EMOTION DYSREGULATION AND SLEEP IN THE PERINATAL PERIOD

EXAMINING THE RELATIONSHIP BETWEEN EMOTION DYSREGULATION AND SUBJECTIVE & OBJECTIVE SLEEP FROM LATE PREGNANCY TO EARLY POSTPARTUM

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A Thesis Submitted to the School of Graduate Studies in Partial Fulfillment of the Requirements for the Degree Master of Science

McMaster University, MASTER OF SCIENCE (2024) Hamilton, Ontario (Neuroscience)

TITLE: Examining the Relationship Between Emotion Dysregulation and Subjective & Objective Sleep From Late Pregnancy to Early Postpartum

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NUMBER OF PAGES: xi, 67

Lay Abstract

The perinatal period is a time of vulnerability for experiencing emotion dysregulation (ED) and sleep difficulties, which can negatively impact maternal wellbeing and infant development. Despite the adverse impacts, the relationship between ED and sleep has been understudied in the perinatal period. As such, the present study examined this relationship in perinatal participants using subjective and objective measures of sleep during their third trimester, at 1-3 weeks, and at 6-12 weeks postpartum. Participants with higher ED displayed greater subjective sleep difficulties across visits, as well as greater objective sleep difficulties in terms of spending more time awake after initially falling asleep, and having a lower sleep quality during late pregnancy. Having limited awareness of emotions and access to strategies may be important in this association. This study has the potential to inform interventions and supports for sleep and ED challenges perinatally, ultimately supporting both maternal and child wellbeing.

Abstract

Background: The perinatal period is marked by biological/hormonal, physiological, and psychosocial changes that can increase the risk of sleep difficulties and emotion dysregulation (ED). While the relationship between ED and sleep is well-documented, it remains understudied in the perinatal period despite the resulting adverse maternal-infant outcomes. This study aimed to address gaps in our understanding by 1) examining the relationship between ED and sleep longitudinally from late pregnancy to early postpartum, and by 2) using both subjective and objective measures of sleep.

Methods: 58 participants were assessed across three visits during their third trimester of pregnancy, at 1-3 weeks, and at 6-12 weeks postpartum. ED was assessed using the Difficulties In Emotion Regulation Scale (DERS) at visit 1. Participants wore actigraphs for two week periods to obtain objective sleep data at each timepoint, including total sleep time (TST), sleep efficiency (SE), wake after sleep onset (WASO), sleep onset latency (SOL), and awakenings. Subjective sleep quality was examined using the Pittsburgh Sleep Quality Index (PSQI).

Results: Subjective sleep quality differed significantly between high and low ED groups at all visits, where those with high ED experienced worse sleep quality. Significant differences in this direction were also found for SE and WASO at visit 1. Significant positive correlations were found between the awareness subscale of the DERS and subjective sleep quality across visits, along with the strategies subscale at visits 1 and 3.

Conclusion: This study provides support for the differential influence of high and low ED on subjective and objective sleep across the third trimester of pregnancy to 1-3 and 6-12 weeks postpartum, where those with higher ED display a trend of increased sleep difficulties across

visits. With its use of a longitudinal design and subjective and objective sleep measures, this study provides novel insights into the ED – sleep relationship perinatally.

Acknowledgements

I would like to acknowledge and express my deepest gratitude to Dr. Sheryl Green, my co-supervisor and mentor, who has guided and supported me throughout this process. Through this challenging yet rewarding year, Dr. Green has not only been dedicated to supporting me academically, but has also been extremely caring and encouraging. I am so grateful for all she has taught me, and for making this an uplifting experience. I would also like to express my gratitude to Dr. Benicio Frey, my co-supervisor, for his guidance and support throughout this process.

I would further like to thank my committee member, Dr. Luciano Minuzzi, for his ongoing support and direction with data analysis, as well as Dr. Jenna Boyd, for her involvement and future guidance as a committee member throughout this process. I would also like to thank Anastasiya Slyepchenko for permitting the use of her important research data that made this study possible. I am grateful for the time and dedication she has put into guiding, teaching, and supporting me with data analysis and editing.

I am also grateful to members of the Women's Health Concerns Clinic for their ongoing support, and to my fellow grad students and close friends, Zoryana and Emily, for being extremely supportive, motivating, and for bringing positivity and light to my life when I need it the most. Finally, I want to thank my mom, and my lifelong best friend, Dakota, for always believing in me, and being sources of unconditional love and strength.

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List of Abbreviations and Symbols

DERS: Difficulties in Emotion Regulation Scale

df: Degrees of Freedom

ED: Emotion Dysregulation

EPDS: Edinburgh Postnatal Depression Scale

FDR: False Discovery Rate

fMRI: Functional Magnetic Resonance Imaging

GAD-7: Generalized Anxiety Disorder 7-item scale

IQR: Interquartile Range

MADRS: Montgomery–Åsberg Depression Rating Scale

MINI: Mini International Neuropsychiatric Interview

n: Number

p: Probability

PDPI-R: Postpartum Depression Predictors Inventory–Revised

PSQI: Pittsburgh Sleep Quality Index

REM: Rapid Eye Movement

r_s: Spearman's rank correlation coefficient

SD: Standard Deviation

SE: Sleep Efficiency

SJHH: St. Joseph’s Healthcare Hamilton

SOL: Sleep Onset Latency

SPSS: Statistical Package for the Social Sciences

t: t-statistic

TST: Total Sleep Time

U: Mann-Whitney test statistic

WASO: Wake After Sleep Onset

WHCC: Women's Health Concerns Clinic

YMRS: Young Mania Rating Scale

> Greater than

≥ Greater than or equal to

Declaration of Academic Achievement

This thesis includes one study, with incorporation of edits from Dr. Sheryl Green and Anastasiya Slyepchenko by the student. This study utilized data collected as part of a larger longitudinal study by Anastasiya Slyepchenko, with co-authors Dr. Benicio Frey, Dr. Luciano Minuzzi, and Dr. James Reilly. This data collection was completed between November 2015 to May 2018.

The present study examined the relationship between emotion dysregulation and subjective and objective sleep difficulties in perinatal participants during their third trimester of pregnancy, at 1-3 weeks postpartum, and at 6-12 weeks postpartum. My supervisors, Dr. Benicio Frey and Dr. Sheryl Green, as well as Anastasiya Slyepchenko whose data I am using for this thesis, were involved in the conceptualization and design of the study. Dr. Benicio Frey, Dr. Luciano Minuzzi, and Anastasiya Slyepchenko also provided guidance with data analysis. Dr. Sheryl Green provided continual guidance with editing the written sections of this thesis and provided approval. With guidance, Julia Peak analyzed the data, interpreted the findings, and wrote the thesis.

Chapter 1: Introduction

The Perinatal Period: Changes and Risk

While having a child is viewed as a positive experience for many women, the perinatal period, encompassing pregnancy and the first year postpartum, is accompanied by an increased risk for developing mental health challenges, with up to 20% of women experiencing depression (Shorey et al., 2018) and up to 20% of women experiencing an anxiety disorder (Fawcett et al., 2019). Further, depression and anxiety disorders are often comorbid during the perinatal period, with a meta-analysis of studies from 30 countries showing a prevalence of approximately 10% (Falah-Hassani et al., 2017). This heightened risk largely stems from biological/hormonal, physiological, and psychosocial changes that occur during this time (Brunton et al., 2015; Polte et al., 2019). For instance, levels of estrogen and progesterone rise significantly during late pregnancy and drop drastically following childbirth (Slyepchenko et al., 2022). This sudden fluctuation in hormone levels can contribute to anxiety and mood challenges (Schiller et al., 2014). Transitioning into the parenting role is also accompanied by social and relationship changes (Biaggi et al., 2016; Coyle, 2009), as well as changes in self-perception and body image (Rallis et al., 2007; Coyle, 2009). Given how rapidly these changes occur (Fahey & Shenassa, 2013), they can be challenging to adjust to and may bring about feelings of insecurity and distress (Polte et al., 2019). Coupled with recovering from childbirth and the new responsibilities and challenges of caring for an infant, vulnerability to mental health difficulties is understandably heightened in the perinatal period.

Experiencing mental health difficulties during the perinatal period can be detrimental to both maternal and child wellbeing. They can impair a woman's ability to bond with her baby (Saharoy et al., 2023) and bring about feelings of guilt and shame, which can ultimately lead to

withdrawal from social supports that are crucial for coping during this time (Gusak et al., 2024). Detrimental physical complications, such as poor prenatal care (i.e., less likely to attend appointments, reduced adherence to medications/vitamins), preeclampsia, and preterm labour have also been associated with experiencing perinatal mental health challenges (Ghimire et al., 2021). Regarding infant wellbeing, anxiety and depression during pregnancy have been linked to having a low birth weight and facing neurodevelopmental and behavioural challenges (Schetter & Tanner, 2012; Hernández-Martínez et al., 2008; Polte et al., 2019). Postpartum mental health challenges, specifically, impact a parent's ability to respond to their infant's needs and parent in a sensitive and responsive manner (Saharoy et al., 2023), and thus have been associated with an array of adverse outcomes, such as early discontinuation of breastfeeding, perceiving one's infant negatively, maternal-infant attachment difficulties, and slower child language acquisition (Kahn et al., 2002; Cheng et al., 2006). Given these significant adverse outcomes, understanding the underlying processes of mental health challenges during the perinatal period is critical. Research suggests that the perinatal period is a time of vulnerability for experiencing heightened emotion dysregulation (Rosebrock et al., 2015; Barrett et al., 2023), which is central to prevalent mental health disorders experienced during this time (D'Agostino et al., 2017), including depression (Woody et al., 2017), anxiety (Fawcett et al., 2019) and trauma (Yildiz et al., 2017). It has been theorized that the dysregulation of negative emotions can lead to an increase in negative affect and a decrease in positive affect, creating a positive feedback loop that reinforces both emotion dysregulation and the associated mental health challenges (Hofmann et al., 2012).

Emotion Dysregulation during the Perinatal Period

Emotion regulation has commonly been referred to as the ability to adaptively manage one's emotional experiences and expressions (Gratz & Roemer, 2004), which may look different

depending on the situation. For instance, engaging in emotional avoidance or suppression as ones main avenues of emotion regulation would not be considered adaptive (Gratz & Roemer, 2004), however, using these strategies some of the time would likely serve a productive purpose, such as supporting new mothers in their ability to care for their infant in the midst of experiencing overwhelming, heightened emotions and stressful situations. While it is important to adaptively process and manage most emotions, engaging in emotional suppression or avoidance some of the time may be practical and necessary. Accordingly, strategies used to manage emotions should also be suitable for a specific situation or context and contribute to broader psychological well-being over time (Wheeler et al., 2017). Transitioning into pregnancy and the parenting role evokes a complex range of emotions, encompassing both the positive and negative; healthy emotion regulation involves feeling this range of emotions while effectively using strategies to manage their internal impact and one's outward reaction to them (Gratz & Roemer, 2004). For example, employing mindfulness strategies (such as identifying emotions and practicing cognitive control; Wheeler et al., 2017) in response to anxiety that exceeds productive levels related to first-time childbirth, changing relationship dynamics, or concerns about infant health can be considered adaptive and contextually appropriate.

Research has theorized that using mindfulness improves emotion regulation through its promotion of cognitive reappraisal, where automatic reactions to emotions are interrupted, enabling one to engage in conscious reflection that reduces rumination and impulsive reactions (Schuman-Olivier et al., 2020). It facilitates self-awareness to, and management of, one's emotional state and has the potential to enhance psychological well-being over time through its continued use in similar future circumstances. As such, practicing this strategy in the contexts mentioned above would be reflective of practicing healthy emotion regulation. In contrast,

relying on emotional avoidance or suppression as main strategies may appear to promote emotion regulation, but are not adaptive in the long-term as they have been linked to an increase in the intensity and frequency of emotions that one aims to alleviate (Schuman-Olivier et al., 2020). Since these strategies would not meet the crucial aspect of supporting psychological wellbeing over time, they would not be reflective of healthy emotion regulation. Rather, employing these strategies more than occasionally may reflect underlying emotion dysregulation.

