IMPROVING UNDERSTANDING AND DETECTION OF POSTPARTUM ANXIETY

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Background: Maternal mental health conditions are the most common complications in the postpartum period (Luca et al., 2019; US Preventive Services Task Force et al., 2019). Recognition that postpartum anxiety (PPA), anxiety during the post-partum period, is more prevalent than postpartum depression (PPD), and its significant impacts on maternal and infant outcomes, has raised interest in improving its detection (Accortt & Wong, 2017; Fairbrother et al., 2016; Fawcett et al., 2019). Yet, detection challenges remain including lack of diagnostic criteria for PPA (Jordan & Minikel, 2019; Zappas et al., 2020), difficulties differentiating between levels of anxiety (e.g., adaptive worry after childbirth, generalized anxiety, and postpartum-specific anxiety) (Howard & Khalifeh, 2020; Lorenzo, 2022; Zappas et al., 2020), and lack of consensus for a PPA-specific screening tool (Thorsness et al., 2018; Zappas et al., 2020). A better understanding of the course and temporal patterns of PPA, such as severity and influencing factors over time, is warranted to improve detection of PPA. Also, more descriptive research is needed to expand understanding of anxiety in postpartum contexts which may help to further delineate postpartum-specific anxiety from generalized anxiety and aid in detection and clinical management of the condition.

Purpose: To describe the prevalence, stability, trends, and context of anxiety from the 3rd trimester of pregnancy (e.g., 27 to 40 weeks of pregnancy) to eight-weeks postpartum using multiple measurement modalities. Modalities included questionnaires to assess mood and ecological momentary assessments (mEMA) asking participants to rate daily anxiety levels and respond to open-ended mEMA questions guided by the Theory of Becoming a Mother (Mercer,

2004). Qualitative findings were compared between those with and without anxiety at eight-weeks postpartum and integrated with quantitative findings in a narrative synthesis.

Sample and Setting: A convenience sample of 73 birthing people who planned to give birth to their infants at a large academic tertiary center in the Mid-Atlantic U.S. were enrolled. Study activities were performed remotely between August 2021 to March 2022.

Methods: The study used a prospective, mixed-methods, cohort design for the purpose of development (i.e., mEMA daily anxiety ratings were used to develop a stratified sampling plan for the qualitative mEMA responses), and for the purpose of expansion (i.e., anxiety questionnaires were used to develop categories of participants by presence of anxiety). The State Trait Anxiety Inventory, State Scale (STAI-S) and Postpartum Specific Anxiety Scale (PSAS) were administered at baseline (3rd trimester, STAI-S only), one-, and eight-weeks postpartum. mEMA prompts were sent to participants to rate their daily anxiety on a scale of 0, "not at all" to 10, "very much so" and respond to open-ended questions regarding perceived stress, social support, role adjustment, environment, and source of daily anxiety. Established cut-off scores for anxiety on the STAI-S and PSAS were used to determine anxiety prevalence at each study timepoint using descriptive statistics. Stability of the STAI-S and PSAS was evaluated with a dependent samples t-test and repeated measures analysis of variance. Linear mixed modeling was used to evaluate trends in individuals' daily anxiety ratings. The mode and variance of daily anxiety ratings for participants who returned ≥ 50% of mEMA prompts were used to stratify participants into four groups, from which 50% of the cases in each group were randomly selected for subsequent qualitative analysis (N = 34). Qualitative data were analyzed using qualitative descriptive methods and a theory-driven coding framework. Participants' responses were organized into thematic-categories and major concepts. Eight-week STAI-S and PSAS scores were used to categorize participants by presence

of anxiety based on established cut-off scores for anxiety (> 40 and > 112), respectively. Thematic-categories between anxiety classifications were compared using matrices, a joint display, and narrative synthesis to expand understanding.

Findings: In our sample of mostly white (81%), partnered (90.4%), and highly educated (≥ graduate degree, 75%) people, mean STAI-S anxiety scores were significantly higher [$F(1.85, 129.18) = 4.305$, $p = 0.018$] at one week postpartum (36.4 ± 11.0) than at eight-weeks postpartum (33.4 ± 9.6). Mean PSAS scores were significantly higher [$t(70) = 3.047$, $p = 0.003$] at eight-weeks postpartum (93.9 ± 20.7) than at one-week (88.6 ± 19.6). The proportion of the sample above the cut-off for anxiety on the STAI-S (> 40) in descending order was greatest at one-week postpartum (28.8%), lower at eight weeks (23.9%), and lowest at baseline (3rd pregnancy trimester) (21.9%). The proportion above the cut-off for anxiety on the PSAS (> 112) in descending order was greatest at eight-weeks (21.1%) and lowest at one-week postpartum (12.3%). The proportion who met anxiety thresholds on either the STAI-S or PSAS was greater at eight-weeks (35.2%) than one-week postpartum (31.5%). Only 33% of the sample's responses for daily anxiety ratings between one- to eight-weeks postpartum (968/2936) indicated no level of daily anxiety (e.g., 0). Aggregated mean daily anxiety ratings were highest at two-weeks, declined and stabilized, then trended upward toward week eight postpartum, $t(65.56) = 2.15$, $p = 0.036$, 95% CI, [0.000034, 000944]. Individuals who met cut-offs for anxiety at eight-weeks postpartum described feeling more overwhelmed, having less support, experiencing more relationship conflict, difficulty adjusting to maternal roles, and having less positive environmental influences than those without anxiety. Further, there were qualitative differences between participants with anxiety per the STAI-S and anxiety per the PSAS. Specifically, participants with anxiety per the PSAS alternated between feeling able to "manage" their responsibilities and "overwhelmed" by their

responsibilities over the study period. Alternatively, participants with anxiety per the STAI-S consistently reported feeling overwhelmed. Regarding support, participants with anxiety per the PSAS reported task-related support in the early weeks postpartum that declined as the time from birth lengthened, while participants with anxiety per the STAI-S consistently described lack of support. Further, individuals with anxiety per the PSAS reported relationship conflict more often and described daily sources of anxiety (e.g., infant-related concerns and return to the workplace) that were different than daily sources of anxiety per the STAI (e.g., self-health, finances, and partner work/travel). Participants with anxiety based on either questionnaire shared similar response patterns for perceived stress, social support, and role adjustment. Regarding environmental influences, participants with anxiety per the STAI-S often mentioned the negative influences of fatigue, deficient support systems, infant temperaments, and/or other children's needs. Alternatively, participants with anxiety per the PSAS reported similarly negative environmental influences from relationship conflict and deficient support as those with anxiety per the STAI-S or both the STAI-S and PSAS, but also recounted more positive influences from socialization opportunities that the other categories of anxiety did.

Conclusions: Our study found that mean anxiety scores decreased from one- to eight-weeks postpartum per the STAI-S, but increased from one- to eight-weeks postpartum per the PSAS. These findings suggest postpartum-specific anxiety may worsen as the time from birth lengthens. Our findings also corroborate reportedly high anxiety prevalence at eight-weeks postpartum, where per the STAI-S, 23.9% of the sample had anxiety and per the PSAS, 21%. Although more participants met the cut-off for anxiety per the STAI-S at eight-weeks postpartum, consideration should be given to the potential that STAI-S scores were falsely inflated, as instrument items were developed to measure somatic symptoms in general and not postpartum populations (Infante-Gil

et al., 2022; Meades & Ayers, 2011; Spielberger et al., 1983). Daily anxiety ratings showed that anxiety is a shared experience across the postpartum; for most peaking at two-weeks, declining and stabilizing, then trending upward toward week eight postpartum. However, for some, daily anxiety ratings increase more dramatically as the time from birth lengthens. Responses to theory-driven mEMA questions offered qualitative validation for existing assumptions regarding relationships between high perceived stress, low social support, relationship conflict, and maternal role adjustment and provide possible new directions for anxiety detection strategies (e.g., assessing presence of relationship conflict, negative environmental influences, or sources of anxiety). Future studies should explore the course and stability of anxiety beyond eight-weeks postpartum, the influence of other participant characteristics on anxiety (e.g., demographics, obstetrical history, presence of pregnancy or birth-related complication), and the relationship between postpartum-specific anxiety and generalized anxiety in postpartum populations.

TABLE OF CONTENTS

PREFACE ..... **XVI**

1.0 INTRODUCTION **1**

1.1 SPECIFIC AIMS **3**

1.2 BACKGROUND, SIGNIFICANCE, AND INNOVATION **5**

1.2.1 Background **5**

1.2.2 Significance **10**

1.2.3 Innovation **11**

1.3 PRELIMINARY STUDIES **12**

1.3.1 Study 1: The Concept of Postpartum Anxiety **12**

1.3.2 Study 2: Usability Testing of SMS-Qualtrics Survey Interface for Daily Mood and Behavior Monitoring in Postpartum Women **13**

1.3.3 Study 3: Trait Anxiety Between the Antepartum and Postpartum Periods **14**

1.3.4 Study 4: Prevalence, Predictors, and Comorbidity of Postpartum Trait Anxiety **17**

1.4 RESEARCH DESIGN AND METHODS **19**

1.4.1 Research Design **19**

1.4.1.1 *Theoretical Framework* **22**

1.4.2 Setting **23**

1.4.3 Sample **24**

1.4.4 Recruitment Procedures **25**

1.4.5 Instruments 26
1.4.5.1 Demographic and Patient Characteristics 26
1.4.5.2 Mood Questionnaires 27
1.4.5.3 Daily Ecological Momentary Assessment Surveys 28
1.4.6 Procedures for Data Collection 30
1.4.6.1 Data Collection 30
1.4.6.2 Data Management 32
1.4.6.3 Study Timeline 33
1.4.7 Procedures for Data Analysis 34
1.4.7.1 General Data Screening Procedures 35
1.4.7.2 Descriptive Statistics 36
1.4.7.3 Aim 1 Planned Analysis 37
1.4.7.4 Aim 2 Planned Analysis 40
1.4.7.5 Aim 3 Planned Analysis 41
1.5 POTENTIAL LIMITATIONS AND ALTERNATIVE APPROACHES 43
1.6 PROTECTION OF HUMAN SUBJECTS 45
1.6.1 Breach of Confidentiality 46
1.6.2 Potential for Study Fatigue 46
1.6.3 Potential for Emotional Distress 47
2.0 SUMMARY OF STUDY 48
2.1 DISSERTATION STUDY OVERVIEW 48
2.2 STUDY STRENGTHS AND LIMITATIONS 50
2.3 FUTURE STUDIES AND IMPLICATIONS FOR NURSING 52

3.0 MANUSCRIPT 1: A DESCRIPTIVE EXPLORATORY STUDY OF POSTPARTUM ANXIETY USING MULTIPLE MEASUREMENT MODALITIES 55

3.1 ABSTRACT 55

3.2 INTRODUCTION 56

3.3 MATERIALS AND METHODS 59

3.3.1 Design 59

3.3.2 Sample 60

3.3.3 Measures 60

3.3.3.1 The State Trait Anxiety Scale (STAI) 60

3.3.3.2 The Postpartum Specific Anxiety Scale (PSAS) 61

3.3.3.3 Daily Postpartum Anxiety Rating 61

3.3.3.4 Edinburgh Postnatal Depression Scale (EPDS) 62

3.3.3.5 Sample Characteristics 62

3.3.4 Procedures 62

3.3.5 Statistical Analysis 63

3.4 RESULTS 64

3.4.1 Stability of Anxiety Scores 65

3.4.1.1 STAI-S 65

3.4.1.2 PSAS 65

3.4.1.3 Detection of Anxiety by Questionnaire 66

3.4.2 Daily mEMA Anxiety Ratings 66

3.5 DISCUSSION 67

3.5.1 Limitations 72

3.6 CONCLUSIONS 73
4.0 MANUSCRIPT 2: A DESCRIPTION OF THE EXPERIENCE OF ANXIETY IN THE POSTPARTUM PERIOD 79
4.1 ABSTRACT 79
4.2 INTRODUCTION 80
4.3 METHODS 83
4.3.1 Design 83
4.3.2 Sample and Setting 84
4.3.3 Data Collection Procedures 85
4.3.4 Quantitative Measures 86
4.3.4.1 Sample Characteristics 86
4.3.4.2 Daily mEMA Anxiety Ratings 86
4.3.4.3 Eight-Week Mood Questionnaires 87
4.3.5 Qualitative Theory-Driven mEMA Questions 88
4.3.6 Analysis 88
4.3.6.1 Sample Characteristics 88
4.3.6.2 Daily mEMA Anxiety Ratings 89
4.3.6.3 Eight-Week Mood Questionnaires 90
4.3.6.4 Responses to Theory-Driven mEMA Questions 90
4.3.6.5 Organization of Qualitative Findings by Quantitative Results 91
4.4 FINDINGS 92
4.4.1 Quantitative Results 92
4.4.1.1 Sample Characteristics 92

4.4.1.2 Eight-Week Mood Questionnaires 93
4.4.2 Qualitative Findings 93
4.4.3 Organization of Qualitative Findings by Anxiety Questionnaire Categories 100
4.5 NARRATIVE SYNTHESIS 100
4.5.1 Limitations 106
4.6 CONCLUSION 107
APPENDIX A 118
APPENDIX B 126
APPENDIX C 132
APPENDIX D 141
APPENDIX E 143
APPENDIX F 148
APPENDIX G 150
APPENDIX H 153
BIBLIOGRAPHY 156

LIST OF TABLES

Table 1. Variables and Levels of Measurement 29

Table 2. Planned Sequence of Study Events 32

Table 3. Study Timeline 33

Table 4. Sample Characteristics (N = 73) 74

Table 5. Mood Questionnaire Scores by Timepoint 75

Table 6. Percentage of Participants Above Cut-off from Self-report Mood Scales at Eight-Weeks Postpartum (n=71) 75

Table 7. Linear Mixed-effect Modeling Results of mEMA Anxiety Ratings 76

Table 8. Qualitative mEMA Questions by Concept of Theory of Becoming a Mother 108

Table 9. Characteristics of the Total Sample, Qualitative Subsample, and by Anxiety Questionnaire Category 109

Table 10. Summary of Daily mEMA Anxiety Ratings for the Total Sample and Qualitative Subsample 110

Table 11. Percentage of Sample Meeting Cut-Offs for Anxiety or Depression on Mood Questionnaires at Eight-Weeks Postpartum 111

Table 12. Comparison of Thematic Categories for Perceived Stress, Social Support, Role Adjustment, and Environmental Influence by Anxiety Questionnaire Category 112

LIST OF FIGURES

Figure 1. Research Design 22

Figure 2. Recruitment Actual Accrual Rate 34

Figure 3. Example Panel Plot of Temporal Response Plots 40

Figure 4. Example of Joint Display Illustrating Integration at the Interpretation and Reporting Level 42

Figure 5. mEMA Anxiety Ratings for those >cut-off for anxiety on the STAI-Sa, PSASb, or neither questionnaire at Eight-Weeks Postpartum 77

Figure 6. Predicted Individual Trajectories (solid lines) and Average Trajectory (dashed line) for Daily Anxiety Rating based on mEMA from One to Eight-Weeks Postpartum 78

Figure 7. Sequence of Data Collection and Analyses 114

Figure 8. Selected Panel Plots of Daily Anxiety Ratings by Group 116

Figure 9. Thematic-Categories of Anxiety Per Anxiety Questionnaire Categories 117

PREFACE

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1.0 INTRODUCTION

Postpartum anxiety (PPA), anxiety during the postpartum period, is increasingly recognized as more prevalent than postpartum depression (PPD), occurring in up to twenty percent of birthing mothers after birth (Anokye et al., 2018; Dennis, Falah-Hassani, et al., 2017; Fawcett et al., 2019; Gavin et al., 2005). Yet diagnostic guidelines continue to focus on perinatal depression (American College of Obstetricians and Gynecologists (ACOG), 2018), which has taken historical precedence in clinical settings (Dennis, Falah-Hassani, et al., 2017; Matthey et al., 2003). Insight into this discordance is urgent, given that PPA and PPD are the most common complications reported after childbirth (US Preventive Services Task Force et al., 2019). Evidence confirms that PPA is associated with maternal distress, problems with daily functioning (Dennis, Brown, Falah-Hassani, et al., 2017; Goldfinger et al., 2020), increased difficulties breastfeeding and infant bonding (Hoff et al., 2019; Tietz et al., 2014) and increased risk for offspring emotional or temperament issues (Petzoldt et al., 2016; Polte et al., 2019). Varied approaches to PPA definition and measurement likely contribute to ambiguities in professional guidelines. Without a clear understanding of PPA, professional organizations are unable to offer specific recommendations for clinical detection. In other words, wide-ranging definitions and measurement strategies undermine what is currently known about PPA and prevent meaningful translation of research into practice.

Complicating research efforts is the question of whether mental health conditions experienced in the perinatal period are distinct from those at other times in the lifespan (Howard & Khalifeh, 2020). While detection of postpartum mood disturbances often occurs through self-report questionnaires (Falah-Hassani et al., 2017) or diagnostic interviews (Fawcett et al., 2019), neither of these strategies were developed for PPA, nor is there consensus on a screening tool for PPA detection (Zappas et al., 2020). Specifically, research studies using diagnostic interviews expose shortcomings in existing "anxiety disorder" constructs when applied to PPA (Delaney et al., 2015; Phillips et al., 2009; Amy Wenzel et al., 2005), and preexisting tools commonly used in perinatal mood screening are controversial for PPA detection, as they were developed to measure somatic symptoms of anxiety in general populations that may not be suitable to postpartum individuals (Fairbrother et al., 2019; Infante-Gil et al., 2022). Further, self-report instruments for generalized anxiety do not reflect the nature of worry experienced by postpartum persons (Fallon et al., 2016). To improve detection failures, a better understanding of the daily course and temporal fluctuations of PPA is needed.

To advance current understanding and improve detection strategies for PPA in clinical settings, I will apply mixed research methods using multiple measurement modalities, including self-report questionnaires and novel mobile ecological momentary assessments (mEMA) to assess mood and contextual factors influencing mood. This mixed-methods strategy will provide detailed information regarding the course and variability of PPA and contextual data to better understand the phenomenon within the postpartum context. EMA in the form of mobile-texted survey links will be used to query participants about daily anxiety levels and sources of anxiety. Additional EMA questions will assess elements of participants' mothering experiences, including their perspectives on perceived stress, social support, role adjustment, and environmental influence,

which are all regarded as central components to the "Theory of Becoming a Mother" (Mercer, 2004). This theory and its elements were chosen to ground the research questions and data to the postpartum context. Feasibility, acceptability, and appeal of EMA mobile surveys for evaluation of affective states is demonstrated in general populations (Yang et al., 2019). Further, it has been used in perinatal populations to evaluate breastfeeding behaviors and experiences of racial discrimination in the perinatal context (Demirci & Bogen, 2017b; D. Mendez et al., 2019; D. D. Mendez et al., 2020) (Demirci & Bogen, 2017; Mendez et al., 2019). Recognized for its utility in collecting data on real-time experiences while accounting for the temporality of mood states, EMA offers a distinct way to pinpoint when and what situations contribute to emotional states. In this study, mobile surveys will provide data to help us understand the multi-factorial course of PPA within the conditions and experiences of the perinatal or postpartum period. This knowledge will help delineate the concept from other anxiety constructs, thus informing development of specific screening measures and detection strategies.

1.1 SPECIFIC AIMS

AIM 1. Describe the prevalence, stability, and daily trends of anxiety among birthing people from the 3rd trimester through the first eight weeks postpartum. Mood questionnaires will be administered during pregnancy (3rd trimester) and at one and eight weeks postpartum to determine prevalence and stability of anxiety. EMA prompts will be sent to assess trends in daily anxiety ratings from weeks one to eight postpartum.

AIM 2. Explore birthing mothers' experiences of anxiety from one to eight weeks postpartum. A theory-driven qualitative descriptive analysis of participants' responses to daily EMA survey prompts will be performed to identify thematic-categories of PPA experiences.

AIM 3. Converge the findings from AIM 1 and 2 to explore relationships between anxiety questionnaire (STAI-S, PSAS) scores, anxiety trends (daily EMA surveys), and thematic categories reflective of the postpartum experiences. Findings from Aim 1 (questionnaires and daily EMA surveys) and Aim 2 (thematic-categories) will be integrated using joint displays and narrative synthesis. This technique will permit comparison of findings to expand understanding of PPA.

The proposed study is significant for increasing understanding of the prevalence, trends, and unique experiences of PPA in postpartum persons. Knowledge from this study will help to identify and characterize PPA. Novel usage of EMA surveys will provide data on the daily variation and contextual factors of anxiety levels. The integration of anxiety level trends with participants' perspectives will provide valuable insight into experiences of PPA within parenting contexts. This information can then be used to improve detection strategies for PPA by revealing better ways to directly assess it, identifying factors and experiences that are associated with distress, and the timeframes when PPA is likely to develop.

1.2 BACKGROUND, SIGNIFICANCE, AND INNOVATION

1.2.1 Background

Postpartum anxiety (PPA) is an emerging clinical condition that is increasingly recognized by researchers as more common than its better known counter-part, postpartum depression (Dennis, Falah-Hassani, et al., 2017; Fawcett et al., 2019). These mood conditions represent the most common complications experienced by individuals after childbirth (US Preventive Services Task Force et al., 2019) and comprise $14.2 billion dollars in societal costs when left untreated from birth to five years postpartum (Luca et al., 2019). Recent reviews and meta-analyses provide evidence that PPA occurs in up to 20% of postpartum individuals compared to the ~14% of women with postpartum depression (Fawcett et al., 2019; Shorey et al., 2018). Despite growing acknowledgement of PPA's previously under-appreciated occurrence, many facets of the condition remain unknown. Consequently, there has been a surge of targeted research over the last few years in response to this disparity. Additionally, to underscore the significance of PPA and to spur continued efforts to improve understanding and detection of PPA, clinical organizations, such as the Association of Women's Health, Obstetrics, and Neonatal Nurses (AWHONN) have called for further research to elucidate the course and predictors of perinatal anxiety (Association of Women's Health Obstetric Neonatal Nurses (AWHONN), 2015). Despite mounting scholarly attention, clinical providers remain ill-equipped to recognize and detect PPA in patient-care settings. Their means are hindered by inconsistent definitions for what constitutes PPA as well as lack of a singular PPA-specific diagnostic screening tool (Fallon, Halford, et al., 2016). Expert opinions published in clinical journals recognize these issues, reminding clinicians to be alert for patients with symptoms of PPA and acknowledging that detection and diagnosis

may be challenging (Jordan & Minikel, 2019; Thorsness et al., 2018). While detection and diagnostic strategies for PPD are well established and clinical guidelines prioritize PPD diagnosis (ACOG Committee Opinion No. 757, 2018), little parallel guidance exists for PPA. Ultimately, there is a disconnect between substantial evidence for PPA's significance as a clinical problem and the means for clinicians to define and detect it in patient care settings. Given that PPA is associated with a host of negative outcomes for postpartum persons, children, families, and communities, more research is urgently needed.

Existing definitions of PPA are inadequate for measurement and detection. *One approach to defining PPA is within the context of depression*; this is likely due to some degree of overlap (Reck et al., 2008) and cooccurrence of the disorders (Fairbrother et al., 2015). However, defining PPA in this manner is problematic since PPA and PPD do not cooccur in the majority of cases (Falah-Hassani et al., 2017). Thus, focused screening for only depression misses a proportion of individuals with only anxiety symptoms (Matthey et al., 2003; Nakić Radoš, 2018). Furthermore, the validity of utilizing self-report instruments developed for depression (e.g., Edinburgh Postnatal Depression Scale) in anxiety detection is controversial (Fairbrother et al., 2019; Matthey et al., 2013). Specifically, while some support the presence and usefulness of an anxiety subscale in the EPDS (Matthey et al., 2013; Smith-Nielsen et al., 2021), its authors maintain that it was not developed for anxiety (Cox et al., 1987). Additionally, others have found that the EPDS can neither reliably differentiate anxiety from depression (Fairbrother et al., 2019) nor detect women with anxiety disorders confirmed by diagnostic interview (Rowe et al., 2008). Lastly, studies have also found that the EPDS subscale only moderately correlates with anxiety criteria when compared to the STAI (van der Zee-van den Berg et al., 2019).

The second approach to PPA definition acknowledges that it occurs independently of depression. This perspective considers PPA by its *degree of correlation with generalized anxiety symptoms or diagnostic anxiety disorder criteria*. When defined in this manner, researchers apply diagnostic interviews or self-report questionnaires developed for generalized anxiety to detect PPA (Dennis, Falah-Hassani, et al., 2017; Fawcett et al., 2019). This approach is also controversial. It assumes PPA is analogous to generalized anxiety and thus can be operationalized with the same instruments and diagnostic criteria. Yet, seminal studies found that current diagnostic "anxiety disorder" criteria fail to account for a proportion of women displaying "clinically significant" anxiety symptoms (Delaney et al., 2015; Phillips et al., 2009; Amy Wenzel et al., 2005). As others have pointed out (Fallon et al., 2016), these findings seem to suggest that generalized anxiety and PPA are not necessarily the same construct. The emergence of pregnancy-related anxiety (PrA) as a discrete construct emphasizes the opinion that anxiety during the perinatal period may be dissimilar to anxiety at other times in life (Bayrampour et al., 2016). Specifically, studies found PrA was clinically distinct from generalized anxiety in regards to its attributes, worry content, and associated consequences (Blackmore et al., 2016; Huizink et al., 2004). Further, scores from generalized anxiety and depression scales were found to contribute minimally to the variance in scores on a scale developed to detect PrA, justifying conclusions that PrA is distinct from generalized anxiety or depression (R. Brunton et al., 2019; R. J. Brunton et al., 2015). These findings raise uncertainties about the field continuing to approach PPA anxiety definition and detection as comparable to generalized anxiety; whether that be by correlation to diagnostic anxiety disorders or measurement of PPA using generalized anxiety scales (Dennis, Falah-Hassani, et al., 2017). Consequently, one self-report instrument was specifically developed for PPA, the Postpartum Specific Anxiety Scale (PSAS) (Fallon et al., 2016). Though since its inception, the

PSAS has remained largely unused in research and clinical settings. Thus despite, or perhaps, in light of overt definition and detection ambiguities, clinical guidelines continue to give diagnostic precedence to depression, recommending screening instruments like the EPDS be used in perinatal settings (American College of Obstetricians and Gynecologists (ACOG), 2018; Thorsness et al., 2018). *Ultimately, there is an urgent need for better understanding of PPA as a distinct perinatal health condition, particularly regarding its severity, course, and variability of lived experiences, before recognition, detection, and management can be improved.*

Lack of a consistent definition and measurement strategy for PPA complicates interpretation of research findings, stalling development of tactics to recognize and mitigate the condition. For example, prevalence estimates of PPA range from ~9% (Goodman et al., 2016) to 20% (Fawcett et al., 2019; Nakić Radoš, 2018), depending upon the studies' measurement strategies. While some investigators measured PPA using self-report questionnaires (Dennis, Falah-Hassani, et al., 2017; Nakić Radoš, 2018), recent systematic reviews of PPA prevalence only included studies which used *diagnosed* anxiety disorders (using DSM-IV criteria) (Fawcett et al., 2019; Goodman et al., 2016). These inconsistencies reinforce the previously mentioned point; that the definition for what constitutes "PPA" differs greatly. Identifying predictors of PPA is similarly complicated. Evidence supports relationships between PPA and perceived stress (Britton, 2008; Martini et al., 2015; Matthey et al., 2003; Amy Wenzel et al., 2005), low or absent social support (Chavis, 2016; Dennis, Brown, Falah-Hassani, et al., 2017), maternal sleep issues (Jackson et al., 2014; Lawson et al., 2015), and low maternal education (Britton, 2008; Martini et al., 2015) Yet, findings are mixed concerning the relationship between PPA and parity. Specifically, some studies report multiparous women are at risk for PPA (Furtado et al., 2018), while others report parity is not a significant predictor of PPA (Cena et al., 2021). Other studies suggest temporal variations in

predictors of PPA over the postpartum (PP) period (Dennis, Brown, Falah-Hassani, et al., 2017; Nakić Radoš, 2018). Practice guidelines reflect these uncertainties about PPA, continuing to focus recommendations on PPD (ACOG Committee Opinion No. 757, 2018).

Not surprisingly, most perinatal mental health intervention studies have focused on elucidating treatment strategies for perinatal depression, while similar support strategies for PPA remain scarce (Gennaro et al., 2020; Marchesi et al., 2016; Nillni et al., 2018). The few available intervention studies for perinatal anxiety had several limitations, including reliance on pre-experimental designs (such as open-trials, lack of comparison groups, or no randomization), focus on populations with diagnosed anxiety disorders (e.g., obsessive compulsive disorder, panic disorder, etc.), and small sample sizes (Marchesi et al., 2016; Nillni et al., 2018). Studies which limited the scope of intervention strategies to include only persons *diagnosed* with anxiety disorders are problematic, as they exclude a substantial proportion of women with clinically significant worry who do not meet diagnostic disorder criteria (Delaney et al., 2015; Phillips et al., 2009; A Wenzel et al., 2003). Nevertheless, this small collection of studies found cognitive behavioral therapy interventions for PPA significantly reduced depressive and anxious symptoms in most women (Nillni et al., 2018). Considering individuals' hesitancy towards pharmacological management in the perinatal period (Battle et al., 2013; Gennaro et al., 2020), cognitive behavioral therapies remain the best identified and studied option for PPA management. Thus, the most pressing gap is the lack of understanding of what it means to have "postpartum anxiety," as this directly relates to the ability to measure, detect, prevent, and treat it.

Descriptive research regarding PPA is limited. There is a scarcity of research evaluating the experiences of PPA and its symptoms. This is problematic, as first-hand accounts are needed to inform efforts to define and measure the phenomenon. Consequently, one study found that

women with "maternally focused worry" were indistinguishable from mothers with generalized anxiety disorder (GAD) in terms of anxiety symptoms or severity (Phillips et al., 2009). While these findings helped delineate anxiety from depression, they did not necessarily describe the phenomenon. Alternatively, perhaps the most relevant insight into PPA and its features was offered by Goldfinger et al. (2020). In their study, PPA, defined by GAD diagnosis, was thematically compared to the worry content and frequency of an age-matched non-perinatal sample with GAD (Goldfinger et al., 2020). Interestingly, substantial differences regarding the type of worry experienced across groups were found. Still, this study relied on diagnostic criteria of GAD to build its sample. Thus, gaps remain. The proposed study aims to acknowledge that PPA may be dissimilar to generalized anxiety because of the context in which it occurs. To better understand how anxiety manifests in postpartum individuals within the mothering experience, the "Theory of Becoming a Mother" will be used as an interpretive lens for findings (Mercer, 2004). This study proposes a prospective, mixed-methods design informed by the "Theory of Becoming a Mother" to yield a comprehensive description of how PPA develops and manifests over time as a construct unique to the postpartum context.

1.2.2 Significance

This investigation may have a significant positive impact on the field of perinatal mental health. *To my knowledge, it is the first in-depth, prospective exploration of PPA, offering valuable insight into how the experiences of anxiety relate to the parenting role.* Use of intensive daily repeated anxiety measures as well as the PSAS will provide additional description of PPA's prevalence, stability, and trends (Aim 1). Daily survey questions, informed by the "Theory of Becoming a Mother," will explain how PPA relates to mothering experiences and environments

(Aim 2). Integrated findings (Aim 3) will allow characterization of PPA and determination of which factors and time periods seem most likely to influence its development or exacerbation. Study findings will improve detection efforts and inform targeted interventions.

1.2.3 Innovation

The proposed research is innovative because: 1) It involves the utilization of a relatively *new instrument* specifically developed for PPA (e.g., PSAS (Fallon et al., 2016)) that, to the knowledge of these authors, has not yet been widely used in US populations. 2) This study features *novel mobile-EMA data collection techniques* designed to reflect the temporal and contextual variance in anxiety levels and symptoms in the postpartum period. While mobile-EMA has been recognized for its utility in exploring temporal and contextual characteristics of mood disorders in general populations (Colombo et al., 2019; Walz et al., 2014; Yang et al., 2019), it has rarely been used to understand perinatal mental health conditions, specifically PPA. 3) The prospective, mixed-methods study design will permit integration of data to expand understanding of PPA's occurrence, exacerbation, or cessation as it relates to the postpartum experience and perspectives of postpartum women. Overall, the data collection instruments, strategies, and study design are novel approaches to conducting PPA research. The proposed study will move the frontier of perinatal mental health research forward by providing insight into the anxiety experiences and perspectives of birthing people that will inform PPA detection strategies.

1.3 PRELIMINARY STUDIES

To obtain a better understanding of the state of the science regarding postpartum anxiety in women's health settings, I conducted four preliminary studies that pertain to the phenomenon. Below are abstracts of the studies and plans for dissemination.

1.3.1 Study 1: The Concept of Postpartum Anxiety

Purpose: Clinical observations of postpartum maternal behaviors led to questions about effects of anxiety. Postpartum anxiety (PPA) is not consistently recognized as a distinct concept in research or practice. Comorbidities and mental health disorders cloud conceptual boundaries of PPA, and definition often fails to account for women at sub-diagnostic levels. Descriptive, prevalence, and predictor studies place prevalence of anxiety at 15-20% of women in the peripartum. PPA leads to adverse outcomes for both mothers and infants, yet many gaps remain in this field. The purpose of this review was to 1) explore the characterization of PPA and 2) develop a conceptual definition for PPA to inform research.

Methods: Roger's Evolutionary Method for concept analysis using keywords "anxiety OR anxiety disorders" and "postpartum OR postnatal OR peripartum." Surrogate terms included "worry" and "stress." Inclusion criteria: English, full text, published between 2005-2020. Attributes, antecedents, and consequences of PPA were synthesized.

Results: Analysis of literature led to the following definition: PPA is a range of worries, fears, and physical symptoms severe enough to interfere with a mother's perceived ability to care for herself and family. Symptoms may present at sub-diagnostic levels and ebb and flow in

response to perceived stressors. Timing of onset and presentation is variable. Risk factors that precede PPA may be history of mood disorder and high perceived stress.

Conclusions: PPA is an independent concept that warrants further attention in maternal-child and family research. Future efforts should focus on developing descriptive characteristics of the concept to inform instrument development and enhance concept recognition in this population.

Dissemination: **Hoberg M.**, & Founds S.F., (2020, April 1). The Concept of Postpartum Anxiety (Abstract, Virtual Poster). Sigma Eta Scholars Night, Pittsburgh, PA, United States.

Contribution to Dissertation Work: As this study required an extensive review of the literature, its findings contributed significantly to development of the concept for the dissertation research study. Specifically it helped to identify gaps in PPA literature questions and directions for future inquiry.

1.3.2 Study 2: Usability Testing of SMS-Qualtrics Survey Interface for Daily Mood and Behavior Monitoring in Postpartum Women

Purpose: Mobile ecological momentary assessment (EMA) is an approach to healthcare data collection increasingly used in research settings. While mental health researchers have recognized the benefits of mobile-EMA methods in exploring the temporal and contextual characteristics of mood disorders, these approaches have not been extensively used or evaluated in perinatal populations. Thus, the purpose of this study was to explore the usability and efficacy of a text (SMS)-delivered daily mobile survey to postpartum women. Primary outcomes of interest were the users' perceived ease of use, acceptability of the survey content, and text (SMS) message method.

Methods: This exploratory usability study used a sequential mixed-methods, within-subjects design for the purpose of complementarity. Postpartum women (n = 3) were asked to receive, open, and complete a mobile survey delivered via text (SMS) message for 3 days and complete a daily study activity log. After 3 days, phone interviews were conducted to collect information on participant experiences and opinions. Descriptive statistics and content analysis were used on performance and preference data.

