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Dreaming for two: A systematic review of mental sleep activity during pregnancy

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ABSTRACT

Changes in sleep and dreams are often observed during pregnancy. Dreaming may represent privileged access to the inner world of individuals, providing relevant information about their well-being. For this reason, a growing but heterogeneous literature has investigated dream experiences of pregnant women. The present paper aimed to systematically review the available evidence on the relationship between pregnancy and oneric activity, focusing on dream and nightmare frequency, dream contents, and emotional features. Moreover, dream changes between pre-partum and post-partum periods and the impact of previous pregnancy-related adverse events on dreaming have been summarized. Overall, 17 studies have been examined. The reviewed evidence suggests that women tend to have an abundant production of dreams and nightmares during pregnancy, and some results support the view that a high rate of dream recall is associated with poor sleep quality. Most studies have shown a high presence of pregnancy-related dream content, likely reflecting waking experiences and concerns. Additionally, dreaming may promote psychological preparation and activation of functional coping strategies to face life changes after childbirth.

1. Introduction

Pregnancy represents a very special period of life for women. It is characterized by profound changes at the physical, hormonal and psychological levels (Avise, 2013; Raphael-Leff, 1991). Many findings highlighted that sleep undergoes significant changes during pregnancy (Sweet et al., 2020). Interestingly, bad dreams seem to be a common sleep-related complaint during pregnancy (Nowakowski et al., 2013).

Dreaming represents a relatively new scientific object of study. It is a peculiar form of mental activity during sleep that involves images, emotions, thoughts, and sensations (Scarpelli et al., 2021). Investigating dreaming in pregnant women is particularly relevant due to the unique psychological and physiological changes they experience. Indeed, pregnancy is a time of significant emotional and physical transformation, which may be reflected in dreams.

Current dream research suggests that dream recall is particularly related to sleep patterns, and specific sleep changes could predict the presence of dream reports upon awakening (Scarpelli et al., 2023). It is well-known that hormonal modulations affect sleep (Nowakowski et al., 2013). For instance, the menstrual cycle of healthy women – characterized by cyclic variations in the production of estradiol, progesterone, luteinizing hormone, follicle-stimulating hormone, prolactin, and growth hormone – not only regulates reproductive function but also affects sleep and circadian patterns (Nowakowski et al., 2013). Estrogen and progesterone secretion increases exponentially during pregnancy, influencing both circadian and homeostatic sleep processes (Pengo et al., 2018). In particular, during the first trimester of gestation, women typically exhibit prolonged sleep durations and heightened daytime sleepiness. Numerous cross-sectional and longitudinal studies using subjective and objective sleep methods consistently reveal elevated wakefulness after sleep onset and diminished sleep quality during the first trimester compared to the pre-pregnancy period (Hedman et al., 2002; Santiago et al., 2001). In the second trimester, daytime sleepiness is reduced, and self-reported sleep duration showed a decline compared to the first trimester (Rawal et al., 2017). Notably, a meta-analysis including data from over 11000 participants reported that 46 % of pregnant women experienced poor sleep (Sedov et al., 2018). Sleep quality appeared to worsen from the second to the third trimester (Sedov et al., 2018). There is compelling evidence that sleep disturbances increase in the last trimester, with 3–5 awakenings per night, frequent daily naps, reduced daytime alertness (Tsai et al., 2012), and approximately 21 % of women may develop an insomnia disorder (Hedman

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et al., 2002). Polysomnographic (PSG) recordings revealed a decline in sleep efficiency, an increase in wake after sleep onset, a decrease in total sleep time, greater stages 1 and 2, and reduced REM sleep, especially during late pregnancy (Driver and Shapiro, 1992; Kizilirmak et al., 2012; Lee et al., 2000; Pien and Schwab, 2004). Several disturbances could explain increased sleep disorders during pregnancy such as urinary frequency, backache, fetal movements, abdominal discomfort, breast tenderness, leg cramps, heart burn and reflux (Nowakowski et al., 2013).

Considering the above-mentioned sleep variations during pregnancy, it is reasonable to expect that dreams and nightmares might change because of these modifications. Indeed, well-established literature emphasizes a strong association between fragmented sleep and increased dream recall and nightmare frequency (Scarpelli et al., 2022a). In other words, the various changes in sleep patterns during pregnancy likely lead to modifications in dream and nightmare frequency, intensity, and content, reflecting the complex interplay of physical, hormonal, and psychological factors during this period.

In contrast, the relationship between dreaming and pregnancy should also be considered from a psychological perspective. A growing body of literature highlighted that oneiric activity can inform about changes in people's lives (Valli et al., 2006; Wood et al., 1992; Scarpelli et al., 2022b; Tempesta et al., 2013) and is strictly dependent on individual well-being (Pesant and Zadra, 2006; Scarpelli et al., 2023). In particular, the so-called "continuity hypothesis" posits that sleep mentation reflects concerns and themes related to waking life (Domhoff, 2017). Some studies suggested that dream content could represent the incorporation of daily experience and the rate of incorporation increases as a function of the degree of emotional intensity of daytime events (Scarpelli et al., 2021). Additionally, several evidence underlined that the neural mechanisms related to cognitive and emotional processes are shared between sleep and wakefulness (Scarpelli et al., 2022a). For instance, neuroimaging studies have shown that specific structural features of the amygdala and hippocampus -involved in emotional waking memory- seem to predict certain qualitative characteristics of dream reports (e.g., bizarreness, and emotional load; De Gennaro et al., 2011). More directly, available research on oneiric activity indicates a relationship between dream content and various aspects of waking experience, including personality traits (Busby and De Koninck, 1980; Hartmann et al., 1991), physical health (King and DeCicco, 2007), and social roles (Lortie-Lussier et al., 1985). Therefore, bearing in mind that pregnancy is a period of significant restructuring of women's identity (Ammaniti et al., 2013), dreaming may incorporate maternal mental representations of the new baby and the woman as a mother (Ammaniti and Trentini, 2009; Slade et al., 2009), mirroring cognitive and emotional processes during wakefulness. The study of dreams during pregnancy may offer valuable insights into the psychological experiences of expectant mothers, opening a privileged access to into inner processing of changes and expectations related to motherhood and may contribute to a better understanding of maternal mental health.

For these reasons, dreaming during pregnancy could be considered a potential multifaceted subject of study. Although for decades researchers have been intrigued by dreams experienced during pregnancy, the literature on this topic appears to be heterogeneous and most of the work lacks systematic investigations, including only qualitative analyses (e.g., Van et al., 2004) or presented as anecdotal reports (e.g., Gillman, 1968) and doctoral dissertations that have never been published in a peer-reviewed journal (e.g., Jones, 1978; Maybruck, 1986).

In light of this background, this paper aimed to provide the first systematic review of the current literature on dreams and pregnancy. Specifically, we have assessed and summarized the available evidence on the effects of pregnancy on dreams and nightmares, focusing on oneiric frequency, dream content, and emotional aspects. We also provided an assessment of dream changes by comparing pre-partum and post-partum periods, and some considerations about the impact of previous pregnancy-related adverse events (e.g., child loss, history of infertility) on mental sleep activity in pregnant women. Finally, we addressed methodological limitations of the available literature and open issues, suggesting insights for future research.

2. Methods

2.1. Search strategy

The systematic review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher et al., 2009). We registered the protocol of this systematic review with the International Prospective Register of Systematic Reviews (PROSPERO; Registration n. CRD42023482535; available from https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=482535). One author systematically searched for literature up to December 2023 using the professional databases PubMed, Scopus, Web of Science, and PsycINFO. Search terms in the abstract or title were ("Pregnancy" OR "Pregnant Women") AND ("Dreaming" OR "Dream Recall" OR "Dream experience" OR "Nightmare*") with slight variations depending on specific search engine parameters. All resulting articles were screened using the inclusion criteria described in the next paragraph. Furthermore, reference lists from the selected papers were checked for potential inclusion.

2.2. Studies selection and data extraction

The article screening process involved a two-step evaluation. After searching the three databases, duplicates were removed. The initial assessment focused on the relevance of the titles and abstracts to the aim of the review. Then, the full texts of papers selected in the first step following inclusion/exclusion criteria were assessed for eligibility.

Studies were assessed based on the following inclusion criteria: a) studies are written in English; b) they are original research articles (books, abstracts, comments, cases-reports, reviews, or meta-analyses were excluded); c) they are observational or experimental studies; d) papers including at least a group of women who were pregnant at the time of the investigation (no age restriction). Specifically, we included a) cross-sectional studies providing a statistical comparison between at least one group of pregnant women and another group (e.g., pregnant vs. non-pregnant) or subgroups of pregnant women (e.g., dreamers vs. non-dreamers; pregnant women with a history of child loss vs. without a history of child loss); b) longitudinal studies providing statistical comparisons between different stages of pregnancy or pregnancy and other periods (e.g. post-partum). Qualitative studies were excluded because they were outside of the scope of the review and would have required a different methodological approach. Papers that lacked any methodological details about the procedure/data collection (e.g., sample size, details about collection of dream experience or dream features, the approach used to analyze dream data) were also discarded.

