               | Yes              | 41 (14.7)               | 33 (80.5)           | 0.14    |
| Education               | Postgraduate     | 81 (29.1)               | 64 (33.2)           | <0.01   |
|                         | University       | 122 (43.9)              | 84 (43.5)           |         |
|                         | College          | 62 (22.3)               | 41 (21.2)           |         |
|                         | High School      | 13 (4.7)                | 4 (2.1)             |         |
| Household income        | >$110K           | 134 (48.2)              | 104 (53.9)          | 0.01    |
|                         | $90,000-109,999  | 60 (21.7)               | 37 (19.2)           |         |
|                         | $60,000-89,999   | 60 (21.7)               | 40 (20.7)           |         |
|                         | <$60,000         | 23 (8.3)                | 11 (5.7)            |         |
|                         | Unknown          | 1 (<1)                  | 0.036               |         |
| Anger (SAS)             | Range 15-53      | 24 (7.6)                | 33 (6.3)            | <0.01   |
| Depression symptoms (EPDS)| Range 0-21      | 9.3 ± 4.7               | 11.8 ± 4.3          | <0.01   |
|                         | Yes              | 73 (26.0)               | 39 (53.4)           | <0.01   |
| Global PSQI             | Range 1-15       | 7.1 ± 2.4               | 8.0 ± 2.5           | <0.01   |
|                         | Yes              | 204 (73.0)              | 70 (25.2)           | <0.01   |
| Maternal sleep quality  | Range 1-4        | 2.6 ± 0.7               | 2.8 ± 0.6           | <0.01   |
| Fatigue (MAF)           | Range 7-45       | 30.3 ± 8.5              | 34 ± 6.4            | <0.01   |
| Characteristic                                      | All Participants | Anger Level<sup>a</sup> | P value |
|----------------------------------------------------|------------------|--------------------------|---------|
|                                                    | N = 278          | Low N = 193, n (%)       | High N = 85, n (%) |
|                                                    | Mean, SD / n (%)  | 194 (69.8)              | 122 (62.3) | 72 (37.1) | < 0.01       |
| Infant sleep problem (BISQ)                        | Yes              |                          |         |
| Maternal cognitions about infant sleep (MCISQ)     | Range 5-69       | 34.9 (12.7)              | 33 ± 12.7 | 39 ± 2.0 | < 0.01       |
| Anger                                              | 6.4 (3.9)        | 5.5 ± 3.5                | 8.5 ± 4.0 |         | < 0.01       |
| Limit Setting                                      | 14.9 (6.0)       | 14.7 ± 6.1               | 15.5 ± 5.6 | 0.26     |
| Doubts                                             | 7.0 (4.5)        | 6.5 ± 4.3                | 8.1 ± 4.6 | < 0.01   |
| Safety                                             | 3.2 (2.4)        | 2.9 ± 2.4                | 3.6 ± 2.4 | 0.07     |
| Feeding                                            | 6.5 (3.7)        | 6.3 ± 3.8                | 7.0 ± 3.3 | 0.12     |
| Family support scale (FSS) total score             | 44.8 (9.4)       | 44.7 ± 9.4               | 45.0 ± 9.4 | 0.82   |

<sup>a</sup>State Anger Scale raw score of 27 (90th percentile). <sup>b</sup>Minimum 12 hours sleep per day (Paruthi et al., 2016).

Table 2

Pearson and Spearman Correlations of Anger and Examined Variables.
Multivariate Analyses

