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Special review article

The relationship between sleep and postpartum mental disorders: A systematic review

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ABSTRACT

Background: Postpartum mental disorders (e.g., anxiety, depression, psychosis) are serious conditions that affect approximately 10–15% of women after childbirth, and up to 40% of women at risk for these disorders. Research reveals an association between poor sleep quality/quantity and symptoms of anxiety, depression and psychosis. The aim of this systematic review was to evaluate the available evidence for the relationship between sleep and postpartum mental disorders.

Methods: Searches included MEDLINE, EMBASE, and EBM Reviews – Cochrane Central Register of Controlled Trials, PsycINFO and EBSCOHost CINAHL through June 30, 2014. Manual searching was performed on reference lists of included articles. Published primary research in any language was included.

Results: There were 3187 unique titles/abstracts and 44 full-text articles reviewed. Thirty-one studies were included. Evidence was found for the impact of self-reported poor sleep during pregnancy and the postpartum on the development of postpartum depression, with not enough evidence for either postpartum anxiety or psychosis. The evidence for objectively assessed sleep and the development of postpartum disorders was mixed. Among the 31 studies included, 1 was strong, 13 were moderate and 17 were weak.

Limitations: Research design, method of assessment, timing of assessment, recruitment strategies, representative adequacy of the samples and inclusion/exclusion criteria all varied widely. Many studies did not use tools validated for the perinatal population and had small sample sizes without power analysis.

Conclusions: Sleep interventions represent a potential low-cost, non-pharmacological prevention and treatment strategy for postpartum mental illness. Further high-quality research is needed on this topic area.

Contents

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1. Introduction

Postpartum depression (PPD), anxiety (PPA) and psychosis (PPP) are serious conditions that affect approximately 10–15% of women after childbirth (Moses-Kolko and Roth, 2004; Steiner, 1998). Symptoms of all three postpartum mental disorders typically endure for anywhere from 2 to 12 months (Cooper et al., 1988; Heron et al., 2008), however postpartum mental illness and its consequences can persist for years following childbirth (Dennis et al., 2012). In some cases postpartum disorders become chronic and persist through more than one pregnancy (Kendler et al., 1993). Furthermore, between 20% and 40% of women with a previous history of postpartum depression are likely to suffer a relapse after birth (Austin and Lumley, 2003). Co-morbid disorders are common in women with postpartum disorders and mental illness is often complicated by issues of drug and alcohol abuse and domestic violence (Cooper and Murray, 1995). Postpartum mental illnesses are among the leading causes of morbidity and maternal death in the perinatal period (Austin et al., 2007).

Postpartum mental illness can also have a significant adverse effect on neonatal outcomes, such as low birth weight, decreased fetal growth and preterm birth (Apter et al., 2011; Dayan et al., 2002; Hoffman and Hatch, 2000; Kelly et al., 2002; MacCabe et al., 2007; Misri and Kendrick, 2007; Orr et al., 2002; Rogal et al., 2007; Steer et al., 1992; Wiencrot et al., 2012). These disorders can negatively impact infant development and health, as well as the health of other family members (Apter et al., 2011; Bacchus et al., 2004; Barnett et al., 1993; Campbell et al., 1995; Civic and Holt, 2000; Murray and Cooper, 1997; O'Connor et al., 2002). Parental relationships are often disrupted when one partner suffers from a mental illness, and some mothers must act as the primary caregiver for infants and young children while managing mental illness (Patel et al., 2004). Difficulties in the mother–child relationship (particularly attachment disruptions) and emotional dysregulation are major consequences of postpartum disorders (Apter-Danon and Candilis-Huisman, 2005). The most extreme outcomes include infant abuse, neglect (Chandra et al., 2006) and infanticide (Spinelli, 2004).

The causes of postpartum mental disorders are not fully understood, although certain factors have been found to correlate with increased risk. For example, it is well known that women who have symptoms of depression and/or anxiety during pregnancy or who have personal or family histories of depression are at high risk for developing PPD and PPA (Matthey et al., 2003; Steiner, 2002). Marital conflict, low socioeconomic status, stressful life events, and lack of social support are also known to be strongly associated with increased risk for PPD, PPA and PPP (Beck, 2001; Kendell et al., 1987; McKee et al., 2001; O'Hara and Swain, 1996; Steiner, 2002), while a history of bipolar disorder or postpartum psychosis (PPP) are significant risk factors for PPP (Doucet et al., 2011). Despite this and other research, no single causative factor has been isolated for PPD, PPA or PPP.

The association of sleep disruption with psychiatric disorders was first described by the founder of modern psychiatry (Kraepelin, 1909). Since this time evidence has accumulated that shows that insomnia and poor sleep quality/quantity independently increases the risk of depression and anxiety in non-psychiatric, non-postpartum populations (Alvaro et al., 2013; Baglioni et al., 2011; Breslau et al., 1996; Buysse et al., 2008; Riemann and Voderholzer, 2003; Taylor et al., 2003). For example, research indicates that major depression in up to 90% of cases is accompanied by disturbances of sleep continuity, regardless of diagnostic subtype (Mendelson, 1977; Winokur et al., 1969) and non-depressed people with insomnia have a twofold risk to develop depression, compared to people with no sleep difficulties (Baglioni et al., 2011). Recent studies have established high comorbidity rates between sleep disturbances and anxiety (Alfano et al., 2007; Spoormaker and van den Bout, 2005; Taylor et al., 2005), rates which vary across different anxiety disorders (Johnson et al., 2006). Longitudinal associations have also been established between sleep disturbances, anxiety, and depression (Baglioni et al., 2011; Fichter et al., 2009). Emerging research on this association in psychosis shows sleep disturbance to be a significant predictor of psychosis (Lunsford-Avery et al., 2013; Zanini et al., 2013), even when controlling for depression (Lee et al., 2012). According to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) sleep disturbances are one of the hallmarks of depression and anxiety, and are associated with psychosis (American Psychiatric Association, 2013).

Women experience dramatic changes to their sleep pattern and sleep quality beginning in late pregnancy and extending well into

the postpartum period (Santiago et al., 2001). Given the literature on the association between sleep disruption and psychiatric disorders, it is unsurprising that there is now a promising line of research that has uncovered a relationship between sleep deprivation and severe negative mood and/or psychosis in postpartum women. For example, insomnia has been noted as a prominent symptom of postpartum psychosis, anxiety and depression, with prevalence estimates of 42–100% of cases (Brockington et al., 1990; Hunt and Silverstone, 1995; Sloan, 2011; Swanson et al., 2011). In women presenting for treatment for postpartum depression, anxiety and psychosis, severe sleep deprivation is almost universal (Dorheim et al., 2009a; Fisher et al., 2002; Sharma and Mazmanian, 2003; Sharma et al., 2004; Sloan, 2011). Given women's reluctance to take psychotropic medications during pregnancy (Harrison-Hohner et al., 2001), a non-pharmacological strategy to prevent and reduce symptoms of postpartum mental illness such as sleep protection has great potential in terms of efficacy and effectiveness.