The final search results were downloaded from each database and converted into a Microsoft Excel spreadsheet 2019 to filter and remove duplicates. Results were qualitatively summarized by one author (SS) using textual descriptions and a recapitulative table. Specifically, from each study, the following details have been extracted and reported in a table: authors and publication year, sample characteristics, inclusion/exclusion criteria, dream features examined, instruments to collect dreams, additional measures, study design and main results (see Table 2). A second author (MG) verified the extracted data and discussed with the first author any disagreements, namely in cases of missing or unclear data. A consensus session solved any disagreement between reviewers with a third reviewer (VA).

2.3. Risk bias assessment

Two researchers (SS and VA) evaluated the quality of the manuscripts using the Newcastle - Ottawa Quality Assessment Scale (NOS) for

nonrandomized studies (Herzog et al., 2013; Modesti et al., 2016; Wells et al., 2021), according to the recommendations of the Cochrane Collaboration Group. The NOS examines potential bias on selection, comparability, and outcome. The overall score ranges from 0 to 10 for cross-sectional studies (adapted version from Herzog et al., 2013, see Supplementary Material for details), and from 0 to 9 for cohort studies. Scores ≤4 were identified as high risk of bias, scores 5–6 as moderate risk of bias, and scores ≥7 indicated a low risk of bias (Scarmeas et al., 2006).

Specifically, the two researchers independently reviewed each included study and assigned scores based on the predetermined criteria within the scale. They used a spreadsheet to record their evaluations. Throughout the assessment process, the researchers communicated regularly to discuss any discrepancies or uncertainties in scoring and reach a consensus. In cases where disagreements persist, a third senior researcher (LDG) was consulted to resolve the conflicts.

The researchers focused their assessment on the reported dream data and dream-related findings. For this reason, the final scores do not necessarily reflect the overall methodological quality of the article, but it is strictly related to the dream-related investigation.

3. Results

3.1. Characteristics of the studies and qualitative assessment

Five hundred and thirty-one articles were identified, 159 duplicates were removed, and after the screening of the title and abstract, 33 full-text articles were assessed for eligibility. At the end of this stage, 17 articles published between 1974 and 2023 were included in this systematic review (Krippner et al., 1974; Hertz et al., 1992; Blake and Reimann, 1993; Dagan et al., 2001; Kron and Brosh, 2003; Mancuso et al., 2008; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2013; Coo et al., 2014; Lara-Carrasco et al., 2014; Schredl et al., 2016; Gül and Şolt, 2021; Van et al., 2023). They were all observational studies. Fig. 1 shows the PRISMA flow chart of the article selection.

Overall, the reviewed studies assessed mental sleep activity in 2112 pregnant women aged between 17 and 44 years. All pregnant women were recruited from healthcare centres, hospitals, departments of obstetrics/gynecology or specialized centres preparing for childbirth. Moreover, dreams from a total of 882 non-pregnant women aged between 14 and 93 years were evaluated (Krippner et al., 1974; Hertz et al., 1992; Dagan et al., 2001; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2013; 2014; Schredl et al., 2016; Sabourin et al., 2018). One study did not provide any information about the normative sample

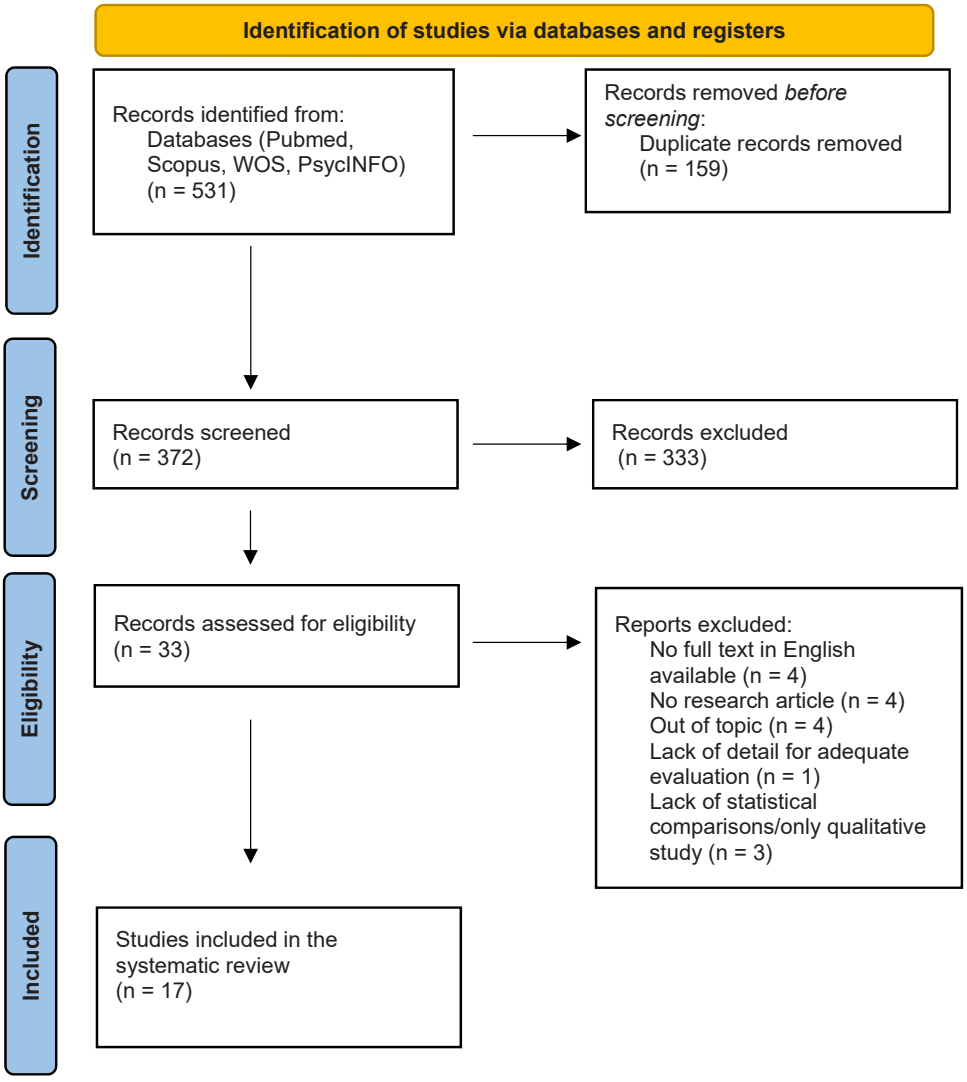

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram for the identification, screening, eligibility, and inclusion of studies.

of non-pregnant females (Coo et al., 2014), while two studies (Krippner et al., 1974; Schredl et al., 2016) used two representative samples of women published in previous studies (Hall and Van de Castle, 1966; Schredl, 2013). Four investigations were longitudinal and retested a total of 509 women post-partum (Hertz et al., 1992; Coo et al., 2014; Sabourin et al., 2018; Schredl et al., 2019). Three of the longitudinal studies also compared the pregnant sample with a non-pregnant sample (Hertz et al., 1992; Coo et al., 2014; Sabourin et al., 2018). Additionally, 7 studies provided comparisons between subgroups of pregnant women without any comparisons with non-pregnant women (Blake and Reimann, 1993; Kron and Brosh, 2003; Mancuso et al., 2008; Wołyńczyk-Gmaj et al., 2017; Kalmbach et al., 2019; Gül and Şolt, 2021; Van et al., 2023) and 1 study also selected a post-partum group for between-subjects comparisons (Nielsen and Paquette, 2007).

Among the pregnant women considered, most of them (n = 1517) were in the third trimester (Hertz et al., 1992; Kron and Brosh, 2003; Mancuso et al., 2008; Lara-Carrasco et al., 2013, 2014; Coo et al., 2014; Schredl et al., 2016, 2019; Wołyńczyk-Gmaj et al., 2017; Sabourin et al., 2018; Van et al., 2023), and 143 women were in the second trimester (Sabourin et al., 2018). Kalmbach et al. (2019) included 267 women between the second and third trimesters, while 6 studies did not distinguish women based on the period of pregnancy (Krippner et al., 1974; Blake and Reimann, 1993; Dagan et al., 2001; Nielsen and Paquette, 2007; Gül and Şolt, 2021). Clinical groups with insomnia and post-partum depression (PPD) were considered in 2 papers, respectively by Wołyńczyk-Gmaj et al. (2017) and Kron and Brosh, (2003). Also, pregnancy-related adverse events (i.e., child loss, history of infertility) were investigated in 2 studies (Gül and Şolt, 2021; Van et al., 2023).

The majority of studies (10) collected dream contents (Krippner et al., 1974; Blake and Reimann, 1993; Dagan et al., 2001; Kron and Brosh, 2003; Mancuso et al., 2008; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2013; Coo et al., 2014; Schredl et al., 2016; Sabourin et al., 2018), 5 investigations evaluated dream recall frequency (Blake and Reimann, 1993; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2014; Schredl et al., 2016; 2019). Nightmare and bad dream frequency were assessed in 9 studies (Hertz et al., 1992; Blake and Reimann, 1993; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2014; Schredl et al., 2016, 2019; Wołyńczyk-Gmaj et al., 2017; Kalmbach et al., 2019; Van et al., 2023) and 2 papers specifically investigated the so-called masochistic dreams, i.e., unpleasant dreams in which the dreamer's self-image or events in the dream are negative (Kron and Brosh, 2003; Mancuso et al., 2008). Finally, 6 papers reported information on dream anxiety and dream emotions (Krippner et al., 1974; Dagan et al., 2001; Kron and Brosh, 2003; Mancuso et al., 2008; Sabourin et al., 2018; Gül and Şolt, 2021).