Results: Participants completed 82% of surveys. Length of time for survey completion was ~2 minutes. Time from text receipt to completion was ~7 minutes. Time and location of survey receipt did not overtly affect completion. Content analysis revealed 1) survey burden was low, 2) survey was easy to use, 3) question content was appropriate, and 4) survey was acceptable for longer term use.

Conclusion: Completion of usability tasks had a high success rate. Participant feedback was overwhelmingly positive. Results suggest that text (SMS)-delivered mobile surveys for the ecological momentary assessment (EMA) of postpartum mothers' moods and perspectives is a feasible and acceptable data collection strategy.

Dissemination: No presentations or publications disseminated to date.

Contribution to Dissertation Work: Results of this pilot study provided evidence for the efficacy of the planned data collection method for the dissertation study. Feedback from pilot study participants was used to modify mEMA question structure for readability and ease of use.

1.3.3 Study 3: Trait Anxiety Between the Antepartum and Postpartum Periods

Purpose: Perinatal mood and anxiety disorders are more complex than previously appreciated. Postpartum depression (PPD) is perhaps the most widely studied and the focus of

current clinical guidelines (American College of Obstetricians and Gynecologists (ACOG), 2018; Shorey et al., 2018). Yet, increasing recognition of perinatal anxiety begs appreciation for a more diverse range of mood disturbances in the peripartum, resulting in calls for additional anxiety research (Association of Women's Health Obstetric Neonatal Nurses (AWHONN), 2015). Recent findings suggest perinatal anxiety is a distinct condition in up to one in five women and is more prevalent than PPD (Dennis, Falah-Hassani, et al., 2017; Fawcett et al., 2019; Nakić Radoš, 2018). Yet, heterogeneous measurement and overlapping anxiety constructs complicate current understanding (Fallon et al., 2016). Specifically, the majority of published efforts concern "state" anxiety and "pregnancy-related" anxiety, leaving comparatively little known regarding "trait anxiety" (Dennis, Falah-Hassani, et al., 2017). Thus, a closer examination of trait anxiety in the perinatal population is warranted to delineate overlapping constructs and inform detection and management strategies. *This study's purpose was to: 1) examine trait anxiety prevalence, correlates, and predictors in the perinatal period, 2) describe the relationship of postpartum anxiety with comorbid depressive symptomatology, and 3) explore the course of trait anxiety between the antepartum and postpartum periods.*

Methods: A secondary data analysis was conducted with the third phase of the Pregnancy Exposures and Preeclampsia Prevention longitudinal cohort study (2009-2013). Women completed surveys for trait anxiety (Spielberger Self-Analysis Questionnaire [SPIEL]) and depression (Edinburgh Postnatal Depression Scale [EPDS]) during pregnancy (n=644). A sub-sample of these completed follow-up questionnaires in the postpartum period (n=371). Socio-demographic and obstetric variables were age at childbirth, race, parity, smoking status during pregnancy, past psychiatric history, pregnancy complications, gestational age at childbirth, and admission to neonatal intensive care unit. Cut-off scores >19 on SPIEL and >12 on EPDS were

used to compare mean scores between trait anxiety and depression prevalence. A paired samples t-test compared mean scores between the antepartum and postpartum periods to evaluate temporal stability of trait anxiety. Simple and hierarchical linear regression analyses were applied to identify correlates and predictors of trait anxiety at each time point.

Results: Trait anxiety was highly prevalent in pregnancy (28%) and the postpartum (33%). Antenatal trait anxiety was associated with past mental illness (p<.001), higher antenatal depression scores (p <.001), and smoking during pregnancy (p<.001). Postpartum trait anxiety scores were further associated with preterm birth (p = .02), parity (p = .03), and mood scores in pregnancy (p< .001). Comorbidity of anxiety and depressive symptoms was high antenatally (35%, r = .68, p < .001) and higher in the postpartum (45%, r = .73, p < .001). Trait anxiety scores significantly increased between the antepartum and postpartum periods (p< .001); this increase was partially predicted by parity, gestational age at birth, and antenatal anxiety scores.

Conclusion: Although considered a stable personality characteristic, trait anxiety scores were higher in the postpartum period than antenatally. Increasing prevalence and severity of trait anxiety was associated with several obstetric factors including parity and gestational age at birth. Future detection efforts for anxiety in perinatal populations should screen for both trait and state anxiety. More research is necessary to clarify the relationship between antenatal and postpartum anxiety.

Dissemination: Hoberg, M., Sereika, S., Founds, S.F., (2021). Trait Anxiety Between the Antepartum and Postpartum Periods. Podium session at the 46th Biennial Sigma Theta Tau National Convention, Indianapolis, IN. [Virtual]. (November, 2021).

Contribution to Dissertation Work: Work from this preliminary research study informed the dissertation research by strengthening my familiarity with proposed statistical procedures,

developing my knowledge on the constructs of anxiety (e.g., state vs trait), and familiarizing myself with the process of manuscript development and results dissemination.

1.3.4 Study 4: Prevalence, Predictors, and Comorbidity of Postpartum Trait Anxiety

Purpose: Recent attention and focus on perinatal mood and anxiety disorders have revealed a broad spectrum of mental health conditions affected by childbearing (Association of Women's Health Obstetric Neonatal Nurses (AWHONN), 2015; Howard & Khalifeh, 2020). Whether or not mental health conditions like anxiety, depression, and its subtypes (e.g., obsessive compulsive disorder, post-traumatic stress disorder) are unique to perinatal contexts remains an open question (Howard & Khalifeh, 2020). For decades, postpartum depression has been the focus of perinatal mood research (Dennis, Falah-Hassani, et al., 2017; Matthey et al., 2003). Perinatal anxiety is comparatively under-researched, leaving its constructs poorly understood. "State anxiety," arising from situational stress is investigated most often in comparison with "trait anxiety", which after birth has been minimally researched (Dennis, Falah-Hassani, et al., 2017; Spielberger et al., 1983). Therefore, the purpose of our study was to 1) describe the prevalence of postpartum TA, 2) describe TA's co-occurrence with depressive symptoms, and 3) identify predictors of TA.

Methods: A secondary data analysis was conducted with the third phase of the Pregnancy Exposures and Preeclampsia Prevention longitudinal cohort study (2009-2013). Women who completed questionnaires for TA (Spielberger Self-Analysis Questionnaire [SPIEL]) in the postpartum period (i.e., 3 months to 2 years) were included in analysis (n=371). Cut-off scores >19 on SPIEL and >12 on Edinburgh Postnatal Depression Scale (EPDS) were used to describe prevalence and co-occurrence of mood symptoms. Associations between anxiety and depression

scores were evaluated with Spearman's rank correlation. Simple linear regression explored the following as predictors of trait anxiety: age at childbirth, race, parity, smoking status during pregnancy, past history of mental illness, pregnancy complications, gestational age at childbirth, and admission to neonatal intensive care unit. Model adjustments were made to account for varied measurement timepoints.

Results: Thirty-three percent of the sample had postpartum TA scores above the cut-off. Mean TA scores were 17 ± 5. There was a higher proportion of individuals with TA alone than with depression alone (17.8% vs. 0.5%). Of those women with high TA, 64/192 (45%) also endorsed depressive symptoms. Mood scores were highly correlated, $r = 0.73$, $p < .001$. After adjustments for measurement timing, predictors of higher postpartum TA scores were having a preterm birth ($p < .05$), smoking during pregnancy ($p < .05$), a history of mental illness ($p < .001$), and high antepartum trait anxiety ($p < .001$) and depression scores ($p < .001$).

Conclusion: Trait anxiety was highly prevalent in the postpartum, considering perinatal anxiety estimates are around 20% (Fawcett et al., 2019). More women experienced TA independently of depression, although correlation between anxiety and depression was high. After adjustment for varied timepoint measurements, higher TA scores were predicted by past history of mental illness, antepartum TA and depression scores, smoking during pregnancy, and having a preterm birth. These findings yield insight into potential situational factors that may influence postpartum TA (e.g., preterm birth) and further underline the importance of screening for both depression and anxiety in postpartum populations. Future studies should differentiate trait anxiety from state anxiety to elucidate perinatal mood disorders separately and from co-morbid mental health conditions.

Dissemination: Hoberg M., Sereika S., Founds S.F., (2021). Prevalence, Predictors, and Comorbidity of Postpartum Trait Anxiety. (Abstract, Virtual Poster). Sigma Theta Tau International Nursing Congress. July 2021.

Hoberg M., Sereika S., Jeyabalan, A., Powers, R.W., and Founds S.F. (2021). **Maternal Anxiety in the Peripartum and Infancy Period**. [Ready for Submission]

Contribution to Dissertation Work: This preliminary study, which was closely related to Preliminary Study 3, also involved performing statistical procedures planed for the dissertation research study, increasing my proficiency with planned analyses. Abstract and manuscript development skills were also practiced in preparation for dissemination of dissertation study findings.

1.4 RESEARCH DESIGN AND METHODS

1.4.1 Research Design

This chapter presents the methods that were proposed and approved during the Comprehensive Exam and Overview (CE & O) on May 28th, 2021. Since the CE & O, with the approval of my dissertation committee, modifications were made to the proposed methods for my dissertation study. These modifications are summarized in chapter 2.0.

To understand the phenomenon of PPA, particularly regarding its course, daily variability, and context, I propose a *prospective mixed-methods cohort study* with convergent design for the purpose of *expansion (i.e, expand the breadth of inquiry by using different methods for different study components).*

This mixed-methods design was selected for its usefulness in converging data types to understand complex phenomena to provide a richer understanding of PPA. Specifically, quantitative findings may inform organization and analysis of qualitative findings, and qualitative findings will contextualize quantitative findings. Integration of data types will be achieved using two mixed methods strategies: *embedding* and *merging* (Cresswell et al., 2018). In the data collection stage, a quantitative question (e.g., daily anxiety level) will be incorporated into a larger qualitative survey question set (e.g., *embedding)*. In the presentation of findings stage (i.e., results and reporting), data types will be integrated with *merging,* using joint displays and narrative synthesis (Fetters et al., 2013). Thus, the convergent design with integration at both the methods level and reporting levels will permit comparison of findings from multiple stages of data collection to expand understanding of PPA. Divergent findings will expand insights into the phenomenon of PPA, providing a glimpse into its unique aspects. To my knowledge, this will be the first study to use this methodology to understand and describe PPA as a dynamic clinical condition.

In this convergent design, quantitative and qualitative data will be collected from late pregnancy through 8 weeks postpartum (See Figure 1 below). This study period was selected for the following reasons: 1) to establish a baseline for PPA in late pregnancy and describe PPA after childbirth *within* the period known as the "fourth trimester (i.e., weeks 0-12 postpartum)," where prevention, detection, and intervention efforts are most likely to occur (American College of Obstetricians and Gynecologists, 2018; Association of Women's Health Obstetric Neonatal Nurses (AWHONN), 2015; Paladine et al., 2019), 2) to facilitate comparison of study findings to other prominent PPA studies with similar timeframes (Dennis, Brown, Falah-Hassani, et al., 2017; Fairbrother et al., 2016; Furtado et al., 2019; Nakić Radoš, 2018), and 3) to balance the benefits

and burdens of EMA data collection on participants as described by other studies (D. D. Mendez et al., 2019; van Genugten et al., 2020).

For Aim 1, quantitative data will be collected and analyzed using standardized mood instruments (State-Trait Anxiety Inventory (STAI-S), Postpartum Specific Anxiety Scale (PSAS)) to describe the prevalence and correlates of anxiety during pregnancy, one, and eight weeks postpartum. Stability of anxiety will be examined by exploring differences in mean scores amongst timepoints. Questionnaire timepoint selection and frequency (e.g., 3rd trimester, 1 week, and 8 weeks postpartum) was determined after considering 1) the study's primary descriptive purpose, 2) data collection procedures of similar PPA studies, 3) the anticipated participant burden of daily EMA questions, and 4) the expense of additional questionnaires at measurement timepoints. Hence, data collection across this time period was determined to be adequate given the mixed methods design and plan for data convergence.

In addition to questionnaire data, the trends in daily ratings of anxiety (0-10) over the 8 week period will be described and analyzed using daily mobile EMA survey data. Exploring daily fluctuations in anxiety levels and how they vary overtime between individuals, will provide a more granular look at the dynamic nature of this condition over time.

In Aim 2, qualitative descriptive analysis will be used to code and interpret participants' responses to open-ended EMA survey questions derived by the "Theory of Becoming a Mother" (Mercer, 2004; Sandelowski, 2000b, 2010). Theory concepts, which guided EMA question choices, will be used to develop a primary coding scheme that may be iteratively revised as new concepts emerge from the data. This analysis will expectantly yield descriptive summaries and thematic undertones of PPA that anchor it to the context of postpartum experiences. Findings from

this aim will help delineate aspects of PPA that may be unique from generalized anxiety as well as illuminate factors that may contribute to its onset, worsening, or resolution.

Aim 3 will involve the integration of Aim 1 and Aim 2 findings using *joint displays* and *narrative synthesis* (Fetters et al., 2013). In joint displays, both data types will be presented together in a figure that will allow generation of new insights (expansion) (see Figure 5). The final study report will use a *narrative* approach with *weaving* to describe the quantitative and qualitative results thematically, enabling the emergence of concepts unique to PPA experiences (Fetters et al., 2013). This integration is expected to achieve the overall study purpose, which is to improve understanding of the PPA phenomenon within the context of mothering experiences. Expectantly, study findings will lay the groundwork for a better understanding of PPA that can be used to inform detection and timing of intervention strategies.

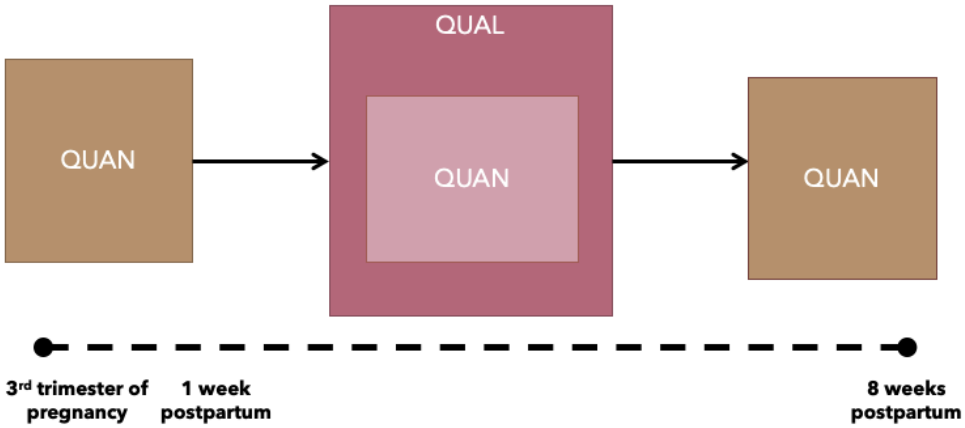

Figure 1. Research Design

1.4.1.1 ***Theoretical Framework***

This proposal is informed by the "Theory of Becoming a Mother," which considers how the interplay between mothers, infants, support systems, and environments affect transition to the mothering role (Mercer, 2004).. Social support (Dennis, Brown, Falah-Hassani, et al., 2017;

Hetherington et al., 2018), high perceived stress (Britton, 2008; Dennis, Brown, Falah-Hassani, et al., 2017; Razurel et al., 2017), and infant temperament (Jover et al., 2014), all empirically associated with PPA, are central components of the theory. Thus, this theory was chosen over others for its ability to provide a "lens" through which to interpret and understand PPA in the context of mothering experiences. Because gaps remain regarding if and how PPA differs from generalized anxiety in the postpartum, using a theory specific to this time period, population, and context was considered most fitting for the study purposes. Tenets of the framework informed the selection of data to include in the electronic health record review and EMA survey questions and will provide an initial scaffold for coding qualitative data in Aim 2. It is important to note that the "Theory of Becoming a Mother" was developed through observations of mostly "western society" mothering and cultural norms (Rubin, 1967) which may not be applicable to the diversity of cultures and ethnicities represented in our sample population (Koniak-Griffin et al., 2006). Therefore, care will be taken to recruit as diverse a sample as possible, practice reflection during data analysis to address participants' cultural backgrounds and norms, and to present findings that include diverse experiences and perspectives with the potential to expand the "Theory of Becoming a Mother".

1.4.2 Setting

The sample will be drawn from the population of birthing people seen at prenatal satellite and affiliated clinicals of Magee Women's Hospital of UPMC (MWH). The University of Pittsburgh and UPMC have a long-standing and strong collaborative relationship. MWH is the region's largest maternity hospital and referral center, caring for over 11,000 new obstetric patients each year. Its patients represent a diverse range of racial, ethnic, and cultural backgrounds. After

recruitment, study activities will be conducted remotely due to the nature of data collection (e.g., electronic questionnaires and EMA mobile surveys).

1.4.3 Sample

The study plans to recruit 75 individuals in their third trimester of pregnancy. In this dissertation-level investigation, sample size was determined using feasibility criteria, which considered the study time frame, exploratory nature, cost, and anticipated participant recruitment rates. Thus, a sample of ~75 birthing people will be recruited to account for attrition rates of ~25-30%. These rates were identified in recent PP studies with longitudinal timeframes of 6 weeks (Nakić Radoš, 2018) and 8 weeks (Dennis, Brown, Falah-Hassani, et al., 2017). The goal is to retain approximately 50 participants through eight weeks postpartum. Considering the frequency of data assessments and similarly small sample sizes of other successful perinatal EMA studies, N = 61 (Demirci & Bogen, 2017b) and N = 28 (D. Mendez et al., 2019), it is anticipated this sample will yield information that can be meaningfully interpreted. Based on a comparable and recent study recruiting from the same population, anticipated enrollment is ~3-5 participants per week (R. Dieterich, personal communication, November 5, 2020) such that recruitment will occur over a period of approximately 4 months. Additional information about recruitment rates, specifically plans for tracking and improving sub-optimal recruitment efforts, can be found in section 1.4.6.3 of this document.

Inclusion criteria for this study will be pregnant people who are >18 years old, English speaking, plan to give birth at MWH, and have access to a smartphone, as this will be the primary data collection method. Similar to other studies, the decision was made to exclude pregnant people with: 1) a positive history of drug or alcohol abuse (abuse of substances may affect mental health

(Tuchman, 2010), 2) lifetime history of severe mental illness (e.g., schizophrenia, major depressive disorder, obsessive compulsive disorder, panic disorder (extreme cases of mental illness may confound results (extreme cases of mental illness may confound results (Grant et al., 2008)), 3) multiple-fetus gestation, or 4) maternal, fetal, or neonatal conditions or complications (these may cause undue or unanticipated psychological distress (Roque et al., 2017)).

1.4.4 Recruitment Procedures

A combination of in-person and remote recruitment methods will be used in this study. The primary investigator (PI) will communicate with clinicians at Magee Womens Hospital (MWH) and affiliated practices about the availability of individuals in their care who might be eligible to participate in the study. Clinicians may then approach potentially eligible mothers to gauge their interest in hearing about the study. If permission is granted to approach a patient, the recruiter will enter the clinic room to introduce the study, confirm eligibility via a screening form, and obtain permission to send patient electronic consent forms for study participation.

Eligible participants may also find the study via the Pitt+Me participant registry or by seeing an announcement on prenatal clinic office communication boards. Additionally, study flyers will be given to potential participants at their prenatal office visits on appointment "check-in" clipboards. These flyers will introduce the study and provide the option to leave one's name and contact number if interested in participation. The PI will routinely collect completed forms and telephone interested individuals for study screening.

In addition to the above methods, the study will be advertised on the PI's social media platforms (Instagram, Twitter, Facebook). Features that would allow potential participants to comment or overshare protected health information, will be manually disabled by the PI. If eligible

participants decide to contact the PI based on any of these remote/indirect recruitment methods, they will be screened for inclusion, electronic consent will be obtained for study participation, and enrollment procedures performed. ***This study was approved by the University of Pittsburgh Human Research Protection Office (HRPO) as of March 11th, 2021, STUDY21010106.***

1.4.5 Instruments

Table 1 provides a list of study variables, roles, levels of measurement, definitions and data collection procedures from instruments and EMA.

1.4.5.1 Demographic and Patient Characteristics

Sociodemographic Questionnaire. This electronic survey was investigator-created to collect data on study participants' demographic characteristics (e.g., age at consent, race, ethnicity, employment status, marital status, educational attainment, occupation, smoking status, mental health history, and income). Additional questions target participants' obstetrical history (e.g., parity, history of infertility or pregnancy complications, and planned infant feeding methods).

Electronic Health Record (EHR). Some of the above-mentioned self-report items will be verified by the PI or research assistant during EHR data abstraction (e.g. past medical history (gynecological, mental health)). The EHR will also be used to abstract data pertaining to the participant's childbirth (e.g., mode of delivery, # complications, presence/absence NICU admission). If discrepancies existed between sources, EHR data was reported.

1.4.5.2 Mood Questionnaires

State Trait Anxiety Inventory (STAI) (Spielberger et al., 1983). The STAI is a self-report questionnaire that measures generalized anxiety and is composed of both a "trait" and "state" scale. For this study, the "state" scale, which measures transient anxiety that results from situational stress, will be used (Spielberger et al., 1983). It includes 20 questions rated on a 4-point Likert scale ranging from "1 = Almost Never" to "4 = Almost Always". Items present statements such as "I feel at ease" and "I feel upset." Some items like are reverse coded. Items will be summed to produce a score ranging from 20 to 80. Higher scores indicate increased state anxiety. Internal consistency in a perinatal population-based study was high, with Cronbach's α= 0.94-0.95; a cutoff score of >40 was determined to detect PPA (Dennis et al., 2013).

Postpartum Specific Anxiety Scale (PSAS) (Fallon et al., 2016). The PSAS is a 51-item self-report questionnaire rated on a 4-point Likert scale from "1 = Not at all" to "4 = Almost always". Items present statements such as "I have repeatedly checked on my sleeping baby." The total possible score is 204. However, participants have the option to indicate when items are "N/A" to them, which may result in a lower total score. Some items are reverse scored. Internal consistency in sample of women from birth to 6 months postpartum was high (Cronbach's α = 0.95) (Fallon et al., 2016). A cut-off score of 112 was determined to have optimal sensitivity and specificity for detection of PPA (Fallon et al., 2016). It was developed in the UK to specifically measure PPA, with input from both field experts and postpartum persons, but has not been widely used in U.S. populations.

Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987). The EPDS is a 10-item self-report questionnaire rated on a 4-point Likert scale from "0 = Yes, all of the time" to "3 – No, not at all." Items present statement such as "I have looked forward with enjoyment to things."

Scores range from 0 to 30, with higher scores indicating lower maternal mood. Studies have established an EPDS cut-off score of >9 in primary care settings and scores of $\geq$ 12 indicative of depressive illness (Cox et al., 1987; McCabe-Beane et al., 2016). Internal consistency in a postpartum sample of women from birth to 3 months, was high (Cronbach's $\alpha = 0.88$) (Cox et al., 1987).

1.4.5.3 Daily Ecological Momentary Assessment Surveys

Mobile EMA has been successfully used in perinatal populations to understand breastfeeding behaviors and daily mood/stressors in the post-partum, and in general mental health populations to understand temporal and contextual variations in mood (Colombo et al., 2019; Demirci & Bogen, 2017b; D. D. Mendez et al., 2019; Walz et al., 2014). In this study, mobile EMA will be used to collect self-reported levels of daily anxiety as well as participants' perspectives on various constructs from the "Theory of becoming a Mother" (e.g., infant temperament, social support, stress, etc.) (Mercer, 2004).

Daily postpartum anxiety levels will be assessed via mobile (SMS) EMA surveys with a single Likert scale question. Participants will be asked to rate their level of anxiety/worry on a scale of 0-10. For descriptive purposes, measures of central tendency and changes over time will be reported. Daily anxiety levels may be dichotomized into "high" and "low" anxiety using the distribution and the median of scores. Dichotomization would allow for frequency counts and percentages of high or low anxiety to be used when describing noteworthy trends and timeframes.

Qualitative EMA data pertaining to participants' experiences and perspectives in the postpartum period will be collected daily from survey questions informed by the study's theoretical framework and are presented in Table 1. The feasibility, acceptability and appropriateness of daily EMA daily survey questions was pilot tested in a usability study with a

small sample of PP mothers and edited using participant feedback (see preliminary study 2) (Hoberg, 2020). Investigator-created EMA questions added after the pilot study were evaluated and edited for readability/applicability by experts in perinatal health research.

Table 1. Variables and Levels of Measurement

Variable	Role	Meas. Level	Definition	Data Sources	Timepoints
Quantitative Data – AIM 1					
Anxiety	Outcome	Interval	Total Score STAI, PSAS	Questionnaire	3rd trimester,††
		Dichotomous	Cut off >40 STAI; >112 PSAS	Questionnaire	week 1 & 8
		Ordinal	Severity level (0 to 10)	EMA daily rating	weeks 1-8
Depression	Covariate	Interval	Total Score EPDS	Questionnaire	weeks 1-8
		Dichotomous	Cut off >12 EPDS		
Demographics	Covariate	Ratio	Age	Questionnaire	3rd trimester
		Nominal	Race; Ethnicity; Employment; Marital status		
		Ordinal	Education; Income		
Patient Characteristics	Covariate	Nominal	Parity; Infertility; Past psychiatric history	Questionnaire	3rd trimester
Delivery characteristics	Covariate	Nominal	Delivery type, delivery complications, NICU admission	Electronic health record	week 1
Breastfeeding	Covariate	Nominal	Intention to breastfeed*	Questionnaire	3rd trimester
Qualitative Data – AIM 2					
Sleep Quality*	How would you rate your quality of sleep last night (considering length and number of disturbances)? 0 = Very Poor, 5 = Excellent			EMA daily survey	weeks 1-8
Mood	How are you feeling today?* (Select appropriate facial rating and descriptors)			EMA daily	weeks 1-8
Infant temperament	How has your infant been for your today?* (Select all that apply)			EMA daily	weeks 1-8
Anxiety Symptoms	Have you experienced any of the following symptoms today?* (Select all that apply)			EMA daily	weeks 1-8
Anxiety Sources	What are the sources of your worry/anxiety today?* (Open-ended)			EMA daily	weeks 1-8
Perceived Stress	How do you feel like you have been coping with everything you have to do? (For example, have things felt overwhelming or too much handle? If so...please explain)†(Open-ended)			EMA 1x weekly	weeks 1-8
Social Support	How are those in your social circle supporting (or not supporting) your emotional needs and helping with newborn care, household chores, decision-making, etc?* (Open-ended)			EMA 1x weekly	weeks 1-8
Role Adjustment	What aspects of everyday life have been hard or challenging since your baby was born?* What aspects of everyday life have been easiest or most natural since your baby was born?* (Open-ended)			EMA 1x weekly	weeks 1-8
Environment	What aspects of your day have positively or negatively impacted your present mood, and why?* (Open-ended)			EMA 1x weekly	weeks 1-8
General	Please share with us some of the thoughts you've had today, whether they have been happy, sad, worrisome, or fearful. Consider this section like a diary entry and share what you are comfortable with.* (Open-ended)			EMA 3x weekly	weeks 1-8

Notes. STAI=State-Trait Anxiety Inventory; PSAS=Postpartum Specific Anxiety Scale; EPDS=Edinburgh Postnatal Depression Scale; NICU=Neonatal Intensive Care Unit; EMA=Ecological Momentary Assessment; All questionnaires sent electronically; All EMA surveys sent via SMS; *Investigator-created; †derived from Perceived Stress Scale (Cohen et al., 2014)**; †† STAI only**

1.4.6 Procedures for Data Collection

1.4.6.1 Data Collection

Pregnant people eligible for study participation will be recruited in their 3rd trimester of pregnancy (e.g., 27 to 40+ weeks) (See Recruitment Procedures, section 1.4.4) and screened for study eligibility. To enroll, participants will engage in an electronic consent process and complete the sociodemographic questionnaire and 3rd trimester anxiety questionnaire (STAI-S). At enrollment, their smartphone numbers and email addresses will be collected. Once enrolled, the PI will monitor participants via the UPMC electronic health record to abstract information about their delivery date and postpartum hospital stay. Specifically, the date, time, and type of delivery (vaginal, vaginal with assist, scheduled cesarean, unscheduled cesarean) will be documented from the participants' UPMC Cerner eRecord. Additionally, the presence of childbirth complications will be recorded as defined by one or more of the following: preterm labor, premature rupture of membranes, placenta previa, placental abruption, failure to progress, arrest of descent, chorioamnionitis, fetal distress, shoulder dystocia, cephalopelvic disproportion, or postpartum hemorrhage. A research assistant will be trained to abstract this information by the study PI, and a sample of participant charts will be co-abstracted and compared to ensure both team members abstract data consistently. At one-week postpartum, mood questionnaires (STAI-S, PSAS, EPDS) will be sent as links to participants via the University of Pittsburgh's Qualtrics Survey platform.

To capture the contextual and temporal characteristics of anxiety (Walz et al., 2014) and facilitate survey completion, participant's preferences for the timing of survey delivery (beginning, middle, end of day or no preference [rotating]) will be assessed at enrollment. Daily EMA surveys will contain a combination of multiple choice, select all that apply, sliding scale, and short answer questions. EMA surveys will contain no more than 12 questions on a given day, with only 1-2 of those questions short-answer. Per expert guidance from research team members, short answer questions will be rotated to mitigate potential fatigue while collecting pertinent study data. Participants' responses to open-ended questions on perceived stress, social support, role adjustment and environment will be collected weekly. Of note, the term "environment" is not meant to reflect individuals' physical surroundings but rather the people, situations, or stimuli of their "micro-systems" that potentially impact mood (Mercer, 2004). Alternatively, the survey question pertaining to anxiety will be asked daily, as exploring participants' anxious experiences is the primary purpose of Aim 2. Lastly, a general open-ended question will be asked 3x/weekly to allow participants an opportunity for a diary-style entry of thoughts/experiences they feel compelled to share. Based on preliminary study #3, the daily EMA surveys are anticipated to take <10 minutes to complete (Hoberg, 2020). Study participants who fail to complete a daily survey will receive one automated evening reminder each day. Once-daily surveys were found to be feasible and of low-burden in other studies that have successfully used EMA in perinatal populations (D. Mendez et al., 2019). Daily survey completion will be tracked by research staff twice weekly to identify participants with low completion rates. These individuals will be contacted by phone to identify and troubleshoot potential barriers to survey completion. At the study's conclusion (8 weeks), participants will be sent follow-up depression and anxiety questionnaires via electronic Qualtrics links. For study participation, individuals will receive tiered

reimbursements in the form of University of Pittsburgh-HRPO approved cash cards. Participant incentive for study participation will be as follows: 1) completion of 1 week questionnaires = $10; 2) completion of at least 75% of daily EMA surveys = $35; 3) completion of end-of-study questionnaires = $25. The maximum amount of compensation that may be awarded to any participant is $70. Sequence of study events is displayed in Table 2 (below).

Table 2. Planned Sequence of Study Events

Enrollment (3rd Trimester)	1 week postpartum	1 to 8 weeks postpartum	8 weeks postpartum
· Screening for eligibility · Informed Consent · Sociodemographic Questionnaire (text/email link)	STAI-S; PSAS; EPDS (text/email link)	· EMA daily surveys (SMS) · Track 2x week to monitor responses and adherence · Contact participants with low completion rates	STAI-S; PSAS; EPDS (text/email link)

Notes: STAI=State-Trait Anxiety Inventory; PSAS=Postpartum Specific Anxiety Scale; EPDS=Edinburgh Postnatal Depression Scale

1.4.6.2 Data Management

All consented participants will be given a unique study ID upon enrollment. Participant contact information, linked to the participants' study ID, will be kept in a single, password-protected, user-restricted computer file. Informed consent will be collected electronically with an HRPO-approved signature on the University of Pittsburgh's secure online data collection and management system, Qualtrics. No identifiers (names, social security numbers) will be recorded on study forms or electronic files, only the study ID. There will be no paper copies of study materials except for recruitment flyers. Any recruitment materials retaining identifiable information will be shredded after use. If there is electronic communication between the research staff and participants (e.g., emails, texts), the PI will permanently delete these communications upon completion of the conversation to minimize breaches of confidentiality.

1.4.6.3 Study Timeline

The proposed study's timeline is displayed in Table 3 below. To adhere to this timeline, recruitment and enrollment activities will be tracked. Specifically, enrollment numbers will be entered into an excel form daily, and preset enrollment number targets will be checked at weekly and monthly intervals (Figure 2). If enrollment trends are slow or sub-optimal, other recruitment approaches will be implemented (e.g., incorporating additional MWH satellite recruitment sites, enhanced networking with MWH clinical personnel, or consideration of recruitment from other hospitals and health systems).

Table 3. Study Timeline

	Months					
Activities	**1-3**	**4-6**	**7-9**	**10-11**	**12**	**13-15**
Enrollment (~8 per month) to reach 75 participants	X	X	X			
Data Analysis Aims 1 and 2			X	X		
Data Analysis Aims 3				X		
Final AWHONN Report					X	
Development of Manuscripts, Abstracts, Presentations					X	X

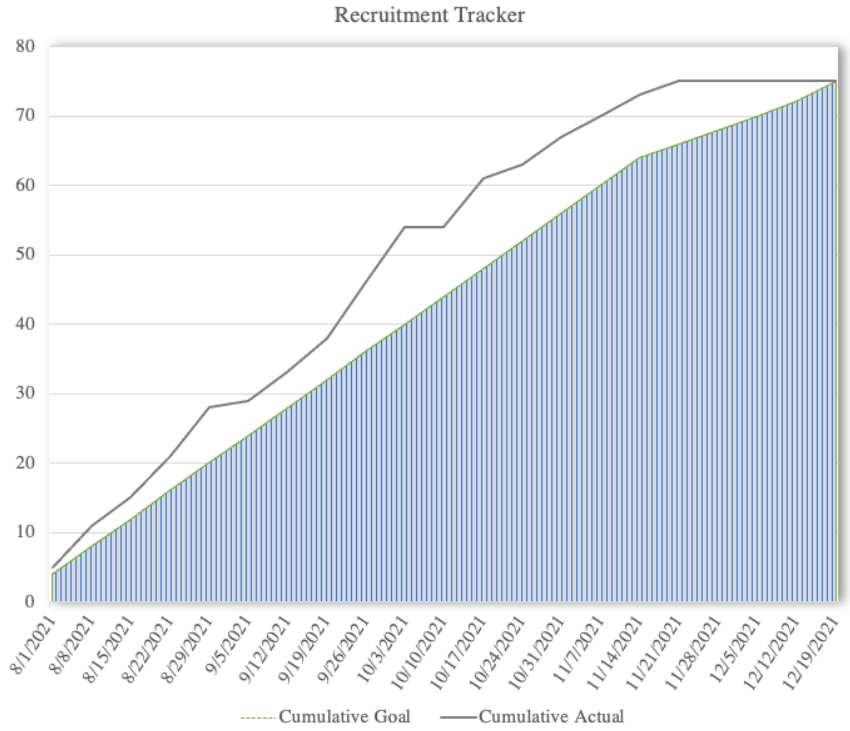

Figure 2. Recruitment Actual Accrual Rate

1.4.7 Procedures for Data Analysis

Convergent Design Analysis and Interpretation: A convergent mixed methods design was chosen to expand current understanding of the PPA construct. Collection and analysis of various data sources will permit a more granular understanding of PPA to emerge by reflecting experiences reported by postpartum individuals. Concurrent quantitative and qualitative data collection will occur first, followed by analysis of aims 1 and 2 respectively. As previously mentioned, integration of qualitative and quantitative components will occur in the methods and results and reporting stages, consistent with the mixed methods' principles of embedding and merging (Sandelowski, 2000a). Comparison and contrast of data types in Aim 3 will permit a better understanding of how and what combinations of circumstances are associated with PPA experiences across groups of individuals. These findings will improve understanding of the PPA

condition and inform current (and future) detection strategies by pinpointing timeframes and trends related to anxiety onset or worsening.