Emotion dysregulation involves both emotionally regulating and reacting in a maladaptive way. More specifically, it includes poor emotional comprehension, limited or improper use of emotion regulation strategies (e.g., rumination, suppression, avoidance; Aldao et al., 2014), and a tendency to perceive emotions as threatening. Regarding the emotional reactivity component, emotion dysregulation involves having excessively elevated or dampened emotional responses (Gratz & Roemer, 2004; Gross & Jazaieri, 2014). Taken together, this may involve feeling "bad", but not being able to recognize what emotions are underlying this, being unaware of what strategies to use to manage this bad feeling, and thus, without being able to manage it, interpreting it as fearful or threatening and reacting in extremes, such as by avoiding or suppressing, or responding in an excessively reactive manner. In the context of the perinatal period, for example, a new mother may feel very uncomfortable when engaging in self-care activities, such as reading or going for a walk, but struggle to identify which emotions are driving this. As such, she may have a difficult time managing the negative feelings that come up when she attempts to engage in self-care, which can start to feel overwhelming as a result. Going forward, when attempting to go for a walk, she may perceive the uncomfortable feelings she experiences as threatening, and in an attempt to prevent feeling this way, avoid going for walks altogether. In this instance, engaging in avoidance does not serve an adaptive purpose, whereas

doing so in specific instances would, such as to meet infant needs despite fatigue, stress, or sadness.

As mentioned above, vulnerability to mental health difficulties is elevated during the perinatal period (Fawcett et al., 2019; Falah-Hassani et al., 2017), in part due to the significant changes and transitions that a woman experiences (Schiller et al., 2014; Biaggi et al., 2016; Rallis et al., 2007), but is potentially also due to heightened emotion dysregulation. Women in the perinatal period exhibit more frequent, intense and variable positive emotions, such as optimism and joy, as well as negative emotions, such as anxiety and sadness, compared to those outside of the perinatal period (Li et al., 2020).

As an indicator of emotion dysregulation, Bowen et al. (2012) found that perinatal women experiencing depression exhibited significantly higher levels of fluctuating mood compared to healthy non-perinatal controls, which persisted when examining perinatal women who were not depressed, although not significantly. In their study examining the role of emotion dysregulation in cognitive-behavioural group therapy, Agako et al. (2021) found that greater difficulty regulating emotions was also present in perinatal participants with an anxiety disorder compared to waitlist controls. However, after completing treatment, perinatal participants showed similar levels of improvement in anxiety and depressive symptoms despite their level of emotion dysregulation. Further, those with high emotion dysregulation at baseline remained in this category after completing treatment. While these studies examined emotion dysregulation in perinatal participants with mental health difficulties, this suggests that though intertwined with anxiety and depression, emotion dysregulation in itself is a distinct concern.

Similar to the detrimental outcomes associated with perinatal mental health difficulties, emotion dysregulation is also linked with adverse outcomes for both mothers and children. For

instance, emotion dysregulation during the perinatal period can increase the risk of maternal obesity (de Campora et al., 2016), reduce the quality of early feeding interactions (de Campora et al., 2014), and have a negative impact on maternal-infant attachment (Brakeet et al., 2020). When examining the link between parenting and maternal-child emotion dysregulation, Morelen et al. (2014) found that maternal emotion dysregulation led to a reduction in supportive parenting, which was linked to emotion dysregulation in children. It is clear that emotion dysregulation is one of the major processes at risk during the perinatal period that can significantly impact wellbeing. Along with emotion dysregulation, sleep difficulties are another major process that places women at risk during the perinatal period (Yang et al., 2020; Kang et al., 2020). Importantly, research has demonstrated a link between emotion dysregulation and sleep (Yang et al., 2020; Kang et al., 2020).

Sleep during the Perinatal Period

Sleep is a complex biological process characterized by the cyclic activity of the central nervous system, where each of the five sleep cycle stages are necessary and have their own purpose for healthy functioning (Witkowska-Zimmy et al., 2024). For instance, stage three deep or "slow wave" sleep plays a role in energy and immune system restoration, whereas stage four or “REM” (Rapid Eye Movement) sleep is crucial for memory consolidation and emotional processing, and in turn, for emotion regulation (Galbiati et al., 2020). Being able to maintain the ideal amount of quality sleep is crucial for health and wellbeing, where good quality sleep has been associated with effective emotion regulation, positive mood, and immune and brain health (Gruber & Cassoff, 2014; Cohen et al., 2009). This is especially important during periods of stress, as sleep plays a vital role in providing the cognitive resources necessary to regulate and cope with stress (Zamore & Veasey, 2022). In the perinatal period, sleep is impacted by the

lifestyle, hormonal, and physiological changes that occur (Hashmi et al., 2016; Micheli et al., 2011; Bei et al., 2012).

For instance, Hashmi et al. (2016) note that a rise in progesterone levels during the first trimester of pregnancy can cause snoring and interrupted sleep. While progesterone is associated with promoting sleep and relaxation, the significant rise in pregnancy can contribute to physiological changes that may have the counterintuitive effect of increasing the amount of awakenings and causing sleep disruption. For instance, progesterone relaxes muscles in the throat and nasal passages that, coupled with weight gain and changes in breathing patterns, can lead to snoring and sleep disturbance in pregnancy. Variations in progesterone levels throughout the day and night can also lead to irregular sleep patterns, such as by promoting daytime sleepiness (Hashmi et al., 2016). While there may be an increase in the amount of sleep time during pregnancy, this sleep may be irregular, disrupted, and overall be of a lower quality (Hashmi et al., 2016). Alongside progesterone, high estrogen levels during pregnancy can also lead to narrowing of the upper airways (i.e., relaxed muscles, excess fluid retention, swelling), which could increase the risk of snoring or experiencing sleep difficulties (Micheli et al., 2011). Physiological symptoms that contribute to sleep difficulties during the perinatal period also include nausea and vomiting, and physical discomfort from back pain and fetal growth and movements (Hashmi et al, 2016; Bei et al., 2012).

Research has found that sleep quality is at risk and progressively worsens throughout the perinatal period, with the height of sleep disturbance occurring in the third trimester of pregnancy and the first month postpartum (Bei et al., 2012; Sedov et al., 2018). This is followed by gradual improvements in sleep in the months following (Matsumoto et al., 2003). In their meta-analysis of sleep quality throughout pregnancy, Sedov et al. (2018) reported that nearly half

of pregnant women experience poor sleep quality. Field et al. (2007) found that women in their second trimester of pregnancy frequently experienced sleep disorders, such as sleep-disordered breathing and insomnia, compared to non-pregnant controls. Research has found that by later into the second trimester (i.e., 23-24 weeks), total time spent sleeping at night is often reduced (Lee et al., 2000). An increase in stage three non-REM sleep (Hashmi et al., 2016), the deepest stage of sleep, coupled with more frequent awakenings during the night due to heightened physical discomfort (i.e., weight gain, fetal growth, difficulty getting comfortable), may contribute to this reduction in total sleep time, as it is harder to fall back asleep when awakened from deep stages of sleep compared to lighter ones (Hashmi et al., 2016). However, stage three non-REM sleep has been found to decrease in the third trimester while sleep challenges generally continue to progress (Hashmi et al., 2016; Sedov et al., 2018), illustrating the multitude of factors at play and the complex nature of sleep throughout the perinatal period.

Reaching the height of sleep disruption and physical discomfort during pregnancy, the vast majority of women experience sleep challenges during the third trimester (Slyepchenko et al., 2022; Witkowska-Zimny et al., 2024), with 98% experiencing awakenings during the night (Hashmi et al., 2016). Given the added challenge of caring for a newborn in the postpartum period, it is not surprising that sleep challenges persist or increase following childbirth (Yang et al., 2020; Witkowska-Zimny et al., 2024).

Poor sleep quality during the perinatal period has been associated with several adverse health consequences, such as an increased risk of preterm birth, cesarian section, longer labour, and placental abruption (Lu et al., 2021; Okun et al., 2011; Naghi et al., 2011; Qui et al., 2015). In their meta-analysis examining how sleep disturbance during pregnancy is related to adverse maternal-infant health outcomes, Lu et al. (2021) found that overall sleep disturbance was

significantly associated with gestational diabetes and hypertension, as well as the risk of having a stillbirth. These maternal health complications, in turn, have implications for infant health and development. For instance, infants born preterm (i.e., before 37 weeks) are at a higher risk of experiencing respiratory distress syndrome, infections, developmental delays, and organ failure (Pravia & Benny, 2020).

In addition to the physiological and hormonal changes that impact sleep and in turn, maternal-infant health outcomes, there are also social and lifestyle aspects that impact sleep in the perinatal period. For instance, it is important to consider social determinants of health that can impact one's stress levels and ability to maintain healthy sleep. In their systematic review and meta-analysis examining socioeconomic status and sleep quality of pregnant women in their third trimester, Silva-Perez et al. (2019) found that lower socioeconomic status (i.e., under $50,000) was associated with poor sleep quality and increased sleep difficulties across 38 articles and/or reviews. The authors note that financial stress can interfere with sleep, as it often necessitates increased work hours to meet financial need. This can also heighten overall stress levels and make it more challenging to maintain a healthy lifestyle. Further increasing stress and practically interfering with sleep, Hagen et al. (2013) found that nighttime infant care needs average to about 80 hours a year during the first postpartum years. Measured using actigraphy watches for one week, Acebo et al. (2005) found that infants within their first year had an average of seven awakenings during the night, for an estimated two hours spent awake each night; maternal sleep disruption during these times was also illustrated by the completion of sleep diaries.

Overall, the various changes affecting sleep during the perinatal period can contribute to stress and impact overall wellbeing. As such, it is not surprising that sleep difficulties during the

perinatal period are also intertwined with mental health challenges (Kang et al., 2020). Inadequate sleep duration, poor sleep quality, and irregular sleep patterns are linked with depression during pregnancy (Field et al., 2007), as well as low mood and anxiety across the perinatal period (Tomfohr et al., 2015). Alongside sleep, emotion regulation is crucial for coping with these changes and the added stress experienced in the perinatal period (Grande et al., 2021). The relationship between sleep and emotion regulation has been well-established in the literature (Lollies et al., 2022; Gruber & Cassoff, 2014; Grove et al., 2017; Fisher et al., 2022), but has largely been understudied in the perinatal period. Given that sleep disruptions significantly impact maternal-infant wellbeing, examining the relationship between emotion regulation and sleep during this time is crucial for informing interventions that seek to improve sleep and enhance wellbeing.

The Relationship Between Emotion Dysregulation and Sleep

Although sleep and emotion regulation are commonly impacted in the perinatal period (Rosebrock et al., 2015; Li et al., 2020; Sedov et al., 2018), the relationship between the two has largely been understudied in the perinatal population despite the resulting adverse maternal-infant outcomes (de Campora et al., 2016; Morelen et al., 2014; Lu et al., 2021; Pravia & Benny, 2020). This is not surprising, as it is representative of a larger gap in women's health research that continually needs to be addressed. While the association between emotion regulation and sleep has been understudied in the perinatal period, it is well-documented in other populations where these processes are also often at risk, such as in adolescents (Lollies et al, 2022), and in those with Borderline Personality disorder (Grove et al., 2017). There is also considerable research examining the relationship in non-clinical populations and healthy adults (Powell et al., 2021).