Seven studies used a dream diary to collect oneiric activity (Krippner et al., 1974; Dagan et al., 2001; Mancuso et al., 2008; Lara-Carrasco et al., 2013; Coo et al., 2014; Lara-Carrasco et al., 2014; Sabourin et al., 2018), while 5 investigations collected dreams or nightmares and their characteristics using one or more items from standardized instruments (Hertz et al., 1992; Lara-Carrasco et al., 2014; Kalmbach et al., 2019; Gül and Şolt, 2021; Van et al., 2023). Ad hoc unstandardized item or questionnaires were used in 6 studies (Blake and Reimann, 1993; Kron and Brosh, 2003; Nielsen and Paquette, 2007; Schredl et al., 2016, 2019; Wołyńczyk-Gmaj et al., 2017). Nielsen and Paquette (2007) also investigated dream-related behaviors.

Regarding the qualitative assessment, Table 1 shows the results of the risk bias assessment carried out through the NOS method (Modesti et al., 2016; Wells et al., 2021). Eight studies had a low risk (Dagan et al., 2001; Kron and Brosh, 2003; Mancuso et al., 2008; Lara-Carrasco et al., 2014; Schredl et al., 2016; Kalmbach et al., 2019; Gül and Şolt, 2021; Van et al., 2023), 8 studies had a moderate risk (Hertz et al., 1992; Blake and Reimann, 1993; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2013; Coo et al., 2014; Wołyńczyk-Gmaj et al., 2017; Sabourin et al., 2018; Schredl et al., 2019), and 1 study had a high-risk bias (Krippner et al., 2014).

The results of each selected and reviewed article are detailed in Table 2.

3.2. Dreams

3.2.1. Cross-sectional findings

3.2.1.1. Dream frequency. Three reviewed articles indicate a high frequency of dream recall during pregnancy (Blake and Reimann, 1993; Lara-Carrasco et al., 2014; Schredl et al., 2016), while Nielsen and Paquette (2007) found no difference in dream recall rate between pregnant, post-partum, and never-pregnant groups. The direct comparison between primiparas and multiparas revealed that in the post-partum group, primiparas had higher dream recall frequency than multiparas (Nielsen and Paquette, 2007). Moreover, additional variables seem to influence dream recall in pregnant women. Mancuso and collaborators (Mancuso et al., 2008) showed that dream frequency was associated with age, middle–high family income, high educational level, regularity of prenatal controls, and satisfactory personal relationship with the physician. Also, one study revealed that dream frequency

Table 1
Quality assessment of documents (Newcastle-Ottawa Quality Assessment Scale for non-randomized studies). Cross-sectional studies are reported in the first part of the table, and longitudinal studies in the second. Articles are organized chronologically.

Article	Design	Selection	Comparability	Outcome	Risk bias
Krippner et al. 1974	Cross-sectional	☆☆	–	☆☆	High risk
Blake and Reimann, (1993)		☆☆	☆☆	☆☆	Moderate risk
Dagan et al. (2001)		☆☆	☆☆	☆☆☆	Low risk
Kron and Brosh, (2003)		☆☆	☆☆	☆☆☆	Low risk
Mancuso et al. 2008		☆☆	☆☆	☆☆☆	Low risk
Nielsen and Paquette, (2007)		☆☆	☆☆	☆☆	Moderate risk
Lara-Carrasco et al. (2013)		☆☆	☆☆	☆☆	Moderate risk
Lara-Carrasco et al. (2014)		☆☆	☆☆	☆☆☆	Low risk
Schredl et al. (2016)		☆☆	☆☆	☆☆☆	Low risk
Wołyńczyk-Gmaj et al. (2017)		☆☆	☆☆	☆☆	Moderate risk
Kalmbach et al. (2019)		☆☆	☆☆	☆☆☆	Low risk
Gül etand Şolt,. 2021		☆☆☆	☆☆	☆☆☆	Low risk
Van et al. (2023)		☆☆☆	☆☆	☆☆☆	Low risk
Hertz et al. (1992)	Longitudinal	☆☆☆	☆☆	☆	Moderate risk
Coo et al. (2014)		☆☆	☆	☆☆	Moderate risk
Sabourin et al. (2018)		☆☆☆	☆☆	☆	Moderate risk
Schredl et al. (2019)		☆☆	☆	☆☆	Moderate risk

Selection: maximum 4 stars for cohort studies; maximum 5 stars for cross-sectional studies
Comparability: maximum 2 stars for both cohort and cross-sectional studies
Outcome: maximum 3 stars for both cohort and cross-sectional studies

Table 2
Data Extraction. Authors, year of publication, study design, sample characteristics, dream features examined, instruments to collect dreaming, additional measures, and main results are detailed. Cross-sectional studies are reported in the first part of the table, and longitudinal studies in the second. Articles are organized chronologically.

Article	*Design*	*Sample*	*Inclusion/ exclusion criteria*	*Dream features examined*	*Instruments to collect dreaming*	*Additional measures*	*Main results*
Krippner et al. 1974	Cross-sectional (pregnant women vs. non-pregnant women)	N = 11 pregnant women (4 primiparas) N = 100 women from a normative group (Hall and Van de Castle, 1966)	- Pregnant women who recorded 3 or more dreams - Women recruited in a department of or a medical centre.	Dream contents Emotional dream features	Dream diary + Hall and Van de Castle Coding	Socio-demographic information	33 pregnancy dreams (vs. 500 normative dreams) showed: - Lower body parts, clothes, travel, questionable settings, individual characters, dreamer as victim, visual activities, apprehension, confusion, references to intensity and velocity - Higher household articles, regions and areas, miscellaneous, no setting, unfamiliar setting, group characters, adult, dreamer as aggressor on small animals, dreamer as befriender, physical activities, anger, positive evaluation, references to linearity.
Blake and Reimann 1993	Cross-sectional (pregnant women with pregnancy-related dreams vs. pregnant women without pregnancy-related dreams)	N = 88 pregnant women between 7 and 42 weeks (18-37 years; 59 with pregnancy-related dreams)	- Pregnant women recruited in a medical centre.	Pregnancy-related dream contents and frequency Bad dream recall frequency	Two-page questionnaire design ad-hoc	- Socio-demographic information - Obstetric history - Feeling about pregnancy	- Pregnancy-related dreams frequency once a week in 60% of women - Dream frequency increases with gestational age Pregnant women with pregnancy-related dreams (vs. without pregnancy-related dreams) reported: - Lower perceived support from child's father than she wants.
Dagan et al. 2001	Cross-sectional (pregnant women vs. non-pregnant women)	N = 10 pregnant women (25-37 years) N = 11 non-pregnant women (23-32 years)	- Pregnant women recruited in a specialized centre preparing women for childbirth - Married - Between 11 and 18 years of schooling.	Pregnancy-related dream contents Emotional and cognitive dream features	- Dream diary for 14 days - The Incorporation Scale analyses - The Gottschalk-Gleser Anxiety Scale - The Auld, Goldberg and Weiss Primary-Process Thinking Scale	Socio-demographic information	- 53 dreams from pregnant women; 68 dreams form non-pregnant women - No differences between groups concerning anxiety and primary-process thinking - Dream contents of pregnant women were: pregnancy, baby/child, woman's body, and baby's body Correlations in the pregnant group between dream contents and anxiety scale:

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Table 2 (*continued*)

Article	*Design*	*Sample*	*Inclusion/ exclusion criteria*	*Dream features examined*	*Instruments to collect dreaming*	*Additional measures*	*Main results*
							- Positive correlation between pregnancy-related contents and separation anxiety - Negative correlation between pregnancy-related contents and guilt and shame anxiety - Positive correlation between baby/ child, baby's body and woman's body and death anxiety - Positive correlation between partner-related contents and injury anxiety, separation anxiety, and generalized anxiety - Negative correlation between family-related contents and injury anxiety and diffuse anxiety Similar correlations in the non-pregnant group between dream contents and anxiety scale: - Positive correlations between pregnancy- or partner-related contents and separation anxiety.
Kron and Brosh 2003	Cross-sectional (pregnant women who developed PPD vs. women who have not developed PPD)	N = 166 pregnant women in the third trimester (22-39 years) N = 166 pregnant women retested only for assessing post-partum depression (PDD) 6-10 weeks post-partum (N = 34 women received PPD diagnosis)	- Pregnant women recruited in a specialized centre preparing women for childbirth - Women with at least high school education.	Dream contents Masochistic/Bad dreams	- Ad hoc question about dreaming during pregnancy + Hall and Van de Castle Coding - The Masochistic Dreams Scale	- Ad hoc questionnaire during pregnancy: demographic details and general information about the condition during pregnancy - Ad hoc questionnaire post-partum: questions about the birth itself and potential complications - The Edinburgh Postnatal Depression Scale (EPDS)	- Women without PPD had a greater frequency of "masochistic dreams" than the frequency of "non-masochistic dreams", while women with PPD displayed the opposite pattern (i.e., lower "masochistic dreams") - Women without PPD had a higher frequency of manifestations of apprehension in their dreams than women who developed PPD
Nielsen and Paquette 2007	Cross-sectional (pregnant women vs. post-partum women vs. non-pregnant women)	N = 50 pregnant women (mean age = 31.1 ± 5.44 years) N = 202 post-partum women (mean age = 29.7 ± 4.94	- Pregnant and post-partum women recruited in a hospital (mother-infant unit) - Exclusion of women unable	Nightmare and dream frequency Dream contents Dream-associated behaviors	- Ad hoc interview with a question on dreams and nightmares, and the request to describe their most intense and realistic dream about their infant	- Obstetric complications - Sleep quality and sleep disorders - Spousal and familial support Breast-feeding practices psychopathology	- No differences between groups for dream recall frequency - Dreams and nightmares of infant were higher in pregnant and post-partum