1.4.7.1 General Data Screening Procedures

IBM SPSS V. 28® will be used for quantitative data analysis (IBM Corp, 2021). Prior to planned analysis, data will be extensively screened. Accuracy of data will be determined in SPSS using the SUMMARIZE command. Examination of data trends in time or space will occur using bivariate scatterplots. Data integrity will be checked with frequency distributions, histograms, cross-tabulations, and descriptive statistics. For continuous variables, visual examination of histograms and boxplots as well interpretation of minimum, maximum, and range values will inform presence or absence of outliers in data. Identified outliers will be classified as either univariate or multivariate dependent upon their influence, assessed by Mahalonobis distances. For categorical variables, frequency tables will be checked for highly uneven splits among categories. Causality of influential outliers will be explored to make a determination of whether to incorporate highly affected variables in planned analysis. Depending on variables' distribution and normality, decisions regarding whether or not score modification or data transformation will occur. If outlier(s) are deemed erroneous, data for the affected variable may be modified or deleted.

After outlier exploration, study variables will be screened for missing data points using the SPSS EXAMINE command and a case processing summary. Missing data will be examined for patterns, reasons, and distributions of missingness. Considering this evaluation, missing data will be attributed to one of the following categories of missingness: 1) attrition, 2) random collection issues, 3) respondent refusal, or 4) skip patterns for study questionnaires. This determination will classify the missing data as either missing completely at random, missing at random, or missing not at random and direct decisions regarding the handling of data points. If the amount of missing

data is severe, variable deletion methods will be considered. For example, if participants fail to provide an answer regarding their education or income, these variables will be excluded from analysis. If a small to moderate amount of sample data is missing, single or multiple imputation methods will be considered based on the mechanism of the missing data. For instance, if one self-report instrument score is randomly missing for one participant, SPSS will be used to generate an imputed score. After exploratory analysis, variables requiring imputation of missing scores will be selected using the SPSS ANALYZE*, Multiple Imputation* command. This procedure will generate a new imputed data set after applying linear regression imputation methods to continuous variables and logistic regression to categorical variables. Prior to this procedure, individuals with and without missing data will be compared for significant differences on demographic and obstetrical characteristics as well as anxiety and depression scores. The remainder of data screening specific to assumptions checking for various procedures will be described in the Aim 1 analysis section.

1.4.7.2 Descriptive Statistics

For the sample's quantitative data, study variables will be summarized with appropriate statistics according for their level of measurement (Table 1). For continuous demographic variables (e.g., age), means and standard deviations will be calculated. For nominal demographic and patient characteristic variables (e.g., ethnicity, marital status, etc.), frequencies and percentages will be calculated. Regarding ordinal variables (i.e., education, income, etc.), medians and inter-quartile ranges will be provided. If data are non-normally distributed for continuous variables, medians and inter-quartile ranges will be presented instead. Self-report instrument scores for the primary outcome of anxiety as well as for depression (covariate) will be presented as means, standard deviations, and ranges due to their approximately interval scales and their potential to display a wide range of values in results.

1.4.7.3 Aim 1 Planned Analysis

Aim 1: Describe the prevalence, stability, and daily trend of anxiety among birthing people from the end of pregnancy through the first 8 weeks postpartum.

Achievement of Aim 1 involves addressing three sub-aims, which will be described separately in the following sections with their planned analysis.

Sub-Aim 1a): Prevalence of self-reported anxiety scores from the STAI-S and PSAS will be described with summary and descriptive statistics at each time point (i.e., 3rd trimester, 1 and 8 weeks postpartum). If scores are normally distributed, ranges, means and standard deviations will be calculated. If distributions are non-normal, medians and inter-quartile ranges will be calculated. Previously established "cut-off" scores for the STAI-S (Spielberger et al., 1983) and PSAS (Fallon et al., 2016) will be used to determine the proportion of individuals categorized as "anxious" at each time point, which will be presented as frequencies and percentages. If distribution permits, study participants will be categorized based on anxiety questionnaire cut-off scores from each postpartum time point: Category 1) "Stable, No Anxiety" (< cut-off at either timepoint), Category 2) "Anxiety Increasing" (from < cut-off to > cut-off)", Category 3) "Anxiety Decreasing" (from >cut-off to < cut-off), Category 4), "Persistent Anxiety" (> cut-off at both timepoints). Category assignment based upon each questionnaire (STAI-S and PSAS) will be descriptively compared using frequency counts and percentages to explore similarities and differences in how individuals were classified.

Sub-Aim 1b) Stability of anxiety will be determined by exploring the change in mean anxiety questionnaire scores (STAI-S, PSAS) from the 3rd trimester of pregnancy to one and eight weeks postpartum.

A repeated measures ANOVA will be used to test for significant differences between mean scores at each time point. Prior to analysis, assumptions of this test will be explored. In addition to outlier inspection (described above), normality of dependent variables (anxiety scores on the STAI and PSAS) will be checked using the EXPLORE command to produce graphical displays (e.g., Q-Q plots) and the Shapiro-Wilk's test. If normality is violated, either a square root or log transformation will be applied to the variable. The procedures will be re-run to determine if remediation occurred. The sphericity assumption will also be checked using output generated from the repeated measures general linear model test. If remediation of violated assumptions fails, the nonparametric Friedman's procedure will be used instead. After assumptions are checked and remediations are performed (when necessary), mean scores during the 3rd trimester will compared to those at one-week and eight-weeks for significant differences within participants. This analysis will be run separately for each instrument.

Sub-aim 1c) Describe daily trends in anxiety levels (0-10) of participants from 1 to 8 weeks postpartum with EMA survey data.

Daily anxiety levels will be self-reported by study participants using a 10-point Likert scale, where 0 is "none", and 10 is "high". In order to describe daily trends of these levels, graphical temporal responses plots will be created for each participant. The observation number of assessments (n = 49) will be displayed on the x-axis and the corresponding anxiety level ratings on the y-axis. The mean anxiety level for each individual will displayed by a linear line on their individual temporal response plots. Participants' responses may also be characterized using simple regression terms (e.g., intercept and slope). The latter approach may provide a more accurate interpretation of individuals' trends by accounting for extra variability in anxiety levels over time. Additionally, multi-level coefficient modeling will be used to quantitatively analyze temporal

trends of anxiety data. This type of modeling permits the relationship between anxiety and time to be considered on average for the total sample against the predicted model as well as for each participant in the sample. Linear mixed-effect modeling is well-suited for EMA data because it: 1) accounts for observations nested within people, 2) estimates how individuals differ from themselves as well as each other, 3) allows time to be treated as a continuous variable, and 4) is flexible enough to handle missing and unbalanced data (Grace-Martin, 2019; Russell, 2018). Participants' graphical displays will also be presented in a panel plot organized by category assignment (e.g., "Stable, No Anxiety", "Anxiety Increasing", "Anxiety Decreasing", "Persistent Anxiety") to allow for cross-comparison between individuals (see Figure 3 below). Only category classification determined by one set of questionnaires scores (either the STAI-S scores or PSAS) will be compared to daily anxiety level trends. The decision of whether to use group assignment based on one instrument versus the other will be determined after analysis in 1a) and based upon distribution of scores. It is anticipated that this comparison will reveal: 1) daily anxiety trends are highest among those in Group 4; 2) daily anxiety trends are lowest in Group 1; 3) daily anxiety trends in Groups 2 and 3 are similar. If cases are found to deviate from these predictions, characteristic of group members from the qualitative findings will be explored separately in Aim 3. If distribution of participants based on questionnaire scores at one- and eight-weeks does not allow for categorization into 4 groups, alternative grouping methods will be explored to facilitate comparison with daily anxiety levels.

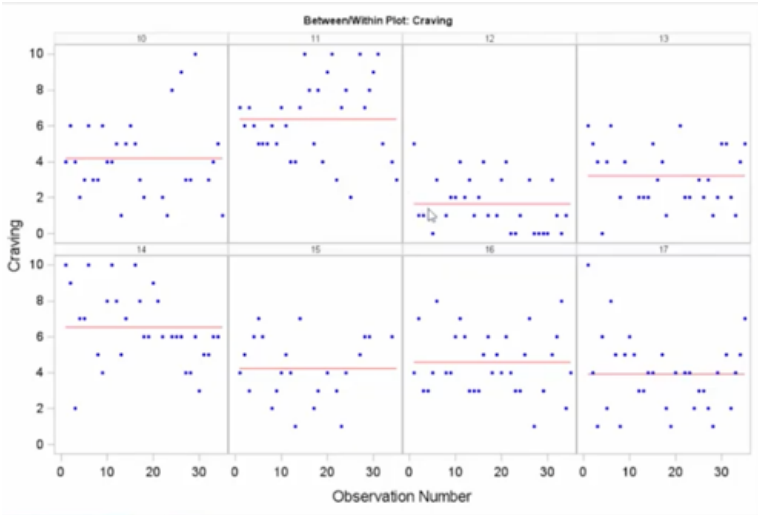

Figure 3. Example Panel Plot of Temporal Response Plots

Notes. From (Russell, 2018).

1.4.7.4 Aim 2 Planned Analysis

AIM 2: Explore postpartum individuals' experiences with and perspectives on anxiety from one- to eight-weeks postpartum.

MaxQDA software will be used for all qualitative analyses (VERBI Software, 2022). The qualitative descriptive method was chosen as the framework for this aim because of its appropriateness for the type of data being collected (i.e., survey responses) and the mode of data collection (i.e., SMS survey). Specifically, qualitative description permits flexibility in data analysis by focusing on descriptive summaries of events rather than in-depth interpretations (Sandelowski, 2000b). This study is exploratory and will likely provide directions for future research inquiries. Thus, presentation of findings as patterns, categories, or processes (Kim et al., 2017) will yield fruitful directions for subsequent studies.

Qualitative data will be collected daily and weekly from participants' responses to EMA survey questions. For a more in-depth description of rotation procedures, refer to the "Data

Collection" section of this manuscript. Data from participants will be collected and coded in a deductive fashion using the initial framework of concepts from the Theory of Becoming a Mother (social support, perceived stress, infant, environment) as a coding scheme (Mercer, 2004). Codes will then be revised in a reflexive and iterative process as data from participants is continuously collected and analyzed (Sandelowski, 2000b). Participants' text responses will be coded concurrently as data collection proceeds so that coding framework can be modified and evolve as needed. The PI will practice "reflexivity" during coding to increase credibility of the process and maintain distance from existing biases (Dodgson, 2019). Coded data will then be analyzed using qualitative content analysis, a prescribed and commonly used method in qualitative descriptive studies (Kim et al., 2017). Final presentation of findings will be decided upon after data is coded and analyzed, but may be displayed as categories, matrices, patterns, or processes that describe participants' PPA experiences (Kim et al., 2017). Results will likely be presented to reflect both chronology and prevalence to reveal timing and trends (Sandelowski, 2000b).

1.4.7.5 Aim 3 Planned Analysis

Aim 3: Converge the findings from AIM 1 and 2 to explore relationships between anxiety questionnaire (STAI-S, PSAS) scores, anxiety trajectories (daily EMA surveys), and categories or themes reflective of postpartum experiences.

Convergence of Results: For aim 3, findings of Aims 1 and 2 will be converged at the interpretation and reporting stage (Sandelowski, 2000a). Qualitative findings from Aim 2 may be separated and clustered according to category assignment determined by questionnaire scores or daily anxiety level trends from Aim 1 (e.g., "Stable, No Anxiety," "Persistent Anxiety," "Anxiety Increasing," "Anxiety Decreasing"). A joint display like the one pictured below (Figure 4), is an example of how the data integration may be displayed for interpretation.

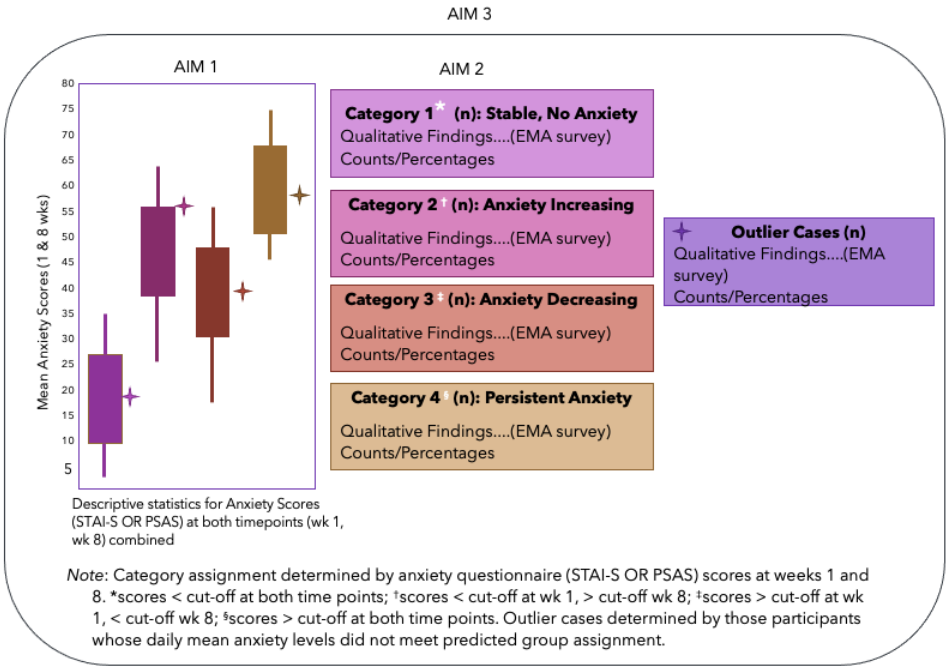

Figure 4. Example of Joint Display Illustrating Integration at the Interpretation and Reporting Level

Notes. From (Fetters et al., 2013).

Qualitatizing (e.g., category assignment) quantitative data using instrument scores (STAI, PSAS) at 1 and 8 weeks postpartum serves as criterion sampling (Sandelowski, 2000a). Specifically, it allows for responses of individuals that should be similar to be grouped together in the context of questionnaire scores. Expectantly, qualitative output should reflect or parallel category assignment. For example, category 1 ("Stable, No Anxiety") cases may reflect qualitative themes of high social support, maternal confidence, stable environment, positive coping, and minimal challenges. These findings would be expected for individuals who are not suspected to have anxiety based on standardized instrument measurements. Alternatively, group 4 ("Persistent Anxiety") may contain opposing themes. Individuals in this group may share more stressful experiences, problems with social support, or negative perceptions of environment/circumstances. Because concepts and themes may overlap or vary considerably between and within the categories of participants, responses and number of participants for each code category may be counted to

generate a description of the patterns and regularities in the data (Sandelowski, 2000b). At this stage, consideration will also be given to the case numbers from Aim 1c which did not meet expected outcomes when comparing daily anxiety level trends to category assignment. These case numbers will be considered separately and their qualitative findings grouped accordingly.

Interpretation of Integration: By means of the joint display using color matching of quantitative and qualitative findings, data will be interpreted using a narrative approach (Fetters et al., 2013). With the weaving technique (Fetters et al., 2013), the experiences of each group of people will be compared and contrasted within themselves and against other groups. Comparison in this fashion will allow for expansion of findings, as results may be similar or dissimilar between and within categories. Special emphasis will be placed on the particular themes that reflect individuals' experiences with high or increasing PPA (Categories 2 and 4) as these will assist in defining the phenomenon. Irregularities at the data integration stage will also be given special consideration, as these outliers may reveal new insights about the phenomenon that have not been previously considered or identified.

Expectantly, this exploratory study will identify thematic patterns amongst individuals experiencing anxiety onset, worsening, or resolution as well as those who display no anxiety so that the phenomenon can be better defined and understood within the context of postpartum experiences.

1.5 POTENTIAL LIMITATIONS AND ALTERNATIVE APPROACHES

This section acknowledges that while this study was carefully planned and its design purposively selected, limitations or challenges may arise that require a priori consideration. Firstly,

the nature of the global COVID-19 pandemic raises uncertainties regarding the ability to recruit and retain research study participants. To mitigate this challenge, the study was designed with alternative recruitment approaches embedded within strategies. Specifically, although in-person recruitment is optimal and preferred, study methods will also include remote engagement strategies (i.e. social media, targeted mailers). Further, all research activities were designed to be conducted remotely and electronically, including an electronic informed consent. The hope is that these steps will eliminate the need for in-person contact to conduct the research study.

A second limitation of the study might be inadequate or insufficient data collection due to the intensive repeated-measures prospective design. In consideration of this possibility, a member of the research team, who is an expert statistician with experience in ecological momentary assessment data collection, was consulted. The exploratory nature of the study was considered in conjunction with anticipated attrition rates to arrive at a sample size that would yield meaningful data regardless of missingness. To further mitigate this problem, daily survey completion will be monitored at least twice a week by either the PI or research assistant. If patterns of missingness are identified within individuals, those persons will be contacted by the PI or research assistant to identify and troubleshoot barriers to completion.

Third, prevalence of anxiety in the sample population may not be high enough to allow for distribution of persons among the four categories outlined in Aim 1. If this occurs, individuals will be will be assigned to one of two categories: 1) Stable, No Anxiety (< cut-off at both timepoints), 2) Some or Persistent Anxiety (> cut-off at one or both time points). This organization will still permit meaningful integration of quantitative and qualitative data while reflecting more appropriate distributions.

Lastly, due to the eight-week study frame, attrition may be a potential problem. To mitigate this challenge, planned recruitment is for more than the number of participants needed to complete the study. Additionally, the study budgeted for an appropriate, escalating incentive package to motivate participants in continued study participation. Further, the PI and a research assistant will track EMA survey completion on a twice-weekly basis to contact and assist participants that may be experiencing challenges with research activities. Confidently, these actions will help prevent high attrition rates and aid significant data collection.

1.6 PROTECTION OF HUMAN SUBJECTS

The proposed study is considered minimal risk to participants. Participation in the study is completely voluntary, and participants may withdraw their participation at any time by contacting the PI directly. Individuals will be made aware of this option during the consent process and provided with contact information for the PI and pertinent research team members. They will also be informed that their decision to withdrawal from study participation will have no effects on their current or future medical care with UPMC nor their relationships with the University of Pittsburgh. If a consented participant decides to withdraw from the study, their collected data will be maintained, but no further data collection will occur from the withdrawal point forward.

The most likely risks anticipated for this study are breach of confidentiality, study fatigue from repeated data collection, and/or emotional distress accompanying completion of survey questions. Mitigation measures for each of these potential risks are discussed below:

1.6.1 Breach of Confidentiality

To minimize potential breaches to confidentiality of participants' personal information, data will be managed responsibly as was outlined in section 1.4.6.2 of this document. During recruitment on social media sites (e.g., Facebook, Twitter, Instagram, LinkedIn), commenting will be disabled on posts so that potential participants cannot identify themselves in connection with the study. Phone calls with participants' during recruitment and consent processes will be conducted in private spaces and not recorded. Email and other modes of electronic communication will be deleted after use. From enrollment to study completion, participants will only be identified by their unique study IDs. Lastly, participants will be made fully aware of potential breaches to confidentiality of their personal information during the informed consent process to facilitate an informed decision and acceptance of risks.

1.6.2 Potential for Study Fatigue

If participants develop fatigue related to the completion of any study activity or ongoing study participation, they will have the option to cease their involvement in the study by contacting the PI. This option will be made clear to individuals during the consent process. As was detailed in section 1.4.6.1 of this document, EMA responses will be tracked twice weekly by the PI or another research team member to identify participants with increasing missingness of data. Per the protocol, these participants will be contacted so that reasons for missingness can be identified and mitigated if possible. At this time, the PI or research team member will again remind participants that study discontinuation is an option if they are feeling fatigued or no longer interested.

1.6.3 Potential for Emotional Distress

There is a light risk that participants may experience emotional distress when answering EMA survey questions. To mitigate the risk for distress, survey answers are not required and completion is completely voluntary. In addition, there is a question at the end of each daily survey that asks participants if they feel like their mental or emotional issues require further support or intervention. If they choose to answer "yes" to this question, they will be directed to either call 911 (for emergent help) or the Behavioral Health hotline number at Magee Womens Hospital to schedule a consultation. During weekly tracking of survey responses, the PI and research assistant will monitor survey responses, trends, and answers to the above-mentioned question. If data irregularities, unacceptable levels of distress, or concerning responses occur, the participant will be contacted by a research team member and encouraged to report distress to medical providers. If at any point during data collection, the participant expresses concern for any crisis (such as the safety of self or others), they will be contacted and referred to the "Re-Solve" crisis helpline through UPMC. Disclosure of or witness of intimate partner violence will be dealt with on a case-by-case basis in consultation with study team, institution, and HRPO according to state regulations.

2.0 SUMMARY OF STUDY

The purpose of this dissertation study was to improve understanding and thus detection of postpartum anxiety (PPA) using a theoretically-driven, mixed-method descriptive approach. PPA is a highly prevalent condition; however, its recognition in clinical settings is complicated by nonexistent diagnostic criteria (Zappas et al., 2020), absence of a universally-agreed upon screening instrument (Lorenzo, 2022), and inconsistencies regarding what it means to have PPA (Howard & Khalifeh, 2020). The study sought to address aforesaid challenges by exploring theory-driven qualitative data of participants' experiences, perspectives, and attitudes in the postpartum period and measurements of anxiety using multiple modalities, to expand understanding of the PPA phenomenon. Study results yielded critical insights into PPA, including optimal timing for detection, evidence for integrating a postpartum-anxiety specific instrument into clinical detection strategies, and understanding of concepts unique to PPA experiences that can be targeted for detection enhancement and future intervention development.

2.1 DISSERTATION STUDY OVERVIEW

Recruitment and data collection for the dissertation research study was conducted from August 2021 through March 2022. Due to the complexity and multi-level nature of the study design, the following modifications were made with the support of the dissertation committee chair.

First, 76 participants were recruited instead of the planned 75. I was contacted by an eligible participant through Pitt + Me before the system was alerted to halt recruitment when the target sample size had been reached. Because the individual completed study screening with Pitt + Me personnel, they were permitted to participate bringing the enrollment number to 76. However, two participants self-withdrew after informed consent and one participant was withdrawn by the primary investigator for meeting an exclusion criterion after childbirth (i.e., traumatic delivery with infant NICU admission and subsequent maternal diagnosis of anxiety and depression related to childbirth events). Thus, 73 participants were ultimately included in the active study.

Second, I was contacted by several individuals with a history of non-psychotic bipolar disorder who expressed interest in study participation. Original exclusion criteria were non-specific regarding this type of mental illness, leaving uncertainty as to whether individuals with non-psychotic bipolar disorder were eligible for participation. I consulted with Dr. Levine, the research team's mental health expert, and Dr. DeVito Dabbs, the dissertation committee chair, to discuss risks and benefits of participation. A modification to amend the exclusion criterion to permit enrollment of individuals who did not demonstrate active suicidality or psychotic features per EMR documentation was approved by the HRPO (see Appendix G). Finally, during scoring of participants' final mood questionnaires at eight-weeks postpartum, it became apparent to me that a protocol was needed to address participants whose scores met the threshold for depression on the EPDS. As this presented an ethical dilemma regarding how I should protect participants from the potential harms associated with depressed mood, it was immediately remediated with input from Dr. Levine and Dr. DeVito Dabbs. A protocol, which included a script and referral resources, was developed and submitted as a modification to the HRPO (See Appendix H). The

modification was accepted, and participants who met criteria for protocol activation were contacted and provided with appropriate resources and next steps for mood management. No further protocol changes were made during active study participation.

Methods for planned data analysis proceeded mostly as propose. Two minor adjustments were made to the plan for qualitative analysis and merging of data types in Aims 2 and 3. In the initial proposal, the plan was to analyze all qualitative mEMA responses for the entire study sample. However, it was not feasible to analyze the volume of responses within the proposed study time frame (e.g., ~ 6,500 open-ended responses) . Therefore, the decision was made to select a representative subsample to include in the qualitative analysis of the five study variables (e.g., perceived stress, social support, role adjustment, environment, and source of anxiety). To ensure diversity, a stratified sampling method based on patterns of daily anxiety scores, was applied to create four groups of participants. Fifty percent (50%) of participants in each group were randomly selected for subsequent qualitative analysis (N = 34). Thus, in addition to the purpose of expansion, the mixed methods design was also used for the purposes of development, in which quantitative data were used to create a subsample of participants for subsequent qualitative analysis. A more detailed description of final study procedures can be found in the study's resulting manuscripts.

2.2 STUDY STRENGTHS AND LIMITATIONS

This dissertation study was strengthened by many factors. First, the study's prospective repeated-measures design and novel mEMA data collection methods yielded a considerably large dataset; each participant was asked to provide data at 52 different timepoints. Second, sample retention rates were much higher than the proposed goal of 50 participants. Of the 76 participants

recruited, 71 (97.2%) returned all mood questionnaires and completed some mEMA, and 68 out of these 71 persons (93.2%) completed ≥ 50% of mEMA prompts. Third, to the knowledge of this author, this study was the first to collect repeated qualitative data on individuals' experiences with anxiety in weeks after childbirth. Further, qualitative mEMA questions were derived from a postpartum-specific theory, resulting in original findings about how individuals uniquely perceive and experience changing roles and responsibilities after childbirth. Finally, and also to the knowledge of these authors, this study was the first to descriptively compare two instruments for PPA detection, a generalized anxiety instrument and postpartum-specific anxiety instrument. Individuals' experiences and daily anxiety ratings were compared and contrasted within the context of instrument scores at eight-weeks postpartum to explore delineation of anxiety constructs.

This study is not without limitations. First, while a substantial effort was made to recruit as diverse a sample as possible, the majority of participants were White, highly educated, and partnered, limiting generalizability of findings. Also, due to time constraints, the size of proposed study, and the overall exploratory design, more advanced statistical methods were not undertaken for this analysis. Specifically, anxiety instruments were not psychometrically compared and quantitative study variables were not examined for significance in individuals' daily mEMA anxiety trends. However, these explorations are planned for future analysis in the post-doctoral period. Lastly, study inclusion criteria allowed participation of individuals with preexisting mental health conditions. This decision was conscious, as investigators felt the experiences and attitudes of these individuals were important to describing the PPA phenomenon and delineating the construct from generalized anxiety and depression. However, this may be viewed as confounding factor in analysis warranting statistical adjustment in future studies with these data.

2.3 FUTURE STUDIES AND IMPLICATIONS FOR NURSING

Our study's findings provided several important implications for nursing practice as well as directions for future research. Regarding clinical practice, our results recommend the addition of a postpartum specific anxiety tool in maternal mood screening during the postpartum period (e.g., postpartum specific anxiety scale (PSAS)). The addition of this tool will likely increase detection of PPA cases that would not be otherwise discovered with lone use of the Edinburgh Postnatal Depression Scale (EPDS). Future studies should continue to evaluate the utility of the PSAS with larger sample sizes, using the newly shortened 12-item version of the scale (Silverio et al., 2021), which is more practical for clinical settings. Clinicians should also consider PPA screening after the traditional six-week postpartum visit; as our findings suggested PPA levels increase after this timepoint (e.g., around eight-weeks postpartum). Further, future studies should evaluate PPA prevalence and trends after eight-weeks postpartum to determine whether anxiety continues to increase, stabilizes, or resolves, which would guide clinical management strategies.

Our quantitative and qualitative study results also expanded understanding of the PPA condition by providing: 1) qualitative validation for previously determined predictors of PPA conditions, 2) additional evidence to consider when delineating postpartum-specific anxiety from generalized anxiety in postpartum populations, and 3) new concepts to consider for future intervention-based PPA research. Specifically, we uncovered discernable qualitative differences in perceived stress, social support, role adjustment, and relationship conflict between individuals with and without PPA, adding support to the importance of these concepts in PPA experiences. Further, while individuals' qualitative responses regarding postpartum concepts (e.g., perceived stress, social support, role adjustment, environment, and daily anxiety source) overlapped between those with generalized anxiety (PPA per the STAI-S) versus postpartum-specific anxiety (PPA per

the PSAS), distinct differences were also discovered. For instance, an individual with generalized anxiety (PPA per the STAI-S) may have consistently stated absent support (both emotional and physical) over the seven-week study period where daily assessments were collected. Alternatively, someone with postpartum specific anxiety (PPA per the PSAS) may have initially had support that decreased as the time from birth lengthened or had consistent task-related support but absent emotional support. These findings provide evidence needed to address the question of whether postpartum-specific anxiety is distinct from generalized anxiety (Howard & Khalifeh, 2020). Specifically, our findings suggest that while related, postpartum-specific anxiety and generalized anxiety may also harbor slight distinctions in individuals' experiences, perspectives, and daily anxiety course. Further, when coupled with our quantitative findings, in which additional persons with PPA anxiety were detected through use of the PSAS that would not have been detected with the STAI-S or EPDS, a further implication is that the spectrum and severity of individuals' experiences with PPA may be wider than previously assumed. Thus, future research should endeavor to further understand the relationship between postpartum-specific and generalized anxiety constructs in postpartum persons.

Finally, our study revealed several new concepts that appear to be of importance to the PPA condition. Specifically, individuals with PPA in our sample had a range of daily anxiety sources, that stemmed from infant-focused concerns to work-related concerns, financial concerns, and self-health concerns. Future research should seek to substantiate relationships between these concepts and PPA development, worsening, or resolution, especially amongst diverse postpartum populations. Next, while relationship conflict has been previously linked to anxiety and depression in postpartum individuals, we can confirm that this concept was repeatedly endorsed in individuals with PPA, and should be targeted in future PPA research efforts. Finally, individuals with PPA

described considerably less opportunities to socialize with others or spend time away from infants than persons without PPA. This finding may present an area of opportunity for future intervention-focused research studies, which are urgently needed due to the scarcity of this type of PPA research (Nillni et al., 2018). Considering our study's collective findings, additional directions for future intervention-based PPA research include: 1) management of perceived stress and improvement of coping skills, 2) increasing availability of physical and emotional support, 3) promoting opportunities for self-care and socialization in the postpartum period, 4) offering relationship support and counseling, and 6) providing resources for financial and work-related assistance.

In addition to providing directions for future research studies, I also plan to pursue additional analyses with the data collected in this primary, exploratory dissertation study. In post-doctoral work, I plan to pursue the following projects:

- Qualitative: Qualitative descriptive study of the **entire samples' responses** from **all open-ended mEMA questions, which include responses to a question asking participants to share their general thoughts in a diary-type entry three times per week.**
- Quantitative: Using daily mEMA anxiety ratings and mood questionnaires at eight-weeks postpartum, **evaluate factors that predict differences in daily anxiety trends based on sample characteristics and questionnaire scores**
- Mixed-Methods: Evaluate the **acceptability and feasibility of mEMA data collection methods** using sample response data and participant feedback

3.0 MANUSCRIPT 1: A DESCRIPTIVE EXPLORATORY STUDY OF POSTPARTUM ANXIETY USING MULTIPLE MEASUREMENT MODALITIES

3.1 ABSTRACT

Objective: To describe the prevalence, stability, and temporal trend of postpartum anxiety (PPA) from one- to eight-weeks postpartum.

Design: Prospective cohort study with repeated anxiety assessments using self-report anxiety questionnaires and daily mobile ecological momentary assessment (mEMA).

Setting: A large academic tertiary center in the Mid-Atlantic U.S. Study activities were remote.

Participants: 73 birthing people recruited in their 3rd pregnancy trimester.

Methods: The State Trait Anxiety Inventory (STAI) and Postpartum Specific Anxiety Scale (PSAS) were administered in the third trimester, one-, and eight-weeks postpartum. mEMA prompts measured daily anxiety levels (e.g., 0 to 10) from one- to eight-weeks postpartum. PPA prevalence was calculated with established questionnaire cut-off scores. Repeated measures analysis of variance and dependent-samples t-tests determined score stability. Linear mixed-effects modeling explored mEMA anxiety trends.

Results: More individuals met PPA thresholds on the STAI or PSAS at eight-weeks (35.2%, 25/71) than one-week (31.5%, 23/73) postpartum. PSAS scores increased from one to eight-weeks ($p = 0.003$); STAI scores decreased ($p = 0.01$). All participants experienced some daily anxiety during the study period, $M = 1.75$, $SD,$ 1.96 (n = 68). Daily anxiety ratings changed nonlinearly over the study period (all $p < 0.001$) and were highest at two-weeks postpartum, declined and stabilized, then trended upward toward week eight postpartum.

Conclusion: Our findings corroborate reportedly high prevalence of PPA in birthing people at eight-weeks postpartum. Daily anxiety ratings showed that experiencing some level of anxiety in the postpartum is a shared experience, but for others, daily anxiety increases as the time from birth lengthens.

3.2 INTRODUCTION

Mood disturbances, including postpartum depression and anxiety, are the most common complications experienced by birthing persons (US Preventive Services Task Force et al., 2019). Yet, postpartum depression (PPD) has been the dominant focus for research and practice (Matthey et al., 2003; Yeaton-Massey & Herrero, 2019). In recent years, professional groups have called for better understanding and management of other mood conditions, including the features and consequences of postpartum anxiety (PPA) (Association of Women's Health Obstetric Neonatal Nurses (AWHONN), 2015; Dennis, Brown, Falah-Hassani, et al., 2017; Zappas et al., 2020).

The prevalence of postpartum anxiety is higher than PPD, occurring in approximately 15 to 20% of postpartum women compared to 10-15% in PPD (Anokye et al., 2018; Dennis, Falah-Hassani, et al., 2017; Fawcett et al., 2019; Gavin et al., 2005). Maternal mental health conditions, when left untreated, result in $14.2 billion in societal costs over a five year period, highlighting a weighty economic burden (Luca et al., 2019). Perhaps of even more importance are the associated clinical consequences of PPA, including maternal distress, problems with daily functioning (Dennis, Brown, Falah-Hassani, et al., 2017; Goldfinger et al., 2020), increased difficulties breastfeeding and infant bonding (Hoff et al., 2019; Tietz et al., 2014) and increased risk for offspring emotional or temperament issues (Petzoldt et al., 2016; Polte et al., 2019).

In response to improved recognition of the prevalence and clinical significance of PPA conditions, the American College of Obstetricians and Gynecologists (ACOG) recommends screening for both anxiety and depression in pregnancy and postpartum (American College of Obstetricians and Gynecologists (ACOG), 2018). Similarly, the Association of Women's Health, Obstetrics, and Neonatal Nurses (AWHONN) calls for further attention to anxiety screening, as well as continued research to further understanding of the condition (Association of Women's Health Obstetric Neonatal Nurses (AWHONN), 2015). Despite recommendations, little progress has been made regarding the detection of PPA, and screening rates remain low (Goldin Evans et al., 2015). Reported challenges relate to the lack of diagnostic criteria for PPA conditions (Jordan & Minikel, 2019; Zappas et al., 2020), difficulties differentiating between adaptive anxiety after delivery and clinically significant anxiety (Zappas et al., 2020), and lack of consensus for a PPA-specific screening tool (Thorsness et al., 2018; Zappas et al., 2020). The lack of clear diagnostic criteria for PPA is problematic, as individuals who present with prominent anxiety symptoms are often considered to have PPD even when these symptoms do not fit diagnostic criteria for PPD (American College of Obstetricians and Gynecologists (ACOG), 2018; Bhat et al., 2022; Matthey et al., 2003; Paul et al., 2013). Further, when individuals present with anxiety symptoms, ambiguities about the type and severity of anxiety experienced remain; namely, whether patients' symptoms are severe enough to meet criteria for generalized anxiety disorder (Howard & Khalifeh, 2020; Lorenzo, 2022). However, the latter questions assumes PPA and generalized anxiety disorder are similar constructs, although this question still remains undetermined (Howard & Khalifeh, 2020; Zappas et al., 2020).

