

Maternal Sleeping Problems Before and After Childbirth - A Systematic Review

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Abstract: The perinatal and postpartum period is of great significance for women due to physiological changes, shifts in circadian rhythms, social setting, and psychological well-being, all of which affect the quality and quantity of their sleep. A mixed-studies systematic review was undertaken to enhance our understanding of sleep disturbances and mood disorders in women in late pregnancy and the postpartum period, their connection with breastfeeding, and the assessment of interventions for sleep disturbance. Three electronic databases (PUBMED, EMBASE and Google Scholar) were searched for qualitative, observational, and mixed-method studies from the year 2016 to June 2023. Twenty-nine articles were included in the analysis. The results were synthesized into four overarching themes: (i) the sleep quality of women in the perinatal period; (ii) the relationship between sleep and breastfeeding; (iii) the relationship between sleep quality and emotional disturbance in the perinatal period; (iv) sleep interventions in the researched group. The subjective nature of the perception of sleep disturbances, along with the absence of an objective measurement tool is clearly an inconvenience. It is advisable to include the assessment of maternal sleep hygiene and family sleep patterns during postpartum healthcare provider appointments to develop strategies not only for women's sleep quality but also for their mental well-being.

Keywords: childbirth, breastfeeding, maternal sleep, sleep quality, sleep disturbance, psycho-emotional states

Introduction

Sleep is a complex physiological process, one of the main features of which is the cyclically changing activity of the central nervous system. Proper quality and quantity of sleep are essential for good health, well-being, and good overall quality of life. The perinatal and postpartum period is of great significance for women due to physiological changes, shifts in circadian rhythms, social setting, and psychological well-being, all of which affect the quality and quantity of their sleep. Sleep patterns may be altered by major hormonal, physiological, and behavioral changes experienced during pregnancy and after childbirth.¹ Various studies have shown that 70% of pregnant women report sleep disorders which increase in the third trimester with fetal growth and movements, the occurrence of back pain, nocturia, and gastro-esophageal reflux.^{2,3} Sleep deficiency is common in postpartum mothers who feed and care for their babies. Sleep deficiency, sleep interruption, and altered sleep patterns cause young mothers to be vulnerable to sleep disorders that sometimes progress to severe insomnia. Sleep disorders in the perinatal and postnatal period may contribute to apathy, somnolence, tiredness, fatigue, low mood, anxiety, and a higher risk of depressive symptoms in the final stage of pregnancy and after childbirth.^{4,5} Sleep disturbances are a very sensitive indicator which allows to identify various mental illnesses, especially depression. There is a significant relationship between sleep disturbance, insomnia, and perinatal depression (antenatal and postpartum), which left untreated may have devastating effects on women, infants,

and families, or even lead to maternal or newborn mortality.⁵ As circadian rhythm disorders frequently co-occur with sleep disorders and depression, many studies have investigated this cause-and-effect relationship.⁶ Is it enough for people predisposed to depression to experience long-term poor sleep quality and insomnia for their effects to add to the set of depressive symptoms and for depression itself to reveal? Or does the occurrence of depressed mood, loss of vital energy, and cognitive disorders impair circadian rhythms to such an extent that the manifestation of insomnia will be a natural consequence?

In the era when scientists investigate the intricacies of the architecture of sleep, the mechanisms that govern sleep and wakefulness, and seek to explain the relationship between sleep disorders, mood deterioration and the onset of depression, patients expect effective interventions or resolution of their sleep disorders.

During pregnancy, women often report reduced sleep duration, poorer sleep quality, and more napping during the day. After delivery, the mother's circadian rhythm changes and depends on hormonal changes in her body and the needs of the newborn.³ Overall, following delivery, the quality of sleep continues to deteriorate, with worsened sleep efficiency and more sleep loss at night; however, some studies show a relatively stable total sleep time with the inclusion of scattered daytime naps.⁷ Several studies have shown the potential of non-pharmacological interventions such as aromatherapy, reflexology, physical activity, or cognitive behavioral therapy to relieve sleeplessness and improve sleep quality in the perinatal period.^{8–10}

Breastfeeding falls exclusively to the mother. The link between breastfeeding and maternal sleep is poorly understood. A few studies have investigated the relationship between sleep duration and breastfeeding; however, research results are inconclusive in this regard.^{11–15} It is not entirely known, how breastfeeding affects sleep, does sleep deficiency hinder breastfeeding and breastfeeding patterns, or is difficulty breastfeeding the reason for maternal sleep disturbances.

Sleep problems are prevalent during pregnancy and in the postnatal period, but there remains a lack of cohort studies and longitudinal population-based studies assessing the quality and quantity of sleep as well as sleep patterns before pregnancy. The most frequently performed and published studies assessing the amount and quality of sleep are based on a subjective assessment reported when completing a questionnaire.

General sleep scales, such as the most common Pittsburgh Sleep Quality Index (PSQI), used most frequently to assess general sleep status, are inadequate for pregnancy and postpartum sleep pattern changes. Only a few studies have used the Postpartum Sleep Quality Scale (PSQS) developed by Yang et al, which is a tool for rapid assessment of sleep quality in postpartum women and includes two factors: sleep inefficiency associated with physical symptoms and daytime dysfunction associated with nighttime care of the infant; yet this tool is not widespread in assessing the quality and quantity of maternal sleep.¹⁶

Given the increasing number of studies on sleep disturbances in pregnant women and young mothers, we believe it is important to compare the research results obtained with the use of standardized tools assessing sleep quality. This review was conducted to better understand sleep patterns and mood disorders in women in late pregnancy and the postpartum period, their relationship with breastfeeding, and to prevent sleep disorders through non-pharmacological interventions.

Methods

To the extent possible, this study followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.

Search Strategy

During this review, we conducted a literature search in electronic databases PUBMED, EMBASE and Google Scholar using key word combinations: insomnia, sleep disorder, sleep quality, mental health, anxiety, postpartum period, breastfeeding, breast milk, lactation, circadian rhythms. The study was limited to original scientific papers written within the last eight years, involving humans, and written exclusively in English. After removing duplicates, articles were selected according to the algorithm shown in the PRISMA diagram in [Figure 1](#).

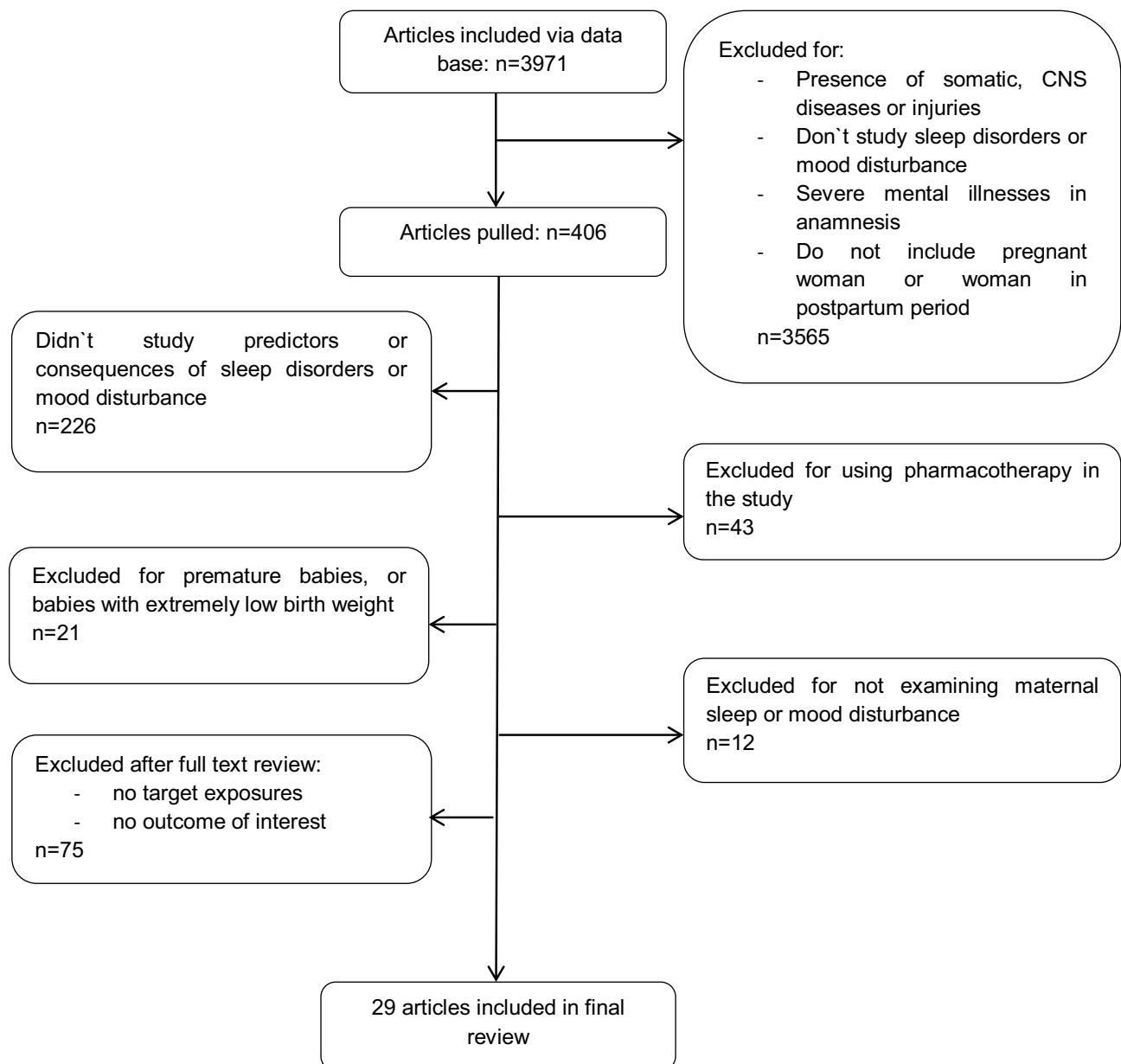


Figure 1 PRISMA flow diagram.