For instance, Fisher et al. (2022) assigned healthy adolescents to good, moderate, or poor sleep quality groups and examined their level of emotion dysregulation using the Difficulties in Emotion Regulation Scale (DERS). The DERS is a widely used self-report questionnaire, and has been established as a valid, comprehensive measure of emotion dysregulation (Agako et al., 2021). Their findings support the link between sleep quality and emotion dysregulation, revealing that participants with good sleep quality reported significantly lower emotion dysregulation, while those with moderate and poor sleep quality reported higher emotion dysregulation. While the researchers focused on the total DERS score to capture emotion dysregulation, the questionnaire contains six subscales that assess different dimensions, including: “Nonacceptance” of emotional responses, difficulty engaging in “Goal”-directed behaviour, “Impulse” control difficulties, lack of emotional “Awareness”, limited access to emotion regulation “Strategies”, and lack of emotional “Clarity” (Gratz & Roemer, 2004). Examining these subscales, in addition to the total emotion dysregulation score, may provide a more nuanced understanding of how different aspects of dysregulation interact with sleep.

Examining the inverse of this association in a similar population of healthy adolescents, Palmer et al. (2017) assessed the impact of emotion dysregulation on subjective and objective sleep difficulties. Emotion dysregulation was again measured using the DERS, but utilizing both its total and subscale scores in analyses. Objective sleep difficulties were measured from six nights of averaged actigraphy data, and variables of interest included sleep onset latency, which refers to the time in minutes spent in bed to transition from wakefulness to sleep, total time spent asleep in hours, wake after sleep onset, referring to the number of minutes spent awake after initially falling asleep; and sleep efficiency. Participants with greater emotion dysregulation endorsed greater subjective sleep difficulties. Specifically, the impulse, clarity, and strategies

subscales were significantly predictive of self-reported sleep difficulties, whereas no emotion dysregulation variables were significantly related to any of the objective sleep variables. When examining the link between subjectively reported and objective sleep difficulties, only sleep duration was significant. Overall, these findings suggest that adolescents with greater emotion dysregulation perceive greater disruptions in their sleep, regardless of whether this is actually demonstrated from an objective standpoint. The authors suggest that participants who struggle with emotional clarity, to understand their emotions, and who possess fewer strategies to manage their emotions, may actually evaluate their sleep inaccurately.

Further highlighting the significance of limited clarity and use of strategies in emotion dysregulation, Grove et al. (2017) assessed their impact on subjective sleep difficulties in American undergraduate participants with borderline personality features, where dysregulation is commonly heightened. The researchers used the Pittsburgh Sleep Quality Index (PSQI), a widely used and validated measure, to assess subjective sleep quality, and the DERS as a measure of emotion dysregulation. Results revealed that emotion dysregulation was significantly associated with low sleep quality and highlight the strategies, clarity, and awareness subscales as notable in this association.

This outcome is in line with expected results, namely, providing support for the notion that sleep disturbance is commonly associated with mental health disorders, potentially facilitated by heightened emotion dysregulation (Grove et al., 2017; Harvey et al., 2011). As demonstrated in Grove et al.'s study, previous research highlights a lack of strategies as being an important component in the association between emotion dysregulation and sleep challenges (Sadeh et al., 2004; Powell et al., 2021; Ballot et al., 2021), such as in patients with insomnia (Harvey et al., 2014).

Low emotional awareness has also stood out as an important factor driving the relationship between emotion dysregulation and sleep (Ong et al., 2012). This may be especially relevant for perinatal women who experience a greater frequency of intense, variable emotions (Li et al., 2020), as having difficulty perceiving and interpreting emotions can impair effective emotion regulation strategy use. However, some studies have also reported that emotional awareness did not play a significant role in the relationship between dysregulation and sleep (Galbiati et al., 2020; Schantz et al., 2024). Further research is needed to examine this more comprehensively.

While most studies focus on the relationship between sleep difficulties and the dysregulation of negative emotions, dysregulation of positive emotions is also an important consideration. In their study, Powell et al. (2021) examined the impact of subjective and objective sleep variables on positive emotion regulation in healthy adults. The PSQI was used to assess subjective sleep quality and actigraphs collected objective sleep data for one week. The Responses to Positive Affect questionnaire was used to assess the use of strategies that maintain or elevate positive emotions (i.e., savouring), and to assess strategies that reduce positive emotions (i.e., dampening). Results revealed that heightened subjective sleep difficulties were significantly associated with increased use of strategies that dampen positive emotions, and lower use of strategies that savour positive emotions.

Powell et al.'s results are particularly relevant when considering the perinatal period, as experiencing satisfaction and positive emotions is a motivating factor for coping with stress and parenting during this time (Jungert et al., 2015). As such, experiencing sleep difficulties that contribute to the dysregulation or "dampening" of positive emotions may lead to feeling less rewarded from the joy that is experienced alongside the stress of caring for a newborn, perhaps

enabling one to experience the situation as more stressful. Similar to Palmer et al.'s (2017) findings, objective sleep difficulties were not associated with use of any positive emotion regulation strategies. This is in line with previous research indicating that individuals' subjective perceptions of their sleep quality may not align with what is demonstrated objectively (Cudney et al., 2022).

Underlying Mechanisms and Processes

It has been established that the relationship between sleep and emotion dysregulation is bidirectional, where poor sleep impacts our ability to regulate emotions, and emotion dysregulation impacts our ability to sleep (Kahn et al., 2013). With respect to the mechanisms underlying this association, Kahn et al. (2013) explored how sleep impacts emotional brain networks; sleep loss may reduce our ability to control negative emotions by disrupting functioning of the prefrontal cortex, which is responsible for inhibitory control (Kahn et al., 2013). Illustrating this, Yoo et al. (2007) used functional magnetic resonance imaging (fMRI) to examine amygdala activity in young adults with and without experimentally induced sleep loss. The researchers found that sleep deprived participants displayed significantly increased amygdala activity in response to stimuli intended to elicit negative emotions, compared to controls.

In their review, Gruber and Cassoff (2014) further explain how connectivity between emotional centers of the brain (i.e., prefrontal cortex and the amygdala), is partly dependent on the sleep system, as connectivity between these regions is higher when someone is rested and lower when someone is lacking sleep; higher connectivity is important for executive functioning, which is a hallmark of emotion regulation (Gruber & Cassoff, 2014). Sleep difficulties, such as experiencing increased awakenings during the night, may also increase emotion dysregulation by

interrupting REM sleep, as frequent interruptions of REM sleep have been found to allow negative thoughts and emotions to be remembered and felt more easily during the day (Riemann et al., 2012). Overall, from a general physiological perspective, sleep difficulties may heighten emotion dysregulation by interrupting REM sleep, and by disrupting brain regions that help with our ability to inhibit and control emotional reactions (Kahn et al., 2013).

From a behavioural perspective, Palmer and Alfano (2017) discuss how getting an insufficient amount of sleep and having a low sleep quality contribute to emotion dysregulation by impairing decision-making, cognitive processing, and the ability to control emotional responses. Accordingly, in their systematic review examining sleep and emotion regulation in adolescents, Lollies et al. (2022) found that sleep problems were associated with decreased emotional regulating behaviour, whereas good quality sleep was found to enhance mood, positive emotional expression, and sensory processing in response to emotional stimuli. Sleep difficulties can also lower the psychological threshold for interpreting events as stressful (Kahn et al., 2013), which in turn, may heighten emotion dysregulation as managing emotions is more challenging in response to stressful situations (Minkel et al., 2012). This is particularly relevant in the context of the perinatal period where stress is often substantially elevated (Fahey & Shenassa, 2013).

While a breadth of studies have examined how sleep difficulties impact emotion dysregulation (Yoo et al., 2007; Gruber & Cassoff, 2014; Lollies et al., 2022), there is also research investigating how emotion dysregulation impairs sleep (Kahn et al., 2013, Galbaiati et al., 2020; Watling et al., 2017), although this direction has been understudied in comparison, especially when examining the perinatal period. More research in this direction has focused on the impact of emotions, rather than emotion regulation, on sleep (Kahn et al., 2013; Sadeh et al.,

2004), but the importance of being able to regulate such emotions to reduce their impact on sleep is evident. Given the increased risk and prevalence of emotion dysregulation (Barrett et al., 2023), mental health challenges (Falah-Hassani et al., 2017), and stress levels (Grande et al., 2021), this is of particular relevance in the perinatal period, where emotion dysregulation may exacerbate the already present sleep challenges, creating a potentially adverse cyclic relationship. Given the detrimental maternal-infant outcomes that can result from this (Brakeet et al., 2020; Lu et al., 2021), further investigation into the impact of emotion dysregulation on sleep is necessary for informing effective interventions and support strategies.

In their review, Kahn et al. (2013) discuss how emotions can activate the stress system (i.e., the hypothalamic–pituitary–adrenal axis; Van Reeth et al., 2000), leading to difficulty falling and staying asleep with the body in an alert state. This suggests that regulating one's stress-associated emotions would be particularly crucial for quality sleep, so as to reduce this alertness. Accordingly, the way one copes with and reacts to emotional states can impact sleep. Sadeh et al. (2004) discuss how engaging in emotion-focused coping (i.e., focused on regulating one's response to a stressful situation), may actually impair sleep, as focusing on emotions in times of stress may heighten alertness. This was illustrated in their study investigating how coping style impacts sleep in response to low and high stress.

Actigraphy results revealed that more emotion-focused coping in the high stress condition was significantly predictive of a lower TST. While this may indicate that using emotion regulation strategies led to sleep difficulties, the undergraduate sample may have had limited knowledge of how to appropriately implement emotion-focused coping, which would be essential for effective regulation (Wheeler et al., 2017). Kahn et al. (2013) discuss this study to illustrate how using emotion regulation strategies may heightened awareness of one's emotions,

leading to a state of alertness that impacts sleep. However, Sadeh et al. (2004) measured sleep difficulties and emotional coping under high and low stress conditions, rather than examining how the use or non-use of coping strategies affects sleep specifically in high stress conditions, which would potentially be more reflective of how emotion regulation ability impacts sleep. This highlights the need for future research into this area, especially during the perinatal period where stress and emotion dysregulation are commonly heightened (Barrett et al., 2023; Grande et al., 2021).

In their investigation of how emotion dysregulation is related to sleep in insomnia patients, Galbaiati et al. (2020) found that emotion dysregulation (i.e., DERS) was significantly related to difficulties with REM sleep onset and time spent in REM sleep, as measured by polysomnography. The researchers discuss how having difficulty using strategies to manage emotions can hinder one's ability to transition out of a state of alertness, leading to hyperarousal that interferes with sleep. Further highlighting the importance of healthy emotion regulation for sleep, in their review, Watling et al. (2017) discuss the evolutionarily adaptive role of negative affect and vigilance during dangerous situations that would hinder one's ability to sleep, which they note is maladaptive in Western society where there is often no threat of harm. The authors suggest that emotion regulation may play a moderating role in the relationship between emotional state and mood, where effective regulation may prevent one from entering a negative mood state that interferes with sleep. In the context of the early postpartum period, experiencing negative affect and a heightened state of vigilance is generally adaptive as it facilitates responsiveness to infant needs (i.e., attending to a crying infant during the night; Barba-Müller et al., 2019), but emotion regulation remains crucial for preventing prolonged states of vigilance that interfere with sleep unnecessarily.

Emotion Dysregulation and Sleep in the Perinatal Period

While the literature discussed above invites speculation, minimal studies have provided direct support for the impact of emotion dysregulation on sleep in the perinatal period (Karami et al., 2018; Kaliush et al., 2022; Kaliush et al., 2024). Though some research does exist, very few studies have included objective sleep data, or have only focused on pregnancy or postpartum periods in isolation (Kaliush et al., 2022; Kaliush et al., 2024). Karami et al. (2018) examined the relationship between subjective sleep quality (i.e., using PSQI) and use of cognitive emotion regulation strategies in pregnant women. Results revealed a significant relationship between maladaptive emotion regulation strategy use and lower sleep quality, specifically noting the role of rumination in this association.