1.1. Objective

The objective of this study is to systematically review the impact of sleep on the development of postpartum mental disorders.

2. Methods

2.1. Study and participant criteria

All published primary research studies on sleep and postpartum mental illness in pregnant and postpartum, or only postpartum, women were included. Given the limited number of studies on the relationship between sleep and postpartum mental illness, all research designs were included.

2.2. Assessment of sleep quality/quantity

Details regarding the mother's sleep quantity and/or quality were elicited during history or by self-administered questionnaires in most instances; however, objective ascertainment data were also collected in some studies. We excluded papers that only tested potential causes of disrupted maternal sleep (e.g., infant sleep, infant temperament) but did not assess sleep directly or used proxy measures of sleep (e.g., circadian rhythm).

2.3. Outcome measures

Studies reporting on a diagnosis of, or assessment of the symptomatology of (1) postpartum depression; (2) postpartum anxiety; (3) postpartum psychosis; and (4) any other mental disorder diagnosed/assessed in the postpartum period (defined as within the first 12 months after childbirth) were included.

2.4. Data sources

Eligible publications were identified through a comprehensive electronic search performed with a trained librarian (EU) (please see Appendix A). Using OvidSP search platform, the following databases were searched: MEDLINE, EMBASE, and EBM Reviews – Cochrane Central Register of Controlled Trials (CCTR), PsycINFO and EBSCOHost CINAHL. Articles included were indexed as of July 30, 2013. Searches were updated on June 27 and June 30, 2014. No language restrictions were applied. We did not search grey literature, dissertation indices or unpublished studies. Abstracts of conference proceedings or professional meetings were excluded. In addition to searching databases, manual searching was performed on reference lists of included articles. Search results were downloaded into the citation management database EndNote 6 and the software's duplication check was used to exclude identical citations retrieved from multiple sources.

2.5. Selection of studies and data

Two authors (AL, AD) independently screened titles and abstracts from all initial searches for possible relevance. All publications and abstracts that appeared to meet eligibility criteria were retrieved. A decision to include or exclude each study was made by each of the two reviewers, with a list of journal articles to be included in the systematic review determined by agreement between the reviewers. Disagreements were resolved by consensus.

2.6. Assessment of quality

Two authors (AL, AD) independently assessed the methodologic quality of the included studies using a predefined checklist based on the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies (EPHPP) (Effective Public Health Practice Project, 2009c). The EPHPP quality assessment tool has been identified as one of the most appropriate for assessing non-RCTs as well as RCTs (Deeks et al., 2003; Thomas et al., 2004) and has been shown to have excellent inter rater reliability on global grades of study quality (Apter-Danon and Candilis-Huisman, 2005). EPHPP quality assessment involves rating each article on a three-point scale (strong, moderate, weak) in seven components: Selection Bias, Study Design, Confounders, Blinding, Data Collection Methods, Withdrawals and Drop-outs, and Analysis. Three of these sections were modified by the authors. First, the Selection Bias section was modified to more rigorously determine representativeness of the sample; an assessment of whether participants had been screened for risk factors for the disorder in question (e.g., history of depression) was included, as well as a determination of whether participants were recruited from a larger study or were a subset of a larger study. Second, the Data Collection Methods section was modified to record the type of tool used to assess sleep disturbance (e.g., objective measure, valid and reliable self-report, sleep diary/other, can't tell), the tool used to assess postpartum symptoms (e.g., structured psychiatric interview, valid and reliable self-report, other, can't tell) and when these tools were used (e.g., third trimester, first three months postpartum). Finally, the Analysis section was modified to grade studies on whether a correction of the family-wise error rate (aka the experiment wise error rate) was necessary and, if so, if one was performed. The family-wise error rate is the probability of making one or more false discoveries, or type I errors, among all the hypotheses when performing multiple hypotheses tests.

The EPHPP quality assessment tool has been used in over 45 systematic reviews (Effective Public Health Practice Project, 2009a), and has been used in previous systematic reviews of similar methodology to the current study (Fullen et al., 2008, 2009; Kelly et al., 2011). It has been shown to be a valid and reliable tool, and The Cochrane Public Health Review Group has recommended its use in public health and health promotion studies (Thomas et al., 2004).

Overall study quality is deemed “strong” if four or more components have “strong” ratings and no “weak” ratings; “moderate” if less than four “strong” ratings and one “weak” rating are found; and “weak” if two or more “weak” ratings are found. Determination of the quality rating for each component was guided by a Quality Assessment Tool Dictionary (Effective Public Health Practice Project, 2009b). Discrepancies were resolved by consensus and the involvement of a second and third author (ES, KM).

3. Results

3.1. Studies included in the review

The results of the search and the study selection log are reported in Fig. 1. Of 3187 unique titles/abstracts from the database search, 30 studies were included in the systematic review. One additional eligible article was identified via manual searching of reference lists of included articles (Chaudron et al., 2001), bringing the total number of included articles to 31.

3.2. Overview of the included studies

Of the 31 studies included in this review, one was a randomized controlled trial (RCT) (Khazaie et al., 2013) and two were chart reviews (Sharma et al., 2004; Swanson et al., 2011). The remainder were either cohort studies (21 articles; 20 prospective, 1 mixed prospective/retrospective) or cross section designs (7 articles).

The quality of the studies was largely compromised by selection bias. The percentage response/consent rate was reported in less than half of the articles (Bilszta et al., 2010; Chaudron et al., 2001; Coble et al., 1994; Dennis and Ross, 2005; Dorheim et al., 2014, 2009a, 2009b; Khazaie et al., 2013; Mead-Bennett, 1990; Okun et al., 2009, 2011; Piteo et al., 2013; Wilkie and Shapiro, 1992) and many did not use representative samples (Bilszta et al., 2010; Calcagni et al., 2012; Chaudron et al., 2001; Coble et al., 1994; Dorheim et al., 2014, 2009b; Frank et al., 1987; Lee and Kimble, 2009; Piteo et al., 2013; Posmontier, 2008; Swain et al., 1997; Swanson et al., 2013, 2011; Tsai and Thomas, 2012) or did not provide sufficient information to rate representativeness (Godfroid et al., 1997; Goyal et al., 2009, 2007; Okun et al., 2009, 2011). Outcome assessments were generally well performed, although their timing was irregular or unclear in some cases. A minority of studies relied solely on unvalidated or unreliable measures of sleep and/or postpartum symptomatology (Chaudron et al., 2001; Dennis and Ross, 2005; Mead-Bennett, 1990; Piteo et al., 2013; Sharma et al., 2004; Swain et al., 1997; Wilkie and Shapiro, 1992; Wolfson et al., 2003).