Inclusion and Exclusion Criteria

Inclusion criteria were as follows: (a) studies involving healthy women aged 18 years or older in the third trimester of pregnancy or in the postpartum period that assessed sleep quality; (b) studies in which the relationship between the mother's sleep and breastfeeding was evaluated; (c) studies in which sleep quality was assessed with tools such as the Pittsburgh Sleep Quality Index, Postpartum Sleep Quality Scale, Actigraphy, and mood disturbance by means of a standardized scales.

Exclusion criteria: (a) meta-analyses, systematic and non-systematic reviews, case studies; and (b) studies that included mothers who had mental health disorders and/or received medical treatment; (c) studies that included mothers with pregnancy and postpartum complications regarding physical and mental conditions that affect the health of the pregnant or postpartum person, their baby, or both, and other than a singleton pregnancy; (d) research focused on the COVID-19 pandemic.

It is important to note that there are factors that could significantly change the quality of sleep in women, such as infant feeding patterns, mother-infant co-sleeping, culture-bound views, other concomitant conditions (sleep education, postpartum depression), socioeconomic status, non-pharmacological interventions (psychotherapy, phytotherapy, psychoeducation, etc.). In this review, they were not among the exclusion criteria but were considered as modifiable factors, and were used and included in the discussion of the results where possible.

To assess methodological quality and minimize the risk of bias, research papers were distributed between three investigators for data processing. If there was any doubt during the review, the article was discussed by the researchers and a consensus was reached on it. To ensure as large a sample as possible, we contacted the authors if the full text of the article was not available in databases.

For each study, we identified a number of key elements: authors; name of the journal; year of publication; country of origin; the aim of the study; sociodemographic data; sample size; design; group number and group description; tools used to assess sleep quality or mood disturbance; research results.

Results

Of the 3971 literature references, 29 research papers were identified that involved the quality of sleep or mood disturbances in mothers during the last trimester of pregnancy and in the postpartum period. Eleven of them are clinical randomized trials regarding interventions on sleep quality and psycho-emotional states in women, such as postpartum depression, anxiety and mood changes. Only three papers evaluated the relationship between the quality of the mother's sleep and infant feeding.^{8,17,18}

The majority of studies were conducted in Taiwan (7 out of 29) and the United States of America (7 out of 29). Other studies were conducted in Belgium, Egypt, Iran, Azerbaijan, Nepal (1 out of 29), Canada, Turkey (2 of 29), and Australia, China (3 of 29). Most of them were cohort (9 out of 29) or cross-sectional studies (9 out of 29), although the main group also included 10 randomized controlled trials and one quasi-experimental study.

The main methods for measuring sleep quality were: PSQI (Pittsburgh Sleep Quality Index), PSQS (Postpartum Sleep Quality Scale), and Actigraphy.

The PSQS is a new scale developed in 2013 that focuses on sleep problems in postpartum women. The PSQS includes 14 self-report questions designed to assess a postpartum woman's sleep quality in the previous 2 weeks, with items rated on a 5-point Likert scale (0 = never, 1 = little, 2 = sometimes, 3 = often, 4 = almost always). PSQS items include quantitative aspects (eg sleep duration, sleep latency, number of awakenings), subjective aspects (eg rest, daytime functioning), and factors affecting postpartum women's sleep quality.¹⁵ The PSQI developed by Buysse et al (1989), uses a 4-point Likert scale questionnaire ranging from 0 (no difficulty) to 3 (significant difficulty) to measure subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of hypnotics and daytime dysfunction. The sum of the scores for the seven components gives a total PSQI score. Higher values indicate a worsening of sleep quality.¹⁹

EPDS (Edinburgh Postnatal Depression Scale), PHQ-9 (Patient Health Questionnaire-9), DASS (Depression, Anxiety, and Stress Scales), HADS (Hamilton Depression Scale) were used to assess the emotional and mental state of women.

The EPDS is a 10-item self-rated questionnaire with each item scored from 0 to 3, with a total possible scale score ranging from 0 to 30 points. The PHQ-9 is used to assess depressive symptoms. This scale assesses nine depressive symptoms based on the DSM-V (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition), and each item is scored on a Likert scale ranging from 0 to 3. Specific items include: decreased pleasure in daily activities, depressed mood, difficulty sleeping, low energy, appetite/eating changes, self-deprecation, difficulty concentrating, psychomotor changes and suicidal thoughts. DASS is a 42-item questionnaire, with a set of three self-report scales to measure psychological and physiological signs of depression, anxiety and stress. HADS includes fourteen items, divided into anxiety and depression subscales. Each item scores on a Likert scale from 0 to 3.

Other questionnaires were used less often: ISI (Insomnia Severity Index) and GSDS (General Sleep Disturbance Scale) to assess insomnia and sleep disturbances; BSES-SF (The Breastfeeding Self-Efficacy Scale-Short Form), PHQ-2 (Patient Health Questionnaire-2), HAMA (Hamilton Anxiety Rating Scale), HAMD (Hamilton Depression Rating Scale), GAD-7 (Generalised Anxiety Disorder Assessment), BRUMS (The Brunel Mood Scale), SEES (Subjective Exercise

Experience Scale), SDS (Self-Rating Depression Scale), PSS (Perceived Stress Scale), PBQ (Postpartum Bonding Questionnaire), PASS (Perinatal Anxiety Screening Scale), SAS (Self-Rating Anxiety Scale) and OASIS (Overall Anxiety Severity and Impairment Scale) to assess the level of different emotional disturbances; ESS (Epworth Sleepiness Scale), PFS (Postpartum Fatigue Scale), MAF (Multidimensional assessment of fatigue) and CIS (Checklist Individual Strength) to examine the level of fatigue.

The results of the research were synthesized into four overarching themes: (i) the sleep quality of women in the perinatal period; (ii) the relationship between sleep and breastfeeding; (iii) the relationship between sleep quality and emotional disturbance in the perinatal period; (iv) sleep interventions in the researched group.

Sleep Quality

Nine studies evaluated maternal sleep quality in the perinatal period (Table 1). They identified key factors related to the quality of maternal sleep: the course of labor, the male gender of the newborn, maternal age, the burden of household duties, the presence of children at home, and the subjective perception of sleep quality.

While investigating certain demographic and obstetric factors related to the subjective quality of sleep of women in the postpartum period (n=202), Taiwanese scientists found that the mean PSQS score was 22.82, indicating that, on average, mothers had mild sleep disturbances. The main problems they highlighted were the inability to sleep more than 7 hours a day and caring for the baby at night. As one of the first studies to establish a relationship between obstetric factors and subjective sleep quality, it revealed that women who were dissatisfied with their childbirth experience (n=43) reported poorer sleep quality compared to those who were satisfied with it. The main indicators of dissatisfaction were: pain during childbirth (81.4%), pain associated with vaginal examination (9.3%), and induction of labor (9.3%). For women who had a C-section performed (n=10), the main criteria for dissatisfaction were: anesthesia (50%) and fear (30%). A positive correlation was also found between sleep quality and daily household workload. A higher daily workload at home was positively correlated with a lower quality of sleep.²⁰

Another study on sociodemographic indicators was conducted by Doering et al in the United States, on a sample of 183 women from low income families. Among the study participants, 65%, mostly African-American, had short sleep duration, that is, they slept six hours or less per day. Compared to existing data that postpartum middle-class women sleep just over 7 hours per night, with the longest uninterrupted period of sleep of 4.1 hours, the study participants had significantly worse indicators. The total duration of their sleep was 5.5 hours, and the longest uninterrupted period of sleep was 2.8 hours.²¹ Christian et al studied subjective sleep quality among nulliparous and multiparous women, African American and European American, during each trimester of pregnancy and 4 to 11 weeks postpartum. In early/mid pregnancy, multiparous women repeatedly reported shorter sleep time, increased sleep latency, and higher prevalence of poor sleep (PSQI > 5) compared to nulliparous women. In the third semester and after childbirth, sleep differences related to the number of births were the smallest. Race also did not emerge as a significant factor affecting the prevalence and indicators of subjective sleep quality.²²

A study on 380 women in Nepal, found about 28% of the respondents to have poor sleep quality and 19% to demonstrate symptoms of postpartum depression. Having children at home, male sex of the newborn, medical complications after delivery, and postpartum depression were factors positively associated with poor sleep quality. This also applied to women of lower socio-economic status and those who continued to work in the postpartum period. This study did not establish a significant relationship between poor sleep quality and mode of delivery or time of introduction of complementary foods.²³ Wen et al found that women over 35 years of age were three times more likely to demonstrate poor sleep quality than younger women at 3 months postpartum, after adjusting for severity of postpartum somatic symptoms, sociodemographics, obstetric history, and health habits. An increased risk of poor sleep quality may be associated with natural aging. Older mothers had significantly higher PSQI scores for sleep efficiency and sleep disturbance, but did not differ in other parameters compared to younger mothers. Fragmented sleep and difficulty falling asleep after interrupted sleep were also more common in mothers over 35 years of age. Using a PSQI threshold score of 5, the study found that more than 65% of women over the age of 35 and 41.3% of women under the age of 35 showed poor sleep quality. The severity of postpartum somatic symptoms was significantly and positively associated with poor sleep quality. Although the severity of postpartum somatic symptoms did not differ significantly by age; cesarean

Table 1 Characteristics of the Studies Included in the Evaluation of Maternal Sleep Quality in the Perinatal Period