(*continued on next page*)

Table 2 (*continued*)

Article	*Design*	*Sample*	*Inclusion/ exclusion criteria*	*Dream features examined*	*Instruments to collect dreaming*	*Additional measures*	*Main results*
		years; 95 primiparas, 107 multiparas) N = 21 non-pregnant women (within 12 weeks after childbirth; mean age = 28.5 ± 6.34 years).	to understand French or English - No neurologic, psychiatric or major sleep disorders (e.g., narcolepsy, sleep apnea syndrome).		since last contact (same interview for never-pregnant; pregnant and post-partum groups). For pregnant women and post-partum women: if a dream about the infant was recalled, a checklist was administered to investigate dream content features and dream-associated behaviors (motor activity; speaking; expressing emotion and mothers' reactions to the episode).		women than the never-pregnant group - The post-partum group had more dream anxiety than other two groups - In the post-partum group, primiparas had higher dream recall frequency, infant dream and nightmares than multiparas - Post-partum women had higher dream-associated behaviors than the pregnancy group - Post-partum women had higher motor activity than other two groups - Never-pregnant women had higher expressing emotion than other two groups - Anxiety, sadness and fear are the most expressed emotions in all groups and only 7% reported pleasant emotions - Post-partum and pregnant with dream-associated behaviors reported more infant dreams and nightmares - Post-partum women reported more post awakening reactions after dream-associated behaviors: lingering anxiety, confusion on awakening and checking on the infant
Mancuso et al. 2008	Cross-sectional (dreamers vs non-dreamers; women with masochistic dreams vs. women with pleasant dreams)	N = 248 pregnant women in the third trimester (35-36 weeks; N = 160 dreamers)	- Pregnant women recruited in a department of obstetrics.	Dream frequency and contents Masochistic/Bad dreams	- Dream diary for 15 days - The Masochistic Dreams Scale	- Socio-demo information - Obstetric history - Physician–patient relationship - The Hamilton Rating Scale for Anxiety (HAM-A) - The Montgomery–Åsberg Depression Rating Scale (MADRS)	- Dream frequency was associated with the age, middle–high family income and high educational level - dream frequency was associated with the regularity of prenatal controls and with "satisfactory" personal relations with the physician. - "masochistic dreams" in 56.2% of the cases and "pleasant" in the

(*continued on next page*)

Table 2 (*continued*)

Article	*Design*	*Sample*	*Inclusion/ exclusion criteria*	*Dream features examined*	*Instruments to collect dreaming*	*Additional measures*	*Main results*
							remaining 43.8% of the cases. - Masochistic content was associated with age < 35 years, quality of information and frequent thoughts of delivery. - Depression levels were higher in women reporting masochistic dreams - Labour duration was shorter in the dreamer group and in women with masochistic dream content (vs. the pleasant dream content group).
Lara-Carrasco et al. 2013	Cross-sectional (early third trimester pregnant women vs. late third trimester pregnant women vs. non-pregnant women)	N = 37 pregnant women in the early (<30 weeks) third trimester (18-39 years) N = 22 pregnant women in the late (8-9 months) third trimester (18-39 years) N = 60 non-pregnant women (18-39 years)	- Women recruited via health care centres - Women should report recalling at least one dream per week - No sleep disorders - No medications - Pregnant women with no major obstetrics complications.	Maternal mental representations in dream content Pregnancy-related dream contents Non-MMR dream features (i.e., dysphoric elements, dream interactions, dream narratives)	Dream diary for 14-days	- Demographic information - The State and Trait Anxiety Inventory (STAI) - The Edinburgh Postnatal Depression Scale (EPDS) - The Beck Depression Inventory-Short Form (BDI- SF)	- Controlling for age, relationship and employment status, education level and state anxiety, women in both pregnant groups reported more dreams depicting themselves as a mother or with babies/children than non-pregnant women - Pregnant women in the late third trimester had less specific baby/child representations than the early third trimester and non-pregnant groups - Both pregnant groups had more pregnancy-related dreams than non-pregnant group - Late third trimester pregnant women had higher childbirth content than the early third trimester group - Both pregnant groups had more morbid elements (dead, destroyed, damaged elements) in dreams than the non-pregnant group.
Lara-Carrasco et al. 2014	Cross-sectional (pregnant women vs. non-pregnant women)	N = 57 third trimester pregnant women (mean age = 28.7 ± 4.06 years) N = 59 non-	- Women recruited via health care centres - Women should report recalling	Dream recall frequency Bad dream recall frequency Nightmare frequency	- Dream diary for 14 days (prospective measures) Three items of the Sleep Disorders Questionnaire	- Demographic information - Sleep features through a sleep log for 14 days - The Sleep Disorders Questionnaire (SDQ)	- Pregnant women (vs. non-pregnant women) had higher prospective bad dream recall frequency and retrospective

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Table 2 (*continued*)

Article	*Design*	*Sample*	*Inclusion/ exclusion criteria*	*Dream features examined*	*Instruments to collect dreaming*	*Additional measures*	*Main results*
		pregnant women (mean age = 26.8 ± 4.21 years)	at least one dream per week - No sleep o psychiatric disorders - No medications affecting sleep - Pregnant women with no major obstetrics complications		assessing dream recall, bad dream and nightmare frequency	- The State and Trait Anxiety Inventory (STAI) - The Edinburgh Postnatal Depression Scale (EPDS) - The Beck Depression Inventory-Short Form (BDI- SF)	dream recall frequency - Pregnant women (vs. non-pregnant women) had greater proportion of nightmare per week - In pregnant women, sleep quality negatively correlated with bad dream and nightmare frequency.
Schredl et al. 2016	Cross-sectional (pregnant women vs. non-pregnant women)	N = 406 third trimester pregnant women (16–40 years) N = 496 non-pregnant women from a normative sample (Schredl, 2013; 14–93 years)	- Pregnant women selected in obstetric hospitals - Pregnant women already included in another project (POSEIDON) - Caucasian descent - Main caregiver - German-speaking - No maternal hepatitis B, C or HIV infections - No current psychiatric disorders - No history of substance dependency other than nicotine during pregnancy.	Dream recall frequency Nightmare frequency Baby-related dream contents	- Ad hoc dream questions on dreaming during the last months - One item from the Prenatal Distress Questionnaire on dreaming about baby	- The German NEO Five-Factor-Inventory - The Perceived Stress Scale (PSS) - The trait version of the State-Trait-Anxiety Inventory (STAI) - The Edinburgh Postnatal Depression Scale (EPDS) - The Life Experiences Survey (LES) - The Anxiety Screening Questionnaire (ASQ) - The Prenatal Distress Questionnaire (PDQ)	- Pregnant women (vs. non-pregnant women) had higher dream recall and night-mare frequency - All stress measures positively correlated with nightmare frequency (even controlling for dream recalling frequency) - Pregnant women had a high percentage of baby-related dream contents - Younger women and nulliparous women dreamed more often about their future babies - Nightmare frequency was correlated with baby-related dream contents
Wołyńczyk-Gmaj et al. 2017	Cross-sectional (pregnant women with insomnia before pregnancy vs. pregnant women with insomnia developed during pregnancy vs. pregnant women without insomnia)	N = 266 third trimester pregnant women (18-24 years) Subgroups: N = 42 with insomnia developed during pregnancy N = 52 with insomnia longer than 1 year N = 160 without insomnia	- Pregnant women recruited in a department of obstetrics - Pregnant women with a normal course of pregnancy.	Nightmare frequency	Ad hoc questions on nightmares	- Demographic information - The Athens Insomnia Scale (AIS) - The Beck Depression Inventory (BDI) - The Regestein Hyperarousal Scale (HS) - The Epworth Sleepiness Scale (ESS) - The General Practice Physical Activity Questionnaire - Sleep-related behaviors: eating at night, snoring, restless legs syndrome, myoclonus, duration of sleep problems, family history of insomnia, use of sleeping medication, daytime, dysfunction, and sleep habits.	- Pregnant women with insomnia developed during pregnancy (vs. without insomnia) had more frequent nightmares and also had more hyperarousal and depression - Pregnant women with insomnia developed during pregnancy (vs. with insomnia before pregnancy) had more frequent nightmares.
Kalmbach et al. 2019	Cross-sectional (poverty pregnant-women vs. non-poverty pregnant women; black pregnant women vs. white	N = 267 pregnant women (25-30 weeks; mean age = 29.76 ± 4.72 years)	- Pregnant women recruited in hospitals - Pregnant women included in a previous Randomized	Bad dream recall frequency	One item from the Pittsburgh Sleep Quality Index (PSQI)	- Socio-demographic information (focus on poverty and race) - Medical information (focus on obesity; Body Mass Index) - The Insomnia Severity Index (ISI)	- Pregnant women in poverty (vs. non-poverty women) had greater bad dream frequency.

