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**EFFECT OF PRIOR PERINATAL LOSS ON MATERNAL DEPRESSIVE SYMPTOMS
AND MATERNAL-INFANT BONDING**

A Dissertation in

Nursing

by

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ABSTRACT

Background. Pregnancy loss occurs in approximately 15-20% of all pregnancies, and women who experience these pregnancy losses are likely to become pregnant again within 18 months. The experience of pregnancy after a previous perinatal loss may be marked by high levels of fear, anxiety, and depression. Furthermore, women who give birth to a healthy baby subsequent to a perinatal loss may experience continuing emotional difficulties related to the previous loss, which could impact the formation of a healthy relationship between the mother and her infant.

Objectives. The objective of this study was to longitudinally examine the emotional impact of previous perinatal loss on maternal depression and maternal infant bonding in a sample of women giving birth for the first time. **Methods.** Secondary data analysis was completed on a longitudinal cohort study, the First Baby Study (FBS). The FBS enrolled 3006 pregnant women in the third trimester who were planning to give birth to their first live-born baby in Pennsylvania, USA between 2009 and 2011. In this analysis, 453 women with a history of miscarriage were compared to 2401 women experiencing their first pregnancy on two outcomes: maternal depression and maternal-infant bonding. Maternal depression was measured during the third trimester, and at 1, 6, and 12 months postpartum via the Edinburgh Postnatal Depression Scale (EPDS), while maternal-infant bonding was measured at all postpartum time points using the Shortened-Postpartum Bonding Questionnaire. First, bivariate analysis was completed for each outcome using Chi-square or Student's t-test followed by appropriate regression models adjusted for confounding factors significant in bivariate models. Longitudinal analysis was completed with each outcome variable as a repeated measure. **Results.** Women with a history of perinatal loss did not differ significantly from those without a history of perinatal loss on probable depression (EPDS>12) except that they had higher risk at 1 month postpartum (adjusted OR 1.66, 95% CI 1.03 – 2.69). Women with a history of perinatal loss also reported bonding scores that did not differ significantly from those without a history of perinatal loss. Furthermore, there was no interaction between time and perinatal loss history in

longitudinal analysis. **Conclusions.** The results of this study provide limited support for the hypothesis that a history of perinatal loss has a negative impact on maternal mental health and maternal-infant bonding in a subsequent pregnancy and postpartum. Future research should utilize population-based samples of women in order to avoid selection bias that is found in some of the existing literature. It is recommended that researchers focus on identifying the specific sociodemographic or psychosocial risk factors that place women at risk for persistent emotional consequences of a perinatal loss history during subsequent pregnancy and postpartum.

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Chapter 1: Introduction

Maternal depression has been a concern in pregnant women with a history of perinatal loss, and evidence shows it may not ameliorate after the birth of a healthy infant. Furthermore, these women may experience disruptions in maternal-infant bonding in the postpartum period, either as a direct result of their previous perinatal loss, or in relation to increases in depressive symptoms. This study examined the relationship between these variables in a large sample of women experiencing their first live birth by comparing women with a history of perinatal loss to those without such a history.

The immediate reaction to perinatal loss for women and their partners is commonly one of grief comparable in intensity to the grief following other types of loss via death (Brier, 2008). Compared to women without a history of loss, women with a history of perinatal loss have higher rates of depression (Sutan et al., 2010); in one study rates of depression were 52% versus 22%, respectively (Adeyemi et al., 2008). Depressive symptoms can continue to manifest for women with a history of perinatal loss even during a subsequent pregnancy. For example, women who are pregnant following a perinatal loss have increased levels of depressive symptoms compared to women who have not experienced such loss (Armstrong, 2002, 2004; Armstrong, Hutti, & Myers, 2009; Cote-Arsenault, 2003, 2007; Couto et al., 2009; Franche & Mikail, 1999; Gaudet, Sejourne, Camborieux, Rogers, & Chabrol, 2010; Gong et al., 2013; Lamb, 2002; Yilmaz & Beji, 2013). Women with a history of perinatal loss may perceive a subsequent pregnancy as a threat (Cote-Arsenault, 2007), stress is increased (Armstrong, 2004), and they describe alterations in their concept of self (Cote-Arsenault, Bidlack, & Humm, 2001). Some women report tremendous uncertainty, anxiety and fear (Lee, McKenzie-McHarg, & Horsch, 2013), even a feeling of waiting to lose the baby (Cote-Arsenault et al., 2001). One study

reported that women who are pregnant after loss experience delayed physical and emotional preparation for the newborn's arrival (Cote-Arsenault & Donato, 2007).