First Author's Name	Sociodemographic Data: 1. Country 2. Maternal age 3. Sample size	Design: 1. Study design 2. Number of groups 3. Description of groups	Aim of the Study	Tools Used to Assess Sleep Quality	Main Results
Hsuan-Man Hung ²⁰	Eastern Taiwan Mean age: 31.5±4.3 Sample size: 202	Cross-sectional study Three groups (based on socioeconomic status): -Upper -Middle - Lower	Demographic and obstetric factors on the subjective sleep quality of postpartum women.	PSQS	Correlation for Postpartum sleep quality and: - Age (r=0.038) - Number of children (r=-0.012) - Daily household work (hours) (r=0.153, p<0.05) - Napping (hours/day) (r=-0.087) No significant associations were found between subjective sleep quality and number of births, feeding type, or type of delivery. Although dissatisfaction with the birth experience and daily housework are factors that affect sleep quality.
Jennifer J. Doering ²¹	USA Mean age: 25.5±4.6 Sample size: 183	Cohort study One group: surveillance at 2 weeks postpartum, 4, 8, 12 and 24 weeks postpartum	To describe and explore patterns of postpartum sleep, fatigue, and depressive symptoms in low income urban women.	PSQS GSDS Actigraphy	Correlations between: • Sleep disturbance and fatigue: 4 week 0.61***; 8 week 0.60***; • Sleep disturbance and depressive symptoms: 4 week 0.39***; 8 week 0.30**; • Sleep quality and depressive symptoms: 4 week 0.31***; 8 week 0.32***; • Sleep quality and fatigue: 4 week 0.40***; 8 week 0.47***; • Depressive symptoms and fatigue: 4 week 0.61***; 8 week 0.66***. ***p<0.001; **p<0.01 In this study, it was found that between 4 and 8 weeks, subjective time spent in bed at night decreased (from 8.0 ± 2.2 hours to 7.7 ± 2.2 hours), but sleep efficiency improved (from 5.0 ± 1.5 hours to 5.4 ± 1.5). Sleep quality also improved during this period (p < 0.0001). According to the GSDS, sleep disturbances decreased from week 2 to week 12 (p < 0.0001). An objective sleep study showed that, on average, participants slept 5.5 hours a night at week 4 and 5.4 hours at week 12. Significant relationships were also identified between fatigue, sleep disturbance, sleep quality, and depressive symptoms.

<p>Lisa M. Christian²²</p>	<p>USA Mean age: African American Nulliparous 23.5±4.8 European American Nulliparous 23.3±3.5 African American Multiparous 24.8±4.2 European American Multiparous 25.8±3.9 Sample size: 133</p>	<p>Cohort study 4 groups: <ul style="list-style-type: none"> • African American Nulliparous • European American Nulliparous • African American Multiparous • European American Multiparous </p>	<p>To examine subjective sleep quality during each trimester of pregnancy and at 4–11 weeks postpartum women inclusive of nulliparous and multiparous African Americans and Whites.</p>	<p>PSQI</p>	<p>Total PSQI Score during 3rd trimester (T3) and postpartum period (PP) <ul style="list-style-type: none"> • African American Nulliparous: T3 6.5±3.0; PP 7.4±2.8; • European American Nulliparous: T3 6.6±2.8; PP 7.5±3.4; • African American Multiparous: T3 7.6±3.7; PP 7.3±3.8; • European American Multiparous: T3 6.6±3.9; PP 7.7±3.4. <p>The study found no significant differences between African-American and Caucasian women on overall subjective sleep quality scores throughout the assessment period. However, 53–71% of respondents reported poor overall sleep quality (PSQI > 5). Studying parity, it was determined that any differences in indicators of subjective sleep quality were observed only during pregnancy, and were not noticed in the postpartum period.</p> </p>
<p>Roshan Khadka²³</p>	<p>Nepal Mean age: 30±3.9 Sample size: 380</p>	<p>Cross-sectional study One group</p>	<p>To identify the prevalence and determinants of postpartum poor maternal sleep and depression.</p>	<p>PSQI</p>	<p>Determinants of poor sleep quality among the mothers at 2–12 months postpartum: <ul style="list-style-type: none"> - Occupation in agriculture/ physical work OR 15.5 [95% CI 5.10–47.2] - Occupation in government/ private business OR 6.69 [95% CI 1.93–23.2] - Sex of infant – boy OR 2.37 [95% CI 1.29–4.33] - Place of delivery - home OR 2.17 [95% CI 1.20–3.93] - Complications after delivery OR 5.58 [95% CI 2.64–11.8] - Postpartum depression OR 2.86 [95% CI 1.49–5.49] <p>The factors of poor sleep quality were: low level of education, involvement in agriculture/physical work low monthly family income, living in rural areas, age over 30 years, multiple children and male newborn (p<0.05).</p> </p>

(Continued)

Table 1 (Continued).

Shih-Yi Wen ²⁴	Taiwan Mean age: 37.2±1.8 Sample size: 160	Cross-sectional study Two groups: - above 35 years of age - 20 to 34 years of age	To describe and compare sleep quality between women younger or older than 35 years of age at 3 months postpartum, and to examine the related factors.	PSQI	<p>Logistic regression models for poor sleep quality:</p> <ul style="list-style-type: none"> - Advanced age group OR 2.79 [95% CI 1.47–5.32] (p=0.002) - Sleeping in the same room as the infant OR 3.24 [95% CI 0.93–11.21] (p=0.06) - Sharing the bed with an infant OR 3.17 [95% CI 0.9–11.1] (p=0.07) - No exercise OR 2.25 [95% CI 1.14–4.45] (p=0.02) - Postpartum physical symptoms severity OR 1.23 [95% CI 1.09–1.38] (p=0.001) <p>Poor sleep quality (PSQI>5) was noted among women older than 35 years of age - 66.25%, and the overall average score was 6.85±3.21. For women of the younger age group, the prevalence of poor subjective sleep quality was 41.25%, the average total score was 5.48±3.22, which was significantly different from those of the older group. Sleep efficiency and sleep disturbance were also worse in women in the older group. Better indicators of the subjective sleep quality were also observed among women who did not share a room or bed with their infants and who exercised during the last 2 weeks.</p>
Soledad Coo ²⁵	Australia Mean age: 31.08±3.82 Sample size: 29	Cohort study One group, surveillance at third trimester of pregnancy (Time 1), 15 days after childbirth (Time 2), 10–12 weeks postpartum (Time 3)	To examine association between measures of objective sleep (OS) and subjective sleep (SS) to postpartum mood in healthy women from the third trimester of pregnancy to 10 to 12 weeks postpartum.	Actigraphy for 7 days PSQI	<p>Objective sleep (actigraphy)</p> <p>*P<0<01; **P<0.001</p> <ul style="list-style-type: none"> ● Efficiency: Time 1 77.43±8.0; Time 2 66.78±8.33*; Time 3 76.93±6.18**; ● Wake after sleep onset: Time 1 76.85±33.48; Time 2 155.60±53.25*; Time 3 98.33±33.62**; ● Sleep disturbance: Time 1 36.65±11.52; Time 2 53.62±12.78*; Time 3 36.18±11.29**; ● Daily nap number: Time 1 1.89±1.22; Time 2 3.56±1.28*; Time 3 2.58±1.20**; <p>Subjective sleep (PSQI)</p> <p>*P<0<01; **P<0.001</p> <ul style="list-style-type: none"> ● Sleep onset latency: Time 1 17.73±15.51; Time 2 10.12±9.61; Time 3 11.69±11.92*; ● Sleep efficiency: Time 1 81.68±10.91; Time 2 66.55±15.66**; ● Time 3 72.65±12.32** <p>In this study, low mood was associated with daytime dysfunction in women in the third trimester of pregnancy and at 10–12 weeks postpartum and subjectively poor night sleep within 15 days after the birth of the child. An objectively bad night sleep also affected stress. These data indicate a stronger relationship between postpartum mood and subjective sleep perception than with objective sleep quality and duration in healthy women without depression.</p>

Christopher Kalogeropoulos ²⁶	Canada Age of mothers: 25–35 years – 60.61% 35–44 years – 39.39% Sample size: 33 couples	Cross-sectional study Two groups: - mothers - fathers	To describe and compare sleep patterns and intraindividual night-to-night variability in mothers and fathers at 6 months postpartum using subjective and objective sleep measures.	Actigraphy Sleep diary	Subjective maternal sleep <ul style="list-style-type: none"> • Nocturnal sleep duration (min) 437.67±45.81 • Longest consecutive sleep duration (min) 240.86±65.40 • Nocturnal awakenings 2.27±1.01 Objective maternal sleep <ul style="list-style-type: none"> • Nocturnal sleep duration (min) 448.07±36.49 • Longest consecutive sleep duration (min) 299.45±70.83 • Nocturnal awakenings 2.46±0.99 It was found that the subjective duration of maternal night sleep ($r=0.380$, $p=0.029$) and the duration of continuous sleep ($r=0.702$, $p<0.001$), as well as a lower number of subjective night awakenings ($r=-0.625$, $p<0.001$) were associated with a longer night's sleep of the child. No association was found between maternal sleep activity variables and employment status, education level, infant feeding method, sleep location, nighttime sleep duration, or infant nighttime awakenings.
Lucy S. King ²⁷	USA Mean age: 34.58±5.82 Sample size: 67	Cross-sectional One group: woman at 18 weeks postpartum.	The association of maternal sleep disturbance with both levels and trajectories of maternal sensitivity during interactions with their infants.	Actigraphy Consensus Sleep Diary	Correlations between: <ul style="list-style-type: none"> • Objective WASO (wake time after sleep onset) and objective number of arousals ($r = 0.75$) • Subjective WASO and subjective number of awakenings ($r = 0.53$) • Subjective WASO and subjective total nighttime sleep time ($r = -0.59$) • Subjective WASO and perceived sleep quality ($r = -0.46$) According to the results of this study, it was found that the poorer sleep continuity of mothers does not decrease the level of their general sensitivity to their babies. But during free play-interaction, there was a decrease in their level of sensitivity over time, which may indicate the importance of uninterrupted maternal sleep for sensitivity to infants.