As one of the only studies investigating emotion dysregulation and sleep challenges within a pregnant population, these results offer valuable insights into how specific strategies can affect sleep in this population and provide a foundation for future studies to examine this in more depth. However, it is important to note that the majority of studies outside of a perinatal context have used the DERS to assess different facets of emotion dysregulation (Fisher et al., 2022; Palmer et al., 2017; Grove et al., 2017; Galbaiati et al., 2020), whereas Karami et al. used the "Garnefski cognitive emotion regulation strategies questionnaire", which specifically assesses cognitive coping strategies employed in response to negative events (Garnefski et al., 2007) and is comparable to the strategies subscale of the DERS. Future research is needed to assess how other facets of emotion dysregulation relate to different aspects of sleep in pregnant women and to extend these investigations into the early postpartum period. Due to the commonly reported discrepancy between subjective and objective measures of sleep, and the research suggesting that they may be measuring different aspects (Palmer et al., 2017; Cudney et al., 2022), additional

research using objective measures is also necessary to deepen our understanding of the complex relationship between emotion dysregulation and sleep in the perinatal period.

To date, one study included objective sleep data, but focused on pregnancy only. Kaliush et al. (2022) examined associations between pre-sleep arousal, components of emotion dysregulation, and sleep efficiency and quality in pregnant women during their third trimester. The authors note that emotion dysregulation is multifaceted, and their use of the DERS and its subscales allowed for a broader analysis of different emotion dysregulation dimensions. Sleep quality and efficiency were examined using seven nights of averaged actigraphy data and the Consensus Sleep Diary, a subjective measure. Pre-sleep arousal was assessed using the Pre-Sleep Arousal Scale, and significantly predicted poor sleep quality and low sleep efficiency. However, this was not the case for participants with access to effective emotion regulation strategies; higher pre-sleep arousal was only predictive of poor sleep quality for participants with limited access to emotion regulation strategies. This is consistent with previous literature (Hoag et al., 2016; Vandekerckhove & Wang, 2018), and suggests that therapeutic efforts during pregnancy should focus on providing individuals with emotion regulation strategies to enhance emotional wellbeing, and in turn improve sleep and support both maternal and infant health. Future research is needed to examine whether this is also true of the postpartum period.

Overall, given the likely discrepancy between subjective and objective sleep measures (Palmer et al., 2017; Cudney et al., 2022), and the differing lifestyle, hormonal, and physiological changes that occur across the late pregnancy and postpartum periods (Hashmi et al., 2016; Micheli et al., 2011; Bei et al., 2012), it is imperative that future studies aim to present a more comprehensive view of the relationship between emotion dysregulation and sleep using both types of measures to examine it longitudinally across the perinatal period. At present, only

one recent study has alluded to the impact of emotion dysregulation on sleep using both subjective and objective measures while also examining this longitudinally throughout late pregnancy up to four months postpartum (Kaliush et al., 2024). However, this was only briefly discussed in the midst of their primary investigation regarding how associations between sleep, emotion dysregulation, and a desire to live across the perinatal period impact postpartum suicide risk. In their third trimester, and at six weeks and four months postpartum, participants recorded seven nights of actigraphy data, and completed a shorter version of the "State DERS" which assesses four dimensions of emotion dysregulation (i.e., Nonacceptance, Modulate, Awareness, Clarity) in response to current emotional states. Participants reported increased emotion dysregulation from pregnancy to the postpartum periods, as well as fluctuating levels of objective sleep challenges across time points, despite reporting relatively stable levels of subjective sleep quality throughout. While Kaliush et al. explored a subset of state DERS dimensions, these results provide a notable foundation for more in-depth investigation into the relationship between emotion dysregulation and sleep in the postpartum period.

The Present Study: Objectives and Hypotheses

Building off previous literature that highlights how emotion dysregulation may intensify the already present sleep difficulties faced by women during the perinatal period, as well as the adverse maternal-infant outcomes that can result from this (de Campora et al., 2016; Brakeet et al., 2020; Lu et al.. 2021), the present study sought to provide a deeper, more comprehensive understanding of how emotion dysregulation impacts sleep perinatally, with the aim of optimally informing therapeutic interventions and supports during this high-risk period. Furthermore, it aimed to address notable gaps in women's health research by examining this relationship 1)

longitudinally from late pregnancy to early postpartum, and 2) using both subjective and objective measures of sleep.

The present study examined how high and low levels of emotion dysregulation are associated with differences in subjective and objective sleep outcomes (sleep quality, total sleep time, number of awakenings, sleep efficiency, wake after sleep onset, and sleep onset latency) across time in a sample of perinatal women progressing through their third trimester to 1-3 weeks and again at 6-12 weeks postpartum. The trajectories of high and low emotion dysregulation and sleep outcomes over time were also examined. Additionally, this study explored whether specific facets of emotion dysregulation as measured by the DERS, namely nonacceptance, goals, impulse, awareness, strategies, and clarity, were meaningfully associated with sleep outcomes.

Based on previous research, it was hypothesized that 1) participants with greater sleep difficulties would display a higher level of emotion dysregulation compared to low emotion dysregulation, and that this would be most evident for subjective sleep quality and sleep efficiency and that 2) the strategies, clarity and awareness subscales of the DERS would be meaningfully associated with these sleep outcomes.

Chapter 2: Examining the Relationship Between Emotion Dysregulation and Subjective & Objective Sleep From Late Pregnancy to Early Postpartum

Methods

Participants

The present study utilized data that was collected as part of a larger longitudinal study examining subjective and objective sleep as well as biological rhythms, melatonin levels, and

light exposure from late pregnancy to early postpartum, and the impact of these variables on mood and anxiety symptoms (Slyepchenko et al., 2022). Participants included 58 women (mean age = 31.28 years, SD = 3.90) recruited during their third trimester of pregnancy from November 2015 to May 2018. Recruitment occurred from community settings, including advertising in midwifery and obstetric clinics, family physician offices, ultrasound clinics, as well as from the Women's Health Concerns Clinic (WHCC), St. Joseph's Healthcare Hamilton (SJHH). The WHCC is an outpatient psychiatric clinic that provides services to women experiencing mental health challenges related to reproductive stages, such as during pregnancy, the postpartum, and perimenopausal periods (Caropreso et al., 2020). To be eligible, participants needed to be 1) aged 16 or above, 2) without a history of head trauma where consciousness was lost for longer than 5 minutes, 3) not experiencing a hypomanic, manic, or depressive episode, 4) and be at least 27 weeks pregnant when enrolling in the study. Demographic information was collected at study enrollment on participants' age, gestational week, expected due date, parity, marital status, education, household income, current medications, family history of mood disorders, and whether they had sleep apnea or were a shift worker. At the second and third visits, participants provided information on their delivery date and method, postpartum week, breastfeeding status, and medication changes. An informed consent agreement was signed by all participants prior to starting the study, and research ethics approval was granted by the Hamilton Integrated Research Ethics Board (Project #0602).

Procedure

Participants attended three study visits at SJHH. The first visit occurred during their third trimester of pregnancy. After providing informed consent, participants were interviewed using the Mini-International Neuropsychiatric Interview (MINI) Version 6.00 (Sheehan et al., 1998),

Montgomery-Asberg Depression Rating Scale (MADRS; Montgomery & Åsberg, 1977), and Young Mania Rating Scale (YMRS; Young et al., 1978) to assess psychiatric diagnosis and mood, which was of particular relevance in the previous study. Following interviews, participants completed a series of questionnaires assessing depression and anxiety, including the Postpartum Depression Predictors Inventory–Revised (PDPI-R; Beck, 2002), Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987), and Generalized Anxiety Disorder 7-item scale (GAD-7; Spitzer et al., 2006). The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) was completed to assess emotion dysregulation. Participants also completed the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) to assess their subjective sleep quality.

The second and third study visits occurred while participants were between one to three weeks, and six to twelve weeks postpartum. During these visits, women were interviewed again using the YMRS and MADRS, and completed the same questionnaires as in the first visit, except for the PDPI-R (i.e., no longer relevant) and the DERS. As emotion dysregulation was not the main focus of the previous study, this questionnaire was distributed during the first visit only. Across all three visits, participants were equipped with actigraphy watches to collect objective sleep data. Participants were instructed to wear the actigraphs on their non-dominant wrist for two-week periods in between visits (Actiwatch 2; Philips Respironics Inc; Biolynx; Montreal, Quebec, Canada). Women also kept a sleep log to record periods where the actigraphs were not worn, as well as to record naps, and bed and wake-up times.

Measures

Emotion Dysregulation

Developed by Gratz and Roemer (2004), the Difficulties in Emotion Regulation Scale (DERS) is a self-report questionnaire assessing emotion dysregulation. It contains 36 items that are scored on a 5-point Likert scale asking how much one agrees with each statement from 1-5 (almost never - almost always), with total scores ranging from 36 to 180. Higher scores on the DERS indicate greater emotion dysregulation. It yields both a total score assessing general emotion dysregulation, and six subscale scores that assess different domains of emotion regulation. The subscales include: nonacceptance of emotional responses (Nonacceptance; 6 statements); difficulty engaging in goal-directed behaviour (Goals; 5 statements), such as having trouble concentrating or completing tasks when experiencing negative emotions; impulse control difficulties (Impulse; 6 statements); lack of emotional awareness (Awareness; 6 statements); limited access to emotion regulation strategies (Strategies; 8 items); and lack of emotional clarity (Clarity; 5 statements). It contains statements such as “I experience my emotions as overwhelming and out of control" (Impulse subscale) and "when I'm upset, I have difficulty getting work done" (Goals subscale).

The DERS is widely used and has been established as a comprehensive measure of emotion regulation (Agako et al., 2021). It has been validated for use with perinatal women, with a clinical cut-off score of 87 or higher (Barrett et al., 2023), which was used in analyses to categorize participants into high and low emotion dysregulation categories. Its subscales have been shown to have good to excellent internal consistency (α= 0.82-0.94) in both perinatal and non-perinatal populations (Barrett et al., 2023; Hallion et al., 2018).

Objective Sleep

Before each study visit, actigraphs were worn continuously for a two-week period. Since actigraphs were continuously collecting data, before processing the data into a format suitable for

analysis, periods of time where participants recorded removing the actigraph in their sleep log and where no activity was captured for 20 minutes or more needed to be removed. In the case that four or more hours of recording was unavailable in a given day, data from this day was removed from analysis. Specialized software was used to extract actirgaphy data and separate it into periods of sleep and wakefulness. Data was collected in 1-minute intervals during each two week period, and Philips Actiware software Version 6.0 was used for processing. Only weekday data was used in analyses. Relevant sleep variables that were calculated from this data include: total sleep time (TST), which is the amount of hours spent asleep; sleep onset latency (SOL), which reflects the time in minutes to transition from wakefulness to sleep; sleep efficiency (SE), which is the percentage of time in bed spent asleep, calculated by dividing TST by the time spent in bed (lower SE reflects a lower sleep quality); wake after sleep onset (WASO), which is the time in minutes that are spent awake after first falling asleep, and aligned with this, the number of awakenings.

Subjective Sleep

The Pittsburgh Sleep Quality Index (PSQI) is a self-report questionnaire that measures subjective sleep quality and difficulties in the past month (Buysse et al., 1989). Its 19 items are designed to assess seven subscales, including: sleep duration, sleep disturbance, sleep latency, daytime dysfunction from sleepiness, sleep efficiency, sleep quality, and use of sleep medications. It contains a mix of open-ended and Likert-style questions that are scored from 0-3, with 0 being "not during the past month" and 3 being "three or more times a week". Total scores range from 0 to 21, where higher scores indicate greater sleep difficulties. The PSQI has been validated for use with pregnant women, demonstrating good reliability and construct validity

(Qiu et al., 2015), and has been used with perinatal women (Slyepchenko et al., 2022). Only the total PSQI score was used in analyses as a measure of overall subjective sleep quality.