Sole reliance on the Edinburgh Postnatal Depression Scale (EPDS) to assess mood disorders in postpartum settings further perpetuates the tendency to misclassify PPA as PPD

(Gibson et al., 2009). In the absence of a suitable alternative, some clinicians advocate use of the EPDS to detect comorbid anxiety, citing research evidence for the reliability and validity of its anxiety 3-A subscale (Matthey et al., 2013; Smith-Nielsen et al., 2021; Thorsness et al., 2018; Zappas et al., 2020). However, recent evidence confirms that the EPDS can neither reliably differentiate anxiety from depression (Fairbrother et al., 2019) nor detect women with anxiety disorders confirmed by diagnostic interview (Rowe et al., 2008). Further data show the anxiety subscale of the EPDS only moderately correlates with anxiety criteria compared to the STAI (van der Zee-van den Berg et al., 2019) and is of limited value to detect anxiety cases beyond what the total EPDS identifies as depression (Smith-Nielsen et al., 2021). In other words, when anxiety occurs independently of depression rather than as feature of it, reliability of the EPDS diminishes. As evidence that PPA often occurs independent of depression mounts (Nakić Radoš, 2018), continued use of the EPDS to detect PPA is insufficient and inappropriate. The Postpartum Specific Anxiety Scale (PSAS) was recently created to capture anxiety domains specific to postpartum populations (Fallon et al., 2016). Routine use of this instrument in conjunction with the EPDS may enhance PPA detection.

In light of these questions, a better understanding of the course and temporal patterns of PPA, such as severity and triggers over time, is warranted to improve detection and treatment of PPA. Ecological momentary assessment (EMA) is a method to collect repeated assessments of an individual's experiences in real-time, real settings, and across contexts (Shiffman et al., 2008). EMA data collection methods include mobile applications, links to online surveys, and interactive voice response structures (Yang et al., 2019). Mental health fields have recognized the benefit of EMA to explore temporal and contextual characteristics of mood conditions (aan het Rot et al., 2012; Colombo et al., 2019; Myin-Germeys et al., 2018; Shiffman et al., 2008). Specifically, real-

time data collection generates valuable information about dynamic fluctuations in mood states that are free from the recall bias inherent with retrospective assessments (Shiffman et al., 2008; van Genugten et al., 2020). Further, EMA is efficient and practical for measuring the context of mood and stress over time when used alone (Yang et al., 2019), or to describe variations between assessments with standard mood questionnaires at certain time points. Therefore, mobile EMA (mEMA) may be particularly useful for describing patterns of anxiety in the postpartum period. The aims of this study were to describe the prevalence and stability of self-reported anxiety assessed in the 3rd trimester and at one- to eight-weeks postpartum with the State Trait Anxiety Inventory (STAI) and Postpartum Specific Anxiety Scale (PSAS), and to describe the trends in daily anxiety ratings using mEMA from one- to eight-weeks postpartum.

3.3 MATERIALS AND METHODS

3.3.1 Design

We conducted a prospective cohort study with repeated anxiety assessments from the 3rd trimester through eight-weeks postpartum using self-report anxiety questionnaires at one- and eight-weeks and mEMA daily for seven-weeks postpartum. The study was approved by the University of Pittsburgh's Human Research Protection Office prior to study initiation and conducted between August 2021- March 2022. (STUDY21010106)

3.3.2 Sample

We recruited birthing people between 27 to 40 weeks of pregnancy who planned to give birth at a large academic tertiary center in the Mid-Atlantic U.S. that has >11,000 births per year. Individuals were approached for consent in-person during prenatal appointments in community clinics or remotely (e.g., social media posts, brochures, and a research registry). We set a target sample size of 75 participants, with the goal to retain at least 50 participants (66.7%) through final data collection at eight-weeks postpartum. Sample size was based on study time frame available for recruitment (≤ 1 year), expected attrition rates, costs, and exploratory nature of the study. Attrition rates of 25-30% from recent postpartum studies with similar longitudinal time frames (e.g., birth to six or eight-weeks postpartum (Dennis, Brown, Falah-Hassani, et al., 2017; Nakić Radoš, 2018)) informed target sample size.

Pregnant persons were eligible if they were ≥ 18 years old, English-speaking, planning to give birth at the study hospital, and had access to a smartphone. Individuals were excluded if their electronic health record (EHR) disclosed: (1) a positive history of drug or alcohol abuse, (2) a history of psychotic disorders or active suicidality (severe mental illness may confound result) (Grant et al., 2008), (3) a multiple-fetus pregnancy, or (4) maternal, fetal, or neonatal complications (these may cause unanticipated psychological distress) (Roque et al., 2017).

3.3.3 Measures

The **State Trait Anxiety Scale (STAI**) is a 40-item, self-report, Likert-style questionnaire developed to detect generalized anxiety (Spielberger et al., 1983), and is the most frequently used questionnaire in perinatal anxiety research (Dennis, Falah-Hassani, et al., 2017). The STAI

consists of two forms, each with 20 questions. The first form measures "state" anxiety, or one's response to situational stress, while the second form measures "trait" anxiety, or one's tendency to experience stress (Spielberger et al., 1983). Our study used the "state" form (STAI-S), as we were primarily interested in participants' responses to situational stress in postpartum contexts. STAI-S scores range from 20 to 80; higher scores indicate increased anxiety. Internal consistency in a perinatal sample was high (Cronbach's $\alpha = 0.95$) (Dennis et al., 2013). For this study, participants with a score > 40 on the STAI-S were considered to have PPA based on established cut-offs (Dennis et al., 2013). The STAI-S was administered at baseline (3rd trimester of pregnancy), one and eight-weeks postpartum to determine its utility for detecting PPA and comparing results with the PSAS to differentiate PPA from general anxiety. In our sample, STAI-S internal consistency was high (Cronbach's $\alpha = 0.84$).

The **Postpartum Specific Anxiety Scale (PSAS),** a 51-item self-report with Likert-style response choices, was developed to detect postpartum-specific anxiety (Fallon et al., 2016). Scores range from 46 to 204. Internal consistency in sample of women from birth to 6 months postpartum was high (Cronbach's $\alpha = 0.95$) (Fallon et al., 2016). For this study, participants with a score > 112 on the PSAS were considered to have PPA based on established cut-offs for optimal sensitivity and specificity (Fallon et al., 2016). The PSAS was used in our study at one- and eight-weeks postpartum to determine its utility for detecting PPA in comparison to the STAI. Internal consistency of the PSAS in our sample was high (Cronbach's $\alpha = 0.85$).

Daily Postpartum Anxiety Rating. Participants were sent daily mEMA prompts with the following investigator-created question: "Overall, how worried or anxious have you felt today?" Responses were on a scale of 0 ("not at all") to 10 ("very much so").

Edinburgh Postnatal Depression Scale (EPDS*),* a 10-item self-report with Likert-style response choices (Cox et al., 1987), was included to examine the presence of depression (Falah-Hassani et al., 2017). EPDS scores range from 0 to 30; higher scores indicate lower maternal mood. Internal consistency in a postpartum sample of women from birth to 3 months was high (Cronbach's $\alpha = 0.88$) (Cox et al., 1987). For this study, participants with scores ≥ 12 on the full EPDS instrument were considered to have symptoms indicative of depressive illness based on established cut-offs (Cox et al., 1987). Internal consistency in our sample was $\alpha = 0.63$.

Sample Characteristics *were collected for a variety of socio-demographics* using an investigator-created self-report questionnaire. The electronic health record was reviewed to collect clinical data regarding infant birth date, pregnancy-related complications and to verify self-reported mental health and gynecological histories. Co-abstraction was performed by a research assistant for a random subsample of 30% of the medical record reviews to verify data consistency and accuracy.

3.3.4 Procedures

After enrollment, all communication and data collection activities were performed remotely via phone, email, or mobile messaging. Once enrolled, hyperlinks were sent to participants' mobile devices to complete questionnaires using the web-based Qualtrics XM platform at baseline and again at one- and eight-weeks postpartum. Mobile EMA (mEMA) prompts to rate anxiety were sent as links to participants' mobile devices daily from one- to eight-weeks postpartum based on their preferred time (i.e.., 9A.M., 1P.M., 6P.M., or no preference/rotating schedule). A daily evening reminder text was sent if the mEMA rating was not returned. An escalating monetary incentive was offered for completion of study activities ($10 for

one-week questionnaires, $25 for completion of ≥ 75% mEMA prompts, and $35 for eight-week questionnaires).

3.3.5 Statistical Analysis

All statistical analyses were performed with IBM SPSS v.27 and Microsoft Excel (IBM Corp, 2021; Microsoft Corporation, 2022). Prior to analysis, study data were screened for accuracy, completeness, and statistical assumptions. No extreme outliers were observed on mood questionnaire scores at study time points; however, STAI-S and EPDS scores violated normality assumptions per visual inspection of score distributions and the Shapiro-Wilk's test of normality. Violations to normality were not deemed extreme, so continuous variables were described using means (*M*) and standard deviations *(SD).* Categorical variables were summarized using frequencies and percentages. First, total *questionnaire scores* (e.g., STAI-S, PSAS, EPDS) were described (*M* ± *SD)*, followed by percentages of participants who met thresholds for anxiety for each questionnaire and at each time point. Cross-tabulations were used to describe the percentage of participants who met the threshold for PPA on one or both of the anxiety questionnaires (e.g., STAI or PSAS) at one- and eight-weeks postpartum.

Stability of anxiety scores was explored using one-way repeated-measures analysis of variance (RM-ANOVA) for mean STAI-S scores across all three time points, and a paired t-test for mean PSAS scores at one-week to eight-weeks postpartum (PSAS). Due to violations in normality for STAI-S scores at each time point, a Log base 10 transformation was applied, mitigating the violation. The assumption of sphericity was also not met, so the Greenhouse-Geiser correction was applied (Greenhouse & Geisser, 1959). For PSAS scores, the assumption of

normality was met (Shapiro-Wilk's test, $p = 0.328$). Statistical significance was set at $p < 0.05$ and estimates were reported with 95% confidence intervals.

Daily mEMA anxiety ratings were aggregated and then summarized for the full seven-week study period for participants who completed 50% or more of daily mEMA prompts. Mean daily anxiety ratings per each study week were also aggregated and summarized. To be included in each week's summary, participants had to have completed 50% or more of the total daily mEMA prompts and have recorded at least four anxiety ratings for that study week. Participants who missed ≥ 4 prompts in a particular study week were excluded from that week's summaries. Mean daily anxiety ratings for those who met the threshold on either anxiety questionnaires (e.g., STAI-S, PSAS) and were below the threshold for PPA at eight-weeks postpartum were also plotted on line graphs for graphical comparison. The overall *sample trend* for daily anxiety ratings was evaluated using linear mixed-effect modeling assuming a normal error distribution. Final models included the interaction term as well as main effects of time as both a linear and quadratic functions.

3.4 RESULTS

Sample characteristics (N = 73) are reported in Table 4. The mean age of participants was 31.2 years, and the majority identified as White (80.8%) and non-Hispanic (95.5%). Most were partnered (90.4%) and had at least a bachelor's degree (75.3%), and almost a third (31.5%) had a history of a mental health condition (e.g., anxiety, depression). Slightly over half the sample was primiparous (54.8%). Of the 73 participants enrolled, 93.4% (n = 71) completed questionnaires at baseline (3rd trimester), one-, and eight-weeks postpartum. Sixty-eight participants (89.5%)

provided anxiety and depression questionnaire measurements at each time point and ≥ 50% of mEMA prompts.

3.4.1 Stability of Anxiety Scores

Total scores for mood questionnaires, including the percentage above the cut-off for each time point, are summarized in Table 5.

3.4.1.1 STAI-S

STAI-S scores in descending order were highest at one-week postpartum (N = 73; 36.4 ± 11.0), lower in the third trimester (N = 73, 35.1 ± 10.1), and lowest at eight-weeks postpartum (n = 71; 33.4 ± 9.6). The percentage of individuals with positive anxiety screens was highest at one-week postpartum (28.8%), lower at eight-weeks postpartum (23.9%), and lowest in the third trimester(21.9%). STAI-S scores were significantly different across time points, $F(1.85, 129.18) = 4.305$, $p = 0.018$. Post-hoc comparisons using the Bonferroni adjustment revealed STAI-S scores significantly decreased from one-week (36.4 ± 11.0) to eight-weeks (33.4 ± 9.6), (-0.036, 95%CI [-0.065 to -0.007], $p = 0.01$) postpartum, but not from the third trimester (35.1 ± 10.1) to one-week postpartum (36.4 ± 11.0), (-0.014, 95%CI [-0.048 to 0.020], $p = 0.916$).

3.4.1.2 PSAS

Scores on the PSAS were higher at eight-weeks postpartum (n = 71; 93.9 ± 20.7) than at one-week postpartum (N = 73; 88.6 ± 19.6). The proportion of participants with PSAS scores above the cut-off (e.g., > 112) was highest at eight-weeks postpartum (21.1%) and lowest at one-

week postpartum (12.3%). During the postpartum period, participants' scores at eight-weeks (n = 71; 93.9 ± 20.7) were significantly higher than at one-week (N = 73; 88.6 ± 19.6), increasing by a mean of 5.2 points, 95%CI [1.80 to 8.63], $t(70) = 3.047$, $p = 0.003$.

3.4.1.3 Detection of Anxiety by Questionnaire

The percentage of participants who met the threshold for anxiety or depression at eight-weeks postpartum, as determined by a score > established cut-offs on either the STAI-S, PSAS, or EPDS was 35.2% (25/71). Cross-tabulations revealed that a combination of the EPDS and STAI-S at eight-weeks postpartum detected 17/71 (23.9%) of participants with anxiety or depression while a combination of the EPDS and PSAS detected 19/71 (26.8%). Alternatively, use of only the EPDS detected 7/71 (9.9%) participants with depressive symptomatology. Cross-tabulated results can be found in Table 6.

3.4.2 Daily mEMA Anxiety Ratings

Of the 68 participants included in mEMA analysis, 80.9% (55/68) completed > 75% and 67.6% (46/68) completed > 90%. Mean daily anxiety ratings for the entire study period were 1.75 ± 1.96 (n = 68). Mean daily anxiety ratings were highest at two-weeks (2.11 ± 1.96, n = 67) and lowest at eight-weeks postpartum (1.55 ± 1.95, n = 59). Mean daily anxiety ratings over each study week between those who did and did not meet the threshold for PPA per eight-week questionnaire scores are presented in Figure 5. Linear mixed-effect modeling revealed a quadratic trend in daily anxiety ratings over the initial eight-week postpartum period (Figure 6), where there was an initial decline in anxiety ratings over the study period that leveled off before beginning an ascent in the latter study weeks. Results of linear-mixed modeling are reported in are reported in Table 7.

3.5 DISCUSSION

In this exploratory, descriptive study, we used multiple measurement modalities to describe the percentage of participants with anxiety scores above established cut-offs at multiple postpartum timepoints, the stability of anxiety scores over time, and the trends in daily anxiety levels in the postpartum period. As ambiguity exists regarding the construct of PPA and best approaches for its detection in perinatal settings, we used three questionnaires to assess the presence of mood conditions: the STAI, a generalized anxiety questionnaire, the PSAS, a postpartum-specific questionnaire, and the Edinburgh Postnatal Depression Scale, a depression questionnaire for use in the postpartum period. We also used daily mEMA anxiety ratings to explain variations in PPA detection and course between questionnaires.

We found in our sample the prevalence of PPA at eight-weeks to be higher than pooled estimates from a systematic review and meta-analysis (Dennis, Falah-Hassani, et al., 2017). While our study was not powered to provide epidemiologic estimates of PPA prevalence, which would have required a sample size of ≥ 240, our results yield insight into discrepancies regarding PPA detection by measurement modality. In our sample, the STAI-S detected the greatest proportion of participants with PPA, 17/71 (23.9%) at eight-weeks postpartum. This finding is consistent with others who support its sensitivity for PPA detection (Dennis et al., 2013; Meades & Ayers, 2011; Paul et al., 2013). By contrast, PPA prevalence in our sample measured by the PSAS at eight-weeks was slightly lower 15/71 (21.1%). Eight participants (11.3%) identified as having PPA on the PSAS did not meet the threshold for PPA using the STAI-S. Similarly, ten participants (14.1%) with anxiety per the STAI-S would not have been detected with the PSAS alone. However, combined use of the EPDS and the PSAS detected a greater percentage of participants with anxiety or depression (26.8%) than the EPDS and STAI-S (23.9%). Otherwise, sole use of the EPDS would

have identified the smallest proportion of mental health cases of all three questionnaires (7/71), validating others' claim that lone use of this instrument in clinical settings is insufficient as a maternal mental health screening tool (Lieb et al., 2020).

Prevalence rates for PPA in our sample are similar to recent estimates. However, it is prudent to note that "true" prevalence of PPA is difficult to discern given the highly variable nature of its measurement in the literature, and the predominant use of "general anxiety" questionnaires to define the phenomenon (Fallon et al., 2016). Nonetheless, a systematic review and meta-analysis of studies defining PPA using a variety of self-report questionnaires reported a postpartum prevalence rate of 15% from birth to six months postpartum (Dennis, Falah-Hassani, et al., 2017). More recently, Rados and colleagues found 20% of their sample at six weeks postpartum had PPA when measured by the STAI-S (Nakić Radoš, 2018). While our PPA estimates based on one questionnaire are similar (e.g., PSAS *or* STAI-S), the proportion of PPA in our sample rises notably when both are used to detect PPA, 25/71 (35.2%). Differences in PPA prevalence rates may be attributed to several factors. First, our study was conducted during the Covid-19 pandemic, during which experts predicted a rise in maternal mental health issues (Matvienko-Sikar et al., 2020; Zeng et al., 2021), which has been confirmed more recently (Perzow et al., 2021). Second, use of an additional questionnaire specific to PPA (e.g., PSAS) may have increased our detection capabilities. This idea supports the assertion that postpartum populations are affected by worry domains specific to maternal roles (Goldfinger et al., 2020; Phillips et al., 2009), and that PPA is a unique condition in the postpartum period. As researchers have already identified the PSAS's predictive advantage over the STAI-S regarding relationships between PPA and maternal and infant feeding outcomes (Fallon et al., 2018, 2019), our results support claims that postpartum-specific anxiety is distinct from generalized anxiety. Collectively, these findings highlight the need

for additional screening strategies in postpartum clinical populations and discourage further exclusive use of the EPDS. Third, other researchers claim that the STAI-S may actually inflate PPA prevalence, as its questions reflect "general" somatic symptoms and not those expected or experienced in "postpartum" populations (Infante-Gil et al., 2022; Meades & Ayers, 2011). For example, fatigue may be a feature of anxiety in general populations; yet, in postpartum persons, it is an expected side effect of newborn care. Finally, PPA prevalence may have been higher in our sample due to convenience sampling and participation bias, where people drawn to participation were more likely than others to experience or exhibit anxiety.

We also investigated the stability of PPA scores per questionnaire. Statistically significant decreases in anxiety scores on the STAI-S were observed from one-to eight-weeks postpartum, but the opposite was true for the PSAS. Rather, participants' PSAS scores significantly increased from one-to eight-weeks postpartum. Regarding STAI-S score stability, our findings are similar to the previously cited systematic review which likewise found a decrease in PPA levels as the time from birth lengthened (Dennis, Falah-Hassani, et al., 2017). Unfortunately, there are too few prevalence studies with the PSAS to draw meaningful comparisons of its stability; but Rados and colleagues (2018) found similar postpartum score increases in their sample when using the STAI-S. While their results seem to contradict our study's finding of decreasing anxiety scores with the STAI-S, Rados and colleagues' sample excluded people with positive depression screens or a history of psychiatric disorders/treatment. Differences in sample inclusion criteria may explain inconsistent findings. Nevertheless, in our sample, there was a significant decrease in "generalized anxiety" scores (STAI-S) and a significant increase in "postpartum specific anxiety" scores (PSAS) over the study period, signifying that PPA-specific instruments may be more reliable and valid to capture new onset or worsening PPA conditions.

To better understand the course and trend of PPA, we utilized innovative mEMA methods to obtain individual daily anxiety ratings over the study period. The combination of mEMA with anxiety questionnaire outcomes at eight-weeks postpartum gave additional insight into reports of anxiety in the postpartum period. Participants below PPA thresholds at eight-weeks displayed some level of anxiety on a daily and weekly basis that declined as the time from birth lengthened. This supports literature and clinical observations regarding the stress and anxiety that is expected during maternal transition and adaptation to new roles and environments after childbirth (Zappas et al., 2020). Also, our findings revealed that for others who met PPA thresholds on either the STAI-S or PSAS at eight-weeks postpartum, mean daily anxiety scores were higher over the study period, and rather than decreasing as time from birth lengthened, actually increased in the latter postpartum weeks.

Our data provide empirical evidence for optimal timing of PPA screening. All participants in our sample experienced highest mean daily anxiety levels at two weeks postpartum, regardless of eight-week anxiety questionnaire scores. This finding supports current guidelines recommending a two-week phone call for early identification of mental health conditions (American College of Obstetricians and Gynecologists, 2018). Further, the curvilinear daily anxiety trend revealed that while anxiety ratings declined from their initial levels and stabilized over the middle study weeks, the final weeks reflected a significant upward trend in rating severity. Because our mEMA demonstrates the trend in average daily anxiety ratings may begin rising at six-weeks postpartum, PPA screening at or after this traditional timepoint should be strongly considered (Stumbras et al., 2016).

Our study explored PPA prevalence using three measurement modalities; offering a descriptive comparison of PPA detection by a generalized and postpartum-specific anxiety questionnaire.

Mobile EMA in conjunction with eight-week anxiety questionnaire scores produced novel empirical data regarding daily anxiety levels from one- to eight-weeks postpartum in people with and without PPA at eight-weeks. Additionally, we found evidence for sustained and worsening PPA in the latter postpartum period (e.g., six- to eight-weeks). Potential explanations for worsening anxiety at this timepoint can be found in some perinatal literature, but are rarely explored in PPA research, as available qualitative studies are scarce. Nonetheless, in a sample of primiparous breastfeeding women, researchers found parental return to the workplace, changing developmental and feeding needs of infants, and milk regulation concerns, were commonly reported issues at eight-weeks postpartum (Demirci & Bogen, 2017a). While these reports yield insight into scenarios that may contribute to PPA onset or worsening, they need to be explored in the PPA context. Others have sought to investigate predictors of sustained or worsening PPA in the latter postpartum period (e.g., six- to eight-weeks postpartum); concluding that low social support, high perceived stress, depressive symptoms in pregnancy, and high trait anxiety after birth predicted worsening PPA (Dennis, Brown, Falah-Hassani, et al., 2017; Furtado et al., 2019; Nakić Radoš, 2018). Yet, each of these studies used generalized anxiety questionnaires to examine relationships, potentially missing characteristics of individuals who would have only had PPA detected by the PSAS. More qualitative research is urgently needed to help understand and explain the experiences that contribute to PPA onset and worsening. Meanwhile, strong consideration should be given to instrumentation choice and timing for routine maternal mental health screening. Our findings support the addition of a postpartum-specific screening tool to optimize detection of postpartum-specific anxiety conditions, particularly at eight-weeks postpartum.

3.5.1 Limitations

Strengths of our study included its prospective design, multiple measurement modalities, and innovative use of mEMA methods to provide novel data on daily anxiety levels. Also, our sample retention and mEMA completion rates were very high, producing a large dataset. In terms of limitations, we chose to include persons with a history of mental illness in our study, which may have inflated PPA prevalence rates and confounded measurement of anxiety constructs (e.g., generalized anxiety vs. postpartum-specific anxiety). Nevertheless, given that current detection and referral of PPA is insufficient regardless of mental health history, we felt inclusion of these persons increased generalizability of our results. Another limitation was our use of self-report instruments rather than clinical diagnostic interviews to report anxiety prevalence, which could have inflated results due to self-report bias (Althubaiti, 2016). However, there are no diagnostic guidelines for PPA, so we felt construct exploration was best served by self-report questionnaires designed to capture postpartum specific anxiety experiences and worry domains. Although these sample characteristics reflected the makeup of the study region, which is estimated to be 79.9% white, 13.4% black, and have a median household income of $62,320 (*U.S. Census Bureau QuickFacts: Allegheny County, Pennsylvania*, n.d.), our sample diversity was somewhat limited with higher proportions of white and highly educated participants. Finally, due to study timeframe constraints, we elected to only examine PPA through eight-weeks postpartum. Additional studies are needed to examine whether PPA persists or worsens at later postpartum time points (e.g., 3-months to 1-year postpartum).

3.6 CONCLUSIONS

In our descriptive, exploratory study, we sought to examine the prevalence, stability, and trend of PPA utilizing multiple measurement modalities. Our findings corroborated the reportedly high prevalence of this condition in postpartum populations, but highlighted considerations regarding timing of measurement and detection approaches. While experiencing minimal levels of anxiety in the postpartum period may be common for all, for some, postpartum-specific anxiety exists independently of generalized anxiety and worsens in the latter postpartum period. Future research should strive to describe PPA experiences in conjunction with daily anxiety ratings to improve detection strategies and inform future intervention development.

Table 4. Sample Characteristics (N = 73)

Characteristics	n (%)
Mean Age (years), (SD)	31.19 (4.81)
Race	
White	59 (80.8)
Black	5 (6.8)
Asian	4 (5.5)
Other	5 (6.8)
Non-Hispanic	70 (95.9)
Education	
Never finished high school	1 (1.4)
High school diploma/GED	6 (8.2)
Some college/vocational program	11 (15)
Bachelor's degree	23 (31.5)
Graduate degree	32 (43.8)
Married/Partnered	66 (90.4)
Primiparous	40 (54.8)
Past issues with Infertility	3 (4.1)
Past History of Mental Illness	23 (31.5)
Smoked in last 12 months	6 (8.2)
Pregnancy Complications	22 (30.1)
Mode of Delivery	
Vaginal	57 (78.1)
Scheduled or repeat cesarean	7 (9.6)
Non-scheduled cesarean	9 (12.3)
Labor Complications	16 (21.9)
Preterm Delivery	2 (2.7)
NICU[a] Admission	2 (2.7)
Feeding preference	
Exclusive breastfeeding*	47 (64.4)
Exclusive formula feeding	5 (6.8)
Combination breast/formula	18 (24.6)
Unsure/undecided	3 (4.1)
Planned length of maternity leave	
N/A – Not employed previously	14 (19.2)
Uncertain	5 (6.8)
≤ 6 weeks	6 (8.2)
6-12 weeks	36 (49.3)
13 weeks – ≥1 year	12 (16.4)
Income Level	
$10,000 – 49,999	12 (16.5)
$50,000 – 89,999	17 (23.3)
>$90,000	42 (57.5)

[a] NICU, Neonatal Intensive Care Unit, *including pumped or expressed breastmilk

Table 5. Mood Questionnaire Scores by Timepoint

Time Point	STAI-S[a]			PSAS[b]			EPDS[c]		
	M	SD	% > cut-off	M	SD	% > cut-off	M	SD	% > cut-off
Baseline (3rd trimester) N = 73	35.1	10.1	21.9	--	--	--	--	--	--
One-week postpartum N = 73	36.5	11.0	28.8	88.6	19.6	12.3	7.3	4.8	19.2
Eight-weeks postpartum n = 71	33.4	9.6	23.9	93.9	20.7	21.1	7.0	4.4	9.9

Notes. M=mean, SD=standard deviation; [a]State-Trait Anxiety Inventory, score range 20-80 (Spielberger et al., 1983), cut-off >40 (Dennis et al., 2013), [b]Postpartum Specific Anxiety Scale, score range 44-204, cut-off >112 (Fallon et al., 2016); [c]Edinburgh Postnatal Depression Scale, score range 0-30, cut-off ≥12 (Cox et al., 1987)

Table 6. Percentage of Participants Above Cut-off from Self-report Mood Scales at Eight-Weeks Postpartum (n=71)

Postpartum Time Point	STAI-S[a] only	PSAS[b] only	EPDS[c] only	STAI-S[a] & PSAS[b] only	STAI-S[a] & EPDS[c] only	PSAS[b]& EPDS[c] only	All positive
Eight-weeks, n (%)	6 (8.5)	8 (11.3)	0 (0)	4 (5.6)	4 (5.6)	0 (0)	3 (4.2)

Notes. [a]State-Trait Anxiety Inventory, score range 20-80 (Spielberger et al., 1983), cut-off >40 (Dennis et al., 2013), [b]Postpartum Specific Anxiety Scale, score range 44-204, cut-off >112 (Fallon et al., 2016); [c]Edinburgh Postnatal Depression Scale, score range 0-30, cut-off ≥12 (Cox et al., 1987)

Table 7. Linear Mixed-effect Modeling Results of mEMA Anxiety Ratings

Fixed Effects	Estimate	SE	t	p	95% CI
Intercept	2.29	0.202	11.22	<0.001	[1.86, 2.67]
Linear	-0.040	0.013	-2.93	0.005	[-0.062, -0.018]
Quadratic	0.001	0.0002	2.15	0.036	[0.0003, 0.001]
Random Effects	Estimate	SE	z	p	95% CI
Level-2 (Between-person)					
Intercept	2.18	0.480	4.56	<0.001	[1.42, 3.35]
Linear	0.006	0.002	3.02	0.003	[0.003, 0.011]
Quadratic	0.000002	0.000001	2.60	0.009	[0.000001, 0.000003]
Intercept and Linear	-0.062	0.025	-2.48	0.013	[-0.112, -0.013]
Intercept and Quadratic	0.001	0.0004	2.21	0.027	[0.0001, 0.002]
Linear and Quadratic	-0.0001	0.00003	-2.76	0.006	[-0.0002, 0.00003]
Level-1 (Within-person)					
Residual	2.15	0.060	35.84	<0.001	[2.04, 2.27]
Autocorrelation	0.129	0.021	6.21	<0.001	[0.0888, 0.169]

Notes. n = 68

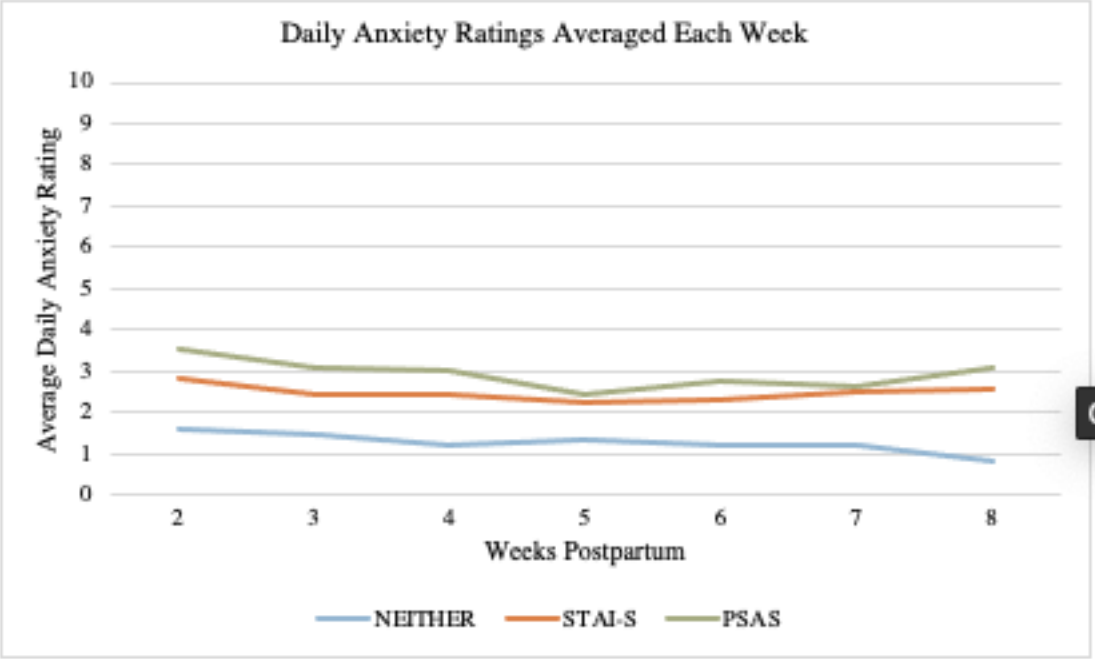

Figure 5. mEMA Anxiety Ratings for those >cut-off for anxiety on the STAI-Sa, PSASb, or neither questionnaire at Eight-Weeks Postpartum

Notes. STAI-S=State-Trait Anxiety Inventory, score range 20-80 (Spielberger et al., 1983), cut-off >40 (Dennis et al., 2013), PSAS=Postpartum Specific Anxiety Scale, score range 44-204, cut-off >112 (Fallon et al., 2016); Sample size varied by postpartum week: Week 2, n = 67; Week 3, n = 67; Week 4, n = 65; Week 5, n = 65; Week 6, n = 63; Week 7, n = 60; Week 8, n = 59

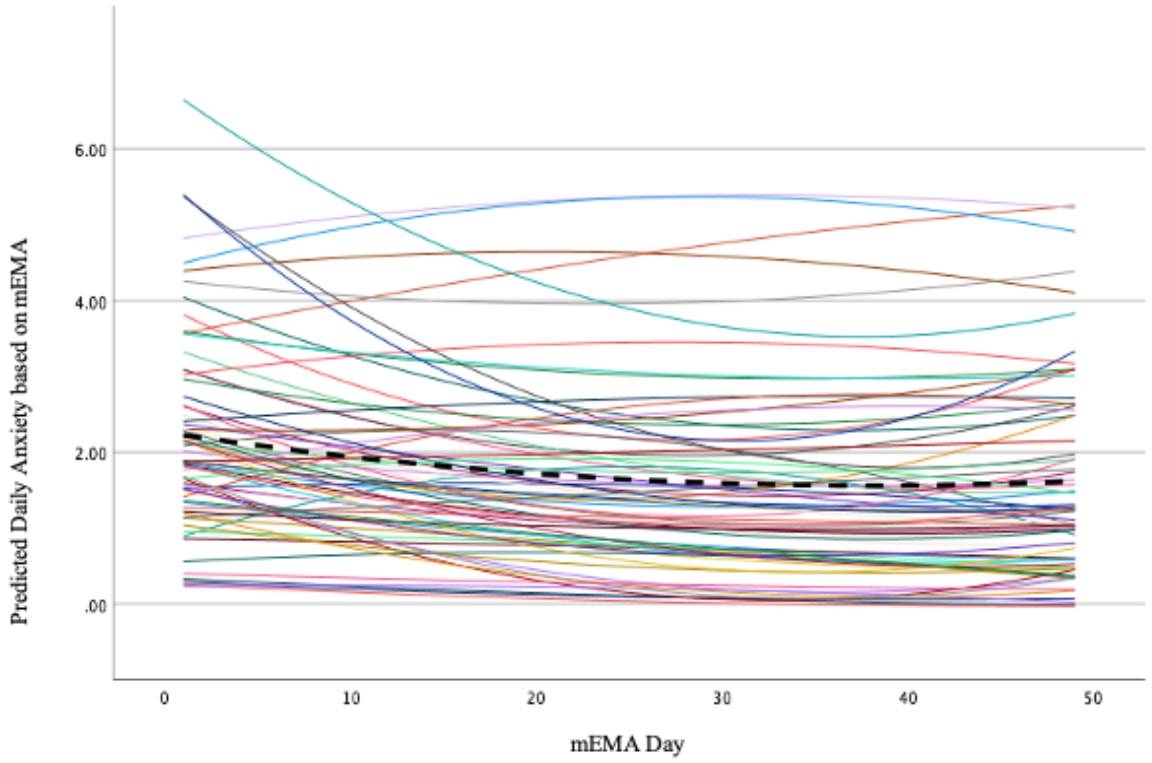

Figure 6. Predicted Individual Trajectories (solid lines) and Average Trajectory (dashed line) for Daily Anxiety Rating based on mEMA from One to Eight-Weeks Postpartum

4.0 MANUSCRIPT 2: A DESCRIPTION OF THE EXPERIENCE OF ANXIETY IN THE POSTPARTUM PERIOD

4.1 ABSTRACT

Objective: To describe experiences of anxiety from one- to eight-weeks postpartum.