(Continued)

Table 1 (Continued).

Robyn Stremier ²⁸	Canada Mean age: not given Sample size: 217	Cohort study One group: surveillance at 6 and 12 weeks postpartum	To examine relationships between self-reported sleep quality, actigraphy data, and depressive symptoms in a sample of women at 6 and 12 weeks postpartum	Actigraphy GSDS	<p>Sleep measures at 6 weeks postpartum:</p> <ul style="list-style-type: none"> - Nocturnal sleep in minutes 391.9±68.6 - Longest stretch of nocturnal sleep in minutes 142.6±58.2 - Number of night awakenings 9.0±4.5 - Daytime sleep in minutes 38.8 ±52.7 - Mean GSDS score 48.49 ±16.3 - Perception that sleep is not a problem (%) 116 ±53,5 - Perception that sleep is a small problem (%) 76 ±35,0 - Perception that sleep is a big problem (%) 17 ±7,8 <p>The average duration of nocturnal sleep of the studied women was 6.5 hours and the longest continuous period of sleep was slightly more than 2 hours. According to the GSDS scale, 38% of mothers had poor sleep. The results of logistic regression modeling showed that GSDS scores at 6 weeks postpartum were associated with high odds of having an EPDS score > 9 (OR = 3.56; 95% CI = 1.73–7.33) at 6 or 12 weeks postpartum. The study did not find a significant relationship between objective measures of sleep 6 weeks postpartum and symptoms of depression.</p>
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Abbreviations: PSQS, Postpartum Sleep Quality Scale; GSDS, General Sleep Disturbance Scale; PSQI, Pittsburgh Sleep Quality Index.

delivery and perineal pain were more pronounced in older women. Mothers who exercised were found to have better sleep quality than mothers who did not exercise.²⁴

In their study on the dynamics of indicators of objective, performed using actigraphy, and subjective sleep quality, Coo et al found that the quality of sleep in the third trimester of pregnancy mainly worsened due to sleep fragmentation. In the first 15 days after childbirth, this indicator increased by two-fold, which was accompanied by a decrease in the duration and efficiency of sleep, and was restored after 10–12 weeks. Impaired nighttime sleep also disrupted sleep and wake habits, as daytime sleep time and daytime napping increased as objective measures of sleep quality, and its quantity declined. Instead, subjective measures of sleep were more closely related to mood than objective measures, although the latter had a significant effect on stress levels, when significant changes in sleep were observed during the first 15 days after delivery.²⁵

In another study, Canadian scientists evaluated subjective and objective indicators of the quality of sleep in mothers and fathers. Maternal sleep was found to be more fragmented and had a significantly shorter duration of continuous night sleep and more night awakenings than paternal sleep, both at 1 month and 3 months postpartum. The results of the study showed that the subjective and objective fragmentation of sleep in women persisted for 6 months in the postpartum period. The researchers also analyzed the relationship between sleep quality and family factors, and found that older mothers reported shorter subjective duration of uninterrupted sleep and fewer nighttime awakenings. They also demonstrated great variability in actigraphy of nighttime sleep duration. Mothers who had more than one child, had shorter subjective nighttime sleep duration, shorter uninterrupted sleep duration, and a lower percentage of nights with 6 consecutive hours of sleep. In addition, mothers who were on maternity leave reported more night awakenings than mothers who were actively working. While mothers on maternity leave cared for their infants during the nighttime period, it is also likely that they slept during the day to compensate for disturbed nighttime sleep. Thus, the increase in time spent in bed during the day could affect maternal sleep at night. No relationship was found between maternal sleep parameters (subjective and objective) and the level of education or the method of feeding the child.²⁶

An American study by King et al investigated the relationship between maternal sleep disturbances and mothers' emotional sensitivity to their infants, and found that none of the symptoms of sleep disturbances or insomnia were significantly associated with the general level of maternal sensitivity to the child, nor with the ability to sustain sensitivity during interaction with the infant. Using multilevel modeling, the researchers found that mothers with worse objective sleep duration showed decreased responsiveness to their infants during free play interactions.²⁷

A study by Stremmer demonstrated a strong relationship between subjective measures of sleep quality at 6 weeks postpartum and symptoms of postpartum depression at 6 or 12 weeks. Women who subjectively rated sleep quality as a "little problem" were three times more likely to demonstrate symptoms of postpartum depression, compared to women who reported a "big problem" with sleep and were eight times more likely to do so. The authors conclude that the subjective perception of sleep quality may be an important clinical indicator of bad mood in women in the postpartum period.²⁹

Psycho-Emotional States and Poor Maternal Sleep Quality

This section discusses the experience of sleep quality related to mood disturbance in women during late pregnancy and after postpartum (Table 2). Nine papers were included in the analysis; however, two of them were previously presented in the section on sleep quality because they relate to both sections: maternal sleep quality and mood disturbance.^{23,25} Insufficient professional postpartum care, subjective sleep quality, low enthusiasm for daily housework, breastfeeding difficulties, lack of support from family and relatives, and the gender of the newborn (male) were identified as factors associated with sleep deterioration and predictors of postpartum anxiety and depression.

An American study of women at increased risk of postpartum depression found a marked improvement in sleep between the sixth and seventh week postpartum. At the same time, linear regression analysis showed that deterioration or only minimal improvement in sleep quality was associated with greater severity of depressive symptoms 7 months after the birth of a child. When studying individual components of sleep quality, a higher level of depressive symptoms led to changes in the indicators of sleep latent period and daytime dysfunction.³⁰

Table 2 Characteristics of the Studies Included in the Evaluation of Maternal Mood Disturbance in the Perinatal Period

First Author's Name [Number in References]	Sociodemographic Data: 1. Country 2. Maternal age 3. Sample size	Design: 1. Study design 2. Number of groups 3. Description of groups	Aim of the Study	Tools Used to Assess Psycho – Emotional State	Main Results
Beth A. Lewis ³⁰	Upper Midwest of United States Mean age: not given Sample size: 122	Cohort study One group, surveillance at six weeks and at seven months postpartum	Examine the relationship between changes in self-reported sleep patterns (from six weeks to seven months postpartum) and depressive symptoms at seven months postpartum among women who were at high risk for postpartum depression.	PHQ-9	At 6 weeks postpartum period: 5.98±3.83 at 7 month postpartum period: 4.17±4.04 p < 0.001 According to linear regression analysis, greater increases in total PSQI scores from 6 weeks to 7 months postpartum predicted more severe depressive symptoms at 7 months postpartum. This was particularly the case for subscales of the PSQI, such as daytime dysfunction and sleep latency. To check for multicollinearity, variance inflation coefficients were calculated for each of the predictor variables in the regression analysis. They ranged from 1.002 to 1.056 for the predictors in the regression analysis, indicating low multicollinearity.
Soledad Coo ²⁵	Australia Mean age: 31.08±3.82 Sample size: 29	Cohort study One group, surveillance at third trimester of pregnancy (Time 1), 15 days after childbirth (Time 2), 10–12 weeks postpartum (Time 3)	To examine association between measures of objective sleep (OS) and subjective sleep (SS) to postpartum mood in healthy women from the third trimester of pregnancy from 10 to 12 weeks postpartum.	EPDS HADS DASS	EPDS - Time 1 5.56±4.07 - Time 2 6.96±3.93 - Time 3 6.19±4.94 DASS stress: - Time 1 9.56±6.87 - Time 2 8.67±6.56 - Time 3 9.63±8.82 HADS depression: - Time 1 3.00±2.62 - Time 2 4.58±3.69** (p<0.001) - Time 3 3.46±3.98 HADS anxiety: - Time 1 5.50±4.38 - Time 2 6.25±4.19 - Time 3 5.29±4.96 With the exception of HADS depression, the indicators of which significantly increased from the third trimester of pregnancy to the first 15 days after delivery, no statistically significant changes in stress, depression and anxiety indicators were observed. Despite the increase in depression at Time 2, scores on all mood scales corresponded to the normal range of distress. The mother's subjective sleep disturbance also had a greater impact on her mood than objective indicators.

Michele L. Okun ²⁸	USA Mean age: 31.4±5.4 Sample size: 116	Cohort study Two groups: - Good sleepers (PSQI<5) - Poor sleepers (PSQI>5) Surveillance at 6 month postpartum	To evaluate the relationship between sleep quality and symptoms of depression and anxiety in women studied in pregnancy and postpartum.	PHQ-9 EPDS/OASIS	OASIS: - Poor sleepers 4.67±3.75 - Good sleepers 2.71±2.53 p=0.001 PHQ-9: - Poor sleepers 5.61±4.82 - Good sleepers 2.93±2.63 p<0.001 EPDS - Poor sleepers 6.5±5.07 - Good sleepers 3.4±3.36 p<0.001 According to the OASIS scale, only 10.3% of the respondents received a score of 8 or higher, which may indicate the presence of an anxiety disorder. Examining the indicators of the PHQ9 scale, 30.2% of the respondents had symptoms of mild depression, 4.3% - moderate, and 2.5% of women - symptoms of severe depression. Although only 9.5% of women scored 11 or more on the EPDS scale, indicating possible postpartum depression. After conducting multivariate linear regression analysis, it was determined that after 6 months, women with poor sleep quality had significantly higher postpartum PHQ9 scores (depression) ($\beta = 0.191$, $p = 0.036$), OASIS (anxiety) ($\beta = 0.233$, $p = 0.012$) and EPDS (postpartum depression and anxiety) scores ($\beta = 0.369$, $p < 0.001$).
Roshan Khadka ²³	Nepal Mean age: 30±3.9 Sample size: 380	Cross-sectional study One group: woman at 2–12 months postpartum	To identify the prevalence and determinants of postpartum poor maternal sleep and depression.	PHQ - 2	Determinants of depression quality among the mothers at 2–12 months postpartum: - Living in a nuclear family OR 48.5 [95% CI 15.3 to 154] - Living in rural areas OR 26.6 [95% CI 5.34 to 132] - Male infant OR 4.61 [95% CI 1.84 to 11.5] - No postnatal care visit OR 98.7 [95% CI 19.4 to 503], - Complications after delivery OR 21.9 [95% CI 7.30 to 65.9]. - Early introduction of complementary foods before 6 months of age OR 4.71 [95% CI 1.88 to 11.8] - Poor sleep quality OR 3.20 [95% CI 1.34 to 7.61]. Women with postpartum depression were more likely to be engaged in agriculture/physical work, lived in a nuclear family and in rural areas, and gave birth to a male infant. They were also more likely to introduce complementary foods to their babies before 6 months of age, had postpartum medical complications in the mother or child, and did not have full access to postpartum care.