Research Question 2. Preliminary model building was carried out using linear regression (Table 3) to answer the second question about variables associated with maternal anger. A priori variables that were tested included income, education, immigration status, depressive symptoms, fatigue, maternal sleep quality, angry cognitions about infant sleep, and social support. Parity was included because maternal report of the number of children demonstrated a significant correlation with anger. The single item capturing maternal perception of sleep quality was chosen over the PSQI global score because the extant literature has indicated that mood disturbances (e.g., depression) are better predicted by individuals’ perceptions of sleep quality [58–60]. In the first step, demographic variables explained a small but significant proportion of the variance in anger, with income and parity demonstrating significant associations, $R^2 = 0.084$, $F (4, 271) = 6.23$, $p < 0.001$. In the second step, depressive symptoms, sleep quality, fatigue, anger about infant sleep, and social support contributed to a model that explained 34% of the variance in maternal anger, $R^2 = 0.341$, $F (9, 261) = 15.03$, $p < 0.001$; parity, depressive symptoms, and anger about infant sleep were significantly associated with maternal anger. Given that large standard errors were identified for fatigue and sleep quality and that these constructs have theoretical overlap, in the third step of model development, when maternal fatigue was removed, sleep quality was significantly associated with maternal anger (with worse perceived sleep quality associated with greater anger), $R^2 = 0.330$, $F (8, 265) = 16.35$, $p < 0.001$. 

| Variable                      | 1   | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       |
|-------------------------------|-----|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. Anger                      | 1.000 |         |         |         |         |         |         |         |         |
| 2. Parity                     | 0.17** | 1.000 |         |         |         |         |         |         |         |
| 3. Education                  | -0.20** | -0.17** | 1.000 |         |         |         |         |         |         |
| 4. Income                     | -0.18** | 0.03 | 0.23** | 1.000 |         |         |         |         |         |
| 5. Depression symptoms        | 0.42** | -0.04 | -0.20** | -0.21** | 1.000 |         |         |         |         |
| 6. Global PSQI$^a$            | 0.26** | -0.02 | -0.27** | -0.18** | 0.37** | 1.000 |         |         |         |
| 7. Perceived sleep quality$^b$| 0.32** | 0.10 | -0.13* | -0.15* | 0.27** | 0.66** | 1.000 |         |         |
| 8. Fatigue                    | 0.38** | 0.04 | -0.04 | -0.21** | 0.50** | 0.47** | 0.54** | 1.000 |         |
| 9. MCISQ anger                | 0.42** | -0.03 | -0.09 | -0.14* | 0.32** | 0.28** | 0.32** | 0.42** | 1.000 |
| 10. Support                   | -0.02 | 0.08 | 0.14* | 0.06 | -0.11 | -0.07 | -0.05 | -0.10 | -0.06 |

Note. * indicates $p < 0.05$. ** indicates $p < 0.01$. $^a$Global PSQI total score (>5 indicates problematic sleep). $^b$PSQI item on perceived sleep quality.
Examination of the residuals in the second and third linear models revealed moderate violations of the assumptions of equal variances (heteroscedasticity) and normality. While moderate degrees of non-normality can generally be tolerated in linear regression, heteroscedasticity can lead to biased standard errors and significance values [57, 61]. Robust regression was employed to improve the accuracy of beta coefficient and significance estimates in the final model (Table 4). In partial support of our hypothesis that socio-economic status indicators would be associated with anger, income was associated with anger in the robust regression model ($b = -0.83, p < 0.05$). Education ($b = -0.28, p = 0.29$) and immigration status ($b = -0.71, p = 0.43$) were not significantly associated with maternal anger. Consistent with our hypothesis, maternal sleep quality ($b = 1.08, p = 0.02$) and anger about infant sleep ($b = 0.5, p < 0.01$) were associated with maternal anger. Contrary to our expectations, social support was not associated with anger in our model ($b = 0.05, p = 0.11$).