Design: A prospective mixed-methods cohort study of postpartum anxiety (PPA) to integrate qualitative findings for responses to frequent theory-driven qualitative questions collected repeatedly over the seven-week period and contextualized based on anxiety questionnaire scores measured at eight-weeks postpartum.

Setting: An academic tertiary center in the Mid-Atlantic U.S. All study activities were remote.

Participants: Birthing people (N=68) were recruited during the 3rd trimester of pregnancy. Stratified sampling was applied to select a diverse subsample (n = 34) for qualitative analysis.

Methods: Mobile phone survey links were sent to collect daily anxiety ratings and responses to theory-driven, open-ended qualitative questions regarding the concepts of perceived stress, social support, role adjustment, environmental influences, and sources of daily anxiety. The State Trait Anxiety Inventory (STAI), Postpartum Specific Anxiety Scale (PSAS) and Edinburgh Postnatal Depression Scale were completed at eight-weeks postpartum. Qualitative description was used to analyze responses to open-ended questions. Findings for each concept were summarized using thematic-categories. Established cut-off scores for anxiety questionnaires were used to classify participants by presence of absence of anxiety. Using a matrix and joint display, qualitative findings were organized by presence or absence of anxiety. Thematic categories were compared and examined in a narrative synthesis of findings.

Results: Individuals who met the threshold for anxiety at eight-weeks postpartum reported feeling more overwhelmed, having less support, experiencing more relationship conflict and difficulty adjusting to maternal roles, and having less positive environmental influences from one- to eight-weeks postpartum than those without anxiety. Differences in responses regarding degree of feeling overwhelmed, nature of support, sources of worry, and types of environmental influences were noted between individuals with anxiety per the STAI versus the PSAS.

Conclusion: Qualitative evidence supported relationships between PPA and high perceived stress, less social support, impaired role adjustment, and relationship conflict. Novel aspects of environmental influence on PPA experiences were discovered, including the positive influence of socialization opportunities in individuals without PPA and the notable lack of these experiences in participants with PPA. Findings regarding sources of daily anxiety revealed potentially modifiable risk factors, including length of maternity leave, financial resources, and provision of education and support for infant health, and infant care after childbirth. Future studies are needed to explore the relationship between generalized anxiety (STAI-S) and postpartum-specific anxiety (PSAS) and the degree to which they overlap in postpartum individuals.

4.2 INTRODUCTION

The phrase ‘maternal mental health conditions’ was coined to bring attention to the spectrum of altered mood experienced by perinatal populations (Yeaton-Massey & Herrero, 2019), which are the most common complications in the postpartum period (US Preventive Services Task Force et al., 2019). In recent years, extensive research has strived to understand these conditions, which include anxiety and its subtypes. Recognition that postpartum anxiety (PPA) is more

common than postpartum depression (PPD), and its significant impact on maternal and infant outcomes, has raised interest in improving detection strategies for PPA (Accortt & Wong, 2017; Fairbrother et al., 2016; Fawcett et al., 2019). Specifically, PPA is associated with increased risk of maternal distress and inability to function (Dennis, Brown, Falah-Hassani, et al., 2017; Goldfinger et al., 2020), challenges in bonding and breastfeeding relationships between mothers and infants (Hoff et al., 2019; Tietz et al., 2014), and development of temperament and/or behavioral issues in infancy and early childhood (Petzoldt et al., 2016; Polte et al., 2019).

Clinical detection of PPA is challenging in several ways. First, there is no collective agreement as to whether PPA is distinct from other types of anxiety (Howard & Khalifeh, 2020; Lorenzo, 2022). Phillips and colleagues (2009) found that the symptoms, consequences, and characteristics reported by a sample of postpartum women diagnosed with "anxiety disorder not otherwise specified" (e.g., "maternally focused worry") were analogous to those with generalized anxiety disorder (GAD), providing justification for further exploration of what the authors considered "maternally focused worry" (Phillips et al., 2009). More recently, Goldfinger and colleagues (2020) compared the types of worry reported by postpartum women diagnosed with GAD to that of non-perinatal women with GAD, finding that the perinatal sample had more parental-themed worries than the non-perinatal group (Goldfinger et al., 2020). While these findings strengthened the argument for the existence of a postpartum-specific anxiety condition, an inclusion criterion for the study by Goldfinger and colleagues (2020) was a diagnosis of GAD, which may have excluded individuals whose experiences with anxiety did not meet GAD diagnostic criteria. A second major challenge to PPA detection is the absence of guidelines or consensus for the best instrument for its identification in clinical settings. To address this gap, Fallon and colleagues (2016) conducted qualitative interviews of postpartum women to develop

the Postpartum Specific Anxiety Scale (PSAS), an instrument for detection of postpartum-specific anxiety. Early assessments of its reliability ($\alpha = 0.95$) and validity were promising (Fallon et al., 2016), yet the PSAS has not been widely adopted or officially included in perinatal mood screening guidelines (American College of Obstetricians and Gynecologists (ACOG), 2018; Fallon et al., 2016; Zappas et al., 2020). In the interim, a recent study revealed that women with perinatal anxiety continue to report challenges disclosing feelings and receiving support from healthcare providers (Oh et al., 2020).

As the field grapples with these challenges, the State-Trait Anxiety Inventory (STAI) remains the most commonly used instrument in PPA research, despite question about its validity to detect anxiety in perinatal populations (Dennis, Falah-Hassani, et al., 2017; Fallon et al., 2016; Infante-Gil et al., 2022; Meades & Ayers, 2011; Spielberger et al., 1983). More descriptive research is needed to delineate postpartum-specific anxiety from generalized anxiety and strengthen the argument for use of a postpartum-specific anxiety instrument in clinical settings.

Furthermore, PPA detection and measurement is challenged by a poor understanding of the experience of anxiety in postpartum contexts; that is, how postpartum environments, experiences, and situations contribute to the development, worsening, or resolution of experiences with anxiety. Although prior qualitative studies identified differences in sources of worry between postpartum and non-postpartum persons, to our knowledge, no prior studies, including the study that described the development of the PSAS (Fallon et al., 2016), examined PPA through a postpartum-specific theoretical lens, or over an extended postpartum time period. Such an approach would situate exploration of individuals' experiences with anxiety in the postpartum context, assist with delineation of PPA from other conditions, and identify potential directions for future intervention

development. **The purpose of this study was to improve understanding of PPA by describing the experience of anxiety from one- to eight-weeks postpartum.**

4.3 METHODS

4.3.1 Design

We conducted a prospective mixed-methods cohort study to better understand the daily experiences of anxiety from one- to eight-weeks postpartum. The mixed-methods design was selected for its utility in combining data types to understand complex phenomena such as PPA (Cresswell et al., 2018). Mobile ecological momentary assessment (mEMA) was used to collect qualitative responses to questions on postpartum theory-driven concepts, sources of anxiety, and daily quantitative ratings of anxiety (e.g., on a scale of 0 to 10). Mobile EMA is well-suited to collect data that reflect temporal and contextual experiences of mood conditions (aan het Rot et al., 2012; Colombo et al., 2019; Myin-Germeys et al., 2018; Shiffman et al., 2008), as it reflects real-time experiences free from recall bias (Shiffman et al., 2008; van Genugten et al., 2020). The State Trait Anxiety Inventory (STAI) (Spielberger et al., 1983) and Postpartum Specific Anxiety Scale (PSAS) (Fallon et al., 2016) were administered at eight-weeks postpartum to contextualize qualitative responses.

The primary focus for this study was the qualitative analysis of participants' responses using qualitative description. Mixed-methods were used to integrate data at two stages. First, for the purpose of development, mEMA daily anxiety ratings were used to develop a stratified sampling plan for the qualitative mEMA responses (Sandelowski, 2000a). Second, for the purpose

of expansion, anxiety questionnaires were used to categorize participants by presence of anxiety (Sandelowski, 2000a). Refer to Figure 7 for sequence of data collection and analyses. Combining qualitative and quantitative data at two levels expanded our understanding of PPA and allowed for a comparison of experiences among birthing people with varying levels of daily mEMA anxiety ratings and presence or absence of PPA at eight-weeks postpartum.

4.3.2 Sample and Setting

We recruited pregnant people in or approaching their 3rd trimester of pregnancy receiving prenatal care at a large academic tertiary center in the Mid-Atlantic U.S.. Recruitment occurred either in-person at prenatal visits, where interested individuals were able to meet with study PI, or via remote strategies (social media posts and a University research registry). We set a target sample size of 75 participants, with the goal to retain at least 50 participants through final data collection at eight weeks postpartum. Sample size was based on feasibility criteria that considered the study time frame (≤ 1 year), exploratory nature, and anticipated attrition rates of 25-30% based on other PPA studies with similar time frames (e.g., birth to six or eight weeks postpartum (Dennis, Brown, Falah-Hassani, et al., 2017; Nakić Radoš, 2018).

Pregnant persons were eligible for inclusion if they were ≥ 18 years of age, English-speaking, planning to give birth at the study hospital, and had access to a smartphone. Persons were excluded if they self-reported or the electronic health record (EHR) revealed any of the following: (1) a positive history of drug or alcohol abuse, (2) a history of psychotic disorders or active suicidality (severe mental illness may confound result) (Grant et al., 2008), (3) a multiple-fetus pregnancy, or (4) severe maternal, fetal, or neonatal complications (e.g., maternal or infant resuscitation or lifesaving interventions) (these may cause unanticipated psychological distress)

(Roque et al., 2017). Once enrolled, all study activities were conducted with remote communication methods (e.g., email, phone, or text messages). The study was approved by the University of Pittsburgh's Human Research Protection Office and conducted between August 2021- March 2022.

4.3.3 Data Collection Procedures

To understand the patterns of participants' experiences from one- to eight-weeks postpartum, we used daily mobile ecological momentary assessments (mEMA). Eight-weeks postpartum was chosen as the cut-off for our exploratory study to balance the benefits and burdens of daily EMA data collection on participants as described by other studies (D. D. Mendez et al., 2019; van Genugten et al., 2020). Further, the one to eight weeks postpartum timeframe made it possible to compare our findings to those reported in previous studies that examined anxiety prospectively over similar time periods (Dennis, Brown, Falah-Hassani, et al., 2017; Fairbrother et al., 2016; Furtado et al., 2019; Nakić Radoš, 2018).

Data were collected by sending mobile links from the web-based Qualtrics XM platform. At study enrollment (e.g., 3rd trimester of pregnancy), participants completed a sociodemographic questionnaire. Daily mEMA prompts were sent between one- to eight-weeks postpartum asking participants to rate their anxiety level on a scale from 0-10. The open-ended mEMA questions were rotated on a daily basis so that each question was asked only once per week for a total of seven times over the study period. The timing for sending prompts was based on participants' preferences (e.g., 9A.M., 1P.M., 6P.M., or no preference/rotating schedule). If mEMA prompts were not answered by 8 P.M. on the day sent, participants received an evening reminder message. A total of 49 daily prompts were scheduled for each participant, and each prompt contained two

to three open-ended questions. They were also prompted to respond "N/A" if they had no sources of anxiety or worry to report on any particular day. At eight-weeks postpartum, participants were sent one additional mobile link to complete two anxiety questionnaires and a depression questionnaire. An escalating monetary incentive was offered for completion of study activities ($25 for completion of ≥ 75% mEMA prompts and $35 for final questionnaires).

4.3.4 Quantitative Measures

4.3.4.1 Sample Characteristics

Participants were asked to provide demographic, mental health, and obstetrical information on an investigator-created self-report questionnaire at enrollment. Electronic health records were reviewed after childbirth to collect clinical data regarding infant birth date, pregnancy-related complications and to verify self-reported mental health and obstetrical histories. Co-abstraction for random 30% of the medical record reviews was performed by MH and a research assistant to verify data consistency and accuracy. If discrepancies were noted between the two sources, EHR data were reported.

4.3.4.2 Daily mEMA Anxiety Ratings

From one- to eight-weeks postpartum, participants were sent daily mEMA prompts to rate their anxiety using the following investigator-created question: "Overall, how worried or anxious have you felt today?" Responses were on a scale of 0 ("not at all") to 10 ("very much so").

4.3.4.3 Eight-Week Mood Questionnaires

The STAI is a reliable and valid, 40-item, self-report, Likert-style instrument for detection of generalized anxiety (Spielberger et al., 1983). It is the most commonly used instrument in perinatal anxiety research (Dennis, Falah-Hassani, et al., 2017). The STAI consists of a "state" and "trait" form; both with 20 questions. The "state" form measures a person's response to recent situational stress, and the "trait" form measures a person's predisposition to experience anxiety (Spielberger et al., 1983). In this study, only the "state" form was used (e.g., STAI-S), as we were interested in participants' situational anxiety in postpartum contexts. Participants with a score > 40 were considered to have PPA based on established cut-offs (Dennis et al., 2013). In our sample, STAI-S internal consistency was high **(**$\alpha = 0.84$).

The PSAS is a reliable and valid, 51-item, self-report, Likert-style instrument developed to detect postpartum-specific anxiety (Fallon et al., 2016). In our study, participants with a score > 112 on the instrument were considered to have PPA based on established cut-offs for optimal sensitivity and specificity (Fallon et al., 2016). A 16-item shortened version of the PSAS was recently validated (Davies et al., 2021), but the original instrument was used in this study. Internal consistency of the PSAS in our sample was high ($\alpha = 0.85$).

The Edinburgh Postnatal Depression Scale (EPDS) was also administered to identify the presence of depressive symptomatology in the sample due to the comorbid relationship between anxiety and depression (Falah-Hassani et al., 2017). The EPDS is a reliable and valid, 10-item self-report instrument (Cox et al., 1987). A cutoff score of ≥ 12 indicated probable depression. Internal consistency in our sample was $\alpha = 0.63$.

4.3.5 Qualitative Theory-Driven mEMA Questions

Concepts for rotating open-ended mEMA questions originated from theoretical and empirical literature (refer to Table 8: Qualitative mEMA Questions by Concept of Theory of Becoming a Mother).To expand understanding and knowledge of PPA, the "Theory of Becoming a Mother" was chosen to guide the development of qualitative questions (Mercer, 2004). This theory considers how intrinsic and extrinsic forces impact transition and adaptation to mothering roles (Mercer, 2004). Components of the theory with links to PPA, including perceived stress, social support, role adjustment, and environment were incorporated into daily mEMA questions. Of note, the term "environment" is not meant to reflect individuals' physical surroundings but rather the people, situations, or stimuli of their "micro-systems" that potentially impact mood (Mercer, 2004). The item pertaining to perceived stress was taken from the Perceived Stress Scale (Cohen et al 2014). All other questions were investigator-created and evaluated for readability and applicability prior to data collection by two experts in perinatal health research (MDL, JRD).

4.3.6 Analysis

4.3.6.1 Sample Characteristics

Statistical analysis of quantitative data were performed using IBM SPSS vs. 28 (IBM Corp, 2021). Means and standard deviations *(SD)* were described for continuous variables and frequencies and percentages for categorical variables.

4.3.6.2 Daily mEMA Anxiety Ratings

IBM SPSS vs. 28 (IBM Corp, 2021) and R statistical software (version 4.0.4 Vienna, Austria) were used to describe daily mEMA anxiety ratings. The anxiety ratings for each participant were described in two ways, using the mode to reflect the most frequently reported anxiety rating, and the variance to reflect the degree of variation in anxiety ratings over the seven weeks. First, the mode, the most frequently reported daily anxiety rating, was calculated. A dichotomous variable was created where participants with a mode of 0 were categorized as having "no anxiety", and participants with a mode of ≥1 were categorized as having "some anxiety". Second, the mean daily variance (determined by calculating individual and sample means for the day to day difference in anxiety ratings over the study period) was dichotomized using the sample's median variance as the cut-off. Participants whose mean variances were less than the sample's median variance (e.g., < 50^{th} percentile) were categorized as having a "minimal" degree of variance, while those above (e.g., > 50^{th} percentile) were categorized as having a "moderate to marked" degree of variance. The dichotomized mode and variance were described using frequencies and percentages.

Sub-Sample Creation. To ensure that the subsample for qualitative analysis reflected maximum variability and representativeness in daily anxiety ratings (Sandelowski, 2000a), the aggregated and newly dichotomized data from the daily anxiety ratings were combined to create four participant groups for stratified purposeful sampling. Groups were based on a combination of each participant's dichotomized mode and day to day variance in anxiety ratings over the study period. Fifty-percent of the individuals in each of the four groups were randomly selected to create the subsample for inclusion in the qualitative analysis. Daily anxiety ratings were graphically displayed using temporal response plots with the EMA day (1-49) on the x-axis and corresponding

anxiety ratings (0-10) per day on the y-axis. Days with missing ratings were left blank on the graphs. The panel plot was visually inspected to verify similarities and differences in response patterns between groupings.

4.3.6.3 Eight-Week Mood Questionnaires

IBM SPSS vs. 28 (IBM Corp, 2021) was used for analysis of questionnaire data. Established cut-off scores for each anxiety questionnaire were used to classify participants based on whether they met thresholds for PPA on one, both, or neither questionnaire as follows: (1) Category 1: Score < cut-off, *STAI-S & PSAS*, (2) Category 2: Score > cut-off, *STAI-S only*, (3) Category 3: Score > cut-off, *PSAS only*, and (4) Category 4: Score > cut-off *both* instruments. The established cut-off score for EPDS was used to describe the proportion of the sample with presence of depressive symptoms.

4.3.6.4 Responses to Theory-Driven mEMA Questions

Qualitative description with content analysis was used to analyze subsample participants' qualitative mEMA responses over the study period (Sandelowski, 2000b, 2010). This method is well suited for survey-type items as it permits flexible analysis and allows for results to be organized as descriptive summaries rather than theoretical interpretations. mEMA qualitative data were exported to MAXQDA 2022 (VERBI Software, 2022) to facilitate coding and analysis. All data were coded by the lead coder (MH), who has training in qualitative research. MH practiced reflexivity during analysis by coding and recoding data (4 separate times) to ensure that biases were not unduly influential (Dodgson, 2019). To increase trustworthiness and credibility (Cope, 2014), final codes were reviewed by the PhD advisor (ADD), an expert in qualitative and mixed-

methods research. If disagreements arose regarding coding, MH and ADD met to discuss and resolve findings using an iterative process. An audit trail was kept of all decisions.

Participants' responses were organized by each theory-driven, open-ended question (e.g., perceived stress, social support, role adjustment, environment, and daily source(s) of anxiety) and coded separately. Codes were aggregated within each question category to form concepts. Concepts were further organized into thematic-categories based on similarities. Content analysis of responses within each thematic-category was performed (Elo & Kyngäs, 2008), and findings were presented as descriptive summaries. Confirmability was established by using participants' direct quotations and thick description (Geertz, 1973) to support findings and by comparing results to empirical literature on similar concepts (Cope, 2014). Exemplar quotes are italicized and labeled by the participant's study ID number and the study week the responses were expressed (e.g., P #, week #). Use of stratified purposeful sampling to create a diverse and representative subsample for qualitative analysis increased transferability of findings (Cope, 2014; Sandelowski, 2000a). To further improve reliability, qualitative findings were reviewed by two experts in perinatal (JRD) and perinatal mental health (MDL) research during manuscript development. Final adjustments to analysis and presentation of findings were made based on feedback.

4.3.6.5 Organization of Qualitative Findings by Quantitative Results

Qualitative findings for each study variable (e.g., thematic categories for perceived stress, social support, role adjustment, environment, and daily anxiety source) were organized by anxiety questionnaire category and displayed in a matrix (Miles et al., 2018) and joint display (Fetters et al., 2013). These displays, which are typical of mixed-methods research, facilitated investigation of differences and similarities in qualitative findings per participant and between categories of anxiety (McCrudden et al., 2021).

To build the matrix, a case by case analysis of mEMA responses over the study period was performed, and participants' codes were used to link qualitative findings within anxiety categories. For daily anxiety sources, a joint display was created (Fetters et al., 2013). To generate the joint display, the top sources of anxiety for the subsample over the study period were identified by code frequencies. Then, the proportion of individuals within each anxiety questionnaire category per anxiety code was summarized. Finally, a profile comparison chart was created to visually compare the prominence of anxiety sources between categories of participants. Due to the mixed evidence regarding the relationship of parity and comorbid depression to PPA, these quantitative sample characteristics were also incorporated into the matrix using markers and footnotes for particular participants. More specifically, some studies found evidence that multiparous women were at higher risk for PPA (Furtado et al., 2018), while others reported that parity was not a significant predictor of PPA (Cena et al., 2021).

4.4 FINDINGS

4.4.1 Quantitative Results

4.4.1.1 Sample Characteristics

Of the 73 participants who were enrolled in the active study, the 68 who provided daily anxiety ratings for at least 25 study days (50%) were included in the analysis. Table 9 displays characteristics for the total sample (N = 68), qualitative subsample (n = 34) and by anxiety questionnaire category. Table 10 presents a summary of mEMA daily anxiety ratings for the total

sample and qualitative subsample. Figure 8 shows selected temporal response plots of daily anxiety ratings organized by category.

4.4.1.2 Eight-Week Mood Questionnaires

The percentage of the sample meeting cut-offs for anxiety or depression on mood questionnaires at eight weeks postpartum is displayed in Table 11.

4.4.2 Qualitative Findings

Perceived Stress. When participants were asked to describe how they were coping with all they had to do in the weeks after childbirth, the majority of responses aligned with three thematic-categories: (1) coping well, (2) managing, or (3) overwhelmed. Responses categorized as "coping well" were typically positive or neutral in tone. The responses reflected tones of acceptance for daily challenges and concerns as they acknowledged prior preparation for changing roles and responsibilities. For example, "*I've been coping well, I've pretty much prepared myself for what having a baby can be like*." (P 74, week 2)

For "managing", responses alternated between feeling capable of managing stress to "barely surviving" or struggling to cope with role responsibilities. For example, "*I've been coping okay. I don't feel too overwhelmed but sometimes I feel like I'm in survival mode*." (P 22, week 8) Availability of social support systems influenced participants' responses in the first two thematic-categories. Specifically, when stress was manageable, participants mentioned active support systems: "*It's all overwhelming but I have a good support network, so it's manageable*." (P41, week 7). Yet, when support was deficient, attitudes of just "managing" were more prevalent,

"*Today I didn't have help with the baby. It was challenging because I am constipated and very tired today. We made it through*." (P 20, week 4)

Responses categorized as "overwhelmed*"* were perceptibly more negative than the other two categories. For example, "*It's too much to handle as my son is not sleeping well and is very needy*." (P42, week 5). Participants who were considered overwhelmed were also less likely to mention support systems, and in some cases, voiced lack of support as a contributing factor to stressful experiences. "*I'm very overwhelmed due to my husband being gone, my support system not being able to help. Lack of sleep since I'm by myself*." (P 29, week 5) Further, these responses consistently reflected the sense that stress could not be managed nor coped with, especially as support dwindled or sleep quality suffered. *"Things are too much to handle and I feel there must be someone from family to help with newborn care."* (P 42, week 8).

Several major factors influenced participants' stress responses: source of stress, sleep quality or quantity, and social support. For most participants, the source of stress fluctuated between the earlier and later study weeks. Initially, participants expressed stress related to infants' needs or health. In latter study weeks, the source of stress shifted away from an infant-centric focus to include household responsibilities, work commitments, and non-infant family matters. For example, *"I'm not getting enough of a break from the baby during the day to get anything done. And I'm not even talking about anything that takes a lot of time. A quick workout…a shower. I'm just not getting a break."* (P 57, week 7)

Sleep quality or quantity was also repeatedly mentioned in participants' responses about feeling overwhelmed. Specifically, some blamed poor sleep on their perceived inability to handle role-related responsibilities (e.g., infant care, household chores, work-related tasks, etc.): *"Last night I was very overwhelmed and cried for a while. Any time I get to that point it's because I'm*

exhausted and the things that are manageable when I have more energy become overwhelming when I'm overly tired." (P 3, week 6)

Social Support. Participants were asked to share if their social circles were (or were not) supportive during the postpartum period. Distinctions regarding the type of support emerged in analysis and informed thematic-categories: (1) task-related support, (2) mental or emotional support, or (3) little to absent support. Task-related support was primarily physical in nature and included infant-care (e.g., feeding, diaper changes), household chores, or meal preparation. For example, "*My partner is very supportive and helps split a lot of the tasks. We make all of our decisions together."* (P 37, week 6) Alternately, examples of mental or emotional support were expressed when participants described shared decision making, positive affirmations received from partner, or role encouragement/advice from family and friends. *"My husband and our family members have been very helpful and supportive physically and emotionally."* (P 44, week 3) Responses in the third thematic-category of little to absent support, were usually detailed accounts of participants' attempts to "juggle" everything alone. Reasons mentioned for deficient support were relationship and/or family conflict, partners' work or travel, or geographic distance from extended family. For example, *"My spouse is making it really hard for me by fighting with me all of the time. It's really effecting my mental health."* (P 59, week 5)

Sources of support fluctuated over the seven-week study period. Partners were identified as the primary source of support in the initial study weeks. However, many participants also endorsed considerable secondary support from family, friends, or community members (e.g., neighbors, church members) at this time. As the time from birth lengthened, secondary support diminished, for example, *"Text and call check ins are weaning off. No more meals or help but husband and I are managing."* (P 4, week 6). Additionally, a small group of individuals also

communicated decreasing partner support, mentioning partner return to the workplace, partner mental health issues, and relationship conflict as reasons for waning support over time.

Role Adjustment. Participants were asked to describe the easiest and most challenging aspects of "everyday life" since the birth of their infant. For the "easiest" aspect, responses were aggregated into two thematic-categories: (1) bonding and caring for infant and/or (2) "nothing" was easier (i.e., "nothing" was explicitly stated or participants' were unable to identify anything considered "easy"). Responses related to bonding and caring for infant expressed positive and loving attitudes towards infants. Some described "snuggling" while others voiced increased self-confidence when they were able to intuitively respond to their infants' needs. Others even conveyed disbelief at having an easier than anticipated time with infant care (e.g., feeding, changing diapers, etc.): *"Loving her. Taking care of her has proved to be much easier than I expected -- my husband and I have both been pleasantly surprised at how natural caring for her feels, and getting to know her and responding to her."* (P 34, week 3) Alternatively, for participants who shared "nothing" was easier, responses were negative and some hinted at frustration and resentment. For example, *"Everything has gotten a lot harder…life has become very stressful and difficult."* (P 40, week 6)

Three thematic-categories emerged when participants were asked to describe the "most challenging" aspects of daily life postpartum: (1) sleep, (2) self-care, and (3) having a routine or enough time. Sleep was universally named as one of the most challenging aspects of the new parenting role. Participants shared that lack of quality sleep profoundly impacted their ability to perform role responsibilities. It was also viewed by some as a catalyst for undesirable moods (e.g., irritability) and behavior (e.g., less motivation). Finding time or energy for self-care emerged as another major challenge for participants. Specifically, responses reflected individuals' difficulty

finding time for basic self-care needs (e.g., showering, eating, resting, etc.) and regret over time lost for other self-care activities (e.g., exercising, having time alone, socializing with friends, etc.,). One participant commented on these challenges: *"As I get more and more tired throughout the day I notice that I tend to be more irritable or struggle to get things done. It's also challenging at times to do the basic things I used to do every day like my get-ready routine - shower, dry my hair, put on makeup…those are the activities that make me feel more normal, like some aspect of my life is still the same."* (P 3, week 3) Lastly, unpredictable schedules and thus "less time" to do things was a common response related to the thematic-category of "having a routine or enough time": *"Trying to live within two hour windows and finding time to sleep, figuring out his needs such as feeding, changing diapers, etc., also trying to work things into our schedule while working around feedings such as tummy time, bath time, reading books, going for walks, not to mention general chores around the house and taking care of our dogs too."* (P 2, week 3) Further, some participants shared how "not having a routine or enough time" led to feeling like their autonomy and control lessened. This was apparent both in the beginning of the study period and towards the end, demonstrated by the following participant quotes: *"Adjusting to this new life has been very challenging. Even during pregnancy I had a schedule and routine and was in control but now I feel like I don't have that same sense of control since nearly every aspect of my life has changed."* (P 3, Week 2) *"At times it's hard with a newborn. Not being able to jump and do whatever you want like in the past."* (P 9, week 7)

Environment. Participants were asked how aspects of their day affected their moods. Several thematic-categories were associated with whether participants' perceived their day as calm, stressful, or neither (e.g., neutral): (1) presence of support systems, (2) time to socialize or time away from infant, (3) sleep or fatigue, (4) infant temperament, and (5) other children's needs.

Calm or good environments were described when participants mentioned the positive influences of available support, adequate rest, the opportunity to socialize with friends or family, and/or spending time away from infants. For example, *"My family is visiting today and we were able to go for a walk -- the beautiful weather and having other people to hold the baby has been a lot of fun!"* (P 34, week 4). Alternatively, stressful environments resulted from absent or deficient support (from people and workplaces), feeling fatigued, caring for infants with challenging temperaments, and/or attending to the demands or difficult temperaments of other children. For example in week 2, Participant 13 demonstrates the link between her mood and her infant's temperament saying, *"Baby's mood controls my day".* When neutral environments were described, participants recognized both positive and negative influences in their day resulting in balanced perspectives. *"Last night baby was very fussy and would only sleep on me. Very tired today but trying to be positive and get back on track with sleep. Relaxed day today, no real need to do anything."* (P 44, week 8)

Daily Sources of Anxiety. Participants were asked daily to share their source(s) of anxiety. Approximately one third of participants denied any anxiety source, answering the question with "N/A" or "none". Remaining responses were coded and aggregated to form thematic-categories for the most frequently reported anxiety sources: (1) infant health/well-being, (2) sleep quality or time, (3) return to the workplace, and (4) self-health. Less prominent thematic-categories of anxiety included financial concerns, partner work or travel, breastfeeding, and other children.

Except for the final study week (e.g., eight weeks postpartum), infant-health related concerns were the primary source of anxiety. Responses were occasionally vague and mentioned "generally concerned" for infants' well-being. When responses were more specific, anxiety was linked to infants' temperament (e.g., fussy or gassy), feeding behaviors (e.g., breastfeeding,

spitting up), sleeping habits and safety (SIDS), and/or exposure to germs/illness (e.g., COVID). Of note, a small group of participants also shared intrusive thoughts about their infants' health, reported such as *"constant fear that [I] will forget to feed [my] baby or fall asleep with him on [my] chest".* (P 4, week 4)

Sleep and return to the workplace were two other dominant anxiety sources for the majority of the study period. In the first few postpartum weeks, participants predominantly felt sleep (or lack thereof) was a source of anxiety. Yet in week five, return to the workplace replaced sleep as a top concern, remaining an important concept until the study's conclusion at eight weeks postpartum. Regarding workplace return, participants shared feeling generally stressed about the end of maternity leave, anxiety about finding childcare for their infant, sadness over impending separation from their infant, concern for maintaining milk supply and pumping in the work-environment, and being able to balance work and home responsibilities.

Finally, participants' self-health remained a steady source of anxiety throughout the study period. It was most apparent at two weeks postpartum, as participants shared concerns regarding physical recovery after childbirth, development of postpartum complications (e.g., high blood pressure), hormonal fluctuations, and general feelings of unwell (e.g., headaches, bouts of nausea, fatigue). However, it resurfaced as a dominant source of anxiety in postpartum weeks six and eight. During this time period, many participants expressed concerns related to their own health (e.g., colds, viruses), headaches, fatigue, and lingering postpartum issues (e.g., persistent high blood pressure, persistent physiological pain after childbirth)

4.4.3 Organization of Qualitative Findings by Anxiety Questionnaire Categories

A matrix of qualitative findings (e.g., thematic-categories) for theory-driven qualitative questions (e.g., perceived stress, social support, role adjustment, and environment) for each anxiety questionnaire category is displayed in Table 12. To provide further context for narrative synthesis, individual participants' with comorbid depressive symptoms (e.g., EPDS score > threshold) and multiparity were denoted in table footnotes.

4.5 NARRATIVE SYNTHESIS

We used a theory-driven mixed-method approach to expand understanding of anxiety from one to eight weeks postpartum. Qualitative themes from participants with varying daily anxiety ratings and different categories of anxiety based on anxiety questionnaires were analyzed and compared. Our findings corroborated previous research regarding predictors of PPA, including its associations with high perceived stress, minimal social support, difficult role adjustment, and relationship conflict. We also revealed several new insights into PPA experiences including the importance of emotional support, the role of positive and negative environmental influences, and the types of daily anxiety sources. Further, we illuminated potential differences between participants with postpartum-specific anxiety (anxiety per PSAS, Category 3) and generalized anxiety (anxiety per STAI-S, Category 2) in the postpartum period.

Consistent with previous studies, our findings provided qualitative confirmation for relationships between PPA, high perceived stress, minimal social support, difficult role adjustment, and partner conflict. Specifically, we found notable differences in the pattern of

responses (over the study period) to qualitative questions on perceived stress and social support between participants with and without PPA per eight-week anxiety questionnaires (Category 1 vs. Categories 2-4). Those with PPA at eight weeks postpartum (Categories 2-4) described feeling overwhelmed, or like they were "just managing" their responsibilities often, compared to those without PPA, who frequently indicated they were coping well. The overwhelmed group also regularly expressed feeling unable to cope with their responsibilities, confirming previous reports that higher perceived stress scores are predictive of higher anxiety scores on the STAI-S at six and eight weeks postpartum (Britton, 2008; Dennis, Brown, Falah-Hassani, et al., 2017; Razurel et al., 2017). Regarding social support, participants without PPA at eight weeks postpartum (Category 1) consistently reported ample physical and emotional support over the study period. Alternatively, those with PPA (Categories 2-4) more often shared having little to no support over the study period or having initial support that declined as the time from birth lengthened. These findings corroborate previous evidence linking low social support to increased risk for anxiety and depression in postpartum persons (Chavis, 2016; Hetherington et al., 2018; Racine et al., 2019; Schwab-Reese et al., 2017).

Our findings also substantiated previous evidence linking insecure maternal attachment to infants (a feature of role adjustment) to symptoms of anxiety and depression (Marques et al., 2018). Specifically, when participants in our sample were asked to describe the easiest aspects of their new role, those with PPA (Categories 2-4) alternated between stating "bonding" with infants was easiest and that "nothing" was easy. When the latter response was shared, responses included tones of frustration and resentment for new roles. Alternatively, responses over the study period from participants without PPA (Category 1) reflected characteristics previously determined to be protective against anxiety and depression, such as self-awareness, self-compassion, and

"nonjudgmental appraisal of thought content" (Monteiro et al., 2019). These participants often responded to questions in positive tones (non-judgmental attitude), demonstrating tolerance to daily challenges (self-compassion) and a tendency to place more emphasis on things going well rather than current challenges (self-awareness).