(Continued)

Table 2 (Continued).

Kathryn Howard ³¹	USA Mean age: 32.0±4.3 Sample size: 26	Cohort study One group: surveillance at 6 and 12 month postpartum	How modifiable maternal factors (body mass index (BMI), household income, fatigue, sleep, breastfeeding status, diet, and physical activity) relate to postpartum depression (PPD) at 6 and 12 months postpartum.	EPDS SEES BRUMS	Correlations between: - PPD and BMI at 6 month postpartum ($r = 0.468$, $p = 0.021$) - PPD and household income at 6 months ($r = -0.391$, $p = 0.065$) and at 12 months ($r = -0.154$, $p = 0.556$) - PPD and SEES at six months: ($r = 0.642$, $p < 0.001$); 12 months ($r = 0.679$, $p = 0.003$) - PPD and BRUMS at six months: ($r = 0.701$, $p < 0.001$); 12 months postpartum: ($r = 0.680$, $p = 0.004$) - PPD and PSQI at 12 month postpartum: ($r = 0.752$, $p < 0.001$) Regression analysis identified factors such as household income and fatigue as the strongest predictors of PPD at six months postpartum.
Hanshuang Zou ³²	China Age (years): - <25 (14.3%) - 26–35 (78.8%) - 36–45 (6.9%) Sample size: 293	Cross-sectional study Two divisions: - Two groups: - PPD - Non-PPD - Three groups - Low dietary inflammatory index (Q1, DII<33.3%) - Intermediate DII (Q2, 33.3% <DII<66.7) - High DII (Q3, DII>66.7%)	Evaluation of the dietary quality by assessing the DII (dietary inflammatory index) scores, exploring whether exclusive breastfeeding mothers' diet contributes to an inflammatory environment in the body, which consequently affected the occurrence of depression	EPDS	Occupation level: - Employed: Non-PPD 36.1%, PPD 63.9%; - Unemployed: Non-PPD 47.1%, PPD 52.9%; $p=0.069$ (Chi-square test) Education levels: - Junior high school and below: Non-PPD 10%, PPD 90%; - Specialized degree: Non-PPD 33.3%, PPD 66.7%; - Bachelor's degree: Non-PPD 46.0%, PPD 54.0%; - Postgraduate and above: Non-PPD 51.6%, PPD 48.4%; $p=0.021$ Number of children: - 1 child: Non-PPD 35.6%, PPD 64.4%; - 2 or more children: Non-PPD 46.9%, PPD 53.1%; $p=0.054$ When comparing sociodemographic factors between groups with and without postpartum depression it was found that women with a junior high school education or less, who had their first child, were the sole caregiver for the infant, and had low levels of social support, were more likely to suffer from PPD. Unemployed women and woman with better sleep quality, on the contrary, were less likely to suffer from depression. The use of an anti-inflammatory diet (DII < 2.89) is also a factor preventing the development of depression among exclusively breastfeeding women (OR = 0.47).
Seyhan Çankaya ³³	Turkey Mean age: 27.3±5.2 Sample size: 245	Cohort study One group: surveillance at 3rd trimester of pregnancy and at 6–8 weeks postpartum	To determine the psychosocial risk factors that may increase the risk of developing postpartum depression (PPD) symptoms in the antenatal period and at 6–8 weeks postpartum.	PSS HADS EPDS	Comparison of different characteristics of woman with and without PPD: - Trouble in marriage $p=0.002$ - Husband wanting the pregnancy $p=0.036$ - Being subjected to violence from the husband or another male in the family $p=0.012$ - Being subjected to emotional abuse $p=0.007$ - Experiencing a sad event in the family during pregnancy $p=0.006$ Among the 245 surveyed women, 18% received an EPDS score above 13, which indicated the presence of symptoms of postpartum depression. Levels of anxiety and depression on the HADS-A and HADS-D scales were also significantly higher in women with PPD. Psychosocial health, perceived stress, and other psychosocial risk factors during pregnancy were also identified as important factors in postpartum depression.

Danielle Clout ³⁴	Australia Mean age: 31.8±4.37 Sample size: 105	Cohort study One group: surveillance at 3rd trimester of pregnancy and at 4–6 months postpartum	To evaluate the relationship between sociodemographic, pregnancy, obstetric, and postnatal variables and postpartum depression, anxiety and stress levels in new mothers	DASS EPDS	<p>*$P < 0.05$; **$P < 0.01$</p> <p>Correlations between depression (DASS) and:</p> <ul style="list-style-type: none"> - Anxiety $r = 0.62^{**}$ - PPD (EPDS) $r = 0.73^*$ - Stress $r = 0.70^{**}$ - Caesarean section $r = 0.22^*$ - Child's current health $r = 0.214^*$ - Child's sleep problems $r = -0.035^{**}$ - Maternal sleep quality $r = 0.29^*$ <p>Correlations between anxiety (DASS) and:</p> <ul style="list-style-type: none"> - Stress $r = 0.66^{**}$ - PPD (EPDS) $r = 0.66^*$ - Child's current health $r = 0.26^{**}$ - Maternal sleep quality $r = 0.2^*$ <p>Correlations between PPD (EPDS) and:</p> <ul style="list-style-type: none"> - Pregnancy intention $r = 0.22^*$ - Gestation at birth $r = -0.26$ - Child's current health $r = 0.32^{**}$ - Child's sleep problems $r = -0.4^*$ - Maternal sleep quality $r = 0.38^{**}$ - Stressful life events $r = 0.24^*$ <p>Among those interviewed, only 14.3% of the women reported symptoms of anxiety and stress without comorbid depression. Further analysis revealed that maternal depression, anxiety, and stress were closely interrelated and correlated with sleep and maternal and child health problems.</p>
Ying Liu ³⁵	China Mean age: not given Sample size: 1204	Cross-sectional study One group	To evaluate the relationship between sociodemographic, perinatal variables, and PPA and PPD symptoms of parturients at 6 weeks postpartum.	SAS EPDS	<p>Factors associated with PPA symptoms:</p> <ul style="list-style-type: none"> - Low monthly income <5000 RMB OR 2.13 [95% CI 1.26 to 3.59] - Low support from the family OR 4.37 [95% CI 3.07 to 7.37] - Unplanned pregnancy OR 2.00 [95% CI 1.36 to 2.94] - Unsatisfactory labour experience OR 6.26 [95% CI 3.27 to 10.51] - Severe fatigue OR 26.85 [95% CI 8.69 to 83.0] - Having PPD symptoms OR 13.41 [95% CI 9.35 to 19.22] <p>Factors associated with PPD symptoms:</p> <ul style="list-style-type: none"> - Low support from family OR 5.46 [95% CI 3.65 to 8.15] - Low support from colleagues or friends OR 5.64 [95% CI 3.74 to 8.52] - Unsatisfactory labour experience OR 2.54 [95% CI 1.53 to 4.24] - Maternal separation OR 1.88 [95% CI 1.33 to 2.64] - Severe fatigue OR 35.97 [95% CI 11.56 to 111.30] - Breastfeeding difficulties OR 2.07 [95% CI 1.57 to 2.73]

Abbreviations: PHQ-9, Patient Health Questionnaire-9; EPDS, Edinburgh Postnatal Depression Scale; HADS, Hamilton Depression Scale; DASS, Depression, Anxiety, and Stress Scales; OASIS, Overall Anxiety Severity and Impairment Scale; PHQ-2, Patient Health Questionnaire-2; SEES, Subjective Exercise Experience Scale; BRUMS, The Brunel Mood Scale; PSS, Perceived Stress Scale; SAS, Self-Rating Anxiety Scale; PPD, postpartum depression; PPA, postpartum anxiety.