### Table 3
Linear Model Building Explaining Maternal Anger

| Variable       | Linear Model 1 |          |          |          | Model 2 |          |          |          | Model 3 |          |          |          |          |
|----------------|----------------|----------|----------|----------|---------|----------|----------|----------|---------|----------|----------|----------|----------|
|                | $B$ (SE)       | $CI$     | $t$      | $p$      | $B$ (SE) | $CI$     | $t$      | $p$      | $B$ (SE) | $CI$     | $t$      | $p$      | $B$ (SE) | $CI$     |
| (Intercept)    | .07 (.48)      | [-.87, 1.02] | -15 | .88      | -1.16 (.42) | [-.67,.98] | .38 | .707      | -2.2 (.42) | [-.61, 1.04] | .51 | .607 |
| Income         | -1.14 (.4)     | [-2.0, -0.5] | -2.61 | .009     | -3.7 (.39) | [-1.14, .4] | -94 | .348      | -4.9 (.39) | [-1.25, .27] | -1.27 | .206 |
| Immigrant-Yes | -50 (1.3)      | [-2.9, 2.0] | -40 | .691     | -1.05 (1.2) | [-3.32, 1.2] | -91 | .363      | -1.16 (1.1) | [-3.40, 1.07] | -1.02 | .307 |
| Education      | -0.72 (0.33)   | [-1.4, -0.07] | -2.17 | .031     | -0.33 (0.30) | [-0.92, 0.26] | -1.1 | .270      | -0.26 (0.30) | [-0.84, 0.32] | -0.87 | .385 |
| Parity         | 1.6 (0.62)     | [0.41, 2.84] | 2.64 | <.009    | 1.6 (0.54) | [0.49, 2.63] | 2.87 | .004      | 1.66 (0.54) | [0.59, 2.72] | 3.06 | .002 |
| Depression     | 0.44 (0.10)    | [0.25, 0.63] | 4.48 | <.001    | 0.46 (0.09) | [0.29, 0.64] | 5.17 | <.001    |
| Sleep Quality  | 1.11 (0.67)    | [-0.21, 2.42] | 1.65 | .099     | 1.35 (0.60) | [0.17, 2.53] | 2.24 | .026     |
| Fatigue        | 0.07 (0.06)    | [-0.06, 0.19] | 1.05 | .296     |
| Infant sleep anger | 0.52 (0.11) | [0.31, 0.74] | 4.74 | <.001    | 0.55 (0.11) | [0.33, 0.76] | 5.07 | <.001    |
| Support        | 0.03 (0.04)    | [-0.05, 0.12] | 0.71 | .476     | 0.02 (0.04) | [-0.06, 0.11] | 0.51 | .607     |
| Observations   | 276            |          |          |          | 271      |          |          | 274      |
| $R^2 / R^2$ adjusted | .08 / .07     |          |          |          | .341 / .319 |          |          | .33 / .31 |

*Note: Beta coefficients are unstandardized. Bolding indicates statistical significance.*

### Table 4
Robust Regression Model Explaining Maternal Anger
### Discussion

Almost one third of women in this study experienced high levels of anger and more than a quarter experienced probable depression. Of the women who experienced high anger levels, about 50% experienced concurrent depressive symptoms while the other 50% did not. Maternal anger has typically been explored in the context of depression, but our finding suggests that anger is a distinct mood disturbance that is not consistently associated with depressive symptoms.

There is remarkable heterogeneity in the presentation of 'postpartum depression', an umbrella term that covers a constellation of symptoms which may include depressive symptoms, anxiety, irritability, hypervigilance, and intrusive thoughts, in addition to anger [62]. A transdiagnostic approach to understanding perinatal depression is gaining momentum as an alternate framework to understand mental illness that bypasses the traditional DSM-5 diagnostic boundaries of mental health problems; it recognizes that psychological distress manifests in many ways, with symptoms occurring on a continuum rather than as a dichotomized presence or absence [63, 64]. As such, when assessing PMADs, we ought to consider anger, depressive symptoms, and anxiety, among other conditions, and place them in a multidimensional view of psychological perinatal distress.

The finding that high anger levels occur independently supports the transdiagnostic nature of postpartum mood problems, with comorbidity of symptoms being common [64, 65], and implicates anger as a relevant dimension of postpartum psychopathology. Identifying anger as a distinct perinatal mood problem suggests that clinicians and researchers ought to be screening for anger when investigating PMADs. More work is needed on perinatal anger to explore its possible origins (e.g., trait anger, antenatal anger, adverse childhood experiences, intimate partner violence), general effects, and consequences for maternal-infant dyadic attachment, maternal functioning and efficacy, and parental relationships. A recent systematic review of partner experiences indicated that partners experience distress, anger, relationship conflict and even breakdown in the context of women's PMADs [66].