Lastly, our findings provided qualitative evidence for pre-established connections between relationship conflict, deficient partner support, and increased PPA (Dennis, Brown, & Brennenstuhl, 2017; Pilkington et al., 2015). In our subsample's responses to questions on environmental influences and social support, partner conflict was often mentioned by persons with PPA at eight weeks postpartum (Categories 2-4) and rarely mentioned by individuals without PPA (Category 1). Thus, our results recommend continued intervention-based research of this modifiable risk factor.

While our qualitative findings substantiated previous PPA research, we also uncovered new findings regarding PPA experiences such as prominent sources of daily anxiety and the number and type of positive/negative environmental influences, and notable differences in responses and sample characteristics between individuals with postpartum-specific anxiety symptoms (Category 3) and generalized anxiety symptoms (Category 2). To our knowledge, our study is the first in-depth comparison of prospective postpartum experiences between individuals with potentially different anxiety conditions (e.g., postpartum-specific or anxiety per PSAS versus generalized anxiety or anxiety per STAI-S), and we present several hypotheses for our findings. Differences between anxiety questionnaire categories were found for all theory-driven concepts. In some cases, qualitative findings between anxiety categories overlapped considerably, but in others, variations were more distinct. Perhaps the most distinct differences were the presence of comorbid depressive symptoms and multiparity in individuals with generalized anxiety per the

STAI-S. Specifically, all participants who met threshold for generalized anxiety per the STAI-S (Category 2, 4) also had probable depression determined by scores above the threshold on the EPDS. Further, the majority of these participants were multiparous. Comparatively, none of the participants with postpartum-specific anxiety per the PSAS only (Category 3) had comorbid depression, and the majority were primiparous. These novel findings provide important context for interpretation of anxious experiences between participants, and may be considered important delineating factors between postpartum-specific (anxiety per PSAS) and generalized anxiety (anxiety per STAI-S). Further, co-existing depression and multiparity should be carefully considered when identifying populations at-risk for PPA and when selecting clinical detection strategies. First-time mothers may be more susceptible to development of postpartum-specific anxiety (anxiety per the PSAS), but may not have co-occurring PPD or generalized anxiety symptoms required to meet thresholds for clinical detection by the EPDS or STAI-S.

Next, our findings regarding participants' daily sources of anxiety from one to eight weeks postpartum were novel. With the exception of a qualitative study published in 2020 by Goldfinger and colleagues, there is a paucity of qualitative literature regarding the nature of worry in individuals with PPA (Ali, 2018; Goldfinger et al., 2020). Nevertheless, our findings supplement those from Goldfinger and colleagues, who found that postpartum women with generalized anxiety disorder (GAD) experienced more parental-themed worries than an age-matched, non-perinatal sample with GAD (Goldfinger et al., 2020). In our subsample, the top concerns for participants with anxiety per the PSAS or a combination of the STAI-S and PSAS (Categories 3-4) were infant health, infant care, or a return to the workplace (e.g., end of maternity leave). However, participants in Category 4, who had anxiety per the STAI-S and PSAS, were also heavily concerned with finances. Participants with anxiety per the STAI-S (Category 2) were less concerned about infants'

health and care than Categories 3 and 4, but more concerned with their own health and their partners' work or travel. Differences in anxiety sources between categories provide additional items to consider when delineating postpartum-specific and generalized anxiety constructs. Namely, individuals with anxiety per the PSAS seem to have more infant-focused and return to work concerns; while individuals with anxiety per the STAI-S seemed less concerned with infant-related anxieties and more concerned with self-health, relationships, and finances. In addition to revealing these potential distinctions between anxiety types, our findings offer novel directions for future research and considerations for PPA detection strategies. Specifically, modifiable risk factors including the length of maternity leave, availability of financial resources, and gaps in infant care knowledge should be assessed during PPA screening and targeted in intervention-based research studies.

We also observed differences in types of environmental influences between participants with and without PPA, a concept that to our knowledge has not been previously investigated. Most participants endorsed both "calm" and "stressful" environments over the course of the study period. However, participants with anxiety (Classes 2-4) reported more negative environmental influences and less positive influences over the course of the study than participants without PPA (Category 1). When examined further by questionnaire category, persons with anxiety per the STAI-S or both the STAI-S and PSAS (Category 2,4) recounted the fewest number of positive influences. Instead, their responses focused on negative experiences with fatigue, absent support, relationship conflict, difficult infant temperament, and the challenging needs of other children. Further, these individuals rarely mentioned social opportunities or time away from infant, which were frequently described by participants without anxiety in Category 1. Upon further comparison, concepts of support, adequate rest, and socialization opportunities were consistently mentioned as

positive influences by individuals without anxiety and thus present modifiable factors to target in future PPA intervention studies.

Next, we found discernable differences in thematic-categories regarding concepts of perceived stress and social support between those with anxiety per the PSAS (Category 3) and anxiety per the STAI-S (Category 2). Specifically, we found that participants with postpartum-specific anxiety (anxiety per the PSAS) more often described "managing" stress and having some task-related support, while those with generalized anxiety (anxiety per the STAI-S) consistently reported feeling overwhelmed and having no support. By comparison, participants without PPA (Category 1) endorsed feeling able to cope with responsibilities which was helped by consistent emotional and physical support over the study weeks. The finding that all participants with generalized anxiety (anxiety per the STAI-S, Category 2) also met the threshold for comorbid depression likely played a role in the contrasting severity of responses between participants by anxiety questionnaire category. Further, responses regarding perceived stress and social support among participants with postpartum-specific anxiety (anxiety per the PSAS, Category 3) fell in-between extremes. Specifically, these participants recounted more stress and less support than persons without PPA (Category 1), but not as consistently as persons with generalized anxiety and comorbid depression (anxiety per the STAI-S, Category 2). These findings raise questions about the relationships between postpartum-specific anxiety, generalized anxiety, and depression, which should be explored further in future studies.

Novel characteristics of PPA, including similarities and differences between participants who met the threshold for anxiety on a postpartum-specific anxiety instrument (e.g., PSAS), generalized anxiety instrument (e.g., STAI-S), or both instruments, provide new information to consider when answering the question if (and how) anxiety experienced in the postpartum is

distinct from anxiety experienced at other times during the lifespan (Howard & Khalifeh, 2020). Our qualitative findings provide support that postpartum-specific anxiety is unique and may result from a combination of factors specific to postpartum contexts. Specifically, we offer qualitative evidence that postpartum-specific anxiety (anxiety per the PSAS) is similar to and may overlap with generalized anxiety (anxiety per the STAI-S) in terms of precipitating experiences and presentation. Yet, as Zappas and colleagues point out in a recent clinical review (2020), we also noted that while experiences of anxiety per the PSAS were distressing, they may not have been to the degree needed to meet criteria for detection by generalized anxiety instruments or clinical diagnosis (Zappas et al., 2020).

4.5.1 Limitations

Although a robust effort was made to recruit a diverse sample, the majority of participants were white and highly educated. We also opted to include people who had a history of mental illness (e.g., depression or anxiety), which may confound interpretation of experiences with anxiety. However, we felt it was important to include these individuals, as preexisting mental health conditions are highly prevalent in perinatal populations rendering their exclusion a limit to generalizability of findings. Next, because of our stratified sampling technique, the distribution of participants between categories of PPA was small, and thus qualitative experiences in mixed analysis were limited to sample sizes of four to six people. Also, we did not use diagnostic interviews to confirm the types of anxiety in our sample; however, no diagnostic criteria exists for postpartum-specific anxiety. Thus, we felt a comparison of individuals' responses based on a postpartum-specific and generalized anxiety instruments offered the best opportunity to explore and describe potential differences in anxiety types in our sample. We also opted not to explore the

influence of other sample characteristics (other than parity and depression) that may affect PPA; however this was intentional, as we were primarily focused on concepts from the Theory of Becoming a Mother with empirical links to PPA (Mercer, 2004). Finally, due to study time frame and exploratory nature, we did not assess experiences with PPA beyond the eight week postpartum timepoint or whether PPA eventually resolves or worsens into related mental health issues (e.g., generalized anxiety disorder and comorbid depression. These limitations present fruitful directions for future inquiries.

4.6 CONCLUSION

Our findings provide qualitative validation for existing assumptions regarding relationships between PPA and high perceived stress, low social support, relationship conflict, and maternal role adjustment. We found additional factors that may be important to consider in PPA screening including presence of emotional support, number and type of positive/negative environmental influences, and parity. We also found that experiences of PPA can exist independent of depressive symptoms, necessitating careful selection of screening strategies to avoid approaches requiring depressive symptom presence for clinical detection of altered mental health states (e.g., sole use of the EPDS). Our findings provide directions for intervention-based research targeting potentially modifiable factors in early PPA development, including relationship support, socialization opportunities, length of maternity leave (e.g., need to return to work), and financial assistance. Comparison of data per anxiety category suggested that several differences in experiences with perceived stress, social support, role adjustment, environment, and source of anxiety exist between individuals with PPA per the STAI-S versus PPA per the PSAS. Future

studies are needed to explore the relationship between these two anxiety constructs and the degree to which they overlap during the first eight weeks postpartum

Table 8. Qualitative mEMA Questions by Concept of Theory of Becoming a Mother

Concept / Variable	Frequency	Content
Anxiety Source	Daily (49x)	What are the sources of your worry/anxiety today?
Perceived Stress [a]	Weekly (7x)	How do you feel like you have been coping with everything you have to do? (For example, have things felt overwhelming or too much handle? If so...please explain)
Social Support	Weekly (7x)	How are those in your social circle supporting (or not supporting) your emotional needs and helping with newborn care, household chores, decision-making, etc?
Role Adjustment	Weekly (7x)	What aspects of everyday life have been hard or challenging since your baby was born? What aspects of everyday life have been easiest or most natural since your baby was born?
Environmental Influence	Weekly (7x)	What aspects of your day have positively or negatively impacted your present mood, and why?[a]

Notes. [a] All questions were investigator-developed except the item from Perceived Stress Scale (Cohen et al., 2014)

Table 9. Characteristics of the Total Sample, Qualitative Subsample, and by Anxiety Questionnaire Category

	Total Sample[a] N = 68	Qualitative Subsample[b] n = 34	Category 1[c] (n = 18)	Category 2[d] (n = 4)	Category 3[e] (n = 6)	Category 4[f] (n = 6)
Mean Age (years), (SD)	31.44 (4.75)	31.76 (4.65)	32.1 (4.5)	32.3 (7.5)	32 (4.7)	30.2 (3.9)
Race, n (%)						
White	57 (83.8)	27 (79.4)	15 (83.3)	1 (25.0)	6 (100.0)	5 (83.3)
Black	3 (4.4)	2 (5.9)	1 (5.6)	2 (50.0)	--	--
Asian	4 (5.9)	3 (8.8)	1 (5.6)	1 (25.0)	--	--
Other	4 (5.9)	2 (5.9)	1 (5.6)	--	--	1 (16.7)
Non-Hispanic, n (%)	65 (95.6)	33 (97.1)	18	4 (100.0)	6 (100.0)	5 (83.3)
Education, n (%)						
Never finished high school	1 (1.5)	1 (2.9)	1 (5.6)	--	--	--
High school diploma/GED	5 (7.4)	2 (5.9)	--	1 (25.0)	--	1 (16.7)
Some college/vocational program	8 (11.8)	7 (20.6)	5 (27.8)	--	1 (16.7)	1 (16.7)
Bachelor's degree	23 (33.8)	8 (23.5)	3 (16.7)	--	3 (50.0)	2 (33.3)
Graduate degree	31 (45.6)	16 (47.1)	9 (50.0)	3 (75.0)	2 (33.3)	2 (33.3)
Married/Partnered n (%)	64 (94.1)	32 (94.1)	18 (100.0)	3 (75.0)	6 (100.0)	5 (83.3)
Primiparous, n (%)	39 (57.4)	22 (64.7)	14 (77.8)	0 (0)	5 (83.3)	3 (50.0)
Past issues with Infertility, n(%)	3 (4.4)	1 (2.9)	1 (5.6)	--	--	--
Past History of Mental Illness, n(%)	20 (29.4)	13 (38.2)	4 (22.2)	1 (25.0)	4 (66.7)	4 (66.7)
Pregnancy Complications, n (%)	22 (32.4)	10 (29.4)	5 (27.8)	1 (25.0)	1 (16.7)	1 (16.7)
Mode of Delivery						
Vaginal	53 (77.9)	26 (76.5)	14 (77.8)	2 (50.0)	4 (66.7)	6 (100.0)
Scheduled or repeat cesarean	6 (8.8)	3 (8.8)	1 (5.6)	2 (50.0)	--	--
Non-scheduled cesarean	9 (13.2)	5 (14.7)	3 (16.7)	--	2 (33.3)	--
Labor Complications, n (%)	16 (23.5)	7 (20.6)	5 (27.8)	--	2 (33.3)	--
Preterm Delivery, n (%)	2 (2.9)	1 (2.9)	--	--	1 (16.7)	--
Neonatal ICU admission, n (%)	2 (2.9)	0 (0)	--	--	--	--
Feeding preference						
Exclusive breastfeeding	45 (66.2)	20 (58.8)	12 (66.7)	1 (25.0)	4 (66.7)	3 (50.)
Exclusive formula feeding	4 (5.9)	1 (2.9)	--	1 (25.0)	2 (33.3)	--
Combination breast/formula	17 (25.0)	12 (35.3)	6 (33.3)	2 (50.0)	--	2 (33.3)
Unsure/undecided	2 (2.9)	1 (2.9)	--	--	--	1 (16.7)
Income Level						
$10,000 – 49,999	9 (13.2)	6 (17.6)	3 (16.7)	1 (25.0)	--	2 (33.3)
$50,000 – 89,999	16 (23.5)	9 (26.5)	6 (33.3)	--	2 (33.3)	1 (16.7)
>$90,000	41 (60.3)	17 (50.0)	8 (44.4)	2 (50.0)	4 (66.7)	3 (50.0)
Did not answer	2 (2.9)	2 (5.9)	1 (5.6)	1 (25.0)	--	--

Notes. [a] Participants who returned ≥ 50% of mEMA prompts; [b] Selected for qualitative analysis using stratified purposeful sampling of mEMA daily anxiety rating data; [c] Category 1:< Cut-off for anxiety on State Trait Anxiety Inventory & Postpartum Specific Anxiety Scale; [d] Category 2: > Cut-off for anxiety on State Trait Anxiety Inventory, (e.g., score >40) (Spielberger, 1983); [e] Category 3: > Cut-off on Postpartum Specific Anxiety Scale, (e.g., score >112) (Fallon et al., 2016); [f] > cut-off on both State Trait Anxiety Inventory and Postpartum Specific Anxiety Scale; [f] Category 4: > Cut-off on both Postpartum Specific Anxiety Scale and State-Trait Anxiety Inventory

Table 10. Summary of Daily mEMA Anxiety Ratings for the Total Sample and Qualitative Subsample

	Total Sample (N = 68) n (%)	Qualitative Subsample (N = 34) n (%)
mEMA[a] % Completion		
- > 90%	46 (67.6)	27 (79.4)
- 75 to 90%	9 (13.2)	4 (11.8)
- 50 to 75%	13 (19.1)	3 (8.8)
Dichotomized mode of anxiety ratings	32 (47.1)	16 (47.1)
- None (0)	36 (52.9)	18 (52.9)
- Some (≥1)		
Dichotomized mean variance of anxiety ratings		
- Minimal (< sample. median)	34 (50.0)	17 (50.0)
- Moderate to Marked	34 (50.0)	17 (50.0)
Category 1: None / Minimal	16 (23.5)	8 (23.5)
Category 2: None / Moderate to marked	20 (29.4)	10 (29.4)
Category 3: Some / Minimal	16 (23.5)	8 (23.5)
Category 4: Some / Moderate to marked	16 (23.5)	8 (23.5)

Notes. [a] Mobile Ecological Momentary Assessments

Table 11. Percentage of Sample Meeting Cut-Offs for Anxiety or Depression on Mood Questionnaires at Eight-Weeks Postpartum

	Total Sample (N = 68), n (%)	Sub-Sample (N = 34), n (%)
Category 1: < cut-off on STAI-S[a] and PSAS[b]	44 (64.7)	18 (52.3)
Category 2: > cut-off STAI-S[a] only	9 (13.2)	4 (11.8)
Category 3: > cut-off PSAS[b] only	8 (11.8)	6 (17.6)
Category 4: > cut-off on STAI-S[a] and PSAS[b]	7 (10.3)	6 (17.6)
Probable depression: > cut-off EPDS [c]	7 (10.3)	6 (17.6)

Notes. [a] State-Trait Anxiety Inventory, score range 20-80 (Spielberger et al., 1983), cut-off for anxiety >40 (Dennis et al., 2013), [b] Postpartum Specific Anxiety Scale, score range 44-204, cut-off for anxiety >112 (Fallon et al., 2016); [c] Edinburgh Postnatal Depression Scale, score range 0-30, cut-off for depression ≥12 (Cox et al., 1987)

Table 12. Comparison of Thematic Categories for Perceived Stress, Social Support, Role Adjustment, and Environmental Influence by Anxiety Questionnaire Category

Category by Anxiety Questionnaires at 8 weeks postpartum	Participant	Perceived Stress			Social Support			Role Adjustment					Environment						
								Easiest		Most Challenging			Positive Influences			Negative Influences			
		Coping well	Managing	Over-whelmed	Task-Related	Emotional	Little to Absent	Bonding, Caring	Nothing	Sleep	Self-Care	Schedule, Time	Supported	Rested	Socialize or Time Away from Infant	Lacking Support	Fatigued	Challenging Temperaments	Other Children Needs
Category 1: < Cut-off on STAI-S[a] and PSAS[b]	P 3		X	X	X	X		X		X	X	X				X	X	X	
	P 9	X			X	X		X		X				X	X	X			
	P 12†		X		X				X	X	X	X	X	X		X			X
	P 13	X			X	X		X		X	X	X	X	X				X	
	P 15†	X			X	X		X	X	X		X	X		X	X			
	P 18	X			X	X			X		X						X	X	
	P 20	X			X	X		--	--	X	X		X		X		X	X	
	P 34	X			X	X		X			X	X	X		X		X		
	P 41		X		X			X			X	X	X	X					
	P 44		X		X	X		X		X	X	X			X		X		
	P 47	X	X		X	X		X		X									
	P 52	X				X	X	X	X	X	X	X	X		X		X	X	
	P 54†	X			X	X		X		X	X	X	X	X	X				
	P 55†	X			X	X		--	--			X				X			X
	P 57	X	X		X	X		X			X	X	X	X	X		X		
	P 58	X			X	X		X		X			X	X	X		X		
	P 71	X	X		X	X		X			X	X	X	X	X	X	X		

	P 74	X			X	X		X		X			X				X		
Category 2: > Cut-off on STAI-S[a]	P 29*†			X			X	X	X	X							X	X	X	X
	P 33*†			X			X		X	X		X				X		X	X	X
	P 42*†			X	X		X		X		X	X						X	X	X
	P 63*†			X			X	--	--			X				X				X
Category 3: > Cut-off on PSAS[b]	P 4		X				X	X		X	X	X		X		X	X			
	P 6		X	X	X			X		X	X	X	X		X				X	
	P 17		X	X	X		X	X			X	X				X			X	
	P 22†		X	X	X		X	X		X	X	X		X	X	X	X	X		X
	P 40		X	X			X		X	X	X	X			X	X			X	
	P 66			X			X		X	X		X				X			X	
Category 4: > Cut-off on STAI-S, PSAS	P 2		X	X	X			X		X	X	X	X		X			X	X	
	P 30†		X	X			X	X	X		X	X				X	X	X	X	X
	P 38†		X	X	X		X	X		X	X	X				X	X	X	X	X
	P 59*†			X			X	X		--	--	--								X
	P 61		X	X	X			X		X	X					X			X	
	P 75*		X	X	X	X		X	X	X	X	X				X	X	X		

Notes. [a] State Trait Anxiety Inventory, Cut-off >40 (Spielberger, 1983); [b] Postpartum Specific Anxiety Scale, Cut-off >112 (Fallon et al., 2016);

*** Met threshold for depression on Edinburgh Postnatal Depression Scale (Cox et al., 1987); † Multiparous.**

Figures

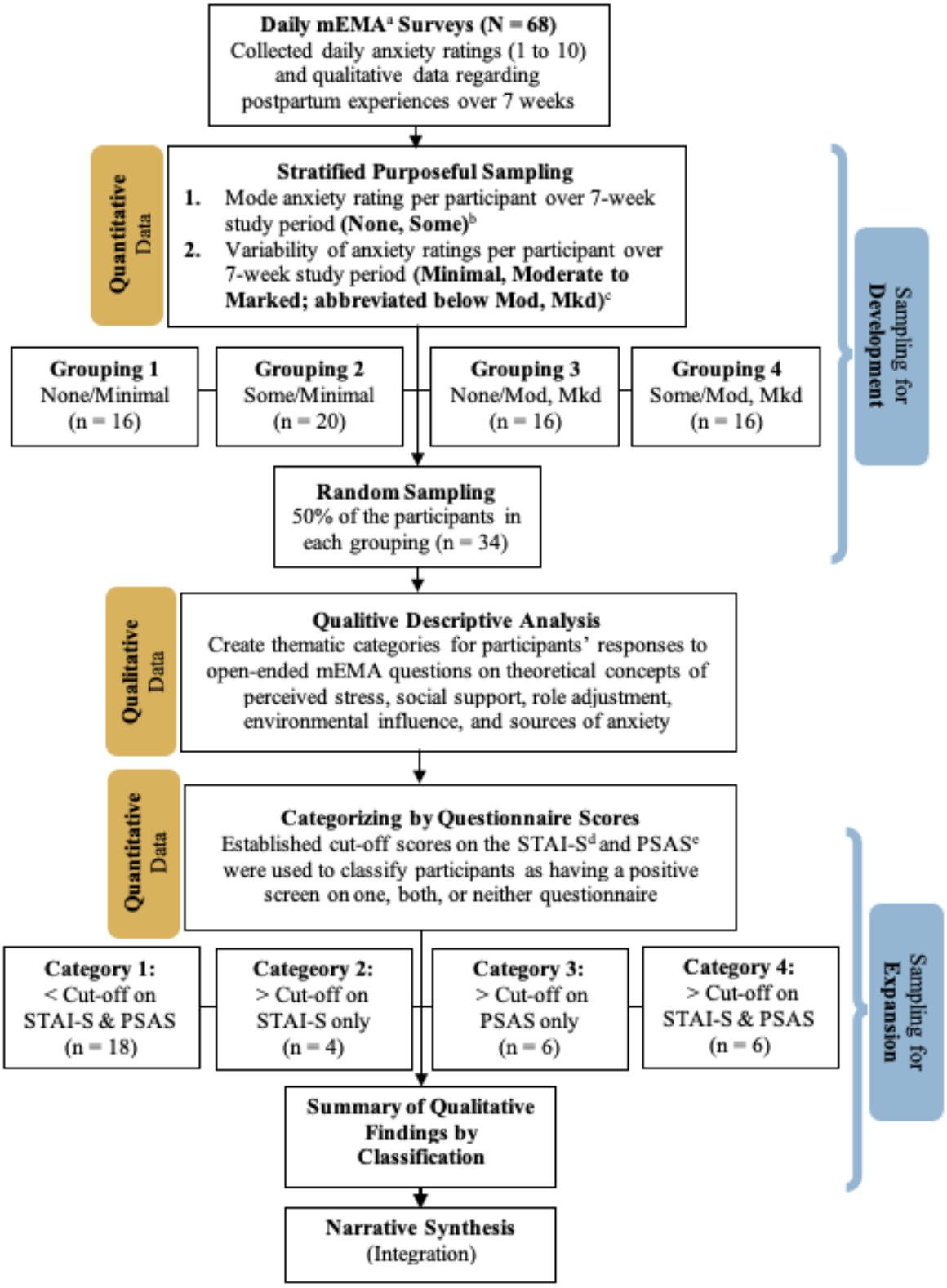

Figure 7. Sequence of Data Collection and Analyses

Notes. [a] mEMA= Mobile Ecological Momentary Assessment; [b] Mode determined by each participant's most common daily anxiety rating (e.g., mode = 0, "none" and mode = ≥1, "some"); [c] Variation determined the day to day variability in anxiety ratings (e.g., individual mean variance < sample median variance = "minimal" and individual mean variance > sample median variance = "moderate to marked"); [d] State Trait Anxiety Inventory, State Scale, cut-off for anxiety >40 (Spielberger, 1983, Dennis et al., 2013); [e] Postpartum Specific Anxiety Scale, cut-off for anxiety > 112 (Fallon et al., 2016)

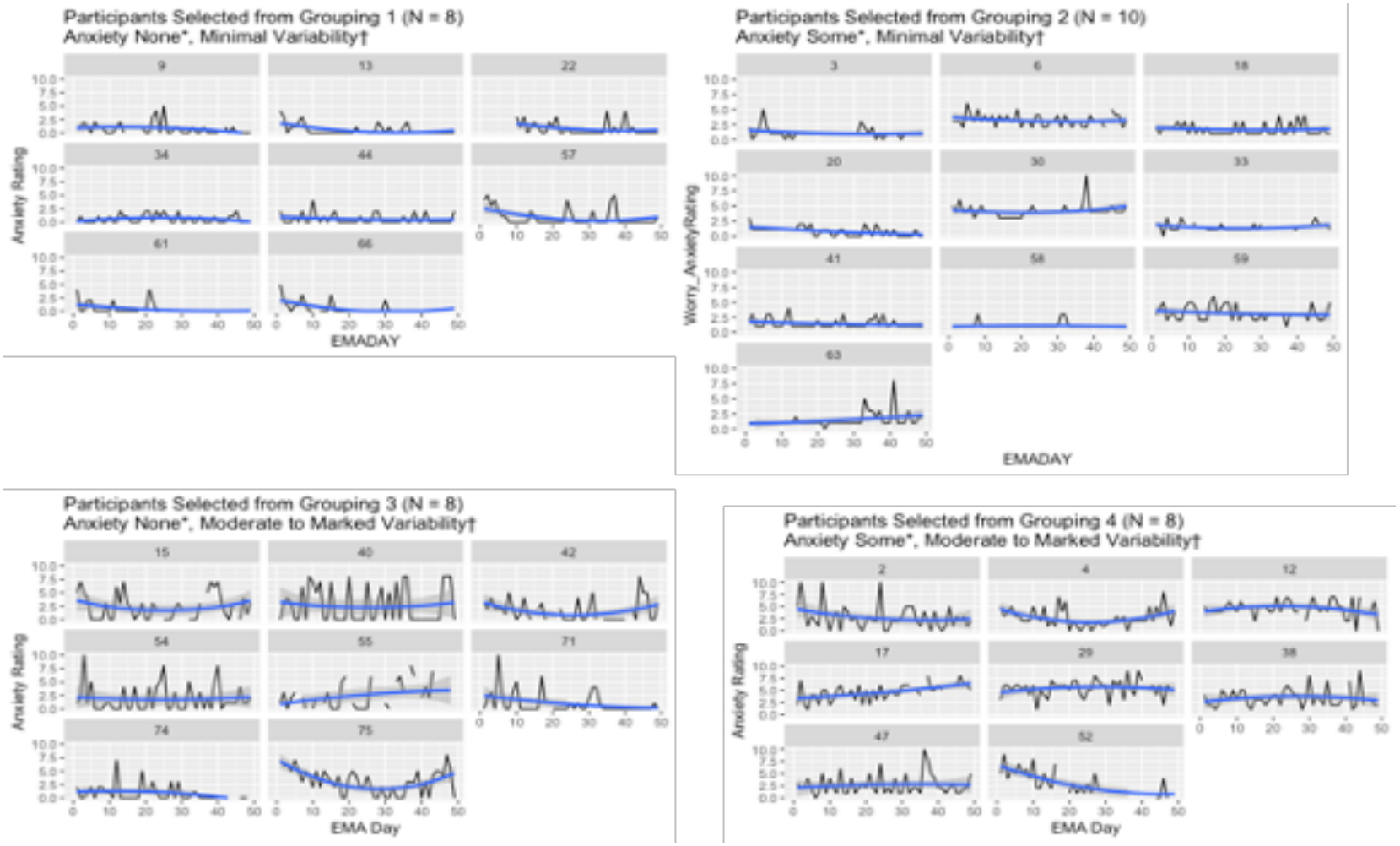

Figure 8. Selected Panel Plots of Daily Anxiety Ratings by Group

Notes. mEMA = Mobile Ecological Momentary Assessment; * Mode of daily mEMA anxiety rating, (0, "None"; ≥1, "Some"); †Variance of daily mEMA anxiety ratings (e.g., scale of 0 to 10), (< sample median variance, "Minimal"; >sample median variance, "Moderate to Marked"); Blue line represents the participant's trend in anxiety ratings over the study period

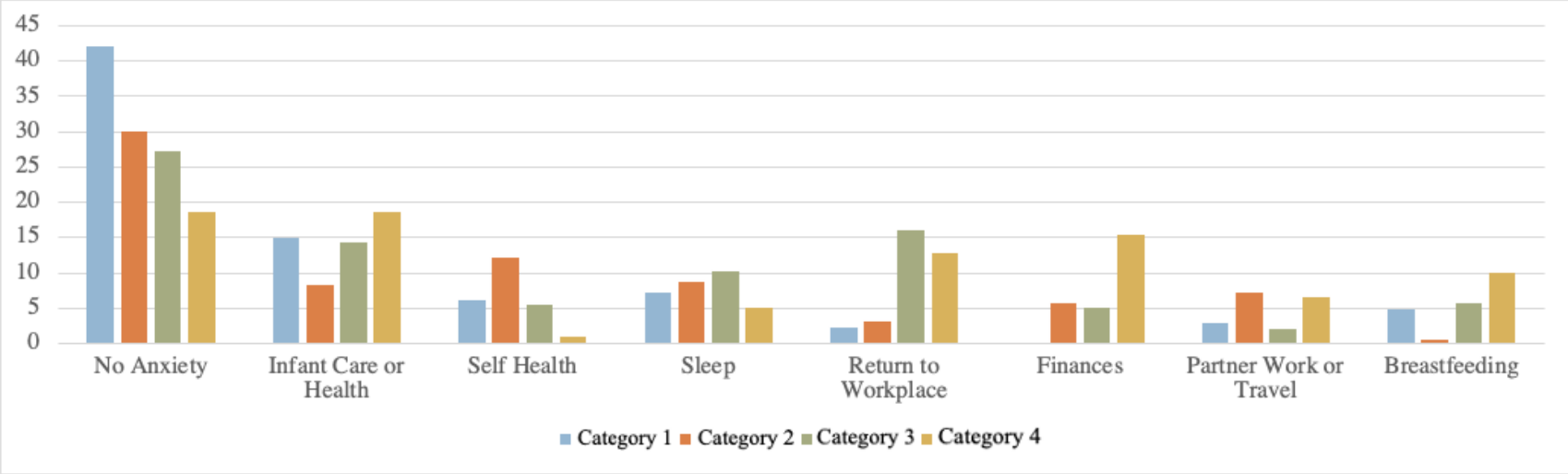

Figure 9. Thematic-Categories of Anxiety Per Anxiety Questionnaire Categories

Notes. ***Category 1:< Cut-off for anxiety on State Trait Anxiety Inventory & Postpartum Specific Anxiety Scale; Category 2: > Cut-off for anxiety on State Trait Anxiety Inventory, (e.g., score >40) (Spielberger, 1983); Category 3: > Cut-off on Postpartum Specific Anxiety Scale, (e.g., score >112) (Fallon et al., 2016); > cut-off on both State Trait Anxiety Inventory and Postpartum Specific Anxiety Scale***

APPENDIX A

HRPO APPROVAL FOR DISSERTATION STUDY

University of Pittsburgh | Institutional Review Board
Office of Research Protections

APPROVAL OF SUBMISSION (Expedited)

Date:	March 11, 2021
IRB:	STUDY21010106
PI:	Mary Hoberg
Title:	Improving Understanding and Detection of Postpartum Anxiety
Funding:	Name: National Institutes of Health , Grant Office ID: CNVA00054078, Funding Source ID: 5T32NR008857-14

The Institutional Review Board reviewed and approved the above referenced study. The study may begin as outlined in the University of Pittsburgh approved application and documents.

Approval Documentation

Review type:	Initial Study
Approval Date:	3/11/2021
Expedited Category	(5) Data, documents, records, or specimens, (7)(b) Social science methods, (7)(a) Behavioral research

Determinations:	• Children • Pregnant women
Approved Documents:	• EnrollmentSurvey_IRB.docx • PostpartumEMASurvey_IRB.docx • EPDS_IRB.doc • Anxiety_Questionnaires_STAI__PSAS-2.docx • DataCollectionForms.pdf • AWHONN Proposal 2020 Consent_to_Act_as_a_Participant_in_a_Research_Study_Understanding_and_Detection_Postpartum_Anxiety.pdf • Informed ConsentMH_Version_0.02.pdf • IRB References.docx • Recruitment Handout.docx • Recruitment HandoutClipboard.docx • ScreeningScript_IRB.docx • Scripts.docx • Social Media Blast_Version_0.02.docx • Social Media Flyer_Version_0.01.docx • Study Flyer_Version_0.01.docx • T32 RENEWAL Program Plan(2).pdf • T32 RENEWAL Program Plan(2).pdf

As the Principal Investigator, you are responsible for the conduct of the research and to ensure accurate documentation, protocol compliance, reporting of possibly study-related adverse events and unanticipated problems involving risk to participants or others. The HRPO Reportable Events policy, Chapter 17, is available at http://www.hrpo.pitt.edu/.

Clinical research being conducted in an UPMC facility cannot begin until fiscal approval is received from the UPMC Office of Sponsored Programs and Research Support (OSPARS).

University of Pittsburgh | Institutional Review Board
Office of Research Protections

APPROVAL OF SUBMISSION (Expedited)

Date:	June 1, 2021
IRB:	MOD21010106-001
PI:	Mary Hoberg
Title:	Improving Understanding and Detection of Postpartum Anxiety
Funding:	Name: National Institutes of Health, Grant Office ID: CNVA00054078, Funding Source ID: 5T32NR008857-14; Name: Association of Women's Health, Obstetric and Neonatal Nurses , Grant Office ID: FP00016544

The Institutional Review Board reviewed and approved the above referenced study. The study may continue as outlined in the University of Pittsburgh approved application and documents.

Approval Documentation

Review type:	Modification / Update
Approval Date:	6/1/2021
Expedited Category	(5) Data, documents, records, or specimens, (7)(b) Social science methods, (7)(a) Behavioral research

Approved Documents:	• Award Letter • Budget and Justification • Informed ConsentMH_Version_0.04.pdf • RecruitmentMaterialsCanva.pdf

As the Principal Investigator, you are responsible for the conduct of the research and to ensure accurate documentation, protocol compliance, reporting of possibly study-related adverse events and unanticipated problems involving risk to participants or others. The HRPO Reportable Events policy, Chapter 17, is available at http://www.hrpo.pitt.edu/.

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APPROVAL OF SUBMISSION (Expedited)

Date:	June 29, 2021
IRB:	MOD21010106-002
PI:	Mary Hoberg
Title:	Improving Understanding and Detection of Postpartum Anxiety
Funding:	Name: National Institutes of Health, Grant Office ID: CNVA00054078, Funding Source ID: 5T32NR008857-14; Name: Association of Women's Health, Obstetric and Neonatal Nurses , Grant Office ID: FP00016544

The Institutional Review Board reviewed and approved the above referenced study. The study may continue as outlined in the University of Pittsburgh approved application and documents.