Statistical Analyses

Histograms were used to visualize the emotion dysregulation (i.e., DERS) and sleep variables (i.e., PSQI, TST, SE, WASO, SOL, awakenings). Based on the established clinical cut-off for perinatal women (Barrett et al. 2023), participants with DERS scores ≥ 87 were categorized into the high emotion dysregulation group, and those with scores of < 87 were categorized into the low emotion dysregulation group. As it was not the focus of the initial study (Slyepchenko et al., 2022), emotion dysregulation data was only collected at the first visit, which was subsequently analyzed in relation to differing sleep data at each of the three visits.

Shapiro tests (Mishra et al., 2019) were used to check normality and Bartlett tests (Lovric & Arsham, 2011) were used to check homoscedasticity across visits. Results of these tests indicated that all variables, except for TST, were not normally distributed or did not meet the assumption of homogeneity of variances. To investigate this further, variables were checked for skewness at each visit. Overall, DERS, PSQI, WASO, SOL, and awakenings were positively skewed, and SE and TST were negatively skewed. We intended to use mixed linear modeling with a normal distribution to examine how emotion dysregulation predicts changes in sleep variables across visits, with participants as a random intercept. However, all efforts to transform the variables towards statistically acceptable levels of normality for parametric tests were not successful. Exploring an alternative approach to account for this, generalized linear mixed models following a gamma distribution were employed, but the models still did not meet assumptions and failed to converge.

Given the persistent non-parametric nature of the data, Mann Whitney U tests (Nachar, 2008) were employed to examine differences in sleep variables between participants with high and low emotion dysregulation at each visit; independent t-tests were used for TST across visits as it was normally distributed and met all assumptions. To gain further insight into the nature of differences between the high and low emotion dysregulation groups in their presentation of sleep variables across visits, the medians, interquartile ranges (IQR), and mean ranks were calculated for each non-normally distributed sleep variable. While the *p* values determined whether there was a statistically significant difference, the mean ranks and medians clarified the direction of this difference, illustrating which group exhibited greater sleep difficulty for each visit. The IQR further highlighted the variability within each group, providing a comprehensive view of sleep patterns associated with high and low emotion dysregulation, where a larger IQR would indicate that participants in that group had more varied sleep experiences. Providing similar insight for the normally distributed variable, the mean and standard deviation was calculated for TST following the t-tests. Lastly, Spearman rho correlations were employed to explore the relationship between subscales of the DERS and measures of sleep across visits. The Benjamini-Hochberg procedure for false discovery rate (FDR; Chen et al., 2017) was used to control for multiple comparisons. Correlations were calculated using Statistical Package for the Social Sciences (SPSS; version 29.0.2), and all other analyses were conducted using RStudio (version 4.3.1).

Results

Demographic Factors

Participant demographic characteristics are presented in Table 1 for 58 women who completed the DERS at visit 1, and actigraphy across all three visits. As mood and anxiety

symptoms were a primary consideration in the initial study (see Slyepchenko et al., 2022), 51% of the sample had histories of either bipolar or major depressive disorder, and 43% had a current or past anxiety disorder, but all participants were euthymic for depression and mania during enrollment. The majority of participants were married/partnered (96%), had a household income above $50,000 (79%), and held post-secondary educations (96%). The majority of participants were also multiparous (i.e., not their first child, 59%).

Table 1. *Participant Demographic Characteristics (n=58)*

Variable	Value		
Age, mean ± SD	31.28 ± 3.90		
Years of education, median (IQR)	17 (2.75)		
	Yes	No	
Shift worker	5 (8.6)	53 (91.3)	
Sleep apnea	1 (1.7)	57 (98.3)	
Psychotropic medication	7 (12.1)	51 (87.9)	
Current smoker	0 (0)	58 (100)	
History of mood disorder	30 (51.7)	28 (48.3)	
Current or past anxiety disorder	25 (43.1)	33 (56.9)	
	Single/Divorced	Married/Partnered	
Marital status	2 (3.4)	56 (96.6)	
	< $50,000	≥ $50,000	
Household income	12 (20.7)	46 (79.3)	
	High school diploma or Trade Certificate	College Certificate or Diploma	University – Bachelor's Degree and Higher
Highest level of education	2 (3.4)	18 (31)	38 (65.5)
	Yes	No	Mixed
Breastfeeding 1-3 weeks	35 (60.3)	5 (8.6)	9 (15.5)
Breastfeeding 6-12 weeks	33 (56.9)	9 (15.5)	7 (12.1)
	Vaginal	Cesarean	
Delivery method	42 (72.4)	13 (22.4)	
	Multiparous	Nulliparous	
Parity	34 (58.6)	24 (41.4)	

Note: Values shown as n(%) unless otherwise noted. Data were unavailable for 3 women for delivery method and 9 women for breastfeeding. IQR = interquartile range, SD = standard deviation.

Sleep Variables by Emotion Dysregulation Group Across Visits

Results of the Mann Whitney U tests revealed that subjective sleep quality, as measured by the PSQI, differed significantly between the high and low emotion dysregulation groups at visit 1 (U = 586, p = 0.004), visit 2 (U = 532.5, p = 0.048), and visit 3 (U = 584.5, p = 0.001). Higher scores on the PSQI indicate worse sleep quality. Across all visits, participants in the high emotion dysregulation group had higher median PSQI scores and higher mean ranks compared to the low emotion dysregulation group, indicating that those with greater emotion dysregulation

experienced worse sleep quality. This discrepancy became most pronounced in visit 3 from 6-12 weeks postpartum. Following a slight improvement at visit 2, participants in the high emotion dysregulation group had the highest mean rank of 38.27 at visit 3, indicating worsening sleep quality over time, and those in the low emotion dysregulation group had the lowest mean rank of 23.31 at visit 3, indicating an improvement in sleep quality over time.

Overall, participants' objective sleep variables were not significantly different between emotion dysregulation groups across visits. SOL (in minutes) was not significantly different between emotion dysregulation groups at visit 1 (U = 386.5, p = 0.740), visit 2 (U = 398.5, p = 0.974), or visit 3 (U = 418.5, p = 0.875). Number of awakenings was not significantly different between emotion dysregulation groups at visit 1 (U = 522.5, p = 0.071), visit 2 (U = 436, p = 0.526), or visit 3 (U = 492, p = 0.187). The results of independent t-tests revealed that there was also no significant difference in TST (in hours) between the low and high emotion dysregulation groups at visit 1, $t(56) = -1.915$, p = 0.060; at visit 2, $t(55) = 0.080$, p = 0.935; or at visit 3, $t(56) = 0.344$, p = 0.731.

A significant difference in SE was found between the low and high emotion dysregulation groups at visit 1 (U = 275, p = 0.036), where participants with low emotion dysregulation presented with better sleep efficiency (mean rank = 33.4, median = 84.1) compared to those with high emotion dysregulation (mean rank = 24, median = 82.1). However, this was only true of the first visit, as significant differences did not persist across visit 2 (U = 336, p = 0.339) or visit 3 (U = 346.5, p = 0.335). Lastly, a significant difference in WASO (in minutes) was also found between the low and high emotion dysregulation groups at visit 1 (U = 535, p = 0.045), where participants with low emotion dysregulation spent significantly less time awake after initially falling asleep (mean rank = 25.8, median = 56.7) compared to those with

high emotion dysregulation (mean rank = 34.8, median = 68.6), but this did not persist at visit 2 (U = 470, p = 0.236) or visit 3 (U = 511, p = 0.105). See Table 2 for Mann Whitney U and Table 3 for t-test results, and Figures 1-6 for illustrations of these results via boxplots.

Table 2.

Mann-Whitey U tests of High and Low Emotion Dysregulation in relation to Sleep variables across Visits (i.e., 3rd trimester, 1-3 and 6-12 weeks postpartum).

Variable (Visit)	Low ED Median (IQR)	High ED Median (IQR)	Low ED Mean Rank	High ED Mean Rank	*U* value	*p* value
PSQI (1)	8 (4)	1 (4.25)	36.9	24.3	586	0.004**
PSQI (2)	8 (4)	9 (4)	25.8	34.7	532.5	0.048*
PSQI (3)	7 (3.5)	9 (3)	23.3	38.3	584.5	0.001***
SOL (1)	12.8 (7.1)	11.3 (9.5)	30.1	28.6	386.5	0.740
SOL (2)	10.1 (4.2)	10.9 (7.2)	29.8	29.1	398.5	0.974
SOL (3)	10.2 (7.1)	11.7 (5.8)	29.2	30.3	418.5	0.875
SE (1)	84.1 (5.2)	82.1 (4.3)	33.4	24	275	0.036*
SE (2)	80.2 (4.3)	79.7 (4.3)	31.6	26.5	336	0.339
SE (3)	83.8 (4.3)	82.9 (2.4)	31.3	26.9	346.5	0.335
WASO (1)	56.7 (24.2)	68.6 (30)	25.8	34.8	535	0.045*
WASO (2)	81.7 (31.8)	89 (35.1)	27.7	32.1	470	0.236
WASO (3)	60 (28.9)	66.6 (12.5)	26.5	33.8	511	0.105
Awakenings (1)	25.1 (11.5)	29.2 (10.4)	26.1	34.3	522.5	0.071
Awakenings (2)	22.1 (6.1)	22.7 (7.8)	28.7	30.7	436	0.526
Awakenings (3)	21.1 (7.5)	24.2 (7.4)	27	33	492	0.187

Note: Emotion Dysregulation data only available at first visit. 34 participants in Low, and 24 in High categories (n = 58). ***p < 0.05, **p <0.01, ***p <0.001.
Abbreviations: ED = emotion dysregulation, IQR = interquartile range, PSQI = pittsburgh sleep quality index, SOL = sleep onset latency, SE = sleep efficiency, WASO = wake after sleep onset.
Variable units: PSQI as a score, SOL and WASO are presented in minutes, SE as a percentage, and Awakenings as an amount of times.

Table 3.

Independent t-tests of High and Low Emotion Dysregulation in relation to Total Sleep Time (in hours) across Visits (i.e., 3rd trimester, 1-3 and 6-12 weeks postpartum).

Variable	Visit	ED Category	Mean (SD)	df	*t* value	*p* value
TST	1	Low	7.42 (0.79)	56	-1.915	0.060
TST	1	High	7.01 (0.83)			
TST	2	Low	6.82 (1.07)	55	0.080	0.935
TST	2	High	6.85 (1.09)			
TST	3	Low	7.16 (0.83)	56	0.344	0.731
TST	3	High	7.24 (0.90)			

Note: Emotion Dysregulation data only available at first visit. 34 participants in Low, and 24 in High categories (n = 58). Tests were not significant.
Abbreviations: TST = total sleep time, ED = emotion dysregulation, SD = standard deviation.

Figures 1-6*:* Boxplots displaying the distribution of sleep variables across visits for Low and High Emotion Dysregulation groups. Abbreviations: Pittsburgh Sleep Quality Index (PSQI), Total Sleep Time (TST), Sleep Efficiency (SE), Wake After Sleep Onset (WASO), Sleep Onset Latency (SOL), Emotion Dysregulation (ED).