Australian researchers found that subjective sleep quality, and therefore the mother's personal perception of sleep and low enthusiasm for daily activities, was more closely related to mood than objective sleep quality. The researchers noted that the improvement in mood during the first 15 days after childbirth depended precisely on subjective night sleep, and not on daytime sleep and the severity of daytime dysfunction.²⁵ When assessing the relationship between subjective sleep quality and symptoms of anxiety and depression, Okun et al found a significant effect of poor sleep quality on postpartum depression, even after taking into account the strong correlation between prenatal and postpartum mood scores.²⁸ A similar study was conducted in Nepal. The sample included 380 women, among whom 18.7% developed postpartum depression at 2 to 12 months after childbirth. A significant correlation was found between postpartum depression and the following subcomponents of the PSQI: sleep quality, efficiency, sleep latency, use of sleep medication, and daytime dysfunction. Among the sociodemographic indicators of the development of depression, separate living was noted, which deprived young mothers of support from their mothers or other relatives. The lack of professional postpartum care, the presence of medical complications in oneself or the child, and the birth of a male child were also factors associated with depression.²³

In a study of the factors that cause postpartum depression (PPD), Howard et al identified a number of modifying factors, including body mass index (BMI), household income, fatigue, sleep, breastfeeding status, diet, and physical activity. Correlation analysis revealed a positive association of PPD with BMI and fatigue, and a negative association of postpartum depression with household income and sleep quality. Women who breastfed also had lower rates of PPD.³¹

Another study on postpartum depression found that breastfeeding women who switched from a pro-inflammatory to an anti-inflammatory diet had a reduced risk of PPD. Moreover, this protective effect persisted after adjusting for mothers' level of employment, sleep quality, and social support.³² A study by Turkish scientists involving 245 pregnant women revealed possible psychosocial risk factors that may contribute to developing symptoms of postpartum depression in the period 6–8 weeks after childbirth. Using a threshold score of ≥ 13 for the EPDS scale, the prevalence of postpartum PPD was determined to be 18%. Among women suffering from postpartum depression, 25% had an unplanned pregnancy or one that their partner did not want, 34.1% had marital problems, and 22.7% experienced family distress during pregnancy. Women who confirmed episodes of abuse and had high levels of anxiety or stress were more likely to suffer from symptoms of postpartum depression. Young mothers with PPD also had low psychosocial health scores.³³

Clout et al found no association between sociodemographic factors, including age, education, and income, and emotional states such as depression, anxiety, and postpartum stress. This could be due to a limitation of the study, which mainly involved upper-middle-income women, which was a factor of low financial stress. Pregnancy factors such as planned pregnancy, repeated births, and use of assisted reproductive technology were also not associated with anxiety, depression, and postpartum stress. Among the obstetric variables, only c-section was associated with increased levels of stress and anxiety in the period up to 6 months after delivery. The established association between children's sleep and health problems and maternal anxiety and depression was no longer significant after adjusting for antenatal distress.³⁴

Predictors of postpartum depression and postpartum anxiety (PPA) were identified by Chinese scientists in a large cross-sectional study involving 1204 women. A multivariate logistic regression analysis showed that mothers with low levels of support from the family, colleagues, or friends were more likely to experience symptoms of postpartum depression six weeks after childbirth. Risk factors for PPD also include smoking, mother-child separation, and breastfeeding difficulties. Women who were satisfied with their birth experience and received high family support were less likely to report symptoms of PPA. The presence of PPA symptoms concurrently increased the risk of developing PPD symptoms. Parturients who experienced severe fatigue reported more anxiety and stress symptoms. They also reported more depressive symptoms than parturients without severe fatigue.⁹

Interventions for Improving Maternal Sleep Quality

The need for sleep is individual and variable, but if improving sleep hygiene does not yield the expected results, there are cheap and easy ways to improve temporary sleep problems before seeking professional help. Sleep-promoting interventions include pharmacological and non-pharmacological treatment, but since many hypnotics are not recommended for pregnant or lactating women, non-pharmacological interventions such as aromatherapy, acupuncture, physical activity,

Table 3 Characteristics of the Studies Included in the Evaluation of Sleep Interventions in Women's Sleep Disturbance in the Perinatal Period

First Author's Name	Sociodemographic Data: 1. Country 2. Maternal age 3. Sample size	Design: 1. Study design 2. Number of groups 3. Description of groups	Aim of the Study	Tools used to Assess Sleep Quality and Psycho – Emotional State	Main Results
Shao-Min Chang ³⁶	Taiwan Age: 24–43 Sample size: 73	Randomized control trial Two groups: - Experimental - Control	Evaluate the effects of single-ingredient chamomile tea on sleep quality, fatigue, and depression in postpartum women.	PSQS EPDS	2 weeks after starting chamomile tea, significant differences were found between the study group and controls on the PSQS "sleep inefficiency associated with physical symptoms" scale ($t = -2482$, $P = 0.015$) and EPDS ($t = -2.372$, $P = 0.020$). However, in the long term, the consumption of chamomile tea did not show a significant difference in the indicators between the groups. Yet, 40% of women from the research group noted that drinking German chamomile tea effectively promotes sleep quality, and 37% - emotional stability and relaxation.
Fatemeh Effati-Daryani ³⁷	East Azerbaijan Age: 18–40 Sample size: 141	Randomized control trial Three groups: - Intervention with lavender cream and foot bath - Intervention with lavender cream - Placebo cream	Effectiveness of Lavender cream and footbath on sleep quality and fatigue in pregnancy and postpartum.	PSQI MAF	At the beginning of the study, the mean total PSQI was 9.7 ± 2.7 , and the fatigue index (MAF) was 25.9 ± 7.1 . When comparing the groups after the start of the intervention, women receiving lavender and foot baths had significantly better sleep quality scores at 6 months postpartum than women in the control group (6.6 vs 8.9; mean difference: -2.3 [95% CI -3.6 to -0.9]). Also, a significant difference in sleep quality at 6 weeks postpartum could be observed between the lavender and placebo groups (5.7 vs 8.9; mean difference: -3.0 [95% CI -4.4 to -1.7]). Significant differences were found between the control group and both intervention groups in fatigue scores (mean difference: -6.2 [95% CI: -9.8 to -2.5] for the lavender group and foot baths, and mean difference: -5.8 [95% CI: -9.4 – -2.2] for lavender group).

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Table 3 (Continued).

Mei-Ling Chen ³⁸	Eastern Taiwan Mean age: 33 Sample size: 60	Randomized control trial Two groups: - experimental - control	Explore the effect of a bergamot essential oil aromatherapy intervention on depressive mood and sleep quality in postpartum women.	PSQS EPDS	According to the results of the regression analysis, there was no significant difference between the sleep quality indicators of women who received aromatherapy with bergamot essential oil and the control group ($p > 0.05$). However, the interaction effect between groups on the depression scale showed a significant difference ($p < 0.001$).
Yi-Li Ko ⁸	Northern Taiwan Mean age: 34.63 ±3,58 Sample size: 30	Quasi-experimental study One group: before and post intervention comparison	Effects of auricular acupressure therapy on women with postpartum insomnia.	Chinese PSQI	At baseline, about 60% of women expressed dissatisfaction with the quality of sleep, 33% noted prolonged falling asleep (>30 minutes), and only 23.3% of women had high sleep efficiency $\geq 85\%$. Acupressure point massage of the auricle (Shenmen point) significantly reduced both the overall average score of the PSQI scale ($t = 6, 6, p = 0.000$), as well as the indicators of individual components of the PSQI scale: subjective perception of sleep quality, sleep latency, sleep duration, and sleep disturbance ($p < 0.05$).
Chiu-Ling Yang ¹⁰	Southern Taiwan Mean age: 31.89±4.03 - experimental, 32.45±4.12 – control. Sample size: 140	Randomized control trial Two groups: - experimental - control	Determine whether the aerobic gymnastic exercise improves stress, fatigue, sleep quality and depression in postpartum women	PSQS EPDS PSS PFS	There is a significant difference among the experimental group between baseline values and values 4 weeks after the intervention (Pre-test 1) on PSQS Factor 1 and EPDS ($p < 0.05$) and between baseline values and values after 12 weeks (Pre-test 2) on PSS, PFS, PSQS Factor 1 and EPDS indicators ($p < 0.05$). In general, using paired t-tests, a significant improvement in stress, fatigue and sleep quality indicators was noted after using daily gymnastic exercises for 12 weeks.

Yu-Hsiang Liu ³⁵	Taiwan Mean age: - experimental group 32.22 ±3.43 - control 32.96 ±3.32 Sample size: 88	Randomized control trial Two groups: - experimental - control	Evaluate the effects of a walking exercise in relieving sleep quality, fatigue, and depression in new mothers during the postpartum period.	PSQS EPDS PFS	A two-way repeated-measures analysis of variance determined that the interaction of experimental group and duration of the study on the PSQS factor 2 “physical symptoms related to sleep inefficiency” was significant ($F = 7.253$, $p = 0.009$) at 4 weeks post-intervention. No significant interaction was found among the indicators of the EPDS and PFS scales in the experimental group.
Hongling Liu ⁹	China Mean age: - intervention group 26.89 ±4.12 - control 27.31 ±4.56 Sample size: 260	Randomized control trial Two groups: - intervention group - control	Prevention of the pathogenesis of postpartum depression in primiparous women using cognitive behavior intervention.	PSQI HAMA HAMD EPDS	Participants receiving cognitive behavioral therapy had significantly lower HAMA (Hamilton Anxiety Scale), HAMD (Hamilton Depression Scale), EPDS, and PSQI scores compared to baseline scores ($p = 0.034$, $p = 0.038$, $p = 0.004$, $p = 0.014$, respectively). The number of women with postpartum depression after 6 weeks of intervention was significantly lower in the experimental group (11.5%) than in the control group (24.3%).
Jennifer N. Felder ³⁹	USA Mean age: - Control 33.21±3.98 - Digital CBT-I 33.9±3.38 Sample size: 208	Randomized control trial Two groups: - Usual treatment (control) - Digital CBT-I (Cognitive behavior therapy for insomnia)	To evaluate the effects of digital cognitive behavior therapy for insomnia (dCBT-I) delivered during pregnancy on subjective sleep outcomes, depressive symptoms, and anxiety symptoms through 6 months postpartum.	PSQI EPDS GAD-7	A decrease in ISI was found in the digital CBT-I group compared to the control group, but not at a significant level ($p = 0.08$). At the same time, women from the experimental group noted higher rates of insomnia remission 6 months after childbirth (approximately 53% vs 35%, $p = 0.02$). PSQI scores did not differ between the two groups at 3 or 6 months postpartum. The likelihood ratio test of two differences in changes from baseline was statistically significant for the EPDS scale ($p = 0.002$) at 3 and 6 months postpartum. Differences between anxiety scores between groups were significant only in the period of 3 months postpartum ($p = 0.001$).