Approval Documentation

Review type:	Modification / Update
Approval Date:	6/29/2021
Expedited Category	(5) Data, documents, records, or specimens, (7)(b) Social science methods, (7)(a) Behavioral research

Approved Documents:	• EnrollmentSurvey_IRB_Version_0.01.docx • Anxiety_Questionnaires_STAI__PSAS-2_Version_0.01.docx • Informed ConsentMH_Version_0.05.pdf

As the Principal Investigator, you are responsible for the conduct of the research and to ensure accurate documentation, protocol compliance, reporting of possibly study-related adverse events and unanticipated problems involving risk to participants or others. The HRPO Reportable Events policy, Chapter 17, is available at http://www.hrpo.pitt.edu/.

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APPROVAL OF SUBMISSION (Expedited)

Date:	July 20, 2021
IRB:	MOD21010106-003
PI:	Mary Hoberg
Title:	Improving Understanding and Detection of Postpartum Anxiety
Funding:	Name: National Institutes of Health, Grant Office ID: CNVA00054078, Funding Source ID: 5T32NR008857-14; Name: Association of Women's Health, Obstetric and Neonatal Nurses , Grant Office ID: FP00016544

The Institutional Review Board reviewed and approved the above referenced study. The study may continue as outlined in the University of Pittsburgh approved application and documents.

Approval Documentation

Review type:	Modification / Update
Approval Date:	7/20/2021
Expedited Category	(5) Data, documents, records, or specimens, (7)(b) Social science methods, (7)(a) Behavioral research

Approved Documents:	• Recruitment Brochure

As the Principal Investigator, you are responsible for the conduct of the research and to ensure accurate documentation, protocol compliance, reporting of possibly study-related adverse events and unanticipated problems involving risk to participants or others. The HRPO Reportable Events policy, Chapter 17, is available at http://www.hrpo.pitt.edu/.

Clinical research being conducted in an UPMC facility cannot begin until fiscal approval is received from the UPMC Office of Sponsored Programs and Research Support (OSPARS).

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APPROVAL OF SUBMISSION (Expedited)

Date:	August 16, 2021
IRB:	MOD21010106-005
PI:	Mary Hoberg
Title:	Improving Understanding and Detection of Postpartum Anxiety
Funding:	Name: National Institutes of Health, Grant Office ID: CNVA00054078, Funding Source ID: 5T32NR008857-14; Name: Association of Women's Health, Obstetric and Neonatal Nurses , Grant Office ID: FP00016544

The Institutional Review Board reviewed and approved the above referenced study. The study may continue as outlined in the University of Pittsburgh approved application and documents.

Approval Documentation

Review type:	Modification / Update
Approval Date:	8/16/2021
Expedited Category	(5) Data, documents, records, or specimens, (7)(b) Social science methods, (7)(a) Behavioral research

Approved Documents:	• Participants Needed!-2.pdf

As the Principal Investigator, you are responsible for the conduct of the research and to ensure accurate documentation, protocol compliance, reporting of possibly study-related adverse events and unanticipated problems involving risk to participants or others. The HRPO Reportable Events policy, Chapter 17, is available at http://www.hrpo.pitt.edu/.

Clinical research being conducted in an UPMC facility cannot begin until fiscal approval is received from the UPMC Office of Sponsored Programs and Research Support (OSPARS).

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APPROVAL OF SUBMISSION (Expedited)

Date:	September 8, 2021
IRB:	MOD21010106-006
PI:	Mary Hoberg
Title:	Improving Understanding and Detection of Postpartum Anxiety
Funding:	Name: National Institutes of Health, Grant Office ID: CNVA00054078, Funding Source ID: 5T32NR008857-14; Name: Association of Women's Health, Obstetric and Neonatal Nurses , Grant Office ID: FP00016544

The Institutional Review Board reviewed and approved the above referenced study. The study may continue as outlined in the University of Pittsburgh approved application and documents.

Approval Documentation

Review type:	Modification / Update
Approval Date:	9/8/2021
Expedited Category	(5) Data, documents, records, or specimens, (7)(b) Social science methods, (7)(a) Behavioral research

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As the Principal Investigator, you are responsible for the conduct of the research and to ensure accurate documentation, protocol compliance, reporting of possibly study-related adverse events and unanticipated problems involving risk to participants or others. The HRPO Reportable Events policy, Chapter 17, is available at http://www.hrpo.pitt.edu/.

Clinical research being conducted in an UPMC facility cannot begin until fiscal approval is received from the UPMC Office of Sponsored Programs and Research Support (OSPARS).

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University of Pittsburgh | Institutional Review Board
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APPROVAL OF SUBMISSION (Expedited)

Date:	November 19, 2021
IRB:	MOD21010106-008
PI:	Mary Hoberg
Title:	Improving Understanding and Detection of Postpartum Anxiety
Funding:	Name: National Institutes of Health, Grant Office ID: CNVA00054078, Funding Source ID: 5T32NR008857-14; Name: Association of Women's Health, Obstetric and Neonatal Nurses , Grant Office ID: FP00016544

The Institutional Review Board reviewed and approved the above referenced study. The study may continue as outlined in the University of Pittsburgh approved application and documents.

Approval Documentation

Review type:	Modification / Update
Approval Date:	11/19/2021
Expedited Category	(5) Data, documents, records, or specimens, (7)(b) Social science methods, (7)(a) Behavioral research

Approved Documents:	• ScreeningScript_IRB_Version_0.01.docx

As the Principal Investigator, you are responsible for the conduct of the research and to ensure accurate documentation, protocol compliance, reporting of possibly study-related adverse events and unanticipated problems involving risk to participants or others. The HRPO Reportable Events policy, Chapter 17, is available at http://www.hrpo.pitt.edu/.

Clinical research being conducted in an UPMC facility cannot begin until fiscal approval is received from the UPMC Office of Sponsored Programs and Research Support (OSPARS).

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APPENDIX B

STUDY CONSENT

CONSENT TO ACT AS A PARTICIPANT IN A RESEARCH STUDY

Study Name: **Improving Understanding and Detection of Postpartum Anxiety**

Principal Investigator: Mary G. Hoberg, MSN, RN
3500 Victoria Street, Suite 440
Pittsburgh, PA 15261
412-780-0575
Mgh30@pitt.edu

Co-Investigators: Annette DeVito Dabbs, PhD, RN, *ajdst42@pitt.edu*
Jill R. Demirci, PhD, RN, IBCLC *jvr5@pitt.edu*

Study Sponsor: Association of Women's Health, Obstetrics, and Neonatal Nurses (AWHONN)

Why is this research being done? The purpose of this study is to improve understanding about the frequency and severity of anxiety in the weeks after childbirth. Additionally, the study will explore how experiences around birth may influence moods and mental health of postpartum people.

Who is being asked to take part in this research study? You are being asked to be in this research study because you are in your third trimester of pregnancy, you and your baby are healthy, you speak and understand English, are 18 years of age or older, and have access to a personal smartphone. About 75 pregnant women will take part in this study.

What is involved? If you agree to take part in this study, you will be asked to complete a set of questionnaires during your third trimester of pregnancy, one week after childbirth, and eight weeks after childbirth. Links to questionnaires will be emailed or text-messaged according to your preference. Initial questionnaires, given in your 3rd trimester of pregnancy, include questions about your background (e.g., age, education, income, employment) as well as questions that screen for anxiety symptoms The research team will also collect information from you and your baby's medical records including past history of physical and mental health conditions, medications you are taking, pregnancy data, and labor and delivery data. This information is needed to examine potential factors that may affect your mental health or mood during being assessed in this study. No information we obtain from you will be included in you or your baby's medical records.

At around one week after the birth of your baby and again at 8 weeks after childbirth, you will be sent a link to complete additional mood questionnaires that screen for anxiety and depression symptoms. There are 3 in total. Completion of these questionnaires should be accomplished in <30 minutes. After you complete the questionnaires at one week after you baby's birth, you will begin to receive **a daily text message** on your smartphone that contains a link to an online daily survey. You will receive daily texted survey links over the next seven weeks. The daily survey is combination of multiple choice and open-ended questions that should take *less than 10 minutes to complete*. At the end of each day, you will also receive a reminder text to complete the survey if you did not have a chance to do so earlier in the day. We will monitor your survey responses weekly and may contact you if we notice that you have not completed a number of texted surveys. This contact would occur to offer assistance with any technical challenges that you may

be experiencing in completing the surveys or to reassess your interest in participating in the study. Responses are voluntary and there is no consequence for not completing daily surveys. If the research team notes any potentially serious health issues during data collection from your completed surveys, we will contact you by phone to ensure the issue is being addressed appropriately by your medical care providers. Daily texted survey links will stop at eight weeks after you baby's birth at which point you will be emailed the same electronic mood questionnaires you completed at one week postpartum.

What are the possible risks and discomforts of this study? It is possible, but unlikely that your enrollment and end-of study survey responses may be visible over the internet. To minimize this risk, we ask that you delete your emailed survey link after completing the survey and empty your computer's "trash" after deletion. Likewise, we advise that you delete texted survey links after you complete them, although once the survey is submitted, it cannot be accessed by the same link again. Further, we will minimize breaches in confidentiality by assigning you a non-specific research ID and using this on your research records, rather than identifiable information like your name or medical record number.

Furthermore, it is possible that you may experience some emotional distress or study fatigue from answering daily survey questions pertaining to your mood and/or experiences. To minimize this risk, responses to daily surveys will be voluntary and can be completed at your convenience. Also, you may choose to skip any daily surveys or stop participating in the study at any time by notifying the study team. If you feel that you are experiencing emotional distress that requires additional support, you have the option to respond "Yes" to a question at the end of each daily survey requesting external assistance. A behavioral health number linked to Magee Womens Hospital services will be provided.

Will I benefit from taking part in this study? Although you may not directly benefit from this study, your participation may help us understand more about what types of experiences in the weeks after childbirth influence birthing people's moods and mental health. This information may in turn improve providers' ability to identify and assist those in need.

Will anyone know that I am taking part in this study? We will make every attempt to protect your privacy and the confidentiality of your records, as described in this document, but cannot guarantee the confidentiality of your research records, including information obtained from your medical records, once your personal information is disclosed to others outside UPMC or the University. *A study number, rather than your name, will be used on all forms and files, with the following exceptions:* We will keep a single password-protected, user-restricted computer file linking your study number with your name as well as an electronic copy of this informed consent. You will not be identified by name in any publication or presentation of research results. Further, the Office of Research Protections may have access to the data, including identifiable medical record data for the purposes of monitoring this project.

Although every reasonable effort has been taken, confidentiality during Internet communication activities cannot be guaranteed, and it is possible that additional information beyond that collected for research purposes may be captured and used by others not associated with this study. This minimal risk occurs for text messaged survey links as well, as text messages are not encrypted or secure during their transmission, and could be intercepted.

Also, in unusual cases the investigators may be required to release identifiable information (which may include identifiable medical information) related to your participation in this research study in response to an order from a court of law. If the investigators learn that you/your child are in potential serious danger, they will need to inform the appropriate agencies, as required by Pennsylvania law. Per University of Pittsburgh policy all research records must be maintained for at least 7 years following final reporting or publication of a project.

Additionally, after identifiers are removed from private information, this information may be used for future research studies or distributed to another investigator for future research studies without additional informed consent from the subject or the legally authorized representative. Your identifiable medical record information will only be made available to study team members for a year following the conclusion of this study. Similarly, authorization to access your or your child's medical records will only be valid for up to a year after this study's conclusion.
Will I be paid for participating in this study? You will receive a University of Pittsburgh cash card, which we will reload as you complete study activities. You will receive $10 at the time of enrollment and completion of initial questionnaires, $35 upon completion of approximately 75% of texted daily surveys, and $25 for completion of end-of-study questionnaires. You can receive up to $70 for study participation.

Will it cost anything for me to participate in this study? Depending on your mobile provider text message plan, daily mobile surveys sent to your smartphone device may incur messaging charges. *The research team is not responsible for any text message charges billed to you.* Aside from this, there are no other direct costs to you or your insurance provider for being in this study.

Is my participation in the study voluntary? Yes. Your participation in this study is completely voluntary. You may refuse to participate or stop participating at any time, even after signing this form. To withdraw from the study, you only need to provide written or verbal intent to do so to the principal investigator (who can be reached with the contact information on this form). Whether or not you provide your consent for participation in this research study will have no effect on your current or future relationship with the University of Pittsburgh, your current or future medical care at a UPMC hospital or affiliated health care provider, or your current or future relationship with a health care insurance provider.

If I agree to take part in the study, can I be removed from the study without my consent? It is possible that you may be removed from the research study by the researchers if, for example you or your baby becomes critically ill. If you lose cell phone access, you may remain in the study and complete questionnaires that will be emailed electronically.

How do I get more information? If you have questions about your participation in this study, contact the Principal Investigator, Mary Hoberg, at the phone number listed on this form. If you have any questions about your rights as a research subject, contact the Human Subject Protection Advocate, IRB Office (1-866-212-2668). You will receive a copy of this consent form.

Additional Information: Surveys will be automatically distributed by the University of Pittsburgh's Qualtrics Data Management System. It is recommended that you add the phone number of this system to your address book to ensure recognition of the study text messages.

Study text messages will be received from this number: 1-833-366-0398

CONSENT TO ACT AS A PARTICIPANT IN A RESEARCH STUDY

VOLUNTARY CONSENT

The above information has been explained to me and all of my current questions have been answered. I understand that I am encouraged to ask questions, voice concerns or complaints about any aspect of this research study during the course of this study, and that such future questions, concerns or complaints will be answered by a qualified individual or by the investigator(s) listed on the first page of this consent document at the telephone number(s) given.

I understand that I may always request that my questions, concerns or complaints be addressed by a listed investigator. I understand that I may contact the Human Subjects Protection Advocate of the IRB Office, University of Pittsburgh (1-866-212-2668) to discuss problems, concerns, and questions; obtain information; offer input; or discuss situations that occurred during my participation. By signing this form I agree to participate in this research study. A copy of this consent form will be given to me.

By signing this form, I also give my authorization to share my/my baby's medical records with the research team. This is necessary in order for the researchers to obtain details related to medical factors that may affect moods and mental health. However, I am aware that I can always withdraw my authorization to allow the research team to review my medical records by contacting the investigator listed on the first page and making the request in writing. If I withdraw authorization to access my/my baby's medical records, I am aware that I will no longer be permitted to participate in the study, and any information obtained from my/my baby's medical records up to the point of withdraw will continue to be used by the research team. A copy of this consent form will be given to me.

For study-related business (e.g., answering my questions), I give permission for researchers to contact me via: *[check all you feel comfortable with]*

□ Email
□ Text message

_____	_____	_____
Maternal Subject/Parent Name	Maternal Subject/Parent Signature	Date/Time

Cell phone for text messages: _____

Email: _____

Secondary phone number: _____

Best time of day to reach you (by phone): _____

CONSENT TO ACT AS A PARTICIPANT IN A RESEARCH STUDY

_____
Infant Subject Name

I understand that as a minor (age less than 18 years), the above-named child is not permitted to participate in this research study without my consent and authorization. Therefore, by signing this form, I give my consent for his/her participation in this research study and provide my authorization for the use of his/her medical records.

*Parent's or Guardian's Name (Print)*_____ *Relationship to Participant (Child):* _____

Parent or Guardian Signature _____ *Date:*_____

INVESTIGATOR CERTIFICATION
I certify that I have explained the nature and purpose of this research study to the above-mentioned maternal participant and I have discussed the potential benefits and possible risks of study participation. Any questions about this information have been answered. I further certify that no research component of this protocol was begun until after this consent form was signed.

_____ _____ _____
Investigator Name Investigator Signature Date/Time

APPENDIX C

SOCIODEMOGRAPHIC QUESTIONNAIRE

Enrollment Survey

Start of Block: Default Question Block

Q1 What is your age in years?

_____

Q2 What is your race?

- ○ American Indian or Alaska Native (1)
- ○ Asian (2)
- ○ Black or African American (3)
- ○ Native Hawaiian or Other Pacific Islander (4)
- ○ White (5)
- ○ Other (6) _____

Q3 What is your ethnicity?

- ○ Hispanic or Latino (1)
- ○ Non-Hispanic or Latino (2)

Q4 What is your highest level of education?

- Currently enrolled in High School (1)
- Never Finished High School (2)
- Graduated from High School/GED (3)
- Completed occupational or vocational program (4)
- Some college (5)
- Associate's degree (6)
- Bachelor's degree (BS, BA, AB, etc) (7)
- Master's or Doctoral degree (MA, MS, MD, DO, DDS, JD, PhD, etc) (8)

Q5 Do you work for pay now?

- Yes, the same number of hours as before pregnancy (1)
- Yes, but with reduced hours (2)
- No (4)

Q6 Do you plan to take time off of work after the birth of your infant? If yes, for how long?

- Yes (1) _____
- No (2)
- Not Applicable (3)

Q7 What is your occupation?

_____

Q8 What is your marital status?

- ○ Single/Separated (1)
- ○ Married/Partnered (2)
- ○ Divorced (3)
- ○ Widowed (4)
- ○ Other (5) _____

Q9 Do you have other biological children?

- ○ Yes (1)
- ○ No (2)

Q10 How many biological children do you have?

_____

Q11 What was your total household income before taxes last year? (Please estimate if you are not sure.)

- ○ $10,000 - $29,999 (1)
- ○ $30,000 - $49,999 (2)
- ○ $50,000 - $69,999 (3)
- ○ $70,000 - $89,999 (4)
- ○ > $90,000 (5)

Q12 Have you ever had issues with infertility? (Infertility means not being able to get pregnant on your own or needing reproductive assistance to conceive.)

- ○ Yes (1)
- ○ No (2)
- ○ Unsure (3)

Q13 If you have had previous pregnancies and deliveries, did you experience any complications? (high blood pressure, diabetes, preterm labor, preeclampsia, etc)

- ○ No, I have not experienced complications with past pregnancies/deliveries (1)
- ○ Yes, I have experienced complications with past pregnancies/deliveries. (2)

_____

Q14 Have you experienced any complications with the current pregnancy? (high blood pressure, diabetes, preterm labor, preeclampsia, etc)

- ○ Yes (Please describe below) (1)

_____

- ○ No (2)
- ○ Click to write Choice 3 (3)

Q15 Have you used tobacco in the last 12 months?

○ Yes (1)

○ No (2)

Q16 Have you ever been diagnosed with a mental illness or mood disorder? (anxiety, depression, bipolar disorder, schizophrenia, etc)

○ Yes (Please describe below) (1)

_____

○ No (2)

○ Prefer not to answer (4)

Q17 How do you intend or hope to feed your baby in the first few weeks after they are born?

- ○ Only breastfeeding (either at-breast/chest or milk from pump/express) (1)
- ○ Only formula (3)
- ○ Combination/mixed feeding (breastfeeding plus formula) (7)
- ○ Unsure/undecided (5)
- ○ Other (4) _____

Q18 Do you have a preference for the time of day you wish to receive your daily texted surveys?

- ○ Yes, I prefer the morning (e.g., around 9 am) (1)
- ○ Yes, I prefer the afternoon (e.g., around 1 pm) (2)
- ○ Yes, I prefer the evening (e.g., around 6 pm) (3)
- ○ No, I do not have a preference. (e.g., rotating times are fine) (4)

End of Block: Default Question Block

APPENDIX D

STATE-TRAIT ANXIETY INVENTORY

www.mindgarden.com

To Whom It May Concern,

The above-named person has made a license purchase from Mind Garden, Inc. and has permission to administer the following copyrighted instrument up to that quantity purchased:

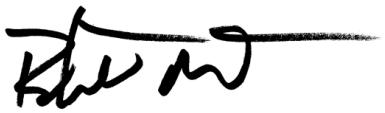
State-Trait Anxiety Inventory for Adults

The four sample items only from this instrument as specified below may be included in your thesis or dissertation. Any other use must receive prior written permission from Mind Garden. The entire instrument may not be included or reproduced at any time in any other published material. Please understand that disclosing more than we have authorized will compromise the integrity and value of the test.

Citation of the instrument must include the applicable copyright statement listed below.
Sample Items:

I feel at ease
I feel upset
I lack self-confidence
I am a steady person

Sincerely,



Robert Most
Mind Garden, Inc.
www.mindgarden.com

APPENDIX E

POSTPARTUM SPECIFIC ANXIETY SCALE

Eleanor Rathbone Building
Bedford Street South
Liverpool
L69 7ZA
E: vfallon@liverpool.ac.uk

5th July 2022

Dear Mary

Re:- Permission to use the Postpartum Specific Anxiety Scale [PSAS].

I am writing in my capacity as Principal Investigator of the Postpartum Specific Anxiety Scale [PSAS] with regard to the use of the Research Short-Form scale in your research. My understanding is that the PSAS will be used as part of your Dissertation project.

The Postpartum Specific Anxiety Scale (PSAS; Fallon et al., 2016) was originally published in the journal *Archives of Women's Mental Health.* Since then, the PSAS Working Group have been liaising with fellow colleagues, collaborators, and researchers to translate and validate the scale into other languages, as well as utilise the scale in different contexts.

The scale is subject to a copyright agreement as follows:

"The PSAS and any approved derivatives are licensed by the creator, Vicky Fallon of the University of Liverpool and is licensed under the Creative Commons Attribution-Non-Commercial-No Derivatives 4.0 International License (CC-BY-NC-ND 4.0)"

This means that you are allowed to download the questionnaire and share it with others as long as you credit the original authorship team, but you cannot change it in any way or use it commercially without permission from the creator.

You can also find out more about the PSAS here: https://www.researchgate.net/project/The-Postpartum-Specific-Anxiety-Scale-PSAS

On behalf of the whole team, we wish you good luck with the research and thank you for your interest in the PSAS. We will happily continue to support the process and your research in any way you deem necessary, and would be very interested in working with you during write-up and publication of these findings.

Yours Faithfully,

Vicky Fallon
Principal Investigator of the PSAS

att.
- Davies et al., (2021) – PSAS-RSF – ***Archives of Women's Mental Health***
- The English Language PSAS-RSF

cc.
- Victoria Fallon – Chief Investigator of the PSAS (UK & Global) OR Sergio A. Silverio – Chief Investigator of the PSAS (Europe & The MENA Region)

The Postpartum Specific Anxiety Scale [PSAS].

Victoria Fallon

Jason Christian Grovenor Halford, Kate Mary Bennett, and Joanne Allison Harrold

Instructions to Participant:

We are interested in how you are feeling since you had your baby. Please choose the answer that comes closest to how you have felt **IN THE PAST 7 DAYS**, not just how you feel today. As this is a reflection of the past seven days, you may want to repeat this scale again to track any changes in your frequency of symptoms.

In developing the scale preliminary consultations identified some items as not being applicable to all mothers. These items have been marked with an asterisk (*), for example: [*2.] If these marked items are not applicable to you or your circumstances, please leave the item response blank.

Please take your time and read each question carefully, selecting the most appropriate answer for each question from the following options:

1 = Not at all

2 = Not Very Often

3 = Often

4 = Almost Always

Notes to Participant:

Women who experience anxiety in the postpartum period need not feel alone. If completing this scale has caused you to feel a heightened level of emotional distress or has confirmed any anxious feelings you may have been experiencing, please talk to the Administering Researcher who should sign-post you to suitable supportive services. The team who developed the scale also recommend the following (English Language) information sources:

Anxiety UK [United Kingdom]:
https://www.anxietyuk.org.uk/our-services/anxiety-information/anxiety-disorders/post-natal-anxiety/

Centre of Perinatal Excellence [Australia]:
http://cope.org.au/

Postpartum Support International [United States of America]:
http://www.postpartum.net/

PARTICIPANT ID:	AGE OF BABY IN WEEKS:	DATE:			
Question Number	**The Postpartum Specific Anxiety Scale Item**	**1 = Not At All**	**2 = Not Very Often**	**3 = Often**	**4 = Almost Always**
1.	I have felt unable to juggle motherhood with my other responsibilities.				
*2.	I have worried more about my relationship with my family than before my baby was born.				
3.	I have worried about accidentally harming my baby.				
4.	I have worried about how I will cope with my baby when others are not around to support me.				
5.	I have felt that I do not get enough support.				
6.	I have been less able to concentrate on simple tasks than before my baby was born.				
7.	I have felt that I should not need help to look after my baby.				
8.	I have felt frightened when my baby is not with me.				
9.	I have worried I will not know what to do when my baby cries.				
*10.	I have worried more about my relationship with my partner than before my baby was born.				
11.	I have worried that my baby feels more content in someone else's care.				
*12.	I have felt isolated from my family and friends.				
13.	I have worried about my baby's weight.				
14.	I have worried about getting my baby into a routine.				
15.	I have worried that I will become too ill to care for my baby.				
16.	I have worried about my baby being accidentally harmed by someone or something.				
17.	I have felt unconfident or incapable of meeting my baby's basic care needs.				
18.	I have worried about being unable to settle my baby.				
19.	I have felt a greater need to do things in a certain way or order than before my baby was born.				
20.	I have had negative thoughts about my relationship with my baby.				
*21.	I have worried more about my relationship with my friends than before my baby was born.				
22.	I have thought of ways to avoid exposing my baby to germs.				
23.	I have worried that my baby is less content than other babies.				
24.	I have felt that other mothers are coping with their babies better than me.				
25.	I have felt that I am not the parent I want to be.				
26.	I have worried more about completing household chores than before my baby was born.				

Question Number	The Postpartum Specific Anxiety Scale Item	1 = Not At All	2 = Not Very Often	3 = Often	4 = Almost Always
27.	I have not taken part in an everyday activity with my baby because I fear they may come to harm.				
28.	I have worried about my baby's milk intake.				
29.	I have felt that I have had less control over my day than before my baby was born.				
30.	I have worried more about my finances than before my baby was born.				
31.	I have worried about my baby's health even after reassurance from others.				
32.	I have felt that when I do get help it is not beneficial.				
33.	I have worried that my baby will stop breathing while sleeping.				
34.	I have used the internet for reassurance about my baby's health.				
35.	I have worried about leaving my baby in a childcare setting.				
36.	I have felt that my baby would be better cared for by someone else.				
37.	I have worried that I am not going to get enough sleep.				
38.	I have felt that motherhood is much harder than I expected.				
39.	I have worried that my baby is picking up on my anxieties.				
40.	I have worried about the bond that I have with my baby.				
41.	I have worried about the length of time that my baby sleeps.				
*42.	I have worried about returning to work.				
43.	I have worried more about my appearance than before my baby was born.				
44.	I have had difficulty sleeping even when I have had the chance to.				
45.	I have worried that other people think that my parenting skills are inadequate.				
*46.	I have worried that my partner finds me less attractive than before my baby was born.				
47.	I have worried that my baby is not developing as quickly as other babies.				
*48.	I have felt resentment towards my partner.				
49.	I have worried about the way that I feed my baby.				
50.	I have repeatedly checked on my sleeping baby.				
51.	I have felt tired even after a good amount of rest.				
- END -		**SCORE: _____ / 204**			

APPENDIX F

EDINBURGH POSTNATAL DEPRESSION SCALE

Edinburgh Postnatal Depression Scale[1] (EPDS)

Name: _____ Address: _____

Your Date of Birth: _____ _____

Baby's Date of Birth: _____ Phone: _____

As you are pregnant or have recently had a baby, we would like to know how you are feeling. Please check the answer that comes closest to how you have felt **IN THE PAST 7 DAYS**, not just how you feel today.

Here is an example, already completed.

I have felt happy:
- □ Yes, all the time
- ☒ Yes, most of the time — This would mean: "I have felt happy most of the time" during the past week.
- □ No, not very often — Please complete the other questions in the same way.
- □ No, not at all

In the past 7 days:

1. I have been able to laugh and see the funny side of things
   - □ As much as I always could
   - □ Not quite so much now
   - □ Definitely not so much now
   - □ Not at all

2. I have looked forward with enjoyment to things
   - □ As much as I ever did
   - □ Rather less than I used to
   - □ Definitely less than I used to
   - □ Hardly at all

*3. I have blamed myself unnecessarily when things went wrong
   - □ Yes, most of the time
   - □ Yes, some of the time
   - □ Not very often
   - □ No, never

4. I have been anxious or worried for no good reason
   - □ No, not at all
   - □ Hardly ever
   - □ Yes, sometimes
   - □ Yes, very often

*5 I have felt scared or panicky for no very good reason
   - □ Yes, quite a lot
   - □ Yes, sometimes
   - □ No, not much
   - □ No, not at all

*6. Things have been getting on top of me
   - □ Yes, most of the time I haven't been able to cope at all
   - □ Yes, sometimes I haven't been coping as well as usual
   - □ No, most of the time I have coped quite well
   - □ No, I have been coping as well as ever

*7 I have been so unhappy that I have had difficulty sleeping
   - □ Yes, most of the time
   - □ Yes, sometimes
   - □ Not very often
   - □ No, not at all

*8 I have felt sad or miserable
   - □ Yes, most of the time
   - □ Yes, quite often
   - □ Not very often
   - □ No, not at all

*9 I have been so unhappy that I have been crying
   - □ Yes, most of the time
   - □ Yes, quite often
   - □ Only occasionally
   - □ No, never

*10 The thought of harming myself has occurred to me
   - □ Yes, quite often
   - □ Sometimes
   - □ Hardly ever
   - □ Never

Administered/Reviewed by _____ Date _____

[1]Source: Cox, J.L., Holden, J.M., and Sagovsky, R. 1987. Detection of postnatal depression: Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry* 150:782-786 .

[2]Source: K. L. Wisner, B. L. Parry, C. M. Piontek, Postpartum Depression N Engl J Med vol. 347, No 3, July 18, 2002, 194-199

APPENDIX G

AMENDMENT TO INCLUSION / EXCLUSION CRITERIA

Study Design

1. **Total number of subjects to be enrolled at this site (enter -1 for chart reviews, banking, registries):**
   75

2. **Describe and explain the study design:**
   Prospective mixed-methods observational cohort study

3. **Describe the primary and secondary study endpoints:**
   Better understanding of the experience of anxiety in the post-partum period

4. **Provide a description of the following study timelines:**

   Duration of an individual subject's active participation:
   Participants will be enrolled in the third trimester of pregnancy, which is between 27 weeks and 42 weeks pregnant. Depending on when the participant is enrolled, their length of participation in the study will vary. The maximum amount of time a participant will be enrolled in this study is 23 weeks or approximately 3 months

   Duration anticipated to enroll all subjects:
   We anticipate ~ 9 months to recruitment 75 participants assuming that ~8 participants can be recruited a month. Recent projects recruiting from the same research population were able to recruit ~15-20 participants a month (R.R. Dieterich, personal communication, Nov 5, 2020).

   Estimated date for the investigator to complete this study (complete primary analyses):
   6/30/2022

5. **List the inclusion criteria:**
   Pregnant persons who are (1) >18 years; (2) English-Speaking; (3) have access to a personal smart-phone device, (4) plan to deliver at MWH

6. List the exclusion criteria:

(1) have a positive history of drug or alcohol abuse, (2) history of severe mental illness (e.g., psychotic disorders, active suicidality etc.), (3) have a multiple-fetus gestation, (4) experience maternal, fetal, or neonatal conditions or complications that may cause undue or unanticipated psychological distress.

Note: Decisions regarding a person's eligibility based on self-reported past history of severe mental illness (determined by medical records) will be made with expert guidance from Dr. Michele Levine. Participants will be excluded for any or all of the following:
1) diagnosis of any psychotic disorder, specific or not otherwise specified
2) recent history (≥ 5 years) of self-harm or active suicidality
3) recent history (≥ 5 years) of hospitalizations for mental illness

7. Will children or any gender, racial or ethnic subgroups be explicitly excluded from participation?

● **Yes** ○ No

*** Identify the subgroups and provide a justification:**

Children <18 years of age will be explicitly excluded from participation in this study. As emotional regulation and reactivity of adolescents differ from that of adults (Silvers et al., 2012), this study population is excluded to control for potential confounding.

8. Describe the power analysis used and cite your method of statistical analysis. If a power analysis is not possible, thoroughly justify the sample size required for the study, including appropriate literature citation (alternatively provide page reference in attached protocol):

In this dissertation-level study, sample size was determined using feasibility criteria, which considered the study time frame, exploratory nature, cost, and anticipated participant recruitment rates. Thus, a sample of ~75 women will be recruited to account for attrition rates of ~25-30%. These rates were identified in recent PP studies with longitudinal time frames of 6 weeks (Radoš et al., 2018) and 8 weeks (C.-L. Dennis, Brown, et al., 2017). We hope to retain ~n = 50 participants at eight weeks PP. Considering the similarly small sample sizes of other successful perinatal EMA studies, n = 61 (Demirci & Bogen, 2017) and n = 28 (Mendez et al., 2019), we anticipate our sample will yield data that can be meaningfully interpreted.

APPENDIX H

PROTOCOL FOR POSITIVE DEPRESSION SCREENS

Additional Protocol for Handling Cases of "Positive Screens" on Mood Questionnaires (e.g., Edinburgh Postnatal Depression Scale (EPDS) or State-Trait Anxiety Inventory (STAI)).

Background/Justification

Participants are asked to complete the EPDS and STAI at 1 week and 8 weeks postpartum. If participants score ≥13 on the EPDS, the PI will reach out to participants by phone call. If after 2 attempts at phone calls are not returned, the PI will reach out to participants via text message. After 2 text message attempts to contact participant, a message will be left with a number to call me and/or the UPMC RESOLVE hotline.

Script for Contacting Participants

Contact by Phone:

If voicemail is received, the PI will leave the following message:

> **Hello [participant name], this is Mary calling from the Postpartum Mood Study. I wanted to touch base with you to see how you and your baby are doing. Also, there are a few things about how you are feeling right now that I would like to discuss with you. Please call me back at your convenience at 412-780-0575. Thank you and have a great rest of your day!**

If participant is reached or returns voicemail, the PI will have the following conversation:

Hello *[participant name],* **this is Mary calling from the Postpartum Mood Study. How are you doing?**

Await response & respond appropriately before stating the reason for the call today.

I wanted to thank you again so much for your participation in the study! Additionally, I wanted to let you know at the end of the study I asked you to complete two questionnaires that assess for any presence of anxious or depressive symptoms you may be having. You may have also completed a similar questionnaire at your 6-week OB-provider visit. I noticed that your answers and scores on these questionnaires suggested that you may be experiencing considerable symptoms of *[anxiety/depression/both].*

Await response & respond appropriately.

We are asking these questions because these feelings are so common. Given their presence among people after childbirth, it's my practice to call anyone who reports symptoms and review how they are feeling. How are you feeling now?

I would like to provide you with resources if feelings have worsened (or if they are doing worse). I'll text you some resource after our phone conversation.

Await response & respond appropriately.

(If response is NO or that a provider has not been made aware). **I would like to encourage you to reach out to your OB provider or one of the resources I gave you so that you can receive support regarding your feelings. Please know that experiencing anxiety and depression after childbirth is the most common**

complication women experience, and it is very important you feel supported with help and resources.

Await response & respond appropriately.

Do you have a plan or a means to contact your OB provider?

Await response & respond appropriately.

Is there anything more I can do for you?

Await response & respond appropriately.

Okay, thank you again so much for your time. I wish you and your family nothing but the best. Please don't hesitate to reach out to me again if you have any other questions or concerns related to the study.