These women may also experience impaired maternal-infant bonding in the postpartum period. In fact, maternal depression is strongly associated with the development of maternal-infant bonding disorders (Moehler, Brunner, Wiebel, Reck, & Resch, 2006; Siu et al., 2010). One study reported that 29% of mothers diagnosed with postpartum depression also displayed some type of maternal-infant bonding disorder (Brockington et al., 2001). Research findings indicate that even subclinical levels of depressive symptoms can impact maternal-infant bonding (Moehler et al., 2006). Therefore, women with a history of perinatal loss may be at increased risk for depression and bonding disorders. In the general population, women presenting for treatment of maternal-infant bonding disorders most often display absent or hostile emotions toward the infant, but may also display maternal responses characterized by anxiety, obsessive impulses, or avoidance (Brockington et al., 2001).

Although the impact of perinatal loss during a subsequent pregnancy on maternal-fetal bonding has been studied (Armstrong, 2002, 2004; Armstrong & Hutti, 1998; Cote-Arsenault, 1999; Cote-Arsenault & Donato, 2007; Cote-Arsenault, Donato, & Earl, 2006; Cote-Arsenault & Mahlangu, 1999; Cote-Arsenault & Marshall, 2000; Hill, DeBackere, & Kavanaugh, 2008), little is known about this potential for disruption following the birth of a healthy newborn. In a 1994 phenomenological study by Smith-Pierce, one mother described a feeling of initial "separateness" from her infant lasting two weeks after birth, which she attributed to a history of pregnancy loss (Smith-Pierce, 1994). Furthermore, one study found that mothers with a history of perinatal loss experienced more problems with their 4 week old infants with regard to crying, sleeping, and eating than women without a history of loss (Hunfeld, Taselaar-Kloos, Agterberg, Wladimiroff, & Passchier, 1997). Although some evidence points to alterations in maternal

perception of the infant born after a perinatal loss, maternal-infant bonding has not been specifically examined in this population.

The effect of a history of perinatal loss on maternal-infant bonding is significant because these disturbed bonding behaviors during infancy can have serious long-term effects on the mother-child relationship and on child development (Brockington et al., 2001) including poor cognitive outcomes at 18 months of age (Murray, Hipwell, Hooper, Stein, & Cooper, 1996). In order for nursing to improve the mental health of women affected by perinatal loss, and promote optimal development of their children, researchers need to examine the effects of a history of perinatal loss in a longitudinal manner to include the first year postpartum.

This study was designed to examine the longitudinal relationship between a history of perinatal loss, maternal depression, and maternal-infant bonding in a large sample of women experiencing their first live birth by comparing women with a history of perinatal loss to those without such a history.

Background

Increased use of reproductive assistive technology and early recognition of pregnancy has led to an increase in perinatal loss (Cote-Arsenault, 1999). Perinatal loss is defined as any loss of pregnancy from 0-19 weeks gestation (miscarriage), from 20 weeks gestation to birth (stillbirth), and the death of a newborn up to 28 days old (neonatal death). In the United States, early perinatal loss (miscarriage) occurs in 12-20% of confirmed pregnancies (Scotchie & Fritz, 2006) and late loss (stillbirth and neonatal death) occurs in 10.73 of 1,000 live births and fetal deaths (MacDorman & Kirmeyer, 2009). After experiencing a perinatal loss, over 85% of women will become pregnant again within 18 months (Cuisinier, Janssen, de Graauw, Bakker, & Hoogduin, 1996). Therefore, a history of perinatal loss affects not only women and their

partners, but may also affect children born subsequent to loss. The effect of a history of perinatal loss on women, partners, and subsequent children has been of interest to researchers in the past several decades; however, the long-term effects of a history of perinatal loss on psychological health, the parenting experience, and the well-being of the family have not been fully examined.

Specific Aims and Hypotheses

The objectives of this study were to analyze data from a recent large, multisite cohort study in order to examine the effect of a history of perinatal loss on mother's mental health (depression) and maternal-infant bonding during and following a subsequent pregnancy. The specific aims of the study were:

Aim 1: To determine the longitudinal relationship between a history of perinatal loss and depression during pregnancy and throughout the first year postpartum in a sample of women giving birth for the first time.

Hypothesis: Women with a history of perinatal loss have an increased risk of depression during late pregnancy, and at 1 month, 6 months, and 12 months postpartum compared to women without a history of perinatal loss.

Aim 2: To determine the longitudinal relationship between a history of perinatal loss and maternal-infant bonding throughout the first year postpartum in a sample of women giving birth for the first time.

Hypothesis: Women with a history of perinatal loss have decreased maternal-infant bonding at 1 month, 6 months, and 12 months postpartum compared to women without a history of perinatal loss.