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Article	*Design*	*Sample*	*Inclusion/ exclusion criteria*	*Dream features examined*	*Instruments to collect dreaming*	*Additional measures*	*Main results*
	pregnant women; BMI ≥ 35 pregnant women vs. BMI < 35 pregnant women)		Control Trial on cognitive-behavioral therapy for insomnia.			- The Pittsburgh Sleep Quality Index (PSQI)	
Gül and Şolt,. 2021	Cross-sectional (pregnant women with recurrent pregnancy losses vs. pregnant women with histories of primary infertility vs. healthy pregnant women)	N = 49 pregnant women with recurrent pregnancy losses (18-40 years) N = 49 pregnant women with histories of primary infertility (18-40 years) N = 51 pregnant women with normal pregnancy (18-40 years)	- Pregnant women recruited in a hospital - Being in the first, second or third trimester of pregnancy - Having a singleton pregnancy - No chronic disease - No thyroid dysfunction - No psychiatric problems.	Dream anxiety in bad dreams	The Van Dream Anxiety Inventory (VDAS)	- The Maternal Information Form (MIF; socio-demographic information) - The Insomnia Severity Index (ISI)	- Greater dream anxiety in pregnant women with recurrent pregnancy losses and primary infertility vs. healthy pregnant women - No correlation between insomnia symptoms and dream anxiety, but insomnia symptoms were higher in pregnant women with recurrent pregnancy losses and primary infertility
Van et al. 2023	Cross-sectional (pregnant women with a prior pregnancy loss vs. healthy pregnant women)	N = 20 pregnant women with a prior pregnancy loss (beyond 34 weeks; at least 18 years) N = 140 pregnant women with normal pregnancy (beyond 34 weeks; at least 18 years)	- Pregnant women included in a large randomized clinical trial to test a behavioral intervention to improve sleep - Women in a relationship - Able to read and write English - Women expecting their first living child - Not working nightshift - No mood or sleep disorders.	Bad dream recall frequency	A single item from the Pittsburgh Sleep Quality Index (PSQI)	- Socio-demographic information - Actigraphy to estimate sleep quality - The Pittsburgh Sleep Quality Index (PSQI) - The 20-item Center for Epidemiological Studies-Depression (CES-D) - The 10-item version of the Perceived Stress Scale - The Relationship Satisfaction Scale - The Perinatal Grief Scale-Short Version (PGS-S)	- Pregnant women with a prior pregnancy loss (vs. healthy pregnant women) had higher bad dream frequency and self-reported sleep disturbances - Pregnancy loss was a significant contributor for bad dream frequency along with sleep disturbance and leg twitching/ jerking (Van et al., 2023). - No between-groups differences in actigraphic measures
Hertz et al. 1992	Longitudinal/ Cohort (dreams at third trimester vs. 3-5 months post-partum) Cross-sectional/ Case-control (pregnant women vs. non-pregnant women)	N = 12 pregnant women in the third trimester (22-40 years) N = 7 pregnant women retested 3-5 months post-partum N = 10 non-pregnant women (28-41 years)	- Pregnant women recruited in a department of obstetrics - Exclusion of women with high risk pregnancy and psychiatric complications - No history of sleep disorders before pregnancy - Non-pregnant women without sleep disorders, medical or psychiatric problems.	Bad dream recall frequency	A single item from the Stanford Sleepiness Scale (SSS)	- Frequency of sleep restlessness - Nocturnal low back pain - Leg cramps - Snoring - Morning headache - Polysomnography with oxygen saturation - Sleep diary after polysomnographic recording	- Pregnant women did not report a significant decrease of bad dreams in post-partum - Pregnant women reported that bad dreams are one of the most frequent sleep complaints along with restless sleep, low back pain and leg cramps - Pregnant women reported longer total bed time, higher, intra-sleep wakefulness, greater number of awakenings lower sleep efficiency, increased stage 1 and decreased REM sleep than

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Article	*Design*	*Sample*	*Inclusion/ exclusion criteria*	*Dream features examined*	*Instruments to collect dreaming*	*Additional measures*	*Main results*
							non-pregnant women - In the post-partum period women showed fewer awakenings, decreased intra-sleep wakefulness and greater sleep efficiency than during pregnancy
Coo et al. 2014	Longitudinal/ Cohort (dreams at third trimester vs. 10-12 weeks post-partum) (Ante- and postnatal dream reports vs. dream of normative women population)	N = 20 pregnant women (data collection during the third trimester and after 10-12 weeks post-partuma; at least 18 years; mean age = 30.63 ± 3.69 years) No information about normative group	- Pregnant women recruited in hospital - Pregnant women included in a larger research project about sleep and pregnancy - No major medical complication during pregnancy - No history of severe psychiatric problems - English speaking.	Dream contents	Dream diary for 7 days + Hall and Van de Castle Coding	- Demographic information - Obstetric history - The Edinburgh Postnatal Depression Scale (EPDS) - The Depression, Anxiety and Stress Scale (DASS)	- Antenatal dreams (vs. postnatal dreams) had more characters known to the dreamer, smaller frequency of family members, and less baby characters - Postnatal dreams (vs. antenatal dreams) had a larger frequency of familiar settings and a smaller rate of success - Antenatal dreams (vs. normative dreams) had higher family characters, smaller presence of friends, more baby characters, less aggressive interactions, low rate of physical aggression, less familiar settings, higher references to dreamer-involved success, more references to the pregnant belly, lower aggression and sexual interactions - Postnatal dreams (vs. normative dreams) had higher family characters, smaller presence of friends, more references to baby characters more frequent social interactions, lower familiar setting, less frequent bodily misfortunes, less aggressive and sexual interactions.
Sabourin et al. 2018	Longitudinal/ Cohort (dreams at second trimester vs. third trimester vs. post-partum) Cross-sectional/ Case-control	N = 143 pregnant women (data collection at 23 weeks, 32 weeks and 1 month after giving birth; 20-34 years)	- Pregnant women recruited in hospitals, medical clinics and childbirth preparation classes	Pregnancy-related dream contents Emotional dream features	Dream diary+ Hall and Van de Castle Coding	None	- Pregnant women (vs. non-pregnant women) had greater pregnancy-related dream contents - Third trimester (vs. non-pregnant women) dream

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Article	*Design*	*Sample*	*Inclusion/ exclusion criteria*	*Dream features examined*	*Instruments to collect dreaming*	*Additional measures*	*Main results*
	(pregnant women vs. non-pregnant women)	N = 125 non-pregnant women (20-34 years)	- No high risk pregnancy - At least high school degree - No major psychiatric problems - No medications in the past 8 weeks - No substance abuse - No major impactful event in the past 12 months - Exclusion of non-pregnant women with children younger than 1 year.				reports contained more references to fetus, pregnancy, baby, medical elements, giving birth and taking care of a newborn - No differences between dreams in the second and third trimester - Multiparas reported more in-dream references to older children and being a mother - Primiparas reported more in-dream references to the future role as mothers than non-pregnant women - Post-partum women reported more in-dream references to baby, medical elements and taking care of a newborn than non-pregnant women - Third trimester pregnant women reported more in-dream references to fetus, pregnancy and giving birth than post-partum women - Post-partum women reported more in-dream references to baby, being a mother and taking care of a baby than third trimester pregnant women. - No significant difference was observed for emotional dream features between groups
Schredl et al. 2019	Longitudinal/ Cohort (dream and nightmare frequency during pregnancy-T1 vs. 6 months post-partum-T3 vs. 3.5 years post-partum-T4)	N = 406 pregnant women (27-40 weeks; 17-44 years) N = 357 women retested at 6 months post-partum N = 302 women retested after 3.5 years post-partum	- Pregnant women selected in an obstetric hospital - Pregnant women already included in another project (POSEIDON) - Caucasian descent - Main caregiver - German-speaking - No maternal hepatitis B, C or HIV infections	Nightmare frequency Dream recall frequency	Ad hoc dream questions on dream recall and nightmare frequency	- Socio-demographic information - The Perceived Stress Scale (PSS) - The state version of the State-Trait-Anxiety Inventory (STAI-S) - The Edinburgh Postnatal Depression Scale (EPDS) - The Life Experiences Survey (LES) - The Anxiety Screening Questionnaire (ASQ) - The Prenatal Distress Questionnaire (PDQ) - The Beck Depression Inventory (BDI)	- Slight decrease in nightmare frequency between T1 and T4 - Perceived stress increased from T1 to T4 - Significant correlations between nightmare frequency and stress-related measures at all three time points - Significant correlation between nightmare and

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Table 2 (*continued*)

Article	Design	Sample	Inclusion/ exclusion criteria	Dream features examined	Instruments to collect dreaming	Additional measures	Main results
			- No current psychiatric disorders - No history of substance dependency other than nicotine during pregnancy.				dream recall frequency - Nightmare frequency at T1 predicts nightmare frequency at T3 and T4. Also, nightmare frequency at T3 predicts nightmare frequency at T4.

increased with gestational age (Blake and Reimann, 1993).