Figure 1:

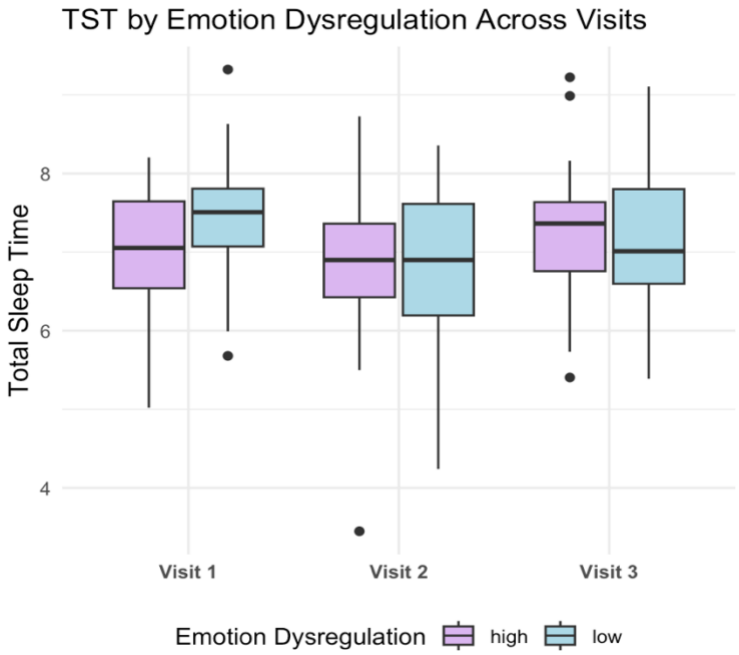


Figure 2:

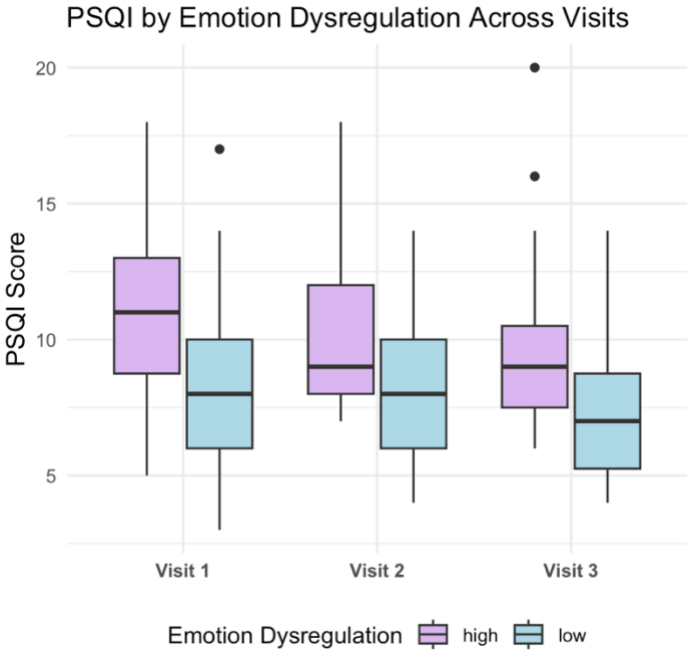
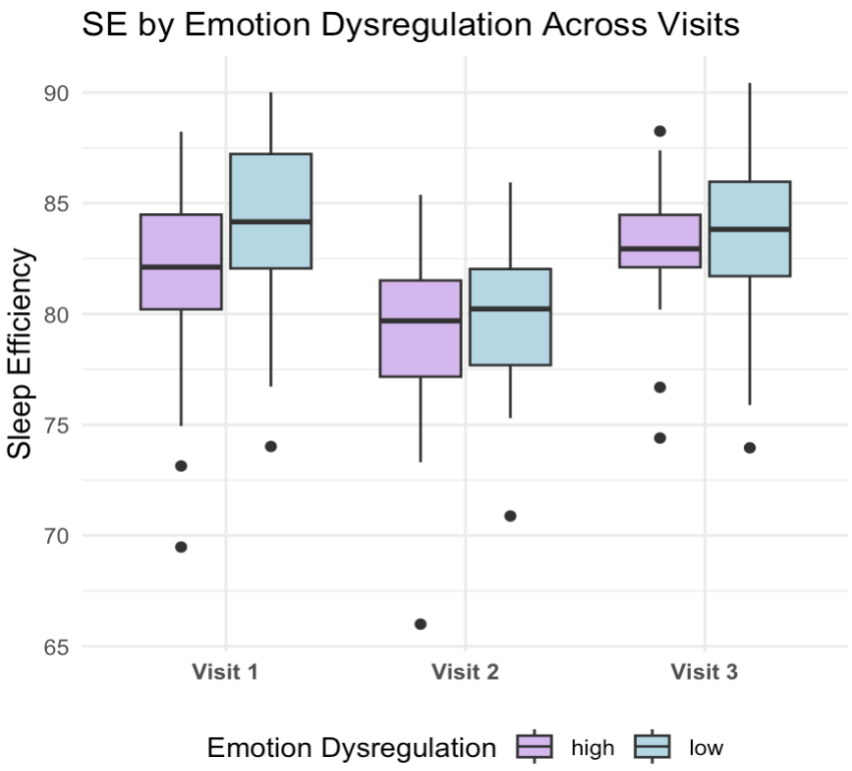


Figure 3:



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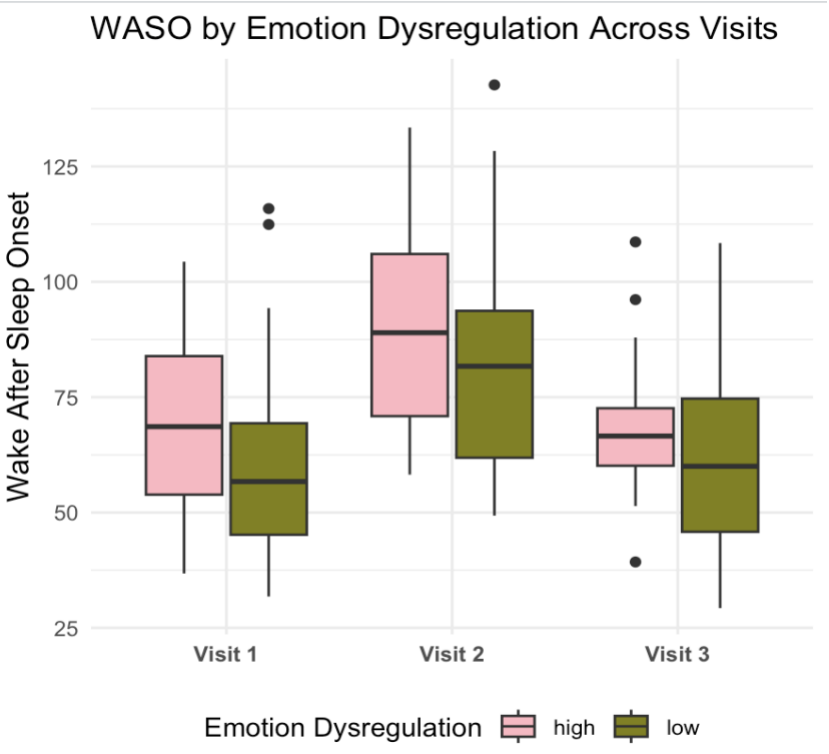


Figure 5:

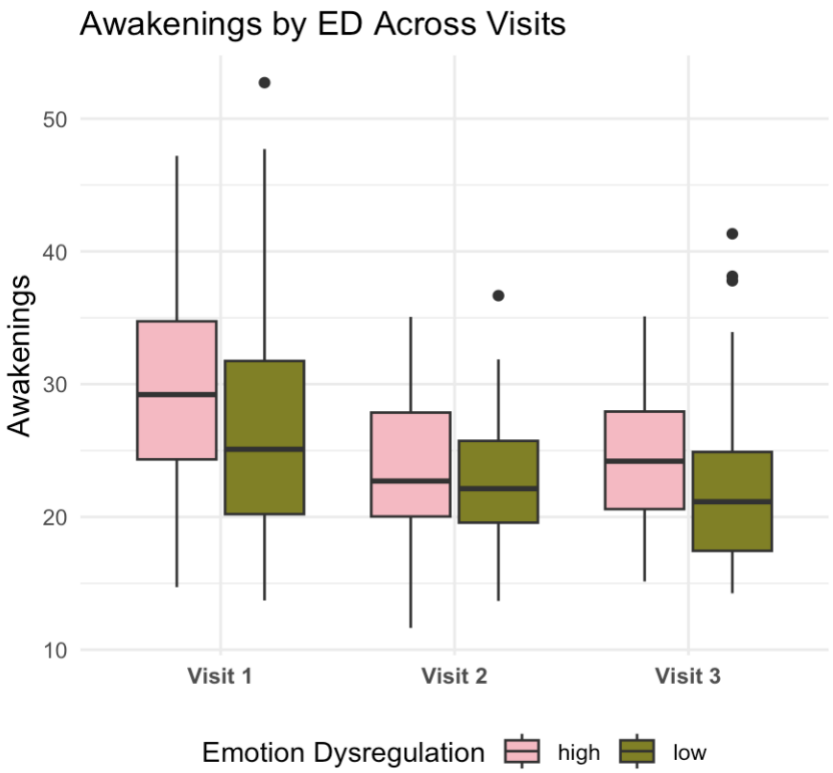
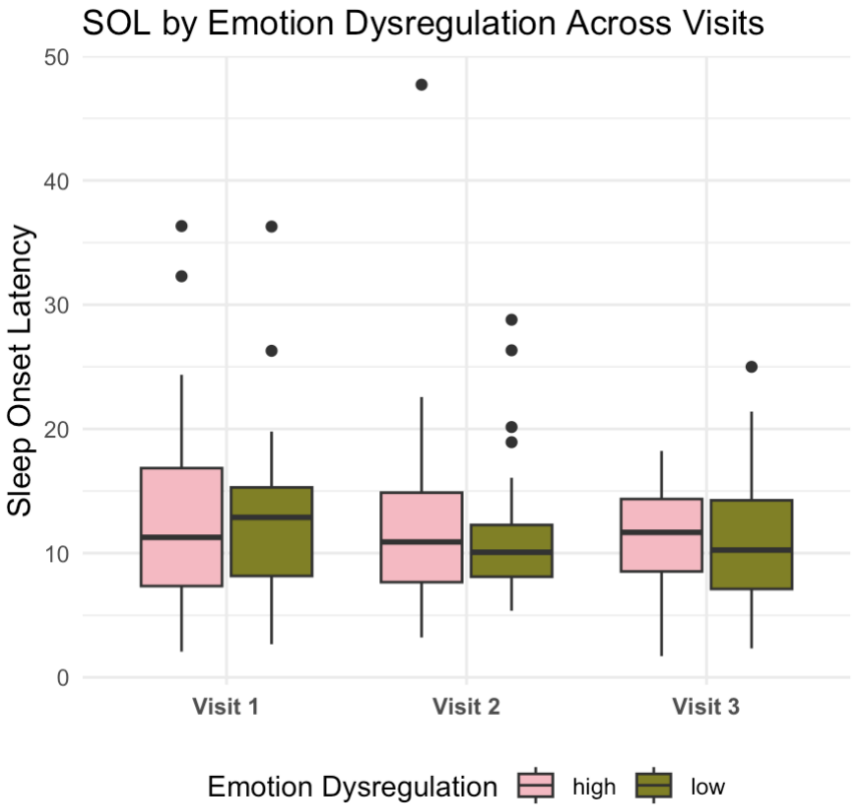