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Table 3 (Continued).

Mozhgan Rouzafzoon ⁴⁰	Iran Mean age: 29.6 Sample size: 82	Randomized control trial Two groups: - intervention group - control	Effects of preventive behavioral sleep intervention (BSI) on infant sleep patterns, maternal sleep quality, and depression.	PSQI EPDS	The quality of maternal sleep in the group receiving the infant behavioral sleep intervention changed from 10.9±2.9 to 8.9±3.1 (p = 0.040). Depression scores also improved: from 9.02±4.65 to 7.22 ±4.29 (p = 0.045). Regarding the analysis of sleep itself, 88% of women considered "maintaining a consistent sleep pattern for babies" to be the most difficult task, and "consistent sleep routine" of women - The second most difficult (66%).
Asmaa A. El Sehmawy ⁴¹	Egypt Age (years): - 18–25 (56–58%) - >25 (42–44%) Sample size: 400	Randomized control trial Two groups: - KMC group - Conventional care group (control)	Evaluation of the effect of skin-to-skin contact [Kangaroo mother care (KMC)] on the postpartum psychiatric disorders in mothers and its effectiveness on their full-term neonate.	PSQI EPDS PASS PBQ	The prevalence of mild depression among mothers who used Kangaroo mother care was 8.5%, compared to 23.5% in mothers who received standard care - [RR=0.62 (0.51–0.74)]. The prevalence of mild to moderate anxiety also differed: 10% in the KMC group versus 25.5% in the control group [RR = 0.63 (0.52–0.76)]. Also, mothers from the KMC group expressed less excessive concern for the child, less specific fears, and social and acute anxiety according to the PASS scale and had significantly better sleep indicators on all PSQI subscales (p<0.001)
Liora Kempler ⁴²	Australia Mean age: 33.3±4.0 Sample size: 215	Randomized control trial Two groups: - intervention - control	Efficacies of prenatal brief, group sleep psychoeducation in improving postpartum maternal sleep, and depression.	PSQI ISI MAF ESS EPDS DASS	A decrease in sleep quality was observed in both groups at 6 weeks postpartum (control group: mean difference -1.82; p < 0.001; intervention group: mean difference = -1.81; 95% CI [-2.64 to -0.98]; p < 0.001). At 4 months postpartum, the intervention group reported improved sleep quality compared to the control group (mean difference = 1.27; 95% CI [0.12 to 2.41]; p = 0.03), but at 10 months the differences between groups were not observed. No significant effect of the intervention was found on general symptoms of postpartum insomnia, depression, anxiety, and stress.

Abbreviations: PSQS, Postpartum Sleep Quality Scale; EPDS, Edinburgh Postnatal Depression Scale; PSQI, Pittsburgh Sleep Quality Index; MAF, Multidimensional assessment of fatigue; PSS, Perceived Stress Scale; PFS, Postpartum Fatigue Scale; HAMA, Hamilton Anxiety Rating Scale; HAMD, Hamilton Depression Rating Scale; GAD-7, Generalised Anxiety Disorder Assessment; PASS, Perinatal Anxiety Screening Scale; PBQ, Postpartum Bonding Questionnaire; ISI, Insomnia Severity Index; ESS, Epworth Sleepiness Scale; DASS, Depression, Anxiety, and Stress Scales.

cognitive behavioral psychotherapy to improve sleep are being extensively studied in this population. Table 3 contains a summary of the 11 publications selected during the analysis of sleep interventions in women's sleep disturbance in the perinatal period.

Randomized controlled trials have found enhancement in sleep inefficiencies associated with physical symptoms and reductions in depressive symptoms after drinking German chamomile tea.³⁶ A longer-term effect on sleep quality was observed with the use of lavender cream and foot baths.³⁷ Another study using aromatherapy, namely bergamot essential oil, found no improvement in sleep quality between experimental and placebo groups. However, a significant difference in depressive mood between groups was found ($p < 0.001$).³⁸

Auricular acupressure treatment also showed positive effects on PSQI measures such as sleep quality, sleep latency, sleep duration, and sleep disturbance. A parallel analysis conducted in this study did not show any significant relationship between sleep quality and demographics in postpartum women.⁸

Performing aerobic exercise at least three times a day (15 minutes per session) has been shown to significantly reduce fatigue, stress, and sleep inefficiency associated with physical symptoms in postpartum women.¹⁰ In contrast, 20–30 minutes of walking exercise showed significant improvement only in physical symptoms related to sleep inefficiency and had no significant effect on fatigue or depression.³⁹

Cognitive behavioral psychotherapy also had a positive effect on anxiety and depression in nulliparous women. In a Chinese study, post-intervention HAMA, HAMD, EPDS and PSQI scores were significantly lower than baseline scores in the experimental group.⁸ However, in an American study conducted by Felder et al, which involved digital cognitive behavioral therapy aimed at treating insomnia, there was no significant improvement in the severity of insomnia symptoms compared to participants in standard treatment, although there were higher rates of insomnia remission and lower rates cases of insomnia 6 months after childbirth. Participants in this study also had significant improvements in depression and anxiety symptoms.³⁹

Behavioral sleep intervention (BSI) on infant sleep patterns, as shown in a study by Rouzafzoon et al, also significantly affects maternal sleep quality and depressive symptoms ($p < 0.05$).⁴⁰ The impact of the skin-to-skin intervention (Kangaroo mother care) on the mother's health had a positive effect: there was an improvement in the quality of sleep, a decrease in the intensity of postoperative pain and proper healing of wounds, a decrease in anxiety and the frequency of depression. In addition, it promoted a better bond between the mother and the child, and had a positive effect on weight gain and increased sleep hours of infants at 12 weeks postpartum.⁴¹

On the other hand, prenatal psychological sleep education did not have a lasting effect on the mother's sleep in the postpartum period, nor was there a significant reduction in depressive symptoms.⁴²

Sleep and Breastfeeding

The connection between infant feeding behavior and maternal sleep patterns requires clarification. Hence, we paid particular attention to research on the relationship between maternal sleep quality and breastfeeding, and surprisingly, only three papers explored this connection (Table 4). There was no significant difference in overall sleep quality scores between breastfeeding and mixed-feeding women. Among women who breastfed, mothers who got up more than twice a night had slightly worse sleep quality indicators.⁸ A similar study was conducted by Belgian scientists who compared the indicators of individual components of the PSQI between women who breastfed and those who use a bottle to feed their baby. Breastfeeding mothers demonstrated better subjective sleep quality ($p=0.008$) but lower sleep efficiency ($p=0.003$). Since these components balanced each other, no significant differences in the overall quality of the PSQI were found depending on the method of feeding. Scores for other components did not differ between the groups.¹⁷ In a study conducted by Aksu and Yilmaz on Turkish mothers, the sleep quality of mothers emerges as an important element in breastfeeding self-efficacy. It was found that there is a strong negative relationship between total means scores for the PSQS and the Breastfeeding Self-efficacy Scale ($p<0.01$).¹⁸ Therefore, it is important to teach and support the mothers on how they can improve their sleep quality.

Table 4 Characteristics of the Studies Included in the Analysis on the Relationship Between Maternal Sleep Quality and Breastfeeding

First Author's Name	Sociodemographic Data: 1. Country 2. Maternal age 3. Sample size	Design: 1. Study design 2. Number of groups 3. Description of groups	Aim of the Study	Tools Used to Assess Sleep Quality	Main Results
Yi-Li Ko ⁸	Northern Taiwan Mean age: 34.63 ±3.58 Sample size: 30	Quasi-experimental study One group: before and post intervention comparison	Effects of auricular acupressure therapy on women with postpartum insomnia.	Chinese PSQI	PSQI scores in woman with different modes of breastfeeding: - Breastfeeding 5.33±2.54 - Mixed feeding 5.72±2.32 PSQI scores in woman with different numbers of milking per night: - No 5.83±3.59 - 1–2 times 5.45±2.0 - >2 times 6.0±4.24 According to the basic demographic indicators of the mothers, before the intervention, 40% of them breastfed only and 60% gave mixed feeding. The majority (73.3%) squeezed milk more than 2 times during the night.
Els Tobback ¹⁷	Belgium Mean age: 30.4±4.51 Sample size: 105	Cross-sectional study Two groups: - Breastfeeding mothers - Bottle-feeding mothers	To investigate whether perceived sleep and fatigue differ between breast- and bottle-feeding women during the postpartum period.	PSQI	Global PSQI score: - Breastfeeding mothers 7.3±3.01 - Bottle-feeding mothers 7.6±3.42 Subjective sleep quality: - Breastfeeding mothers 1.2±0.7 - Bottle-feeding mothers 1.6±0.81 Habitual sleep efficiency: - Breastfeeding mothers 2.2±0.97 - Bottle-feeding mothers 1.5±1.3 In this study, breastfeeding women had better subjective sleep quality scores but lower habitual sleep efficiency. There was no significant difference in total PSQI scores between the two groups.
Aslihan Aksu ¹⁸	Turkey Mean age: 25.4±5.1 Sample size: 128	Cohort study One group: primiparous women after vaginal delivery at 2 weeks postpartum	Relationship between sleep quality and breastfeeding self-efficacy of the mothers in the postpartum period.	PSQS BSES-SF	Mean PSQS score 33.57±11.26 Breastfeeding self-efficacy increased as maternal quality of sleep increased.

Abbreviations: PSQI, Pittsburgh Sleep Quality Index; PSQS, Postpartum Sleep Quality Scale; BSES-SF, The Breastfeeding Self-Efficacy Scale-Short Form.