3.2.1.2. Dream content. Concerning dream content, several studies have found increased oneiric themes about babies in pregnancy dreams compared to never-pregnant women (Krippner et al., 1974; Blake and Reimann, 1993; Dagan et al., 2001; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2013; Schredl et al., 2016). Cross-sectional comparisons provided from two longitudinal studies (Coo et al., 2014; Sabourin et al., 2018) are in line with these findings; indeed, antenatal dream contents significantly diverged from normative dream ones (see Table 2 for details), particularly involving greater references to the child (Coo et al., 2014), as well as pregnant women reported more baby-related content that non-pregnant women (Sabourin et al., 2018).

Interestingly, Nielsen and Paquette (2007) revealed that both pregnant and post-partum groups had higher baby-related dreams than never-pregnant women. Also, Schredl et al. (2016) found that younger women had higher content related to the future baby.

Blake and Reimann (1993) explored possible variables that influence dream content. They revealed that women having pregnancy-related dreams reported less perceived support from the child's father than they wanted compared to women without pregnancy-related dreams (Blake and Reimann, 1993).

An investigation assessing oneiric contents at different stages of pregnancy found that pregnant women in the late third trimester had less specific baby representations than the early third trimester and non-pregnant groups (Lara-Carrasco et al., 2013). In addition, late third trimester pregnant women had more childbirth content than the early third trimester group (Lara-Carrasco et al., 2013). Other dream contents were also reported by pregnant women, such as household articles, unfamiliar settings, physical activities (Krippner et al., 1974), woman's body (Dagan et al., 2001), and destroyed/damaged elements (Lara-Carrasco et al., 2013).

3.2.1.3. Emotional features. Some studies have investigated the emotional features of pregnant women's dreams and the relationship between dream emotions and oneiric contents. Krippner et al. (1974) found that pregnant women experienced more anger in their dreams and were more likely to represent themselves as aggressors against small animals than the normative sample.

A study focusing on anxiety and primary thinking (i.e., irrationality and bizarreness of dream contents) reported no difference between pregnant and non-pregnant women in these dimensions (Dagan et al., 2001). However, the authors found correlations between specific anxiety dimensions and dream content (i.e., pregnancy, women's body positivity, partner, family) (Dagan et al., 2001). Nevertheless, some of these correlations were not specific to the pregnant group and the authors found no differences between pregnant and non-pregnant women concerning anxiety and primary-process thinking (Dagan et al., 2001).

Nielsen and Paquette (2007) showed that anxiety, sadness, and fear were the most expressed emotions in pregnant, post-partum, and never-pregnant groups with only 7 % reporting pleasant emotions. The authors also found that post-partum women had higher dream-associated behaviors than the pregnant group, and these behaviors were linked to dream anxiety (Nielsen and Paquette, 2007). In particular, post-partum women had higher motor activity than pregnant and never-pregnant women, and the latter group reported higher expressed emotion (e.g., laughing or crying) than pregnant and post-partum groups (Nielsen and Paquette, 2007).

3.2.2. Longitudinal findings

Sobourin et al. (2018) provided within-subject comparison between dreams at second and third trimester and found no difference. The authors also revealed that third trimester dreams contained more references to the fetus, pregnancy, and birth than post-partum dreams. Complementarily, post-partum dreams reported more references to the future baby, being a mother, and taking care of a baby than third-trimester dreams. Multiparas reported more references to older children and being a mother, while primiparas reported more references to the future role as mothers than non-pregnant women (Sabourin et al., 2018).

When post-partum women were compared with non-pregnant women group, they reported more references to baby, medical elements and taking care of a newborn. Accordingly, Coo et al. (2014) revealed that antenatal dreams included fewer baby characters than postnatal dreams. Furthermore, postnatal dreams had a greater frequency of familiar settings than antenatal dreams.

3.3. Bad dreams and nightmares

3.3.1. Cross-sectional findings

3.3.1.1. Bad dream and nightmare frequency. High frequencies of unpleasant dreams and nightmares have been found in pregnant women (Blake and Reimann, 1993; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2014; Schredl et al., 2016). In particular, Nielsen and Paquette (2007) revealed that primiparas had higher nightmare frequency than multiparas in the post-partum group. Additionally, a study designed to control for socio-economic status, body-mass index (BMI), and race, revealed that pregnant women in poverty had higher bad dream frequency than non-poverty women (Kalmbach et al., 2019).

Notably, one study highlighted that the sleep quality of pregnant women negatively correlated with bad dreams and nightmare frequency (Lara-Carrasco et al., 2014). Consistently, some findings showed that pregnant women with insomnia had a higher nightmare frequency than women without insomnia and this relationship was stronger in the group of women who developed insomnia during pregnancy (Wołyńczyk-Gmaj et al., 2017). In addition, the insomnia group exhibited more hyperarousal and depression (Wołyńczyk-Gmaj et al., 2017).

3.3.1.2. Bad dream and nightmare contents. As for dreams, also nightmares containing infants were higher in pregnant and post-partum women than in the non-pregnant group (Nielsen and Paquette, 2007),

and the frequency of nightmares correlated with baby-related contents (Schredl et al., 2016). In addition, dream-associated behaviors are associated with nightmares concerning babies both in post-partum and pregnant groups. Moreover, post-partum women reported the highest prevalence of behaviors with more post-awakening reactions after these events, such as confusion, anxiety, and checking on the infant.

3.3.1.3. Bad dreams, nightmares, and psychological aspects. Few studies examined the relationship between psychological variables and frightening dreams (Kron and Brosh, 2003; Nielsen and Paquette, 2007; Mancuso et al., 2008; Schredl et al., 2016). Only one study directly compared pregnant women who developed post-partum depression (PPD) with a group without PPD, showing that the latter had a greater frequency of "masochistic dreams" (Kron and Brosh, 2003). Furthermore, women without PPD had a higher frequency of manifestations of apprehension in their dreams than women who developed PPD. Differently, Mancuso et al. (2008) showed that depression levels were higher in women reporting masochistic dreams, but no information was provided on the development of PPD. In addition, the authors found that labour duration was shorter in dreamers with masochistic contents, as compared with women having pleasant dreams (Mancuso et al., 2008).

Stress dimensions also appeared to be linked to nightmares (Schredl et al., 2016). Indeed, Schredl et al. (2016) revealed that stress levels positively correlated with nightmare frequency during pregnancy. Moreover, Nielsen and Paquette (2007) found more dream anxiety in post-partum women than pregnant and never-pregnant women.

Finally, regarding bad dreams in women with adverse events related to pregnancy (i.e., history of primary infertility or child loss), authors found that women with recurrent pregnancy loss and primary infertility reported significant dream anxiety compared to healthy pregnant women (Gül and Şolt, 2021). Also, insomnia symptoms were higher in pregnant women with pregnancy-adverse events (Gül and Şolt, 2021). Consistent with this, a more recent study found that pregnant women with a prior pregnancy loss had higher recall of bad dreams and more self-reported sleep disturbances (Van et al., 2023). The authors underlined that pregnancy loss was the only significant factor accounting for the variance in bad dream frequency (Van et al., 2023).

3.3.2. Longitudinal findings

Although bad dreams are one of the most common sleep complaints in pregnant women, evidence from longitudinal studies revealed that pregnant women did not report a significant reduction in bad dreams at 3–5 months post-partum (Hertz et al., 1992). Also, Hertz and collaborators (1992) showed that women along with disturbing dreams during pregnancy reported other disorders provoking sleep fragmentation such as restless sleep, low back pain, and leg cramps. Their polysomnographic (PSG) data revealed that women had higher number of awakenings, greater wakefulness after sleep onset (WASO) and lower sleep efficiency during pregnancy compared to the post-partum period (Hertz et al., 1992). However, these polysomnographic sleep measures were not correlated with dream activity.

Considering three time points, Schredl et al. (2019) found that nightmare frequency slightly decreased after 3.5 years post-partum compared to pregnancy. Moreover, their regression analyses revealed that nightmare frequency during pregnancy predicts nightmare frequency at both post-partum periods (at 6 months post-partum and 3.5 years from childbirth), and nightmare frequency at 6 months post-partum predicts the rate at 3.5 years from childbirth. Overall, the rate of nightmares in one stage of pregnancy is always a predictor of future nightmare frequency. Additionally, the authors found significant correlations between nightmare frequency and stress-related measures at all three time points (Schredl et al., 2019).

4. Discussion

This systematic review synthesized scientific evidence from 17 articles exploring dream activity in pregnant women. Although study designs varied significantly and very few investigations are longitudinal, the literature reviewed highlights that dreaming during pregnancy has distinctive features such as increased dream recall and nightmare frequency (Blake and Reimann, 1993; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2014; Schredl et al., 2016), some relationships with sleep patterns (Wołyńczyk-Gmaj et al., 2017; Lara-Carrasco et al., 2014; Hertz et al., 1992), pregnancy-related contents and concerns often shared with waking experiences (Krippner et al., 1974; Blake and Reimann, 1993; Dagan et al., 2001; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2013; Schredl et al., 2016; Kalmbach et al., 2019; Gül and Şolt, 2021; Van et al., 2023), and a potential association with psychological conditions during wakefulness (Kron and Brosh, 2003; Mancuso et al., 2008; Wołyńczyk-Gmaj et al., 2017; Schredl et al., 2016; 2019). Additionally, some changes in dream activity seem to occur at different stages of pregnancy (Hertz et al., 1992; Lara-Carrasco et al., 2013; Coo et al., 2014; Sabourin et al., 2018; Schredl et al., 2019).