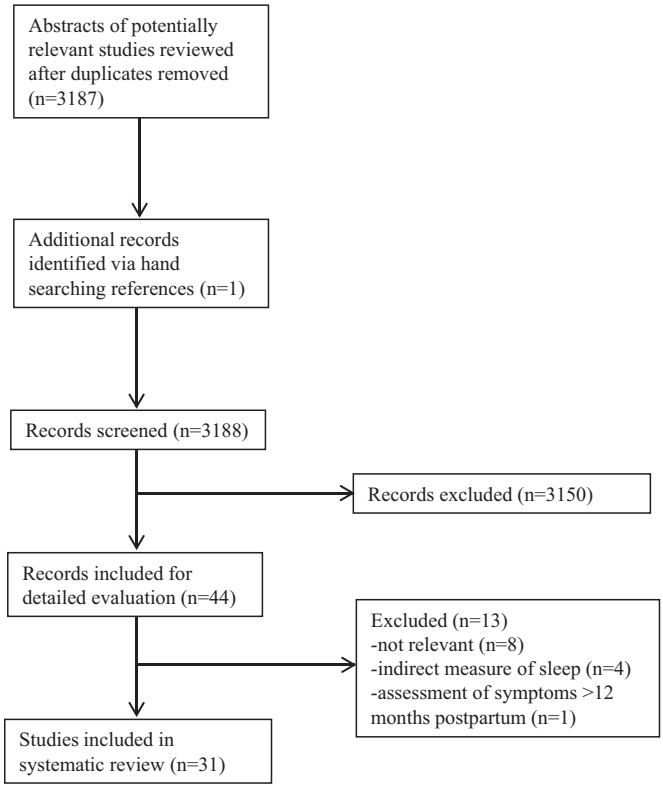

Fig. 1. Literature search strategy.

Attrition was inconsistently described. For those studies with two or more groups, several did not report on or adequately adjust for relevant confounders (Alipour et al., 2012; Bilszta et al., 2010; Calcagni et al., 2012; Chaudron et al., 2001; Dennis and Ross, 2005; Dorheim et al., 2014, 2009a; Frank et al., 1987; Marques et al., 2011; Park et al., 2013; Swanson et al., 2013; Wilkie and Shapiro, 1992). Analytic techniques were generally appropriate, although very few papers adjusted significance levels to account for the family-wise error rate when necessary (Calcagni et al., 2012; Coble et al., 1994; Dorheim et al., 2009a; Khazaie et al., 2013; Park et al., 2013; Swain et al., 1997; Swanson et al., 2011; Wolfson et al., 2003). Sample sizes varied greatly, with the smallest at 16 participants (Swanson et al., 2013) and the largest over four thousand (Dorheim et al., 2014), although the majority of the samples were less than 100 (58%). Only three studies included a formal sample size calculation (Alipour et al., 2012; Dorheim et al., 2009b; Posmontier, 2008).

Eighty percent of the included studies were conducted in the 2000s. Two were published in 1997, while four were published earlier. Of the 31 articles which met the inclusion criteria a little under half ($n=15$) were conducted in the United States. The remainder were from all over the world, including Norway (Dorheim et al., 2014, 2009a, 2009b), Iran (Alipour et al., 2012; Khazaie et al., 2013), Portugal (Marques et al., 2011), Canada (Dennis and Ross, 2005; Sharma et al., 2004), United Kingdom (Wilkie and Shapiro, 1992), Australia (Bei et al., 2009; Bilszta et al., 2010; Calcagni et al., 2012; Piteo et al., 2013), Belgium (Godfroid et al., 1997) and Taiwan (Huang et al., 2004; Tsai and Thomas, 2012). The characteristics of included studies are reported in Table 1.

3.3. Quality of the studies

One of the included articles scored a global rating of "strong" based on EPHPP criteria (Khazaie et al., 2013). The remaining studies were either "moderate" (13 articles) or "weak" (17 articles). See Table 2.

4. Primary outcome – postpartum depression (PPD)

Apart from two articles (Bilszta et al., 2010; Sharma et al., 2004), postpartum depression or possible precursors of postpartum depression (e.g., the blues) were the main focus of all the included articles (29 articles). Two of these examined both postpartum depression and anxiety (Calcagni et al., 2012; Swanson et al., 2011).

4.1. Sleep during pregnancy

4.1.1. Subjective assessment of sleep

Ten studies evaluated the relationship between subjectively assessed sleep during pregnancy and PPD symptoms and/or PPD diagnosis (Alipour et al., 2012; Bei et al., 2010; Calcagni et al., 2012; Dorheim et al., 2014; Marques et al., 2011; Mead-Bennett, 1990; Okun et al., 2009; Park et al., 2013; Wilkie and Shapiro, 1992; Wolfson et al., 2003), while one evaluated the difference in subjectively assessed sleep during pregnancy between women with and without a history of affective disorder (Coble et al., 1994). Seven of these found a relationship between self-reported sleep disruption in the third trimester and the development of depressive symptoms/PPD in the postpartum (Alipour et al., 2012; Bei et al., 2010; Dorheim et al., 2014; Marques et al., 2011; Okun et al., 2009; Park et al., 2013; Wilkie and Shapiro, 1992). One found a relationship between longer sleep times and later rise times during the 3rd trimester and elevated depression scores in the

Table 1
Summary of studies on the relationship between sleep and postpartum mental health problems.