Discussion

Pregnancy and the postpartum period bring about numerous changes since women undergo adaptation not only at the physiological level but they also adapt to a new lifestyle, which involves physical, social, and emotional changes as well as adjusting to a newborn child's sleep/wake cycles. This review was conducted to better understand sleep disruption and mood disorders in late pregnancy and postpartum women, their association with breastfeeding, and the prevention of sleep disturbances.

Sleep has a critical role in promoting the health of both the woman and the fetus. There is a growing recognition of the role of maternal circadian rhythm and sleep hygiene, which entrain the fetus and then the newborn's circadian rhythms. In young mothers at 6 weeks of the postpartum period, a shift in the circadian sleep phase to an earlier, compared to late pregnancy period was observed, as an adaptation mechanism for caring for infants during the night.⁴³ At the same time mothers who had a later sleep onset time and a shorter duration of night sleep had an increased level of melatonin, which was shown by backward stepwise regression as a predictor of more severe depressive symptoms.⁴⁴ Taking into account socio-economic and demographic factors, certain patterns of their influence on women's sleep and mood disorders were found.

Studies have reported that the most common determinants of poor sleep quality among healthy pregnant women were: advanced age, higher gestational age, being unmarried or living in a nuclear family, multiparity, multigravida, watching television in the bedroom, anxiety, and fatigue.^{21,23,45-47} Depressive symptoms have been found to be more common in the third trimester of pregnancy⁴⁸ which increases women's sensitivity to stress and, in turn, to anxiety. Conversely, increased symptoms of antenatal anxiety are a risk factor for postpartum depression.⁴⁹ The severity of obsessive-compulsive disorder (OCD) symptoms also increases the risk of the exacerbation of anxiety symptoms. OCD symptoms have demonstrated tend to be affected by stress during pregnancy, childbirth, and the postpartum period, when women may experience anxiety and obsessive thoughts about preparing for childbirth and providing a safe environment for their newborns. Maternal sleep did not appear to be a factor in increasing perinatal anxiety in women with pre-existing anxiety disorders.⁵⁰ Higher levels of anxiety and depression were found in women during pregnancy than in the postpartum period. Researchers suggest that this may be related to the course of pregnancy, the pregnant woman's concern about her health and the health of the child, as well as her fears about the pregnancy. A higher level of prenatal commitment was found in highly educated and actively working pregnant women, and a lower level in women with a larger number of live births. The difference between the levels of postpartum attachment, depending on the birth of a child of the desired sex, was established. Difficulty with breastfeeding after birth, intestinal colic or the child's crying that does not stop cause mothers to have negative feelings towards the child, experience anxiety and depression. Mothers who have a high level of prenatal attachment to their unborn children experience more positive bonding in the postpartum period as well.^{51,52} As indicated by our systematic review, insufficient professional postpartum care, labor difficulties, the male gender of the newborn, lack support from the family and relatives, too many domestic chores, and the subjective perception of sleep are strongly associated with maternal poor sleep and mood disturbance. The gender of the child as a prognostic factor of an attachment disorder can be taken into account only while also considering social parameters, such as, for example, giving preference to the birth of boys in some Asian countries, which have been confirmed by research.⁵³

By the first weeks after childbirth, women go through a period of enormous adaptation. Postpartum women also experience altered sleep patterns that may lead to sleep disturbance. One of the most common reasons for maternal sleep disturbance is related to newborn sleep and feeding patterns. Among selected manuscripts, there were many, which noted sleep disturbances in women in the postpartum period. During this period, the mother's bond with her baby is of particular importance. Better indicators of sleep quality had a positive effect on social interactions, although individual symptoms of sleep disorders or insomnia were not related to the general level of maternal sensitivity.²⁷ Lillis et al have found that mothers were better able to cope with daytime problems and negative social interaction (NSI) if they had a good night's sleep the night before.⁵⁴ A comparable effect may explain the association of maternal sleep with postpartum depression, where poor sleep increases mood reactivity and increases perception of NSI, as well as hinders recovery from a bad day. When studying different factors of social interaction in young mothers, playing or cuddling with the baby was rated as the most positive social interaction (PSI) of all. At the same time, if the baby's crying at night disturbed the

mother's sleep, it led to difficulties for the mother to cope with negative social interaction. If we take into account socio-economic and demographic factors, specific patterns emerge regarding their impact on sleep and mood disorders. Women with postpartum poor sleep quality had significantly higher depression scores adjusted for age, employment, BMI, marital status, and education. Postpartum fatigue also had a negative impact on the mother-child bond. Based on the findings reported by Henderson et al, women with postpartum fatigue (PPF) used significantly more negative adjectives to describe their child and themselves, and perceived their caregiving to be much worse than average. They also slower to bond with the child, and often reported that their child belonged to them "only recently" or "not quite yet". Interestingly, women experiencing fatigue were also more inclined to report not receiving enough assistance and guidance, although more hands-on help from a partner in postpartum care had a negative effect on the development of PPF at 3 months.⁵⁵

According to the mothers themselves, there are quite a few factors that affect their postpartum functioning. The negative impact of excessive fatigue and the importance of sleep were reported by 73% of mothers. They noted that lack of sleep leads to less satisfaction with time spent with the child and is associated with impaired emotion regulation. All women indicated support as the main factor of maternal well-being, the main aspects of which were: emotional support, encouragement to take care of themselves, involvement in social relationships, practical help with childcare, and household management.⁵⁶

Low socioeconomic status may be an additional factor in sleep disturbance and anxiety, as it limits a woman's ability to obtain resources. One month after birth, the level of women's depressive symptoms was the same in low and high socioeconomic groups. This may be related both to the mother's adaptation to the new role and routine with her child, and to additional financial support from the state and emotional support from friends and relatives in the first weeks after childbirth. After 2–3 months, the low-income women again reported significantly higher anxiety and a greater number of depressive symptoms. The risk of PPD was also high in unmarried women, unemployed women, and those who did not have a high level of education.⁵⁷

There are also many environmental and health-related factors that are responsible for sleep quantity and quality, eg diet, sleeping arrangements, or using electronic devices before bedtime, which have not been taken into consideration in research.^{58,59}

Diet is equally important for a woman's physical and emotional functioning. Previous studies found that both a low BMI³¹ and the use of anti-inflammatory products significantly reduced the level of PPD.⁵⁴

Furthermore, due to lifestyle modernization and the common use of artificial lightning, chronodisruption may pose a significant risk to the maternal circadian rhythm and make it difficult to form a circadian system in a child. One reason for lost sleep duration and quality is that the maternal circadian rhythm is disturbed by various factors such as endocrine changes, newborn feeding, and baby activity. Nevertheless, perinatal sleep disturbance must be distinguished from insomnia to avoid an overdiagnosis of the latter. A randomized controlled study conducted by American scientists confirmed that, without taking into account the criteria for the ability to sleep, insomnia rates could be 2–4 times higher than the actual reported rates.⁶⁰ Preventing the misdiagnosis of insomnia and establishing the factors of "adequate sleep opportunity" is an important step to improve the prevention and treatment of sleep disturbance. It is worth considering the assessment of maternal sleep hygiene and habits as a component of identifying women at risk for postpartum depression and anxiety. Women typically attend a postpartum provider appointment and the practitioner or a midwife could ask about and assess the maternal quality and quantity of sleep and educate them about sleep hygiene and good sleep habits. The strategies have the potential to enhance not only women's sleep but also their mental well-being.

Our review took into consideration the efficacy and incorporation of behavioral interventions, including cognitive behavioral therapy, mindfulness meditation, herbal medicine, aromatherapy, gymnastics and physical exercises, psychotherapy and relaxation, as there is growing evidence that they are helpful for sleep issues as well as mood symptoms.^{9,10,35–40} The positive effect of a woman's relaxation also affects the behavior of infants.⁶¹

Our understanding of the link between maternal sleep and breastfeeding remains limited. Improving sleep, reducing symptoms of mood disorders, and reducing stress levels enhance the mother's psychological and physiological functioning, including an increase in the volume of breast milk.⁶² Ruan et al investigated the relationship between sleep duration and breast milk macronutrient concentrations but did not find a significant correlation.¹⁵ A study by Astbury et al has demonstrated that breastfeeding itself is not associated with lower quality and quantity of nocturnal sleep, but a higher number of nighttime feeds is a strong predictor of shorter sleep duration and poor sleep quality.⁶³

There is a compelling need for a thorough investigation of the factors affecting postpartum sleep quality and breastfeeding, with a focus on the relationship between them through qualitative examinations. It would be interesting to determine which genes and biological pathways mediate or moderate the association between sleep and maternal mood. It would also be interesting to compare data on sleep quality and sleeping habits of mothers and newborns in different ethnographic cultures.

Limitation

There are some limitations of this study. First, in research, sleep quality was not measured repeatedly in the same conditions or at the same time points. The authors did not collect always data on daytime naps. Future work should include repeated measurements of sleep quality before and after childbirth.

Second, a major challenge lies in the lack of an objective tool for the measurement of sleep disturbance. Many studies do not use the questionnaire, validated for use during pregnancy and the postpartum period, which is a potential limitation.

There are no replicable studies on the same population, and results may differ depending on the women's origin, and cultural patterns of a given country or region. Future studies should include additional measures and pursue a deeper understanding of the relationships between maternal mood, sleep, and mother-infant interactions, eg collecting information on bed-sharing, breastfeeding behavior, or the structure of the family.

Conclusion

This mixed-studies systematic review was conducted to better understand sleep disturbance and mood disorders in late pregnancy and postpartum women, their association with breastfeeding, and the efficacy of sleep disturbance interventions. The inclusion of the assessment of maternal sleep hygiene and family sleep habits during postpartum provider appointments is worth considering. This may lead the improvement of not only women's sleep but also their overall mental well-being.

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