4.1. High dream recall and nightmare frequency characterized pregnancy

The increased dream recall and disturbing dream frequency in pregnant women (Blake and Reimann, 1993; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2014; Schredl et al., 2016; 2019) is consistent with the literature revealing that critical life events lead to greater oneiric production (Blagrove et al., 2004; Cernovsky, 1984; Gorgoni et al., 2022; Mathes et al., 2023). Moreover, it is worth noting that modifications in dream activity appear related to hormonal variations (Bucci et al., 1991). For instance, it is well established that the hormonal fluctuations across the menstrual cycle are linked with emotional changes that in turn could affect dreaming (Natale et al., 2003). In particular, women report a greater presence of dreams during the pre-ovulatory and pre-menstrual phases of the cycle, when progesterone and estrogen tend to increase (Natale et al., 2003). Natale and collaborators (2003) also showed that dreams become significantly longer and more complex during the pre-menstrual phase when both estrogen and progesterone are present. Collectively, these findings point to heightened cognitive activation in the presence of high levels of estrogen. On the other hand, progesterone might play a significant role in enhancing mnemonic function, which is crucial for the recall or generation of dreams (Natale et al., 2003). Notably, both progesterone and estrogen gradually augmented their concentrations during pregnancy, showing their peak in the last trimester (Di Renzo et al., 2016). Another hormone that could impact dream activity is cortisol (Lara-Carrasco et al., 2014). This stress hormone varies with sleep and pregnancy, typically rising during the latter part of sleep and peaking during REM sleep when dream imagery and emotions are most pronounced (Payne, 2010). Accordingly, Schredl and colleagues (2016; 2019) found that nightmare frequency and stress-related measures were associated at each time point examined (pre- and post-partum periods). Moreover, several findings highlighted that stressful conditions during wakefulness may increase dream frequency, such as the perceived lower support from the baby's father (Blake and Reimann, 1993) and poverty (Kalmbach et al., 2019). These experiences may increase rumination during pre-sleep cognitions, impacting the level of cortisol and sleep disturbances.

Importantly, cortisol levels increase near labor (Parry et al., 2006), and this may contribute to increased intra-sleep awakenings in pregnant women (Rodenbeck et al., 2002), inducing a high dream and nightmare recall rate. Exploring dream content in conjunction with sleep parameters and cortisol fluctuations could offer valuable insights into the physiological correlates and common dream themes linked to disturbing dreams experienced by pregnant women.

It is well established that sleep features may significantly impact mental sleep activity (Scarpelli et al., 2023). Consistently, some results

from the reviewed articles showed an association between bad dreams/nightmares and poor sleep quality (Lara-Carrasco et al., 2014; Wołyńczyk-Gmaj et al., 2017; Van et al., 2023) and the only study investigating dream-associated behaviors – a potential index of high level of arousals - revealed significant correlations of these phenomena and dreams/nightmares production (Nielsen and Paquette, 2007). Interestingly, pregnant women suffering from insomnia reported higher nightmare frequency and hyperarousal (Wołyńczyk-Gmaj et al., 2017). Although no correlational analyses were conducted, the only study collecting PSG measures found that pregnancy is characterized by greater sleep fragmentation and reduced sleep efficiency than post-partum period (Hertz et al., 1992). However, bad dreams were not reduced in the post-partum (Hertz et al., 1992). It should be considered that sleep remains disrupted after childbirth (Witkowska-Zimny et al., 2024), and this fragmentation could lead to an abundant dream production and recall of emotionally charged dream contents (Scarpelli et al., 2022a).

Overall, these findings are partly consistent with the view that greater sleep fragmentation is associated with a high rate of dream recall and nightmares (Scarpelli et al., 2023). Indeed, electrophysiological studies have shown that the recall of oneiric activity is related to increased awakenings (van Wyk et al., 2019), more cortical activation (D'Atri et al., 2019; Simor et al., 2013), higher fast-frequencies EEG power (Siclari et al., 2017; Scarpelli et al., 2020a) and lower slow oscillations (Siclari et al., 2017; Scarpelli et al., 2017; 2020b). In this regard, Koulack and Goodenough (1976) hypothesized that high sleep fragmentation promotes the transfer of dream contents from short-term to long-term memory storage. This has been recently confirmed by COVID-19 studies revealing that greater intra-sleep awakenings and poor sleep were associated with high rate of dream recall and nightmares (Gorgoni et al., 2022).

4.2. Shared mental activity between different states of consciousness during pregnancy

In line with the continuity hypothesis (Domhoff, 2017), the majority of the reviewed papers showed that women in their dreams reported many pregnancy-related contents and themes or concerns strictly linked to their waking state (Krippner et al., 1974; Blake and Reimann, 1993; Dagan et al., 2001; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2013; Schredl et al., 2016; Kalmbach et al., 2019; Gül and Şolt, 2021; Van et al., 2023). Specifically, pregnant women tend to represent themselves as mothers (Lara-Carrasco et al., 2013; Sabourin et al., 2018) and the future baby (Blake and Reimann, 1993; Dagan et al., 2001; Lara-Carrasco et al., 2013; Coo et al., 2014; Schredl et al., 2016; Sabourin et al., 2018) in their dreams. These contents seem to mirror the internalized representations of the self and the imagined child during wakefulness during gestation (Ammaniti and Trentini, 2009; Leckman et al., 2004; Slade et al., 2009; Vizziello et al., 1993) and are often influenced by contextual factors and psychological conditions (Pajulo et al., 2001; Theran et al., 2005). For instance, primiparas showed more references to their role of mother (Sabourin et al., 2018) and to infant (Nielsen and Paquette, 2007) than multiparas, suggesting that already having a child could modify the women's imagery.

The time of gestation could also influence dream contents and the quality of maternal representations during the waking state (Ammaniti et al., 1992). It should be underlined that the sample involved in most of the examined studies were women in the third trimester (Hertz et al., 1992; Kron and Brosh, 2003; Mancuso et al., 2008; Lara-Carrasco et al., 2013, 2014; Coo et al., 2014; Schredl et al., 2016, 2019; Wołyńczyk-Gmaj et al., 2017; Sabourin et al., 2018; Van et al., 2023). The last period of pregnancy is characterized by more fearful imagery and worries about the child (Leckman et al., 2004; Vizziello et al., 1993). However, results on dream content variations during pregnancy are quite heterogeneous. On the one hand, Lara-Carrasco and collaborators (2013) revealed that the late third trimester had less specific baby representations but more childbirth contents than the early third-trimester group. Also, another investigation revealed no differences between dreams and nightmares of infants in pregnant and post-partum women (Nielsen and Paquette, 2007). On the other hand, longitudinal results showed that there are no differences in terms of pregnancy-related contents between the second and third trimesters, while dream contents change between pre- and post-partum period (Sabourin et al., 2018). Indeed, references on the fetus and pregnancy during the third trimester are replaced by references to real baby and to the role of mother during the post-partum (Sabourin et al., 2018). Similarly, another study comparing the pre- and post-partum periods found that antenatal dreams contained fewer baby characters (Coo et al., 2014). This finding appears consistent with the continuity hypothesis since the dream activity evolve with waking experiences of the pregnant women.

Some authors have hypothesized that the unpleasant emotions reported in the dream recall may also reflect the psychological condition of women during wakefulness (Kron and Brosh, 2003).

However, it is important to note that the continuity hypothesis does not assign specific functions to dreaming. Instead, it views dreaming as merely reflecting waking memory and other cognitive activities. On the other hand, the reviewed findings may give some hints about the possible functional role of dream changes during pregnancy, which can be considered in light of other experimental findings and theoretical models.

For instance, sparse evidence revealed that pregnant women associated themselves with negative self-definitions or events in dreams (Krippner et al., 1974; Kron and Brosh, 2003; Mancuso et al., 2008). These contents could represent a mechanism to face pregnancy and childbirth (Cartwright, 1986). Indeed, masochistic dreams appeared to predict a lower incidence of depression after childbirth (Kron and Brosh, 2003). Additionally, although masochistic dreams were associated with higher depression symptoms during pregnancy, this kind of oneiric activity seems to predict a shorter labour duration (Mancuso et al., 2008).

Notably, different dimensions of anxiety have been correlated with pregnancy-related dream content (Dagan et al., 2001) and previous pregnancy-related adverse events such as child losses or a history of infertility may influence the actual pregnancy of women predicting increased levels of anxiety (Gul and Şolt, 2021) and unpleasant dreams (Van et al., 2023). Nevertheless, dream anxiety does not seem to be exclusive to the pre-partum period (Nielsen and Paquette, 2007).