Author, year, country postpartum depression ($n=27$)	Study design	Study sample and characteristics (sample size, attrition)	Sleep assessment/timing	Postpartum disorder assessment/timing	EPHPP quality score
Frank et al. (1987), United States	Prospective cohort study (two groups)	Having a minimum of one child. Recruitment setting not reported (NR; $n=52$, attrition NR) *Group 1*: One or more depressive episodes during or after pregnancy ($n=24$) *Group 2*: No history of pregnancy-related depression (pregnancy or postpartum) ($n=28$)	EEG/NR	*Screen*: Structured interview with the Schedule for Affective Disorders and Schizophrenia – Lifetime Version (SADS-L) *Process measures*: Hamilton Rating Scale for Depression (HRSD), Raskin Severity of Depression Scale (RSDS)/NR	Weak
Mead-Bennett (1990), United States	Prospective cohort study	3rd trimester, recruited from two large urban hospitals and one small community hospital ($n=85$, 67% attrition)	Author developed questions/ pre-pregnancy, 3rd trimester	Multiple Affect Adjective Check List (MAACL)/ 3rd trimester, 1st postpartum day	Moderate
Wilkie and Shapiro (1992), Scotland	Prospective cohort study (two groups)	3rd trimester, recruited from a hospital-based OB clinic ($n=80$, 21% attrition) *Group 1*: day time labor ($n=28$) *Group 2*: night time labor ($n=35$)	Author developed questions/ 3rd trimester, 1st 10 days postpartum	Kendell visual analog scale, Stein questionnaire/1st 10 days postpartum	Moderate
Coble et al. (1994), United States	Prospective cohort study (two groups)	1st trimester, self-referred from three large, private obstetrical practices, a hospital, and an early prenatal class ($n=34$, 21% attrition) *Group 1*: History of affective disorder ($n=14$) *Group 2*: No history of affective disorder ($n=20$)	EEG, 3 sleep items from the HRSD/two consecutive nights at 12, 24, and 36 weeks' gestation and at 1 and 8 months' postpartum	*Screen*: structured interview with SADS-L, Research Diagnostic Criteria (RDC) and DSM-III-R	Moderate
Godfroid et al. (1997), Belgium	Cross section (3 groups)	Recruitment NR ($n=24$). *Group 1*: 1st six months postpartum and suffering from PPD ($n=8$) *Group 2*: No childbirth ≥ 3 years, major depression with history of PPD ($n=8$) *Group 3*: No childbirth ≥ 3 years, major depression without a history of PPD ($n=8$)	EEG/*Group 1*: within the 1st six months postpartum	DSM-IV criteria for major depression, groups matched for severity of depression via HRSD (NIMH version)	Weak
Swain et al. (1997), United States	Prospective cohort study (two groups)	Recruited from a university hospital ($n=83$, 30% attrition). *Group 1*: Pregnant or postpartum with 1 child ($n=53$) *Group 2*: Not postpartum, 1 child under 5 who sleeps through the night ($n=30$)	Pittsburg sleep diary/daily for the 1st three postpartum weeks	Visual analog scales/daily for the 1st three postpartum weeks	Moderate
Chaudron et al. (2001), United States	Prospective cohort study (two groups)	Between weeks 12–25 pregnant, not clinically depressed, recruited from 8 obstetrics and gynecology clinics ($n=465$) *Group 1*: Major depression diagnosis and/ or CES-D ≥ 16 and/or receiving antidepressants between 1 and 4 months postpartum ($n=27$) *Group 2*: No diagnosis or CES-D < 16 or not receiving antidepressants ($n=438$)	Author generated/second trimester, 1 and 4 months postpartum	*Screen and process measures*: Structured interview using the Diagnostic Interview Schedule (DIS), Center for Epidemiologic Studies Depression Scale (CES-D)/second trimester, 1 and 4 months postpartum	Weak
Wolfson et al. (2003), United States	Prospective cohort study (two groups)	Pregnant with their 1st child, recruited from $\sim$20 hospital based prenatal classes ($n=56$, 32% attrition) *Group 1*: CES-D ≥ 16 at 2–4 weeks postpartum ($n=10$) *Group 2*: CES-D < 16 at 2–4 weeks postpartum ($n=28$)	Author generated sleep diary/ 3rd trimester, 2–4 weeks, 12–16 weeks, and 12–15 months postpartum	CES-D/3rd trimester, 2–4 weeks, 12–16 weeks, and 12–15 months postpartum	Moderate
Huang et al. (2004), Taiwan	Cross section	1st time mothers from 4 hospitals ($n=400$, 59% attrition)	Pittsburg Sleep Quality Index (PSQI)/10th–17th postpartum day for normal delivery, 13th–20th day for cesarean	CES-D/10th–17th postpartum day for normal delivery, 13th– 20th day for cesarean	Weak
Dennis and Ross (2005), Canada	Prospective cohort study (one/two groups)	32+ weeks pregnant, recruited from family physician, obstetrician, and midwifery offices ($n=505$, 16% attrition) *Group 1*: EPDS > 12 (4 weeks post $n=21$; 8 weeks post $n=20$)	Author generated/1-, 4-, and 8-weeks postpartum	EPDS/1-, 4-, and 8-weeks postpartum	Moderate

Table 1 (*continued*)

Author, year, country postpartum depression (*n*=27)	Study design	Study sample and characteristics (sample size, attrition)	Sleep assessment/timing	Postpartum disorder assessment/timing	EPHPP quality score
		Group 2: EPDS <13 (4 weeks post *n*=435; 8 weeks post *n*=405)			
Goyal et al. (2007), United States	Prospective cohort study (two groups)	Pregnant 1st time mothers, recruited from childbirth education classes (*n*=124, attrition NR) *Group 1*: CES-D ≥16 (3rd trimester *n*=32; 3 months post *n*=19) *Group 2*: CES-D ≤15 (3rd trimester *n*=92; 3 months post *n*=105)	General Sleep Disturbance Scale (GSDS)/third trimester, 1, 2, and 3 months postpartum	CES-D/third trimester, 1, 2, and 3 months postpartum	Weak
Posmontier (2008), United States	Prospective cohort study (two groups; case control)	6–26 weeks postpartum, recruited from one suburban midwifery practice and 2 obstetric practices via brochures/posters (*n*=54, attrition 15%) *Group 1*: PPD diagnosis (*n*=23) *Group 2*: no PPD diagnosis (*n*=23)	Actigraph, activity log/between 6–26 weeks postpartum	*Screen*: Mini Neuropsychiatric Interview (MINI). *Process measures*: Postpartum Depression Screening Scale (PDSS)/between 6–26 weeks postpartum (one week after actigraph)	Moderate
Dorheim et al. (2009a), Norway	Cross section (two groups)	7 weeks postpartum, recruited from 1 university hospital (*n*=42) *Group 1*: EPDS ≥10 (*n*=21; *n*=20 actigraph) *Group 2*: EPDS ≤7 (*n*=21; *n*=20 actigraph)	Actigraph, PSQI and sleep diary/7–10 weeks postpartum	*Screen*: EPDS	Weak
Dorheim et al. (2009b), Norway	Cross section (two groups)	7 weeks postpartum, recruited from 1 university hospital (*n*=2825) *Group 1*: EPDS ≥10 (*n*=466) *Group 2*: EPDS ≤10 (*n*=2359)	PSQI and author generated questions/7–10 weeks postpartum	EPDS/7–10 weeks postpartum	Weak
Goyal et al. (2009), United States	Prospective cohort study (pre-post)	1st time mothers, 3rd trimester, recruited from childbirth education classes (*n*=112)	Actigraph, sleep diary, and GSDS/3 months post	CES-D/3rd trimester and 3 month postpartum	Weak
Lee and Kimble (2009), United States	Cross section	1st time mothers, low birth weight infant, 2nd week postpartum, recruited from hospital NICU, number NR (*n*=20)	GSDS, sleep diary and actigraph/2nd week postpartum	EPDS/2nd week postpartum	Weak
Okun et al. (2009), United States	Prospective cohort study (three groups)	At 36 weeks gestation with history of PPD <5 years, not currently depressed, recruitment NR (*n*=56, attrition 9%) *Group 1*: PPD relapse within 4 postpartum weeks (*n*=5) *Group 2*: PPD relapse between postpartum weeks 5 and 28 (*n*=14) *Group 3*: no relapse (*n*=32)	PSQI/late pregnancy	*Screen*: Schedule for Affective Disorders and Schizophrenia (SADS) and HRSD/36th gestational week *Process measure*: HRSD and clinical evaluation by two psychiatrists using DSM-IV criteria/weekly for the 1st 20 weeks postpartum.	Moderate
Bei et al. (2010), Australia	Prospective cohort study (pre-post)	3rd trimester, not depressed, from an antenatal clinic at a regional hospital (*n*=44, attrition 43%)	PSQI and actigraph/3rd trimester and 1 week postpartum	Positive Negative Affect Schedule (PANAS), the Hospital Anxiety Depression Scale (HADS), and the Depression Anxiety Stress Scale (DASS)/3rd trimester and 1 week postpartum	Moderate
Marques et al. (2011), Portugal	Prospective/retrospective cohort study (two groups, 6 subgroups)	3rd trimester, recruited from health medical centres, maternity/childbirth preparation classes (*n*=581, attrition 34%) *Lifetime History of Insomnia* *Group 1*: insomnia (*n*=152) *Group 2*: insomnia symptoms (*n*=43) *Group 3*: no current/history of insomnia (*n*=366) *Insomnia During Pregnancy* *Group 1*: insomnia (*n*=89) *Group 2*: insomnia symptoms (*n*=366) *Group 3*: no current/history of insomnia (*n*=126)	Author generated questions, actigraph (*n*=60)/3rd trimester and at min. 3 months postpartum	*Screen and process measures*: psychiatric interview via Portuguese version of Diagnostic Interview for Genetic Studies, BDI-II, Profile of Mood States (POMS)/3rd trimester and at min. 3 months postpartum	Moderate