Anger can be understood as a highly social emotion [34, 66, 67], which is more often than not fueled by social context and situations involving others. The study findings support the social nature of anger. The framework of relational autonomy would indicate that affective responses (e.g., anger and sadness) are reactions to constrained personal autonomy. Lower income was associated with higher anger levels. Inadequate income has been linked with feelings of powerlessness and hardship, which are associated with anger in women [6, 68]. Such findings speak to the necessity of structural supports, such as governmental child benefits, subsidies, parenting programs to enhance parenting confidence, and childcare provisions for women experiencing economic hardship.

| Variable         | B (SE)   | CI       | t   | p     |
|------------------|----------|----------|-----|-------|
| (Intercept)      | -.16 (.46)| [-1.76, .04] | -1.87 | .062 |
| Income           | - .83 (.37)| [-1.56, -.09] | -2.21 | .028 |
| Immigrant-Yes    | -.71 (.90)| [-2.47, 1.1] | -.79 | .431 |
| Education        | -.28 (.27)| [-.81, .24] | -1.06 | .292 |
| Parity           | 2.08 (.52)| [1.06, 3.10] | 4.00 | <.001 |
| Depression       | .35 (.08)| [.18, .51] | 4.11 | <.001 |
| Sleep Quality    | 1.08 (.67)| [.15, 2.0] | 2.29 | .023 |
| Infant sleep anger | .50 (.12) | [.27, .72] | 4.24 | <.001 |
| Support          | .05 (.03)| [-.01, .12] | 1.60 | .111 |

**Note:** Beta coefficients are unstandardized. Bolding indicates statistical significance.
Contrary to our hypothesis, social support had little effect on maternal anger in this study. We suspect that the FSS measure did not adequately capture the types of supports that were important for participants, such as the provision of instrumental or emotional support. We also suggest that partner support was not adequately weighted in this measure. In romantic relationships and especially during childbearing, women expect their partners to be their greatest source of support [69, 70]. Lack of desired forms of support from partners was a significant cause of distress for women in other studies [71, 72].

Our finding that higher parity was associated with higher anger scores suggests that women struggle as they have more children; this is contrary to findings that indicate that multiparous mothers do not require additional supports because they are experienced and have greater parenting efficacy [73, 74]. We argue that increased anger highlights the need for increased social and structural supports for women who have a second or third child in response to differing infant temperaments, increased demands for mothers related to managing sleep, needs of her infant and older child(ren), and her own needs, or to income sufficiency. Anthropologist Edward Hagen [75] argued that postpartum depression is an evolutionary adaptation that assists mothers to acquire adequate support (e.g., from partners and kin) to meet their physical (e.g., sleep) and emotional needs when they are experiencing resource deficits during the energy intensive time of caring for a young infant. It is possible that women resort to anger when expressing distress, sadness, or anxiety fails to elicit sufficient support from partners and kin or that some women have been socialized to display anger rather than sadness when experiencing distress.

To our knowledge, this is the first study that has examined the relationships between maternal state anger and sleep after childbirth. Almost three-quarters of the sample had problematic sleep as indicated by a PSQI global score of >5. In a meta-analysis of 28 studies, Yang et al. [21] found that 67.2% (95% CI [57.6-75.5%]) of postnatal women had problematic sleep using the PSQI. The PSQI attempts to quantify self-reported sleep characteristics (e.g., sleep latency, total sleep time, and sleep efficiency, as well as perceived sleep quality). Although almost three-quarters of women in our study had problematic sleep scores on the PSQI, only 50% of the women rated their sleep quality as poor on the single item about sleep quality. Maternal perceived sleep quality (PSQI sleep quality item) was associated with anger. This was not the case for other self-reported sleep characteristics (e.g., sleep duration, efficiency, latency etc.). Maternal anger about infant sleep was also correlated with the perception of an infant sleep problem ($r = 0.45, p < 0.01$). Taken together, the study findings suggest that 1) it is critical to screen mothers and infants for sleep problems because they can be associated with mood problems [13, 76] and that 2) clinicians ought to provide education around maternal-infant sleep patterns and teach psycho-behavioral interventions to parents to promote maternal-infant sleep and manage sleep problems. There is empirical support for psycho-behavioral education around sleep contributing to improved maternal mental health [51, 77], suggesting that education about parental-infant sleep and mood is important as anticipatory guidance. This could be viewed as a PMAD prevention measure during pregnancy and after childbirth.