Contact by Text Message:

If participant is unable to be reached by phone, the following text message will be sent:

Hello [participant name], this is Mary from the Postpartum Mood Study. I wanted to touch base with you to see how you and your baby are doing. Also, there are a few things about how your reported feeling that I need to discuss with you. Please call me back at your convenience at 412-780-0575. Thank you and have a great rest of your day!

List of Resources:

1. **Crisis Hotline: 1-888-796-8226**
2. **Behavioral Health Number (UPMC): 412-641-1238**

BIBLIOGRAPHY

aan het Rot, M., Hogenelst, K., & Schoevers, R. A. (2012). Mood disorders in everyday life: a systematic review of experience sampling and ecological momentary assessment studies. *Clinical Psychology Review*, *32*(6), 510–523. https://doi.org/10.1016/j.cpr.2012.05.007

Accortt, E. E., & Wong, M. S. (2017). It is time for routine screening for perinatal mood and anxiety disorders in obstetrics and gynecology settings. *Obstetrical & Gynecological Survey*, *72*(9), 553–568. https://doi.org/10.1097/OGX.0000000000000477

ACOG Committee Opinion No. 757. (2018). Screening for perinatal depression. *Obstetrics & Gynecology*, *132*(5), e208–e212.

Ali, E. (2018). Women's experiences with postpartum anxiety disorders: a narrative literature review. *International Journal of Women's Health*, *10*, 237–249. https://doi.org/10.2147/IJWH.S158621

Althubaiti, A. (2016). Information bias in health research: definition, pitfalls, and adjustment methods. *Journal of Multidisciplinary Healthcare*, *9*, 211–217. https://doi.org/10.2147/JMDH.S104807

American College of Obstetricians and Gynecologists. (2018). ACOG committee opinion no. 736: optimizing postpartum care. *Obstetrics and Gynecology*, *131*(5), e140–e150. https://doi.org/10.1097/AOG.0000000000002633

American College of Obstetricians and Gynecologists (ACOG). (2018). ACOG committee opinion no. 757: screening for perinatal depression. *Obstetrics and Gynecology*, *132*(5), e208–e212. https://doi.org/10.1097/AOG.0000000000002927

Anokye, R., Acheampong, E., Budu-Ainooson, A., Obeng, E. I., & Akwasi, A. G. (2018).

Prevalence of postpartum depression and interventions utilized for its management. *Annals of General Psychiatry*, *17*, 18. https://doi.org/10.1186/s12991-018-0188-0

Association of Women's Health Obstetric Neonatal Nurses (AWHONN). (2015). Mood and anxiety disorders in pregnant and postpartum women. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, *44*(5), 687–689. https://doi.org/10.1111/1552-6909.12734

Battle, C. L., Salisbury, A. L., Schofield, C. A., & Ortiz-Hernandez, S. (2013). Perinatal antidepressant use: understanding women's preferences and concerns. *Journal of Psychiatric Practice*, *19*(6), 443–453. https://doi.org/10.1097/01.pra.0000438183.74359.46

Bayrampour, H., Ali, E., McNeil, D. A., Benzies, K., MacQueen, G., & Tough, S. (2016). Pregnancy-related anxiety: A concept analysis. *International Journal of Nursing Studies*, *55*, 115–130. https://doi.org/10.1016/j.ijnurstu.2015.10.023

Bhat, A., Nanda, A., Murphy, L., Ball, A. L., Fortney, J., & Katon, J. (2022). A systematic review of screening for perinatal depression and anxiety in community-based settings. *Archives of Women's Mental Health*, *25*(1), 33–49. https://doi.org/10.1007/s00737-021-01151-2

Blackmore, E. R., Gustafsson, H., Gilchrist, M., Wyman, C., & G O'Connor, T. (2016). Pregnancy-related anxiety: Evidence of distinct clinical significance from a prospective longitudinal study. *Journal of Affective Disorders*, *197*, 251–258. https://doi.org/10.1016/j.jad.2016.03.008

Britton, J. R. (2008). Maternal anxiety: course and antecedents during the early postpartum period. *Depression and Anxiety*, *25*(9), 793–800. https://doi.org/10.1002/da.20325

Brunton, R., Dryer, R., Saliba, A., & Kohlhoff, J. (2019). Re-examining pregnancy-related anxiety: A replication study. *Women and Birth : Journal of the Australian College of*

Midwives, *32*(1), e131–e137. https://doi.org/10.1016/j.wombi.2018.04.013

Brunton, R. J., Dryer, R., Saliba, A., & Kohlhoff, J. (2015). Pregnancy anxiety: A systematic review of current scales. *Journal of Affective Disorders*, *176*, 24–34. https://doi.org/10.1016/j.jad.2015.01.039

Cena, L., Gigantesco, A., Mirabella, F., Palumbo, G., Trainini, A., & Stefana, A. (2021). Prevalence of maternal postnatal anxiety and its association with demographic and socioeconomic factors: A multicentre study in italy. *Frontiers in Psychiatry*, *12*, 737666. https://doi.org/10.3389/fpsyt.2021.737666

Chavis, L. (2016). Mothering and anxiety: Social support and competence as mitigating factors for first-time mothers. *Social Work in Health Care*, *55*(6), 461–480. https://doi.org/10.1080/00981389.2016.1170749

Cohen, S., Kamarck, T., & Mermelstein, R. (2014). Perceived Stress Scale. *American Psychological Association (APA)*. https://doi.org/10.1037/t02889-000

Colombo, D., Fernández-Álvarez, J., Patané, A., Semonella, M., Kwiatkowska, M., García-Palacios, A., Cipresso, P., Riva, G., & Botella, C. (2019). Current State and Future Directions of Technology-Based Ecological Momentary Assessment and Intervention for Major Depressive Disorder: A Systematic Review. *Journal of Clinical Medicine*, *8*(4). https://doi.org/10.3390/jcm8040465

Cope, D. G. (2014). Methods and meanings: credibility and trustworthiness of qualitative research. *Oncology Nursing Forum*, *41*(1), 89–91. https://doi.org/10.1188/14.ONF.89-91

Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *The British Journal of Psychiatry*, *150*, 782–786. https://doi.org/10.1192/bjp.150.6.782

Cresswell, J. W., Klassen, A. C., Plano Clark, V. L., & Smith, K. C. (2018). *Best Practices for Mixed Methods Research in the Health Sciences*. Office of Behavioral and Social Sciences Research. https://obssr.od.nih.gov/sites/obssr/files/Best_Practices_for_Mixed_Methods_Research.pdf

Davies, S. M., Christiansen, P., Harrold, J. A., Silverio, S. A., & Fallon, V. (2021). Creation and validation of the Postpartum Specific Anxiety Scale Research Short-Form (PSAS-RSF). *Archives of Women's Mental Health*. https://doi.org/10.1007/s00737-021-01114-7

Delaney, A. M., George Dalmida, S., & Gaydos, L. (2015). When it is not postpartum depression: understanding the postpartum mental health needs of mothers and how they are being met. *Issues in Mental Health Nursing*, *36*(6), 416–423. https://doi.org/10.3109/01612840.2014.1002645

Demirci, J. R., & Bogen, D. L. (2017a). An ecological momentary assessment of primiparous women's breastfeeding behavior and problems from birth to 8 weeks. *Journal of Human Lactation*, *33*(2), 285–295. https://doi.org/10.1177/0890334417695206

Demirci, J. R., & Bogen, D. L. (2017b). Feasibility and acceptability of a mobile app in an ecological momentary assessment of early breastfeeding. *Maternal & Child Nutrition*, *13*(3). https://doi.org/10.1111/mcn.12342

Dennis, C.-L., Brown, H. K., & Brennenstuhl, S. (2017). The Postpartum Partner Support Scale: Development, psychometric assessment, and predictive validity in a Canadian prospective cohort. *Midwifery*, *54*, 18–24. https://doi.org/10.1016/j.midw.2017.07.018

Dennis, C.-L., Brown, H. K., Falah-Hassani, K., Marini, F. C., & Vigod, S. N. (2017). Identifying women at risk for sustained postpartum anxiety. *Journal of Affective Disorders*, *213*, 131–

137. https://doi.org/10.1016/j.jad.2017.02.013

Dennis, C.-L., Coghlan, M., & Vigod, S. (2013). Can we identify mothers at-risk for postpartum anxiety in the immediate postpartum period using the State-Trait Anxiety Inventory? *Journal of Affective Disorders*, *150*(3), 1217–1220. https://doi.org/10.1016/j.jad.2013.05.049

Dennis, C.-L., Falah-Hassani, K., & Shiri, R. (2017). Prevalence of antenatal and postnatal anxiety: systematic review and meta-analysis. *The British Journal of Psychiatry*, *210*(5), 315–323. https://doi.org/10.1192/bjp.bp.116.187179

Dodgson, J. E. (2019). Reflexivity in qualitative research. *Journal of Human Lactation*, *35*(2), 220–222. https://doi.org/10.1177/0890334419830990

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), 107–115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

Fairbrother, N., Corbyn, B., Thordarson, D. S., Ma, A., & Surm, D. (2019). Screening for perinatal anxiety disorders: Room to grow. *Journal of Affective Disorders*, *250*, 363–370. https://doi.org/10.1016/j.jad.2019.03.052

Fairbrother, N., Janssen, P., Antony, M. M., Tucker, E., & Young, A. H. (2016). Perinatal anxiety disorder prevalence and incidence. *Journal of Affective Disorders*, *200*, 148–155. https://doi.org/10.1016/j.jad.2015.12.082

Fairbrother, N., Young, A. H., Janssen, P., Antony, M. M., & Tucker, E. (2015). Depression and anxiety during the perinatal period. *BMC Psychiatry*, *15*, 206. https://doi.org/10.1186/s12888-015-0526-6

Falah-Hassani, K., Shiri, R., & Dennis, C. L. (2017). The prevalence of antenatal and postnatal co-morbid anxiety and depression: a meta-analysis. *Psychological Medicine*, *47*(12), 2041–

2053. https://doi.org/10.1017/S0033291717000617

Fallon, V., Halford, J. C. G., Bennett, K. M., & Harrold, J. A. (2016). The Postpartum Specific Anxiety Scale: development and preliminary validation. *Archives of Women's Mental Health*, *19*(6), 1079–1090. https://doi.org/10.1007/s00737-016-0658-9

Fallon, V., Halford, J. C. G., Bennett, K. M., & Harrold, J. A. (2018). Postpartum-specific anxiety as a predictor of infant-feeding outcomes and perceptions of infant-feeding behaviours: new evidence for childbearing specific measures of mood. *Archives of Women's Mental Health*, *21*(2), 181–191. https://doi.org/10.1007/s00737-017-0775-0

Fallon, V., Silverio, S. A., Halford, J. C. G., Bennett, K. M., & Harrold, J. A. (2019). Postpartum-specific anxiety and maternal bonding: Further evidence to support the use of childbearing specific mood tools. *Journal of Reproductive and Infant Psychology*, 1–11. https://doi.org/10.1080/02646838.2019.1680960

Fawcett, E. J., Fairbrother, N., Cox, M. L., White, I. R., & Fawcett, J. M. (2019). The Prevalence of Anxiety Disorders During Pregnancy and the Postpartum Period: A Multivariate Bayesian Meta-Analysis. *The Journal of Clinical Psychiatry*, *80*(4). https://doi.org/10.4088/JCP.18r12527

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs-principles and practices. *Health Services Research*, *48*(6 Pt 2), 2134–2156. https://doi.org/10.1111/1475-6773.12117

Furtado, M., Chow, C. H. T., Owais, S., Frey, B. N., & Van Lieshout, R. J. (2018). Risk factors of new onset anxiety and anxiety exacerbation in the perinatal period: A systematic review and meta-analysis. *Journal of Affective Disorders*, *238*, 626–635. https://doi.org/10.1016/j.jad.2018.05.073

Furtado, M., Van Lieshout, R. J., Van Ameringen, M., Green, S. M., & Frey, B. N. (2019). Biological and psychosocial predictors of anxiety worsening in the postpartum period: A longitudinal study. *Journal of Affective Disorders*, *250*, 218–225. https://doi.org/10.1016/j.jad.2019.02.064

Gavin, N. I., Gaynes, B. N., Lohr, K. N., Meltzer-Brody, S., Gartlehner, G., & Swinson, T. (2005). Perinatal depression: a systematic review of prevalence and incidence. *Obstetrics and Gynecology*, *106*(5 Pt 1), 1071–1083. https://doi.org/10.1097/01.AOG.0000183597.31630.db

Geertz, C. (1973). *Thick description: toward an interpretive theory of culture* (1st ed.). Basic Books.

Gennaro, S., O'Connor, C., McKay, E. A., Gibeau, A., Aviles, M., Hoying, J., & Melnyk, B. M. (2020). Perinatal anxiety and depression in minority women. *MCN. The American Journal of Maternal Child Nursing*, *45*(3), 138–144. https://doi.org/10.1097/NMC.0000000000000611

Gibson, J., McKenzie-McHarg, K., Shakespeare, J., Price, J., & Gray, R. (2009). A systematic review of studies validating the Edinburgh Postnatal Depression Scale in antepartum and postpartum women. *Acta Psychiatrica Scandinavica*, *119*(5), 350–364. https://doi.org/10.1111/j.1600-0447.2009.01363.x

Goldfinger, C., Green, S. M., Furtado, M., & McCabe, R. E. (2020). Characterizing the nature of worry in a sample of perinatal women with generalized anxiety disorder. *Clinical Psychology & Psychotherapy*, *27*(2), 136–145. https://doi.org/10.1002/cpp.2413

Goldin Evans, M., Phillippi, S., & Gee, R. E. (2015). Examining the screening practices of physicians for postpartum depression: implications for improving health outcomes.

Women's Health Issues, *25*(6), 703–710. https://doi.org/10.1016/j.whi.2015.07.003

Goodman, J. H., Watson, G. R., & Stubbs, B. (2016). Anxiety disorders in postpartum women: A systematic review and meta-analysis. *Journal of Affective Disorders*, *203*, 292–331. https://doi.org/10.1016/j.jad.2016.05.033

Grace-Martin, K. (2019). *Six Differences Between Repeated Measures ANOVA and Linear Mixed Models*. The Analysis Factor. https://www.theanalysisfactor.com/six-differences-between-repeated-measures-anova-and-linear-mixed-models/

Grant, K.-A., McMahon, C., & Austin, M.-P. (2008). Maternal anxiety during the transition to parenthood: a prospective study. *Journal of Affective Disorders*, *108*(1–2), 101–111. https://doi.org/10.1016/j.jad.2007.10.002

Greenhouse, S. W., & Geisser, S. (1959). On methods in the analysis of profile data. *Psychometrika*, *24*(2), 95–112. https://doi.org/10.1007/BF02289823

Hetherington, E., McDonald, S., Williamson, T., Patten, S. B., & Tough, S. C. (2018). Social support and maternal mental health at 4 months and 1 year postpartum: analysis from the All Our Families cohort. *Journal of Epidemiology and Community Health*, *72*(10), 933–939. https://doi.org/10.1136/jech-2017-210274

Hoberg, M. (2020). *Usability testing of SMS-Qualtrics survey interface for daily mood monitoring in postpartum women*. 20.

Hoff, C. E., Movva, N., Rosen Vollmar, A. K., & Pérez-Escamilla, R. (2019). Impact of maternal anxiety on breastfeeding outcomes: A systematic review. *Advances in Nutrition (Bethesda, Md.)*, *10*(5), 816–826. https://doi.org/10.1093/advances/nmy132

Howard, L. M., & Khalifeh, H. (2020). Perinatal mental health: a review of progress and challenges. *World Psychiatry : Official Journal of the World Psychiatric Association*

(WPA), *19*(3), 313–327. https://doi.org/10.1002/wps.20769

Huizink, A. C., Mulder, E. J. H., Robles de Medina, P. G., Visser, G. H. A., & Buitelaar, J. K. (2004). Is pregnancy anxiety a distinctive syndrome? *Early Human Development*, *79*(2), 81–91. https://doi.org/10.1016/j.earlhumdev.2004.04.014

IBM Corp. (2021). *IBM SPSS Statistics for Macintosh* (28) [Computer software]. IBM Corp.

Infante-Gil, L., Silverio, S. A., Fallon, V., & Wendland, J. (2022). Postpartum specific anxiety in a French population: Validation of the French version of the Postpartum Specific Anxiety Scale [PSAS-FR]. *Perspectives in Psychiatric Care*, *58*(1), 418–428. https://doi.org/10.1111/ppc.12808

Jackson, M. L., Sztendur, E. M., Diamond, N. T., Byles, J. E., & Bruck, D. (2014). Sleep difficulties and the development of depression and anxiety: a longitudinal study of young Australian women. *Archives of Women's Mental Health*, *17*(3), 189–198. https://doi.org/10.1007/s00737-014-0417-8

Jordan, V., & Minikel, M. (2019). Postpartum anxiety: More common than you think. *The Journal of Family Practice*, *68*(3), 165;168;170;174.

Jover, M., Colomer, J., Carot, J. M., Larsson, C., Bobes, M. T., Ivorra, J. L., Martín-Brufau, R., & Sanjuan, J. (2014). Maternal anxiety following delivery, early infant temperament and mother's confidence in caregiving. *The Spanish Journal of Psychology*, *17*, E95. https://doi.org/10.1017/sjp.2014.87

Kim, H., Sefcik, J. S., & Bradway, C. (2017). Characteristics of qualitative descriptive studies: A systematic review. *Research in Nursing & Health*, *40*(1), 23–42. https://doi.org/10.1002/nur.21768

Koniak-Griffin, D., Logsdon, M. C., Hines-Martin, V., & Turner, C. C. (2006). Contemporary

mothering in a diverse society. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, *35*(5), 671–678. https://doi.org/10.1111/j.1552-6909.2006.00089.x

Lawson, A., Murphy, K. E., Sloan, E., Uleryk, E., & Dalfen, A. (2015). The relationship between sleep and postpartum mental disorders: A systematic review. *Journal of Affective Disorders*, *176*, 65–77. https://doi.org/10.1016/j.jad.2015.01.017

Lieb, K., Reinstein, S., Xie, X., Bernstein, P. S., & Karkowsky, C. E. (2020). Adding perinatal anxiety screening to depression screening: is it worth it? *American Journal of Obstetrics & Gynecology MFM*, *2*(2), 100099. https://doi.org/10.1016/j.ajogmf.2020.100099

Lorenzo, L. S. (2022). Beyond the 'normal' worries: detection and treatment of perinatal anxiety and anxiety disorders. *BJPsych Advances*, 1–11. https://doi.org/10.1192/bja.2022.9

Luca, D. L., Garlow, N., Staatz, C., Margiotta, C., & Zivin, K. (2019). Societal Costs of Untreated Perinatal Mood and Anxiety Disorders in the United States. *Mathematica Policy Research*.

Marchesi, C., Ossola, P., Amerio, A., Daniel, B. D., Tonna, M., & De Panfilis, C. (2016). Clinical management of perinatal anxiety disorders: A systematic review. *Journal of Affective Disorders*, *190*, 543–550. https://doi.org/10.1016/j.jad.2015.11.004

Marques, R., Monteiro, F., Canavarro, M. C., & Fonseca, A. (2018). The role of emotion regulation difficulties in the relationship between attachment representations and depressive and anxiety symptoms in the postpartum period. *Journal of Affective Disorders*, *238*, 39–46. https://doi.org/10.1016/j.jad.2018.05.013

Martini, J., Petzoldt, J., Einsle, F., Beesdo-Baum, K., Höfler, M., & Wittchen, H.-U. (2015). Risk factors and course patterns of anxiety and depressive disorders during pregnancy and after delivery: a prospective-longitudinal study. *Journal of Affective Disorders*, *175*, 385–395. https://doi.org/10.1016/j.jad.2015.01.012

Matthey, S., Barnett, B., Howie, P., & Kavanagh, D. J. (2003). Diagnosing postpartum depression in mothers and fathers: whatever happened to anxiety? *Journal of Affective Disorders*, *74*(2), 139–147. https://doi.org/10.1016/s0165-0327(02)00012-5

Matthey, S., Fisher, J., & Rowe, H. (2013). Using the Edinburgh postnatal depression scale to screen for anxiety disorders: conceptual and methodological considerations. *Journal of Affective Disorders*, *146*(2), 224–230. https://doi.org/10.1016/j.jad.2012.09.009

Matvienko-Sikar, K., Meedya, S., & Ravaldi, C. (2020). Perinatal mental health during the COVID-19 pandemic. *Women and Birth : Journal of the Australian College of Midwives*, *33*(4), 309–310. https://doi.org/10.1016/j.wombi.2020.04.006

McCabe-Beane, J. E., Segre, L. S., Perkhounkova, Y., Stuart, S., & O'Hara, M. W. (2016). The identification of severity ranges for the Edinburgh Postnatal Depression Scale. *Journal of Reproductive and Infant Psychology*, *34*(3), 293–303. https://doi.org/10.1080/02646838.2016.1141346

McCrudden, M. T., Marchand, G., & Schutz, P. A. (2021). Joint displays for mixed methods research in psychology. *Methods in Psychology*, *5*, 100067. https://doi.org/10.1016/j.metip.2021.100067

Meades, R., & Ayers, S. (2011). Anxiety measures validated in perinatal populations: a systematic review. *Journal of Affective Disorders*, *133*(1–2), 1–15. https://doi.org/10.1016/j.jad.2010.10.009

Mendez, D. D., Sanders, S. A., Karimi, H. A., Gharani, P., Rathbun, S. L., Gary-Webb, T. L., Wallace, M. L., Gianakas, J. J., Burke, L. E., & Davis, E. M. (2019). Understanding pregnancy and postpartum health using ecological momentary assessment and mobile technology: protocol for the postpartum mothers mobile study. *JMIR Research Protocols*,

8(6), e13569. https://doi.org/10.2196/13569

Mendez, D. D., Sanders, S. A., Lai, Y.-H., Wallace, M. L., Rathbun, S. L., Gary-Webb, T. L., Davis, E. M., & Burke, L. E. (2020). Ecological momentary assessment of stress, racism and other forms of discrimination during pregnancy using smartphone technology. *Paediatric and Perinatal Epidemiology*, *34*(5), 522–531. https://doi.org/10.1111/ppe.12619

Mendez, D., DeVaughn, S., & Duell, J. (2019). The Pregnancy Ecological Momentary Assessment Pilot Study: Applications of Mobile Technology. *Integrative Gynecology and Obstetrics Journal*, *2*(1), 1–6.

Mercer, R. T. (2004). Becoming a mother versus maternal role attainment. *Journal of Nursing Scholarship*, *36*(3), 226–232. https://doi.org/10.1111/j.1547-5069.2004.04042.x

Microsoft Corporation. (2022). *Microsoft Excel* (16.61.1) [Computer software]. Microsoft Corporation.

Miles, M. B., Huberman, A. M., & Saldana, J. (2018). *Qualitative Data Analysis* (p. 408). Sage Publications.

Monteiro, F., Fonseca, A., Pereira, M., Alves, S., & Canavarro, M. C. (2019). What protects at-risk postpartum women from developing depressive and anxiety symptoms? The role of acceptance-focused processes and self-compassion. *Journal of Affective Disorders*, *246*, 522–529. https://doi.org/10.1016/j.jad.2018.12.124

Myin-Germeys, I., Kasanova, Z., Vaessen, T., Vachon, H., Kirtley, O., Viechtbauer, W., & Reininghaus, U. (2018). Experience sampling methodology in mental health research: new insights and technical developments. *World Psychiatry : Official Journal of the World Psychiatric Association (WPA)*, *17*(2), 123–132. https://doi.org/10.1002/wps.20513

Nakić Radoš, S. (2018). Anxiety During Pregnancy and Postpartum: Course, Predictors and Comorbidity with Postpartum Depression. *Open Journal of Atmospheric and Climate Change*, *57*(1), 39–51. https://doi.org/10.20471/acc.2018.57.01.05

Nillni, Y. I., Mehralizade, A., Mayer, L., & Milanovic, S. (2018). Treatment of depression, anxiety, and trauma-related disorders during the perinatal period: A systematic review. *Clinical Psychology Review*, *66*, 136–148. https://doi.org/10.1016/j.cpr.2018.06.004

Oh, S., Chew-Graham, C. A., Silverwood, V., Shaheen, S. A., Walsh-House, J., Sumathipala, A., & Kingstone, T. (2020). Exploring women's experiences of identifying, negotiating and managing perinatal anxiety: a qualitative study. *BMJ Open*, *10*(12), e040731. https://doi.org/10.1136/bmjopen-2020-040731

Paladine, H. L., Blenning, C. E., & Strangas, Y. (2019). Postpartum care: an approach to the fourth trimester. *American Family Physician*, *100*(8), 485–491.

Paul, I. M., Downs, D. S., Schaefer, E. W., Beiler, J. S., & Weisman, C. S. (2013). Postpartum anxiety and maternal-infant health outcomes. *Pediatrics*, *131*(4), e1218-24. https://doi.org/10.1542/peds.2012-2147

Perzow, S. E. D., Hennessey, E.-M. P., Hoffman, M. C., Grote, N. K., Davis, E. P., & Hankin, B. L. (2021). Mental health of pregnant and postpartum women in response to the COVID-19 pandemic. *Journal of Affective Disorders Reports*, *4*, 100123. https://doi.org/10.1016/j.jadr.2021.100123

Petzoldt, J., Wittchen, H. U., Einsle, F., & Martini, J. (2016). Maternal anxiety versus depressive disorders: specific relations to infants' crying, feeding and sleeping problems. *Child: Care, Health and Development*, *42*(2), 231–245. https://doi.org/10.1111/cch.12292

Phillips, J., Sharpe, L., Matthey, S., & Charles, M. (2009). Maternally focused worry. *Archives of*

Women's Mental Health, *12*(6), 409–418. https://doi.org/10.1007/s00737-009-0091-4

Pilkington, P. D., Milne, L. C., Cairns, K. E., Lewis, J., & Whelan, T. A. (2015). Modifiable partner factors associated with perinatal depression and anxiety: a systematic review and meta-analysis. *Journal of Affective Disorders*, *178*, 165–180. https://doi.org/10.1016/j.jad.2015.02.023

Polte, C., Junge, C., von Soest, T., Seidler, A., Eberhard-Gran, M., & Garthus-Niegel, S. (2019). Impact of Maternal Perinatal Anxiety on Social-Emotional Development of 2-Year-Olds, A Prospective Study of Norwegian Mothers and Their Offspring : The Impact of Perinatal Anxiety on Child Development. *Maternal and Child Health Journal*, *23*(3), 386–396. https://doi.org/10.1007/s10995-018-2684-x

Racine, N., Plamondon, A., Hentges, R., Tough, S., & Madigan, S. (2019). Dynamic and bidirectional associations between maternal stress, anxiety, and social support: The critical role of partner and family support. *Journal of Affective Disorders*, *252*, 19–24. https://doi.org/10.1016/j.jad.2019.03.083

Razurel, C., Kaiser, B., Antonietti, J.-P., Epiney, M., & Sellenet, C. (2017). Relationship between perceived perinatal stress and depressive symptoms, anxiety, and parental self-efficacy in primiparous mothers and the role of social support. *Women & Health*, *57*(2), 154–172. https://doi.org/10.1080/03630242.2016.1157125

Reck, C., Struben, K., Backenstrass, M., Stefenelli, U., Reinig, K., Fuchs, T., Sohn, C., & Mundt, C. (2008). Prevalence, onset and comorbidity of postpartum anxiety and depressive disorders. *Acta Psychiatrica Scandinavica*, *118*(6), 459–468. https://doi.org/10.1111/j.1600-0447.2008.01264.x

Roque, A. T. F., Lasiuk, G. C., Radünz, V., & Hegadoren, K. (2017). Scoping review of the mental

health of parents of infants in the NICU. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, *46*(4), 576–587. https://doi.org/10.1016/j.jogn.2017.02.005

Rowe, H. J., Fisher, J. R. W., & Loh, W. M. (2008). The Edinburgh Postnatal Depression Scale detects but does not distinguish anxiety disorders from depression in mothers of infants. *Archives of Women's Mental Health*, *11*(2), 103–108. https://doi.org/10.1007/s00737-008-0003-z

Rubin, R. (1967). Attainment of the maternal role. 2. Models and referrants. *Nursing Research*, *16*(4), 342–346. https://doi.org/10.1097/00006199-196716040-00012

Russell, M. (2018, November 14). *Introduction to multilevel modeling for intensive longitudinal data* [Webinar].

Sandelowski, M. (2000a). Combining qualitative and quantitative sampling, data collection, and analysis techniques in mixed-method studies. *Research in Nursing & Health*, *23*(3), 246–255. https://doi.org/10.1002/1098-240X(200006)23:3<246::AID-NUR9>3.0.CO;2-H

Sandelowski, M. (2000b). Whatever happened to qualitative description? *Research in Nursing & Health*, *23*(4), 334–340. https://doi.org/10.1002/1098-240X(200008)23:4<334::AID-NUR9>3.0.CO;2-G

Sandelowski, M. (2010). What's in a name? Qualitative description revisited. *Research in Nursing & Health*, *33*(1), 77–84. https://doi.org/10.1002/nur.20362

Schwab-Reese, L. M., Schafer, E. J., & Ashida, S. (2017). Associations of social support and stress with postpartum maternal mental health symptoms: Main effects, moderation, and mediation. *Women & Health*, *57*(6), 723–740. https://doi.org/10.1080/03630242.2016.1181140

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual*

Review of Clinical Psychology, *4*, 1–32. https://doi.org/10.1146/annurev.clinpsy.3.022806.091415

Shorey, S., Chee, C. Y. I., Ng, E. D., Chan, Y. H., Tam, W. W. S., & Chong, Y. S. (2018). Prevalence and incidence of postpartum depression among healthy mothers: A systematic review and meta-analysis. *Journal of Psychiatric Research*, *104*, 235–248. https://doi.org/10.1016/j.jpsychires.2018.08.001

Silverio, S. A., Davies, S. M., Christiansen, P., Aparicio-García, M. E., Bramante, A., Chen, P., Costas-Ramón, N., de Weerth, C., Della Vedova, A. M., Infante Gil, L., Lustermans, H., Wendland, J., Xu, J., Halford, J. C. G., Harrold, J. A., & Fallon, V. (2021). A validation of the Postpartum Specific Anxiety Scale 12-item research short-form for use during global crises with five translations. *BMC Pregnancy and Childbirth*, *21*(1), 112. https://doi.org/10.1186/s12884-021-03597-9

Smith-Nielsen, J., Egmose, I., Wendelboe, K. I., Steinmejer, P., Lange, T., & Vaever, M. S. (2021). Can the Edinburgh Postnatal Depression Scale-3A be used to screen for anxiety? *BMC Psychology*, *9*(1), 118. https://doi.org/10.1186/s40359-021-00623-5

Spielberger, C. D., Gorsuch, R., Lushene, P. R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Consulting Psychologists Press.

Stumbras, K., Rankin, K., Caskey, R., Haider, S., & Handler, A. (2016). Guidelines and Interventions Related to the Postpartum Visit for Low-Risk Postpartum Women in High and Upper Middle Income Countries. *Maternal and Child Health Journal*, *20*(Suppl 1), 103–116. https://doi.org/10.1007/s10995-016-2053-6

Thorsness, K. R., Watson, C., & LaRusso, E. M. (2018). Perinatal anxiety: approach to diagnosis and management in the obstetric setting. *American Journal of Obstetrics and Gynecology*,

219(4), 326–345. https://doi.org/10.1016/j.ajog.2018.05.017

Tietz, A., Zietlow, A. L., & Reck, C. (2014). Maternal bonding in mothers with postpartum anxiety disorder: the crucial role of subclinical depressive symptoms and maternal avoidance behaviour. *Archives of Women's Mental Health*, *17*(5), 433–442. https://doi.org/10.1007/s00737-014-0423-x

Tuchman, E. (2010). Women and addiction: the importance of gender issues in substance abuse research. *Journal of Addictive Diseases*, *29*(2), 127–138. https://doi.org/10.1080/10550881003684582

U.S. Census Bureau QuickFacts: Allegheny County, Pennsylvania. (n.d.). Retrieved March 29, 2022, from https://www.census.gov/quickfacts/alleghenycountypennsylvania

US Preventive Services Task Force, Curry, S. J., Krist, A. H., Owens, D. K., Barry, M. J., Caughey, A. B., Davidson, K. W., Doubeni, C. A., Epling, J. W., Grossman, D. C., Kemper, A. R., Kubik, M., Landefeld, C. S., Mangione, C. M., Silverstein, M., Simon, M. A., Tseng, C.-W., & Wong, J. B. (2019). Interventions to prevent perinatal depression: US preventive services task force recommendation statement. *The Journal of the American Medical Association*, *321*(6), 580–587. https://doi.org/10.1001/jama.2019.0007

van der Zee-van den Berg, A. I., Boere-Boonekamp, M. M., Groothuis-Oudshoorn, C. G. M., & Reijneveld, S. A. (2019). The Edinburgh Postpartum Depression Scale: Stable structure but subscale of limited value to detect anxiety. *Plos One*, *14*(9), e0221894. https://doi.org/10.1371/journal.pone.0221894

van Genugten, C. R., Schuurmans, J., Lamers, F., Riese, H., Penninx, B. W., Schoevers, R. A., Riper, H. M., & Smit, J. H. (2020). Experienced Burden of and Adherence to Smartphone-Based Ecological Momentary Assessment in Persons with Affective Disorders. *Journal of*

Clinical Medicine, *9*(2). https://doi.org/10.3390/jcm9020322

VERBI Software. (2022). *MAXQDA 2022 [computer software]* (2022) [Computer software]. VERBI Software.

Walz, L. C., Nauta, M. H., & Aan Het Rot, M. (2014). Experience sampling and ecological momentary assessment for studying the daily lives of patients with anxiety disorders: a systematic review. *Journal of Anxiety Disorders*, *28*(8), 925–937. https://doi.org/10.1016/j.janxdis.2014.09.022

Wenzel, A, Haugen, E. N., Jackson, L. C., & Robinson, K. (2003). Prevalence of generalized anxiety at eight weeks postpartum. *Archives of Women's Mental Health*, *6*(1), 43–49. https://doi.org/10.1007/s00737-002-0154-2

Wenzel, Amy, Haugen, E. N., Jackson, L. C., & Brendle, J. R. (2005). Anxiety symptoms and disorders at eight weeks postpartum. *Journal of Anxiety Disorders*, *19*(3), 295–311. https://doi.org/10.1016/j.janxdis.2004.04.001

Yang, Y. S., Ryu, G. W., & Choi, M. (2019). Methodological strategies for ecological momentary assessment to evaluate mood and stress in adult patients using mobile phones: systematic review. *JMIR MHealth and UHealth*, *7*(4), e11215. https://doi.org/10.2196/11215

Yeaton-Massey, A., & Herrero, T. (2019). Recognizing maternal mental health disorders: beyond postpartum depression. *Current Opinion in Obstetrics & Gynecology*, *31*(2), 116–119. https://doi.org/10.1097/GCO.0000000000000524

Zappas, M. P., Becker, K., & Walton-Moss, B. (2020). Postpartum Anxiety. *The Journal for Nurse Practitioners*. https://doi.org/10.1016/j.nurpra.2020.08.017

Zeng, L.-N., Chen, L.-G., Yang, C.-M., Zeng, L.-P., Zhang, L.-Y., & Peng, T.-M. (2021). Comment: Mental health care for pregnant women in the COVID-19 outbreak is urgently

needed. *Women and Birth : Journal of the Australian College of Midwives*, *34*(3), 210–211. https://doi.org/10.1016/j.wombi.2020.03.009