Table 1 (*continued*)

Author, year, country postpartum depression (*n*=27)	Study design	Study sample and characteristics (sample size, attrition)	Sleep assessment/timing	Postpartum disorder assessment/timing	EPHPP quality score
Okun et al. (2011), United States	Prospective cohort study	Pregnant with history of PPD < 5 years, not currently depressed, recruited from a women's psychiatry outpatient program (*n*=56, attrition NR)	PSQI/2, 3, 4, 6, 8, 11, 14, and 17 weeks postpartum	HRSD and clinical evaluation by two psychiatrists using DSM-IV criteria/2, 3, 4, 6, 8, 11, 14, and 17 weeks postpartum	Moderate
Alipour et al. (2012), Iran	Prospective two group cohort	28–30 weeks pregnant, recruited from 10 prenatal care clinics (*n*=156, attrition 10%) *Group 1*: > 10 EPDS at 3 months postpartum (*n*=55) Group 2: ≤ 10 EPDS at 3 months postpartum (*n*=101)	PSQI/28th and 38th week of pregnancy	EPDS/3 months postpartum	Moderate
Tsai and Thomas (2012), Taiwan	Cross section	1st time mothers, < 3 months postpartum, recruited via advertisements in the community and maternal–infant care clinics/pediatric offices of a medical center (*n*=26, attrition 15%)	Actigraph, GSDS, sleep diary/ < 3 months postpartum	EPDS/ < 3 months postpartum	Weak
Piteo et al. (2013), Australia	Cross section	12 weeks postpartum, recruited by Child and Family Health nurses at a "well child" visit (*n*=111)	Author generated/12 months postpartum	EPDS/12 months postpartum	Weak
Khazaie et al. (2013), Iran	RCT	26–30 weeks pregnant, seeking treatment for sleep disturbance at a psychiatric outpatient clinic (*n*=61, attrition 12%). *Group 1*: trazodone (*n*=20) *Group 2*: diphenhydramine (*n*=21) *Group 3*: placebo (*n*=20)	*Screen*: Global sleep assessment questionnaire (GSAQ) *Process measures*: Actigraph/ worn for 72 h at baseline, and after 2 and 6 weeks of treatment	*Screen*: structured psychiatric interview using the DSM-IV-TR *Process measures*: structured psychiatric interview using the DSM-IV-TR, EPDS/2 and 6 weeks postpartum	Strong
Park et al. (2013), United States	Prospective cohort study (two groups)	28–35 weeks pregnant, 1st pregnancy, recruited from local hospital-affiliated obstetric–gynecologic offices (*n*=25, attrition 0%) *Group 1*: history of depression (*n*=9) *Group 2*: no history of depression (*n*=16)	Actigraph, sleep diary, GSDS/3rd trimester, 2, 6, 10t, and 14 postpartum weeks.	EPDS, CES-D/3rd trimester, 2, 6, 10, and 14 postpartum weeks.	Moderate
Swanson et al. (2013), United States	Prospective cohort study	Within 12 months postpartum, current MDD, > 11 EPDS, > 60 min wake time/ min. 3 nights/week for at least one month, impairment in daytime functioning due to insomnia, score > 7 on ISI. Recruited from a mood disorders clinic and the greater Ann Arbor community (*n*=16, attrition 25%)	Sleep diary/every day for five weeks ISI, PSQI/1st and last treatment sessions (within 12 months postpartum)	*Screen*: MINI *Process measures*: EPDS, Quick Inventory of Depressive Symptoms-Self Report (QIDS-SR)/1st and last treatment sessions (within 12 months postpartum)	Weak
Dorheim et al. (2014), Norway	Prospective cohort study (four groups)	17th week of pregnancy, participating in a large longitudinal questionnaire study of all women giving birth in one hospital (*n*=4662, attrition 55%) *Group 1*: ≤ 10 EPDS (*n*=1657) *Group 2*: > 10 EPDS postpartum (*n*=162) *Group 3*: > 10 EPDS during pregnancy and < 10 EPDS postpartum (*n*=153) *Group 4*: > 10 EPDS during pregnancy and postpartum (*n*=116)	Bergin Insomnia Scale (BIS), 3 questions from the PSQI/32 week of pregnancy, 8 weeks postpartum	EPDS, Lifetime Major Depression Scale/ 32 week of pregnancy, 8 weeks postpartum	Weak
Postpartum depression and anxiety (*n*=2)					
Swanson et al. (2011), United States	Chart review	Seeking treatment at a university hospital-affiliated outpatient psychiatry clinic (*n*=257) *Group 1*: Pregnant (*n*=114) *Group 2*: < 6 months postpartum (*n*=143)	Insomnia Severity Index (ISI)/ pregnancy or < 6 months postpartum	*Depression*: EPDS/pregnancy or < 6 months postpartum *Anxiety*: Penn State Worry questionnaire/pregnancy or < 6 months postpartum.	Weak

Table 1 (*continued*)

Author, year, country postpartum depression (*n*=27)	Study design	Study sample and characteristics (sample size, attrition)	Sleep assessment/timing	Postpartum disorder assessment/timing	EPHPP quality score
Calcagni et al. (2012), Australia	Prospective cohort study (pre-post)	3rd trimester, recruited from a antenatal clinic at a local health service and the general community via advertisement (*n*=72, attrition 25%) *Group 1*: Nulliparous (*n*=37) *Group 2*: Multiparous (*n*=35)	PSQI, actigraphy/3rd trimester, within the 1st 2 weeks postpartum	*Depression and anxiety*: DASS, HADS/3rd trimester, within the 1st 2 weeks postpartum	Weak
Postpartum psychosis (*n*=2)					
Sharma et al. (2004), Canada	Chart review (matched control)	Admitted to 1–3 southern Ontario hospitals (*n*=42) *Group 1*: Admitted for postpartum psychosis (*n*=21) *Group 2*: Admitted for childbirth (*n*=21)	Time of labor onset (day vs. night), duration of labor, and report of insomnia	Charted diagnosis.	Moderate
Bilszta et al. (2010), Australia	Prospective cohort study (two groups)	Pregnant with a history of bipolar disorder/PPP or no history. Recruited via medical records, advertisements in local consumer/mutual-support groups and mental health clinics (*n*=44, attrition 14%) *Group 1*: History of PPP or bipolar (*n*=27) *Group 2*: No history of PPP or bipolar (*n*=17)	Sleep diary/once within the last two weeks of each trimester of pregnancy and postpartum weeks 1, 4, and 8.	*Screen*: diagnosis from a treating psychiatrist, inpatient notes, or the MINI. *Process measures*: Mood Disorder Questionnaire (MDQ), HRSD, Bipolar Depression Rating Scale (BDRS), and the Young Mania Rating Scale (YMRS)/ once within the last two weeks of each trimester of pregnancy and postpartum weeks 1, 4, and 8	Weak

Table 2
Quality ratings for each study.