**Limitations and Future Research Directions**

This study has limitations that warrant caution with the interpretation of results. First, a convenience sampling frame was used, with the resulting sample being highly educated, financially secure, and less ethnically diverse. Second, this study was cross-sectional and only examined anger at one time-point; as such, it was not possible to know whether the anger captured was episodic or chronic in nature. Chronic experiences of anger would be of greater concern from an individual and family health perspective. A future longitudinal study of anger would be necessary to differentiate between episodic and chronic anger and associated outcomes for women and the effects of anger on maternal-infant and family outcomes. Third, because the study was framed around maternal-infant sleep, the number of women with mood disturbances may be overrepresented relative to the general population because participants experiencing sleep problems and infant sleep problems may have been more likely to complete the survey. Only 30% of our sample indicated an absence of infant sleep problems as compared to 75-88% in other samples [58, 78]. Fourth, contrary to our expectations and empirical support for the role of social support in reducing maternal anger, we were not able to demonstrate this relationship quantitatively. This may have been because the support measure that we used did not explicitly measure partner and family support in terms of maternal emotional adjustment. In future studies of anger, it would be important to examine the role of partner support specifically for mothers’ mental wellbeing, given that women most often expect partners to be a chief source of support.

**Conclusion**

Research about anger after childbirth and its connection to maternal-infant sleep remains in its infancy. This study extends our understanding of intense maternal anger as a distinct PMAD. In agreement with the extant literature, maternal and infant sleep
problems were associated with maternal mood disturbances in this study. Two distinct findings emerged from this study, that 1) anger does not always occur in the context of postpartum depressive symptoms, and 2) intense postpartum anger is associated with lower perceived maternal-infant sleep quality. Anger was slightly more prevalent than depressive symptoms, suggesting that mothers’ anger in the postpartum period requires close attention by clinicians and researchers. Higher numbers of children, maternal anger about infant sleep, lower perceived maternal sleep quality, and depressive symptoms were associated with maternal anger. Taken together, it is important to assess for the presence of intense anger and sleep problems in the first postpartum year and to educate health care providers, women, and families about the associations between poor quality sleep and postpartum emotional distress.

Abbreviations

BISQ – Brief Infant Sleep Questionnaire
EPDS – Edinburgh Postnatal Depression Scale
MAF – Multidimensional Assessment of Fatigue
PMAD – Perinatal Mood and Anxiety Disorders
PND – Postnatal Depression
SAS – State Anger Scale

Declarations

Ethical Approval & Consent to Participate

This project received approval from the University of British Columbia's Behavioral Research Ethics Board (BREB) - Ethics ID# H18-03761. All participants completed the informed consent process.

Consent for Publication

All participants provided consent for publication of de-identified data during the informed consent process.

Availability of data and material

Data can be made available from the corresponding author on request for non-commercial purposes.

Competing interests

The authors have no competing interests to declare.

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Authors' contributions

CO co-conceptualized the study design and methodology, collected and analyzed the data, wrote the main manuscript text and prepared the tables and figures. WH co-conceptualized the study design and methodology, supervised the study operations and data
analysis, contributed to the manuscript text. PR and RS co-conceptualized the study design and methodology, and contributed to the manuscript text. All authors have reviewed the manuscript.

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Figures

Boxplots of Anger Scores by Sleep Quality and Depression Scores