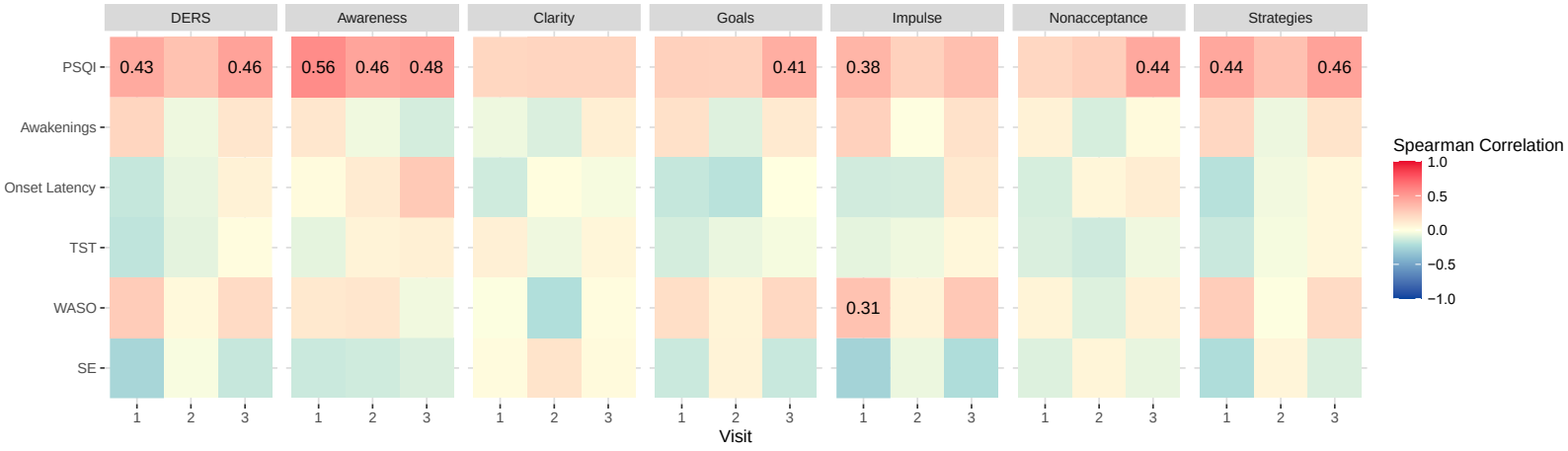
Figure 6:



The Relationship Between Dimensions of Emotion Dysregulation and Sleep Variables

Spearman rho correlations were employed to explore the relationship between subscales of the DERS (i.e., nonacceptance, goals, impulse, awareness, strategies, and clarity) and all subjective and objective sleep variables, with the use of an FDR correction for multiple comparisons. Correlations that survived this correction are reported with the uncorrected p values below. There was a significant positive relationship between subjective sleep quality (i.e., PSQI) and awareness at visit 1, $r_s([N(58)\text{-}2]) = .56$, $p < .001$; visit 2, $r_s([N(58)\text{-}2]) = .46$, $p < .001$; and visit 3, $r_s([N(57)\text{-}2]) = .48$, $p < .001$, and with strategies at visit 1, $r_s([N(58)\text{-}2]) = .44$, $p < .001$; and visit 3, $r_s([N(57)\text{-}2]) = .46$, $p < .001$. Significant positive relationships were also found between subjective sleep quality and goals at visit 3, $r_s([N(57)\text{-}2]) = .41$, $p < .001$, impulse at visit 1, $r_s([N(58)\text{-}2]) = .38$, $p = .003$, and nonacceptance at visit 3, $r_s([N(57)\text{-}2]) = .44$, $p < .001$. Overall, objective sleep variables were not significantly associated with any of the DERS subscales, except for impulse with WASO at visit 1, $r_s([N(58)\text{-}2]) = .31$, $p = .016$. See Figure 7 below for a heatmap displaying the significant correlations between DERS subscales and sleep variables.

Figure 7: Heatmap of significant correlations between Emotion Dysregulation dimensions and subjective and objective sleep variables. Abbreviations: Pittsburgh Sleep Quality Index (PSQI), Total Sleep Time (TST), Sleep Efficiency (SE), Wake After Sleep Onset (WASO).



Chapter 3: Discussion

The present study examined differences in sleep outcomes between perinatal participants with high and low levels of emotion dysregulation. This was assessed longitudinally at three time points namely, the third trimester of pregnancy, at 1-3 weeks postpartum, and at 6-12 weeks postpartum. Results of Mann Whitney U and t-tests, supplemented with other calculations, partially supported the hypothesis that participants with increased difficulty with subjective sleep quality and SE (i.e., percentage of time in bed spent asleep) would display a high level of emotion dysregulation across all visits. Results revealed that participants with high emotion dysregulation scored significantly lower in their subjective sleep quality across all three time points. In addition, those with high emotion dysregulation presented with significantly lower sleep efficiency and increased WASO compared to those with low emotion dysregulation, but only in late pregnancy. Awakenings during the night were not notably different between participants with high and low emotion dysregulation at any timepoint. When exploring

associations between facets of emotion dysregulation and sleep variables, Spearman rho correlations revealed significant positive relationships between subjective sleep quality and a lack of emotional awareness across visits, as well as with limited access to emotion regulation strategies, but only at visits 1 and 3. Contrary to hypotheses, subjective sleep quality was not meaningfully associated with a lack of emotional clarity. Notably, the amount of wakeful minutes after sleep onset (WASO) was the only objective sleep variable to be significantly related with any subscales, namely, with impulse control difficulties at visit 1.

Interpretations

The impact of emotion dysregulation on sleep quality has been highlighted outside of the perinatal period (Fisher et al., 2022; Grove et al., 2017; Powell et al., 2021), but had yet to be examined during late pregnancy and early postpartum. While Karami et al.'s (2018) results illustrated a significant relation between subjective sleep quality and maladaptive emotion regulation strategy use, and Kaliush et al. (2022) highlighted the impact of pre-sleep arousal on poor sleep quality in pregnant women, this research focused specifically on access to strategies as a dimension of emotion dysregulation. Thus, the present study extended our understanding by highlighting how overall emotion dysregulation plays an adverse role in sleep quality disruption, beyond what is driven and exacerbated by hormonal, physiological, and lifestyle changes that accompany the perinatal period (Brunton et al., 2015; Polte et al., 2019).

In addition to extending the literature, the significant positive association between subjective sleep quality and limited access to emotion regulation strategies found in the present study supports existing research suggesting that access to strategies may be driving the overall impact of emotion dysregulation on sleep quality (Kaliush et al., 2022; Karami et al., 2018). However, the fact that significant associations between strategies and sleep quality were found

only during visits 1 and 3, while the awareness subscale showed a consistent significant relationship across all visits, highlights the importance of examining other dimensions of emotion dysregulation apart from strategy use. Coupled with findings from previous literature noting the impact of awareness on emotion dysregulation outside of the perinatal period (Grove et al., 2017; Ong et al., 2012), it is possible that research thus far has overlooked the importance of other dimensions, particularly a lack of emotional awareness, in the relationship between emotion dysregulation and sleep quality in the perinatal period.

According to Gratz and Roemer (2004), poor emotional comprehension (i.e., awareness) may lead to interpreting emotions as fearful or threatening, which in turn, can lead to engaging in maladaptive strategy use, such as overuse of emotional avoidance or suppression. Given that the awareness and strategies subscales were both significantly related with subjective sleep quality, it is likely that they influence one another as dimensions of the same construct, where emotional awareness is necessary for the implementation of adaptive strategy use.

Nearly half of pregnant women experience poor sleep quality, which progressively worsens throughout the perinatal period, and peaks in the third trimester and the first month postpartum (Sedov et al., 2018; Bei et al., 2012). This decline in sleep quality has not only been linked with an increased risk of preterm birth, cesarean delivery, and prolonged labour, but has also been associated with adverse infant outcomes such as developmental delays and respiratory distress syndrome (Lu et al., 2021; Okun et al., 2011; Naghi et al., 2011; Pravia & Benny, 2020). As such, our results suggest that targeting emotion dysregulation in interventions during this time, and in particular, improving emotional awareness and access to emotion regulation strategies, is crucial for supporting sleep quality and in turn, reducing the risk of adverse health outcomes for both mothers and infants. However, analysis of emotion dysregulation subscales

was correlational, and future research focused on dimensions of emotion dysregulation and sleep quality using a directional analysis is needed.

Overall, the consistent significant differences in PSQI scores between high and low emotion dysregulation groups suggests that the impact of emotion dysregulation on sleep quality is relatively stable across the late pregnancy and early postpartum periods. The mean ranks and medians further suggest that the gap in sleep quality between participants with high and low emotion dysregulation becomes more pronounced over time, where women with high emotion dysregulation reported, on average, the lowest sleep quality and women with low emotion dysregulation reported their best sleep quality from 6-12 weeks postpartum at visit 3. While sleep quality typically worsens throughout pregnancy, and is understandably lowest during the first month postpartum (Bei et al., 2012; Sedov et al., 2018), this is reportedly followed by gradual adjustments and subsequent improvements in sleep challenges thereafter (Matsumoto et al., 2003). As such, the height of sleep quality decline at visit 3 for those with high emotion dysregulation in contrast to the height of improvement for those with low emotion dysregulation highlights how regulation ability may be influencing the trajectories of sleep quality.

As described, effective emotion regulation necessitates the use of psychologically adaptive strategies that, over time, enhance one's ability to emotionally manage similar situations in the future (Gratz & Roemer, 2004). In the context of the present study, noting the significant relation of access to strategies found, it is possible that women with low emotion dysregulation, who presumably have greater access to adaptive emotion regulation strategies, may improve in their sleep quality over time as they gain experience with managing stressors and emotional challenges of the postpartum period in an adaptive way. Conversely, those with high emotion dysregulation may have limited access to emotion regulation strategies or over-rely on strategjes

such as suppression or avoidance (Schuman-Olivier et al., 2020). As relying on these strategies has actually been linked to an increase in the intensity and frequency of emotions that one aims to alleviate (Schuman-Olivier et al., 2020), participants in the high emotion dysregulation group may experience a decline in sleep quality as emotion regulation becomes increasingly difficult with negative emotions arising more frequently in this time of heightened stress and change (Li et al., 2020).

However, it is important to note that emotion dysregulation data was only collected during the first study visit, and as such, it can only be speculated that worsened emotion dysregulation may be driving the reduction in sleep quality scores for those in the high group and improvement of those in the low group over time. Additionally, differences in scores were not drastic, and the influence of other factors, such as variability in mental health (Falah-Hassani et al., 2017), support systems, or infant sleep patterns (Falah-Hassani et al., 2017) may also be contributing to this finding. Future research is needed to investigate this in more depth, particularly focused on controlling for these factors, collecting emotion dysregulation data at each timepoint, and extending observations beyond the early postpartum period to discern if trajectories of sleep quality persist.

While significant differences in subjective sleep quality persisted across visits, this was not the case for any objective sleep variables over time, apart from those in the high emotion dysregulation group having a significantly higher WASO and a lower SE at visit 1. This significance at visit 1 supports the findings of previous research regarding SE; Kaliush et al. (2022) found that pre-sleep arousal for participants with limited access to emotion regulation strategies significantly predicted low sleep efficiency in pregnant women during their third trimester. These investigations were not extended into the postpartum period, however, SE has

been identified as the objective sleep outcome that most closely resembles and is predictive of subjective sleep quality (Pierson-Bartel & Ujma, 2024). As such, coupled with the meaningful findings for subjective sleep quality across visits in the present study, it is surprising that SE did not also remain significantly different between emotion dysregulation groups into the early postpartum period.