Study	Study design	Selection bias	Confounders	Blinding	Data collection method	Withdrawals/dropouts	Analyses	GLOBAL RATING
Frank et al. (1987)	Moderate	Weak	Weak	N/A	Weak	Weak	Moderate	**WEAK**
Mead-Bennett (1990)	Moderate	Moderate	N/A	N/A	Moderate	Weak	Strong	**MODERATE**
Wilkie and Shapiro (1992)	Moderate	Moderate	Weak	N/A	Moderate	Moderate	Strong	**MODERATE**
Coble et al. (1994)	Moderate	Weak	Strong	N/A	Strong	Moderate	Moderate	**MODERATE**
Godfroid et al. (1997)	Weak	Weak	Strong	N/A	Moderate	N/A–N/A	Moderate	**WEAK**
Swain et al. (1997)	Moderate	Weak	Strong	N/A	Moderate	Moderate	Strong	**MODERATE**
Chaudron et al. (2001)	Moderate	Weak	Weak	N/A	Strong	Strong	Moderate	**WEAK**
Wolfson et al. (2003)	Moderate	Weak	N/A	N/A	Strong	Moderate	Strong	**MODERATE**
Huang et al. (2004)	Weak	Moderate	N/A	N/A	Moderate	Weak	Strong	**WEAK**
Sharma et al. (2004)	Weak	Moderate	Strong	N/A	Moderate	N/A–N/A	Moderate	**MODERATE**
Dennis and Ross (2005)	Moderate	Moderate	Weak	N/A	Moderate	Strong	Moderate	**MODERATE**
Goyal et al. (2007)	Moderate	Weak	Strong	N/A	Strong	Weak	Moderate	**WEAK**
Posmontier (2008)	Moderate	Weak	Strong	N/A	Moderate	Strong	Moderate	**MODERATE**
Dorheim et al. (2009a)	Weak	Weak	Strong	N/A	Strong	N/A–N/A	Moderate	**WEAK**
Dorheim et al. (2009b)	Weak	Moderate	Weak	N/A	Moderate	N/A–N/A	Strong	**WEAK**
Goyal et al. (2009)	Moderate	Weak	Strong	N/A	Strong	Weak	Moderate	**WEAK**
Lee and Kimble (2009)	Weak	Weak	N/A	N/A	Strong	N/A–N/A	Strong	**WEAK**
Okun et al. (2009)	Moderate	Weak	N/A	N/A	Strong	Strong	Strong	**MODERATE**
Bei et al. (2010)	Moderate	Moderate	N/A	N/A	Strong	Moderate	Moderate	**MODERATE**
Bilszta et al. (2010)	Moderate	Weak	Weak	N/A	Strong	Strong	Strong	**WEAK**
Marques et al. (2011)	Moderate	Moderate	Weak	N/A	Strong	Moderate	Strong	**MODERATE**
Okun et al. (2011)	Moderate	Weak	N/A	N/A	Strong	Weak	Moderate	**WEAK**
Swanson et al. (2011)	Weak	Weak	Weak	N/A	Strong	N/A–N/A	Strong	**WEAK**
Alipour et al. (2012)	Moderate	Moderate	Weak	N/A	Moderate	Strong	Moderate	**MODERATE**
Calcagni et al. (2012)	Moderate	Weak	Weak	N/A	Strong	Moderate	Strong	**WEAK**
Tsai and Thomas (2012)	Weak	Weak	N/A	N/A	Strong	Strong	Strong	**WEAK**
Piteo et al. (2013)	Weak	Weak	N/A	N/A	Weak	Moderate	Strong	**WEAK**
Khazaie et al. (2013)	Strong	Moderate	Strong	Strong	Strong	Strong	Strong	**STRONG**
Park et al. (2013)	Moderate	Moderate	Weak	N/A	Strong	Strong	Strong	**MODERATE**
Swanson et al. (2013)	Moderate	Weak	N/A	N/A	Weak	Moderate	Moderate	**WEAK**
Dorheim et al. (2014)	Moderate	Weak	Weak	N/A	Strong	Weak	Moderate	**WEAK**

postpartum (Wolfson et al., 2003). In some cases, however, findings may not have attained significance had the authors corrected for the family-wise error rate (Bei et al., 2010).

Of the seven studies that found a relationship between self-reported sleep disruption in the third trimester and the development of depressive symptoms/PPD in the postpartum, six were moderate in quality (Alipour et al., 2012; Bei et al., 2010; Marques et al., 2011; Okun et al., 2009; Park et al., 2013; Wilkie and Shapiro, 1992) and one was weak (Dorheim et al., 2014). The study that found a relationship between longer sleep times and later rise times and elevated depression scores was moderate in quality (Wolfson et al., 2003).

Two studies found no relationship between subjective assessments of sleep in pregnancy and PPD symptomatology (Calcagni et al., 2012; Mead-Bennett, 1990), while one found a trend ($p=0.056$) toward higher rates of middle insomnia (waking repeatedly throughout the night) during pregnancy for women with a history of affective disorder compared to women without such a history (Coble et al., 1994). All three had sample sizes less than 100 and none performed a power calculation, leaving open the possibility that these studies were biased towards the null. One did not use validated or reliable measures of sleep and measured postpartum mood only on the first postpartum day (Mead-Bennett, 1990). Two articles were moderate in quality (Coble et al., 1994; Mead-Bennett, 1990), while one was weak (Calcagni et al., 2012).

4.1.2. Objective assessment of sleep

Five studies assessed sleep objectively during pregnancy (Bei et al., 2010; Calcagni et al., 2012; Coble et al., 1994; Khazaie et al., 2013; Park et al., 2013). One study used electroencephalography (EEG) measurement and found that women with a history of affective disorder experienced a significant decrease in REM latency values in the 3rd trimester to 8 months postpartum, as well as in total sleep time between the 3rd trimester and 1 month postpartum, as compared to women with no such history (Coble et al.,1994). The only RCT included in this review used actigraph to determine insomnia during pregnancy, and found significant differences in depression scores at 2 and 6 weeks postpartum between those treated for insomnia in the 3rd trimester vs. placebo (Khazaie et al., 2013).