Overall, the current findings are consistent with the idea that dreaming may play a functional role in mental reorganization and emotional regulation during pregnancy. Indeed, oneiric contents are involved in the processes responsible for changes in self-identity and the creation of a first relationship with the baby, promoting the activation of the attachment and caregiving system. This is in line with Cartwright's assumption (Cartwright, 2005; 2010), which suggested that dreams are useful for establishing connections between recent emotional experiences and personally relevant memories, enhancing psychological well-being and coherence within the self-system. In this view, dream activity with negative topics or nightmares might alleviate similar negative states from entering wakefulness and thus increase the individual's emotional well-being during wakefulness. Furthermore, pregnancy-related content could represent a simulation of reality (Revonsuo, 2000; Revonsuo et al., 2015). On the one hand, the findings concerning abundant child representation (Krippner et al., 1974; Blake and Reimann, 1993; Dagan et al., 2001; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2013; Coo et al., 2014; Schredl et al., 2016; Sabourin et al., 2018) and herself as mother (Lara-Carrasco et al., 2013; Sabourin et al., 2018) may be interpreted in light of the "social simulation theory" of dreaming (Revonsuo et al., 2015), stating that dreaming serves to simulate significant social bonds and interactions, thereby strengthening them. According to this theory, pregnant women would likely simulate interactions with their baby and their role as mothers in their dreams, reflecting the importance of these future social

relationships. More directly, the observations that the future mothers dream about the future baby and about being mothers in late pregnancy (Krippner et al., 1974; Blake and Reimann, 1993; Dagan et al., 2001; Nielsen and Paquette, 2007; Lara-Carrasco et al., 2013; Coo et al., 2014; Schredl et al., 2016; Sabourin et al., 2018) appear consistent with the "constructive episodic simulation hypothesis" proposed by Wamsley (2022). In fact, when recent experiences are reflected in dreams, even partially, it enhances subsequent memory of those experiences. Consistently, numerous recent studies have shown that after participants complete a learning task introduced in the laboratory, those who report dreaming about the task exhibit greater performance improvements following sleep compared to those who do not dream about the task (Plailly et al., 2019; Schoch et al., 2019).

In contrast, the morbid/negative elements in the dream scenario, along with unpleasant emotions (Dagan et al., 2001; Mancuso et al., 2008; Kron and Brosh, 2003), could serve as a "threat simulation", namely as psychological preparation that helps the dreamer to face and deal with similar negative events in the future. More directly, dreams about threats to the life/health of baby or mother would prepare pregnant women for potential future dangers (Revonsuo, 2000). Several research offers additional evidence supporting this hypothesis. For example, Cartwright and collaborators (Cartwright et al., 2006) suggest that after a divorce, depressed individuals who have dreams involving their ex-partner are more likely to show psychological improvements several months later. In this view, negative elements of dream activity may produce adaptive advantages. Moreover, during the pandemic some results highlighted that unpleasant emotions are prevalent in dream activity, and higher contents related to contamination and cleanness were found in dream reports, reflecting an attempt to develop strategies to contain the consequences of COVID-19 infection (Mota et al., 2020).

4.3. Methodological issues

Some methodological limitations of the reviewed studies should be stressed. Many investigations had a small sample size ($\leq$20 subjects *per* group; Krippner et al., 1974; Hertz et al., 1992; Dagan et al., 2001; Coo et al., 2014; Van et al., 2023) and in most cases, a control group is lacking (i.e., non-pregnant women; Blake and Reimann, 1993; Kron and Brosh, 2003; Mancuso et al., 2008; Wołyńczyk-Gmaj et al., 2017; Kalmbach et al., 2019; Schredl et al., 2019; Gül and Şolt, 2021; Van et al., 2023). Moreover, while most findings refer to a third trimester group of pregnant women (Hertz et al., 1992; Kron and Brosh, 2003; Mancuso et al., 2008; Lara-Carrasco et al., 2013, 2014; Coo et al., 2014; Schredl et al., 2016, 2019; Wołyńczyk-Gmaj et al., 2017; Sabourin et al., 2018; Van et al., 2023), other studies mixed pregnant women at different gestation ages (Krippner et al., 1974; Blake and Reimann, 1993; Dagan et al., 2001; Nielsen and Paquette, 2007; Gül and Şolt, 2021), making it difficult to explore the specific dream features of each trimester. This is relevant considering evidence of modifications in dreaming activity during different stages of pregnancy (e.g., Lara-Carrasco et al., 2013; Coo et al., 2014; Sabourin et al., 2018). A relevant flaw of many protocols stems from the absence of sleep (Dagan et al., 2001; Mancuso et al., 2008; Lara-Carrasco et al., 2013; Coo et al., 2014; Schredl et al., 2016; 2019; Gül and Şolt, 2021) and psychological measures (Hertz et al., 1992; Kalmbach et al., 2019; Van et al., 2023) or both (Krippner et al., 1974; Blake and Reimann, 1993; Kron and Brosh, 2003; Sabourin et al., 2018). Furthermore, in most cases, the inclusion/exclusion criteria used in the examined studies did not allow researchers to exclude participants suffering from full-blown psychiatric disorders (Krippner et al., 1974; Blake and Reimann, 1993; Dagan et al., 2001; Kron and Brosh, 2003; Mancuso et al., 2008; Wołyńczyk-Gmaj et al., 2017). It is well-known that both sleep and psychological parameters have a pivoltal influence on the dream experience (Scarpelli et al., 2023). With exception of two studies (Hertz et al., 1992; Van et al., 2023), no other investigation recorded sleep objectively, which makes it impossible to systematically assess the influence of sleep patterns on dreaming. Although one of the strengths of the examined studies lies in the fact that dream information is required from pregnant women at the time of the investigation, methods to collect dreams or nightmares are extremely heterogeneous. They vary from prospective ones, as dream diaries (i.e., participants are instructed to record their dreams as they occur, typically immediately upon waking up) (Krippner et al., 1974; Dagan et al., 2001; Mancuso et al., 2008; Lara-Carrasco et al., 2013; Coo et al., 2014; Lara-Carrasco et al., 2014; Sabourin et al., 2018; Schredl et al., 2019) to retrospective measures with standardized questionnaires/items or interviews created ad hoc (i.e., typically participants are required to remember their dream activity referring to previous days/weeks) (Hertz et al., 1992; Blake and Reimann, 1993; Kron and Brosh, 2003; Nielsen and Paquette, 2007; Schredl et al., 2016; Wołyńczyk-Gmaj et al., 2017; Kalmbach et al., 2019; Gül and Şolt, 2021; Van et al., 2023). It should be noted that retrospective methods allow for rapid collection of dream information, but they are more prone to a "recall bias" (Robert and Zadra, 2008). Additionally, we reviewed altogether the results concerning nightmares and bad/disturbing dreams due to the fact they were not accurately differentiated and defined in the selected studies (Hertz et al., 1992; Blake and Reimann, 1993; Kron and Brosh, 2003; Nielsen and Paquette, 2007; Mancuso et al., 2008; Lara-Carrasco et al., 2014; Schredl et al., 2016, 2019; Wołyńczyk-Gmaj et al., 2017; Kalmbach et al., 2019; Gül and Şolt, 2021; Van et al., 2023).

Finally, specific limitations of this systematic review should be underlined: a) the inclusion of English-language papers only may have provided a partial view of the existing research on the relationship between dreaming and pregnancy; b) the variability in the quality of the included studies may affect the overall reliability of the findings. Moreover, we used an adapted and not validated version of the NOS for cross-sectional findings which may have overestimated or underestimated the study risk bias; d) no meta-analysis was performed due to the heterogeneity of the dream data provided by the examined papers. For all these reasons, the results synthesized in the current review should be taken with caution.

5. Conclusion

The available evidence on the dreaming features in pregnancy is still at a preliminary stage and several methodological flaws were detected in the examined studies. However, dreams and nightmares may represent privileged access to the inner world of individuals and may provide important information on women's well-being.

This systematic review allows different interpretations of the relationship between dreaming and pregnancy. First, dream and nightmare frequency may depend on the sleep patterns during pregnancy. Second, dream contents may reflect a non-functional continuity and similarity with waking life experiences. Third, dreams may play a functional role in emotion regulation, helping to maintain emotional balance and promote psychological well-being in waking life. Lastly, dreams might act as episodic future simulations, preparing expectant mothers for their future roles and relationships with their babies, or simulating potential dangers to the baby, thereby enabling mothers to be better prepared for such scenarios. However, current research on dreams during pregnancy does not yet provide sufficient evidence to confirm any of the mentioned hypotheses.

Definitively, further studies are needed aiming at a) longitudinally investigating dream changes along with objective sleep changes (e.g., through actigraphic recordings) during different trimesters of gestation and post-partum period; b) providing comparisons of dream activity between different groups of pregnant women such as those with and without sleep disorders; c) carrying out a systematic investigation taking under control specific variables influencing oneiric activity such as socio-demographic features, being primipara or multipara, presence of previous traumatic/adverse experiences, psychological variables, and comorbid medical conditions; d) conducting PSG recordings with dream

collection to investigate for the first time the neural correlates of dreaming in pregnant women; e) evaluating the predictive power of some aspects of dreaming activity during pregnancy for developing a post-partum depression carrying out longitudinal studies.

Overall, we suggest that the assessment of mental sleep activity and especially of dream content could be particularly useful for health professionals to evaluate emotional processes and mood-related aspects in pregnant women, to predict some adverse evolution such as difficulties during labour or post-partum depression. We also believe that the evaluation of dreaming should always be associated with the collection of subjective and/or objective sleep measures. It should be emphasized that many studies revealed that pregnant women are more prone to develop sleep disorders (e.g., Hedman et al., 2002; Sedov et al., 2018) and increase their nightmare frequency (e.g., Hertz et al., 1992; Lara-Carrasco et al., 2014). In this view, specific short-term intervention protocols should be employed to promote the health of women during gestation, especially when some risk factors were identified (i.e., previous pregnancy loss).

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Appendix A. Supporting information

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