While this may indicate that the relationship between emotion dysregulation and sleep efficiency diminishes over time, it is possible that a significant difference would have presented if emotion dysregulation data had been collected across the three visits. Given that the risk of emotion dysregulation increases in the postpartum period (Grolleman et al., 2023), it is likely that it would have worsened throughout visits. With the presence of this data, it is possible that significant differences would have persisted longitudinally, and that it would provide a more accurate view of emotion dysregulation's impact on sleep efficiency. Alternatively, it is also possible that the lack of statistically meaningful difference at visits 2 and 3 is due to the hormonal/physiological and lifestyle changes that precipitate the height of sleep disturbance in the early postpartum period (Hashmi et al., 2016; Micheli et al., 2011; Bei et al., 2012), such as adjusting to caring for a newborn and attending to, on average, up to seven infant awakenings during the night in the first year (Acebo et al., 2005). The practical severity of sleep disturbance may actually overshadow the impact of emotion dysregulation, where all participants, regardless of their level of emotion dysregulation, would experience comparable levels of sleep difficulties, leading to less variability in results. However, it is possible that once hormones begin returning to typical levels (i.e., around 3-6 months; Schiller et al., 2015) and women begin adjusting to these lifestyle changes, that the influence of emotion dysregulation would become more apparent, revealing significant differences later on. This may also explain why the strategies

subscale was significantly related to subjective sleep quality at all timepoints except during the first month postpartum, where regardless of access to adaptive or maladaptive strategies, participants presented with less variable, and inevitable levels of reduced sleep quality.

It is crucial for future research to extend past the early postpartum period to explore whether the impact of emotion dysregulation on objective sleep becomes more detectable as the initial disruptions decrease and more typical patterns of sleep resume. Nevertheless, findings from the present study ultimately suggest a significant influence of emotion dysregulation on objective sleep during the third trimester of pregnancy, which may persist, however subtly, into the early postpartum period. Thus, addressing emotion dysregulation in interventions and supports during this period remains essential for improving sleep outcomes, and consequently, for promoting maternal-infant wellbeing.

Similar to the findings of SE, participants with high emotion dysregulation only experienced significantly greater difficulties with WASO at visit 1. As mentioned, increased sleep difficulties due to other factors may be reducing variability between groups and overshadowing the impact of emotion dysregulation on SE. This may be especially relevant to explain the absence of a significant difference in WASO in the early postpartum periods. Infant care needs during the night would necessitate spending increased time awake after initially falling asleep irrespective of emotion dysregulation, whereas emotion dysregulation may play a more significant role in increasing time spent awake at night during the third trimester where there may be less uniformity in sleep disturbances.

While this may explain the absence of a significant difference in the early postpartum periods, it is interesting that WASO was significantly higher for those with high emotion dysregulation during the third trimester, whereas awakenings was not. This suggests that emotion

dysregulation is linked to difficulties with falling back asleep once awakened. According to Kahn et al. (2013), emotions can activate the stress system which leads to a state of alertness that makes it difficult to fall asleep. The hormonal fluctuations and physical discomfort experienced during late pregnancy (Hashmi et al, 2016; Bei et al., 2012) can lead to increased awakenings overall. However, participants in the low emotion dysregulation group, who presumably possess a better ability to regulate effectively in response to intense emotions that might be felt upon waking (Li et al., 2020) and in response to the stress of waking itself, may be able to transition out of a state of alertness more easily and thus spend less time awake after initially falling asleep.

While directionality cannot be discerned, the impulse subscale was significantly associated with WASO at visit 1, suggesting that impulse control difficulties in those with high emotion dysregulation may have contributed to increased time spent awake as compared to those with low emotion dysregulation. Though understudied in the perinatal period, literature has established the adverse impact of impulse control difficulties on sleep via heightened arousal (Dahl & Lewin, 2002; Bauducco et al., 2019). In the context of the present study, participants with high emotion dysregulation, and subsequently, with greater impulse control difficulties, may have reacted more intensely to waking during the night, and this heightened reactivity could have prolonged the transition from alertness to sleep. It is also important to note that the level of practical support one has to assist with infant care during the night may influence not only the number of awakenings in general, but also stress levels upon waking, and could thus impact the ease with which one is able to fall back asleep. Future research should explore how support systems may alter the relationship between emotion dysregulation and sleep difficulties in the perinatal period.

Consistent with previous literature, results revealed a discrepancy between subjective and objective measures of sleep (Palmer et al., 2017; Cudney et al., 2022). Subjective sleep quality was the only variable significantly different between emotion dysregulation groups across all visits; SE and WASO only displayed significance differences at visit 1. However, apart from TST at visit 1 and SOL at visits 1 and 2, objective sleep variables indicated greater sleep challenges for participants with high emotion dysregulation at all timepoints. While this should be interpreted with caution, this trend may indicate that despite the absence of significant findings, emotion dysregulation did in fact influence objective sleep difficulties as a whole in the study. Given the significance found for sleep quality, this would also support the idea that participants were accurately reporting their subjective experience with sleep challenge.

Some researchers have suggested that subjective and objective measures of sleep are measuring different constructs (Watling et al., 2017; Bower et al., 2010; Franzen et al. 2008; Palmer et al., 2017). Watling et al. (2017) also suggest that reporting bias accompanying subjective measures may exaggerate the gravity of sleep disturbance present, and as such, objective measures are crucial to gain a more accurate presentation of sleep challenges. Providing a different perspective, Ballot et al. (2021) found that perceived sleep difficulties (i.e., PSQI) actually impacted objective sleep in participants with insomnia. Supporting this link between subjective and objective measures, researchers Pierson-Bartel and Pryzemyslaw (2024) found that objective sleep quality was accurately reflected in subjective ratings of sleep.

In the context of the present study, the overall trend of greater objective sleep difficulties among those with high emotion dysregulation suggests that subjective and objective sleep measurements are in fact interrelated and linked to emotion dysregulation. While the relationship with emotion dysregulation exists for both, the subjective measure is potentially better able to

display it. It is also possible that while both objective and subjective sleep difficulties are influenced by emotion dysregulation, what matters most is how participants feel about their sleep, rather than the level of difficulty they are actually experiencing.

Limitations and Future Directions

While this study provides novel insights into the relationship between emotion dysregulation and subjective and objective sleep difficulties through late pregnancy to early postpartum, these insights are limited by the absence of emotion dysregulation data across all visits. As emotion dysregulation was not a primary focus in the larger study (Slyepchenko et al., 2022), participants were only administered the DERS at visit 1. Given the added stress of caring for an infant and transitioning into the parenting role, research has found that the risk of emotion dysregulation is heightened in the early postpartum period (Biaggi et al., 2016; Polte et al., 2019). As such, it is possible that emotion dysregulation could have worsened from pregnancy to 1-3 and 6-12 weeks postpartum.

This could influence the results by amplifying the differences in sleep difficulties between those with high and low emotion dysregulation across the postpartum period. As previously theorized regarding access to adaptive strategies, those with high emotion dysregulation might experience more pronounced sleep disturbances over time, and conversely, those with low emotion dysregulation might demonstrate more improvement in sleep earlier in postpartum. It is possible this increased variability in emotion dysregulation across visits would have revealed significant differences in sleep outcomes between groups, beyond what was detected in this study for objective measures. Future research is necessary to replicate study procedures with the addition of collecting emotion dysregulation data across timepoints to discern whether this alters results.

Additionally, while this study revealed how DERS dimensions relate to subjective and objective sleep difficulties longitudinally in the perinatal period, these results were correlational, limiting our ability to make directional inferences. While it is likely that limited access to emotion regulation strategies, for example, impacts subjective sleep difficulties, it is also possible that sleep difficulties impact our ability to access or implement such strategies (i.e., reduced cognitive resources; Zamore & Veasey, 2022). In actuality, associations are likely bidirectional. However, employing directional analyses is needed to gain further insight into the potential direction of these relationships in late pregnancy and early postpartum.

Another critical avenue for future research is to extend these analyses across the entire postpartum period. Given that emotion dysregulation can lead to a reduction in supportive parenting (Morelen et al., 2014), gaining insights into the effect of emotion dysregulation on maternal sleep further into postpartum is crucial. As parenting dynamics evolve, emotion dysregulation can continue to adversely impact maternal sleep, further exacerbating sleep difficulties and creating a cycle that has detrimental implications for parenting quality and subsequently, child development. Interventions and supports are often concentrated on major life stages like pregnancy and early postpartum, however, these supports may continue to be necessary after these periods have passed. Understanding how emotion dysregulation and sleep relate further into the postpartum period can help in designing more comprehensive interventions that address ongoing mother-infant needs and support healthy development.

Given that the initial study examined the impact of changing sleep on mood and anxiety symptoms, the majority of participants had histories of either bipolar or major depressive disorder, or had a current or past anxiety disorder. While all participants were euthymic for depression and mania at study enrollment, the sample is ultimately characterized by mental

health difficulties that were not possible to control for given the non-parametric nature of the data and the analysis used. It is possible that the relationship between emotion dysregulation and sleep in the present study is being impacted by participants' mood and anxiety symptoms, and future research that controls for the impact of mental health symptoms in perinatal women should be conducted. Additionally, while this study advanced an understudied area of perinatal health research, findings may only be generalizable to women with histories of and current difficulties with mood and anxiety. However, given that the prevalence of mental health challenges is heightened in the perinatal period, with up to one in five pregnant and one in four postpartum women experiencing anxiety (Kendig et al., 2017; Shorey et al., 2018; Fawcett et al., 2019), participants in the present study are representative of a large percentage of perinatal women. Nevertheless, future research should examine if the relationship between emotion dysregulation and sleep changes in perinatal women without histories of mental health difficulties, though it is possible that they would develop during the course of the study.

Another important limitation to note is the use of the DERS as a self-report measure of emotion dysregulation. It is possible that participants did not accurately report on their perceived level of emotion dysregulation, which could have impacted results. As such, future research measuring emotion dysregulation using experimental paradigms would be useful.

Another potential future direction is to conduct the present study's analysis using a state-dependent measure of emotion dysregulation from late pregnancy to early postpartum. State dependent measures of emotion dysregulation are well-suited to capture how emotion dysregulation may fluctuate over time based on a variety of factors, such as in response to trauma or heightened periods of stress (Lavender et al., 2015). Given that up to a third of women rate their delivery as psychologically traumatic (Ayers et al., 2001), with an incidence of over

19% for developing Posttraumatic Stress Disorder after a traumatic birth experience (Lai et al., 2022), it is possible that emotion dysregulation levels and processes would change from the third trimester of pregnancy to early postpartum. As well, given the intense fluctuations in emotions, mood states, and stress levels in the perinatal period (Schiller et al., 2014; Li et al., 2020), measuring emotion dysregulation using state-dependent measures may be an important consideration to accurately capture its impact on sleep. While using a state-dependent measure of emotion dysregulation to capture changes over time is an interesting future direction, use of the DERS in the present study, a trait-dependent measure, is acceptable as it was only captured at the first timepoint; trait-dependent measures of emotion dysregulation are designed to assess how one perceives their ability to regulate in general, which is thought to be stable over time (Gratz & Roemer; Daniel et al., 2023).

Conclusion

Overall, the present study provides support for the differential influence of high and low emotion dysregulation on subjective and objective sleep difficulties across the third trimester of pregnancy to 1-3 and 6-12 weeks postpartum. More specifically, Mann Whitey U and t-test analyses, coupled with means, medians, and mean ranks, suggest trends towards those with high emotion dysregulation displaying significantly greater subjective sleep difficulties at all timepoints, as well as significantly greater objective difficulties with sleep efficiency and with spending time awake after sleep onset during late pregnancy. Correlational analyses revealed that the awareness subscale was significantly associated with subjective sleep quality across visits, along with the strategies subscale in late pregnancy and from 6-12 weeks postpartum. With its use of a longitudinal design and inclusion of subjective and objective measures of sleep, this study provides novel insights into the emotion dysregulation – sleep relationship perinatally, and

contributes to addressing large gaps in women's health research. As combined emotion dysregulation and sleep challenges can have adverse impacts on maternal wellbeing, parenting, and infant development, understanding this relationship is crucial for optimally informing interventions and supports during this time.

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