Three studies used actigraphy and found no relationship between 3rd trimester sleep and postpartum depressive symptoms (Bei et al., 2010; Calcagni et al., 2012; Park et al., 2013), although one did find that poorer objective night time sleep was associated with lower positive affect in the postpartum (Bei et al., 2010). However, these studies may have also been biased towards the null due to small sample sizes (one <100, two <50); none performed a power calculation. One study was strong in quality (Khazaie et al., 2013), three were moderate (Bei et al., 2010; Coble et al., 1994; Park et al., 2013), while one was weak (Calcagni et al., 2012).

4.2. Sleep during the postpartum.

Twenty-two studies looked at the relationship between sleep in the postpartum and PPD symptomatology/PPD diagnosis (Bei et al., 2010; Calcagni et al., 2012; Chaudron et al., 2001; Coble et al., 1994; Dennis and Ross, 2005; Dorheim et al., 2014, 2009a, 2009b; Godfroid et al., 1997; Goyal et al., 2009, 2007; Huang et al., 2004; Lee and Kimble, 2009; Okun et al., 2011; Park et al., 2013; Piteo et al., 2013; Posmontier, 2008; Swanson et al., 2013, 2011; Tsai and Thomas, 2012; Wilkie and Shapiro, 1992; Wolfson et al., 2003).

4.2.1. Subjective assessment of sleep

Twenty studies assessed the relationship between subjectively assessed sleep during the postpartum and symptoms of PPD/PPD diagnosis (Bei et al., 2010; Calcagni et al., 2012; Chaudron et al., 2001; Dennis and Ross, 2005; Dorheim et al., 2014, 2009a, 2009b; Goyal et al., 2009, 2007; Huang et al., 2004; Lee and Kimble, 2009; Okun et al., 2011; Park et al., 2013; Piteo et al., 2013; Swain et al., 1997; Swanson et al., 2013, 2011; Tsai and Thomas, 2012; Wilkie and Shapiro, 1992; Wolfson et al., 2003), while one evaluated the difference in subjectively assessed sleep in the postpartum between women with and without a history of affective disorder (Coble et al., 1994). Seventeen found a relationship between subjectively reported sleep disruption in the postpartum and the development of depressive symptoms in the postpartum/PPD diagnosis (Bei et al., 2010; Calcagni et al., 2012; Chaudron et al., 2001; Dennis and Ross, 2005; Dorheim et al., 2014, 2009a, 2009b; Goyal et al., 2009, 2007; Huang et al., 2004; Okun et al., 2011; Park et al., 2013; Piteo et al., 2013; Swain et al., 1997; Swanson et al., 2011; Tsai and Thomas, 2012; Wilkie and Shapiro, 1992), while one found a significant reduction in depressive symptoms after a 5-week course of treatment for insomnia (Swanson et al., 2013). In some studies, however, correction for the family-wise error rate may have resulted in some findings losing significance (Bei et al., 2010; Chaudron et al., 2001; Okun et al., 2011). Five of these studies were moderate in quality (Bei et al., 2010; Dennis and Ross, 2005; Park et al., 2013; Swain et al., 1997; Wilkie and Shapiro, 1992) and thirteen were weak (Calcagni et al., 2012; Chaudron et al., 2001; Dorheim et al., 2014, 2009a, 2009b; Goyal et al., 2009, 2007; Huang et al., 2004; Okun et al., 2011; Piteo et al., 2013; Swanson et al., 2013, 2011; Tsai and Thomas, 2012).

Two studies found no relationship between subjective assessments of sleep in the postpartum and PPD symptomatology (Lee and Kimble, 2009; Wolfson et al., 2003), while one found no difference in subjectively assessed sleep in the postpartum between women with and without a history of affective disorder (Coble et al., 1994). Two studies used non-validated and unreliable measures of sleep (Coble et al., 1994; Wolfson et al., 2003) and all three had sample sizes less than 50 with no power calculation. Two of the articles were moderate in quality (Coble et al., 1994; Wolfson et al., 2003), while one was weak (Lee and Kimble, 2009).

4.2.2. Objective assessment of sleep

Eight studies assessed sleep objectively, as well as subjectively, in the postpartum (Bei et al., 2010; Calcagni et al., 2012; Coble et al., 1994; Dorheim et al., 2009b; Goyal et al., 2009; Lee and Kimble, 2009; Park et al., 2013; Tsai and Thomas, 2012), while two relied solely on objective measures (Godfroid et al., 1997; Posmontier, 2008).

One study used EEG measurement and found that time spent asleep was less at 1 month postpartum for those with a history of affective disorder compared to those with no such history. In addition, rapid eye movement (REM) latency decreased for those in the positive history group late in the 3rd trimester and remained reduced up to 8 months postpartum, while increases were seen in the negative history group (Coble et al., 1994). One other study used EEG measurement (Godfroid et al., 1997) and found that those suffering from PPD had significantly longer stage 4 sleep compared with two groups of women, both currently depressed and greater than 3 years postpartum, one with a history of PPD and one without.

All other studies used actigraph. Four of these found a relationship between disrupted, shorter, variable or poorer sleep quality and PPD symptoms/PPD diagnosis (Goyal et al., 2009; Park et al., 2013; Posmontier, 2008; Tsai and Thomas, 2012), while four did not (Bei et al., 2010; Calcagni et al., 2012; Dorheim et al., 2009b; Lee and Kimble, 2009). All four non-significant studies were biased toward the null due to sample sizes (one study <100, three studies <50) with no power calculation. Four of these studies

were moderate in quality (Bei et al., 2010; Coble et al., 1994; Park et al., 2013; Posmontier, 2008), while the rest were rated as weak (Calcagni et al., 2012; Dorheim et al., 2009b; Godfroid et al., 1997; Goyal et al., 2009; Lee and Kimble, 2009; Tsai and Thomas, 2012).

4.3. Timing of sleep assessment undetermined

In one study, the timing of sleep assessment with respect to postpartum was unclear (pregnant women were excluded from this study). This study was a secondary analysis of data that included 52 women who had a minimum of one child of any age. This study found that those who retrospectively reported depressive episodes during/after pregnancy experienced significantly longer REM time and more REM activity, as measured by EEG, than those whose depression was not pregnancy-related (Frank et al., 1987). This study received a weak quality rating.

5. Primary outcome – postpartum anxiety (PPA)

Two studies assessed postpartum anxiety (Calcagni et al., 2012; Swanson et al., 2011). One found no relationship between either objective or subjective night time sleep during the third trimester, nor objective sleep in the postpartum, and symptoms of PPA. However, the authors did find that poor subjective postpartum sleep made a significant contribution to more frequent symptoms of anxiety, but only for nulliparous women (Calcagni et al., 2012). This study may have been biased toward the null due to a sample size less than 100 with no power calculation.

The second study found that women who scored above the threshold for moderate insomnia symptoms in the postpartum had significantly higher odds for reporting symptoms of generalized anxiety (Swanson et al., 2011). Both articles were rated as weak in quality.

6. Primary outcome – postpartum psychosis (PPP)

Two articles assessed the relationship of sleep to the development of symptoms of PPP (Bilszta et al., 2010; Sharma et al., 2004). One study operationalized sleep as the timing (day vs. night) and duration of labor and found that a significantly greater proportion of women hospitalized with a diagnosis of postpartum psychosis had night time deliveries and significantly longer labor than a group of matched control women. Insomnia was the most common symptom to precede the onset of PPP symptoms (Sharma et al., 2004). The second study found that women with a history of PPP and/or bipolar disorder did not experience significant differences in subjective ratings of sleep behavior than a control group with no such history (Bilszta et al., 2010), although a sample size of less than 50 and the use of an unvalidated/unreliable measure of sleep may have biased this study toward the null. One study was moderate in quality (Sharma et al., 2004) while the other was weak (Bilszta et al., 2010).

7. Discussion

The aim of this systematic review was to examine the evidence for the impact of sleep on the development of postpartum mental disorders. Given the lack of research on this topic, we included primary research of all research designs. Overall, there was evidence that *subjectively* reported disrupted or poor sleep during pregnancy and the postpartum period impacts the development of postpartum depression, with not enough evidence to determine whether sleep affects either postpartum anxiety or psychosis. The evidence for objectively assessed sleep and the development of postpartum disorders was mixed. Among the 31 studies included, 1 was strong, 13 were moderate and 17 were weak, indicating an overall weak-to-moderate quality. The main threats to study quality were the weak study designs (e.g., cross section, case report), selection bias and small sample sizes. In addition, for the 19 studies with two or more groups, 12 did not adequately report on or adjust for relevant confounders (e.g., poor partner relationship, previous depression).

The current review identified additional limitations in the literature. Many studies measured sleep disruption and symptoms of postpartum disorders concurrently, making determination of the direction of causation impossible since disturbed night time sleep can be a symptom of depression (Bunney and Potkin, 2008; Schrijvers et al., 2008). Only 12 of the 31 included studies assessed sleep using objective measures (Bei et al., 2010; Calcagni et al., 2012; Coble et al., 1994; Dorheim et al., 2009b; Frank et al., 1987; Godfroid et al., 1997; Goyal et al., 2009; Khazaie et al., 2013; Lee and Kimble, 2009; Park et al., 2013; Posmontier, 2008; Tsai and Thomas, 2012); the remaining papers relied almost exclusively on self-report, some using non-validated or unreliable tools, and some retrospective assessments. The most frequently used self-report measure of sleep was the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989) however this measure has not been validated for use in postpartum populations, nor has the General Sleep Disturbance Scale (GSDS) (Lee and DeJoseph, 1992), another frequently used scale. In some cases assessment of sleep was potentially too brief (e.g., 1 night of EEG) (Godfroid et al., 1997) to adequately assess sleep/wake patterns. Comparing papers assessing the relationship of subjective vs. objective sleep to postpartum disorders is difficult, given their relatively modest correlation (Morin et al., 1998; Pilowsky et al., 1985) and their assessment of different aspects of sleep (Coates et al., 1982; Vitiello et al., 1997).

The studies included in this review used a variety of criteria to determine participant postpartum symptomatology. Eleven of the 31 included studies used structured clinical interview diagnostic assessments to determine a clinical diagnosis of a postpartum mental disorder (Bilszta et al., 2010; Coble et al., 1994; Frank et al., 1987; Godfroid et al., 1997; Khazaie et al., 2013; Marques et al., 2011; Okun et al., 2009, 2011; Posmontier, 2008; Sharma et al., 2004; Swanson et al., 2013), although one did not report the results of these assessments (Khazaie et al., 2013). Beyond clinical diagnosis, the Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987) was the most consistently used measure of depressive symptomatology (Alipour et al., 2012; Dennis and Ross, 2005; Dorheim et al., 2014, 2009a, 2009b; Khazaie et al., 2013; Lee and Kimble, 2009; Park et al., 2013; Piteo et al., 2013; Swanson et al., 2013, 2011; Tsai and Thomas, 2012). While the EPDS is not able to diagnose postpartum depression, it has well documented sensitivity and specificity when compared with diagnosis of postpartum depression established through a psychiatric interview (Cox et al., 1987; Harris et al., 1989; Murray and Carothers, 1990). Other articles relied solely on measures not validated for use in perinatal populations, such as the Centre for Epidemiologic Studies – Depression Scale (CES-D) (Radloff, 1977), the Hospital Anxiety Depression Scale (HADS) (Zigmond and Snaith, 1983), the Positive Negative Affect Schedule (PANAS) (Watson et al., 1988), the Depression Anxiety Stress Scale (DASS) (Lovibond and Lovibond, 1995) and the Penn State Worry Questionnaire (PSWQ) (Meyer et al., 1990). One study defined postpartum depression via a variety of criteria, including a clinical diagnosis via the Diagnostic Interview Schedule (DIS), a score greater than 15 on the CES-D, and/or receiving antidepressants (Chaudron et al., 2001). Given the inability of the CES-D to diagnose depression, and the host of off-label uses of antidepressants (e.g., pain, restless leg syndrome), it is in fact unknown whether this study was in fact assessing participants with PPD.

According to the DSM-5, the onset and consequent diagnosis of PPD, PPA and PPP should occur within 4 weeks postpartum

(American Psychiatric Association, 2013), while research suggests onset unlikely after 12 weeks (Cox et al., 1993). While all but one of the included articles assessed postpartum symptomatology within this vulnerable period (Piteo et al., 2013) (assessment at 12 months), some confined their assessments to one measurement within this period (e.g., the 1st postpartum day, the 1st postpartum week) (Bei et al., 2010; Mead-Bennett, 1990), putting the study at risk of missing the emergence of a postpartum mental disorder at a later date. One did not state their definition of the postpartum period (Frank et al., 1987).

The two main strengths of this systematic review are (1) our broad, multi-modality search strategy and the lack of language restrictions, and (2) that almost 50% of the studies came from a variety of geographic regions, allowing for generalization of the results to other populations.

However, there are also limitations that warrant consideration. First, the quality of the existing literature makes definitive conclusions about the impact of sleep on postpartum mental disorders untenable. Only one article was rated as strong in quality; an RCT that found significant differences in depression scores at 2 and 6 weeks postpartum between those treated for insomnia in the 3rd trimester vs. placebo (Khazaie et al., 2013). However, this was the only RCT included in the review. The remaining articles represent a variety of research designs and measures of sleep and postpartum mental disorders in various combinations, precluding any clear comparisons between studies. Second, our assessment of the risk of study bias was necessarily subjective. However, we systematically applied the EPHPP criteria when assessing the studies, as has been advised for systematic reviews with broad study design inclusion criteria.

8. Conclusion

While it appears that this systematic review found modest evidence that subjectively reported sleep disruption impacts the development of postpartum depression (mixed evidence for objectively assessed sleep and postpartum anxiety/psychosis), the overall low quality of the studies, and their heterogeneity, precludes any definitive conclusions to be drawn from this review. Rigorous, systematic studies of the role of sleep in the development of postpartum mental disorders would significantly contribute to the field, and provide important information about the non-pharmacological prevention and treatment of postpartum mental illness. As such, further high-quality research is needed.

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Conflict of interest

No conflict declared.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jad.2015.01.017.

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