Sub aim 2.1: To evaluate the relationship between depression and maternal-infant bonding throughout the first year postpartum to determine whether depression mediates the relationship between a history of perinatal loss and maternal-infant bonding.

Examination of depression as a mediator of the relationship between a history of perinatal loss and maternal-infant bonding was planned to determine whether depression should be an area of focus for intervention in this population. A longitudinal study design such as this aids in the identification of specific time periods where depression is most prevalent, and maternal-infant bonding is most affected. The results of this study may provide valuable information which can be used to develop focused interventions for depression and impaired maternal-infant bonding for women with a history of perinatal loss that can be administered prior to the most vulnerable time periods.

Conceptual Definitions

Perinatal loss- In the literature, perinatal loss is defined as any loss of pregnancy from 0-19 weeks gestation (miscarriage), from 20 weeks gestation to birth (stillbirth), and death of a newborn up to 28 days old (neonatal death). In this study, women with a history of miscarriage were considered those with a history of perinatal loss.

Perinatal depression- A mental health disorder occurring during pregnancy or the postpartum period where the most common feature is a period of at least 2 weeks during which a person experiences depressed mood or loss of interest in nearly all activities (APA, 2013). The diagnosis of perinatal depression does not differ from that of major depressive episode with the exception of the time limitations relative to birth. According to the Diagnostic Manual for Psychological Disorders (DSM-V), for a diagnosis of major depressive episode to be given, one must exhibit at least five of the symptoms listed in Table 1-1, with at least one of the symptoms being depressed

mood or loss of interest or pleasure. Persons with these symptoms must also show significant distress or impaired functioning to receive a diagnosis.

Maternal-infant bonding- “Maternal-infant bonding is a maternal-driven process that occurs primarily throughout the first year of a baby’s life, but may continue throughout a child’s life. It is an affective state of the mother; maternal feelings and emotions toward the infant are the primary indicator of maternal-infant bonding.” (Bicking Kinsey & Hupcey, 2013)

Conceptual Framework

The study framework utilized a combination of theoretical assertions and empirical evidence to examine the three relationships shown in Figure 1-1. **Aim 1** examined the longitudinal relationship between a history of perinatal loss and maternal depression. This relationship is empirically supported by cross-sectional studies (Armstrong, 2002, 2004; Armstrong et al., 2009; Cote-Arsenault, 2003, 2007; Couto et al., 2009; Franche & Mikail, 1999; Gaudet et al., 2010; Gong et al., 2013; Lamb, 2002; Yilmaz & Beji, 2013), but has not been examined extensively using a longitudinal approach. **Aim 2** examined the relationship between a history of perinatal loss and maternal-infant bonding. Maternal-infant bonding was used in accordance with the work of Ian Brockington and colleagues, who consistently define and measure maternal-infant bonding in terms of the maternal emotional response to the infant (Bienfait et al., 2011; Brockington, 2004; Brockington, Fraser, & Wilson, 2006; Brockington et al., 2001). Although some evidence is available that shows that mothers who have a history of perinatal loss view their children as more vulnerable (Rosenblatt, 2000) and less ideal (Hunfeld et al., 1997), and perceive their children to have more problems (Hunfeld et al., 1997; Turton, Badenhorst, Pawlby, White, & Hughes, 2009) than mothers without a history of perinatal loss, no studies were found that directly examined maternal-infant bonding in this population. The theoretical support for the hypothesis that a history of perinatal loss is related to impaired

maternal-infant bonding came from Ramona Mercer's theory of becoming a mother. The theory is based on the assumption that a disruption during pregnancy, such as perinatal loss, can lead to the mother's failure to fully incorporate the maternal role into her own identity, affecting her relationship with her infant (Mercer, 1995). This disruption (perinatal loss) may cause a negative effect on the mother's perception of herself as a capable woman (Cote-Arsenault et al., 2001) and of her ability to successfully navigate the process when she becomes pregnant again after the loss. Finally, **Sub aim 2.1** was designed to examine whether the relationship between a history of perinatal loss and maternal-infant bonding is mediated by maternal depression.

There is some evidence indicating that there is a relationship between depression and maternal-infant bonding (Moehler et al., 2006; Reck et al., 2006; Siu et al., 2010), however, this has not been examined in the context of a history of perinatal loss. Finally, potential confounders were chosen for inclusion based on empirical evidence that sociodemographic factors (Beck, 2001; Figueiredo & Costa, 2009; MacDorman & Kirmeyer, 2009; Price, 2006; Whitaker, Kavanaugh, & Klima, 2010), a history of infertility (Brockington, 1996), partner relationship and social support (Bienfait et al., 2011; Crouch, 2002; Dayan et al., 2010), birth experience (Righetti-Veltema, Conne-Perreard, Bousquet, & Manzano, 1998; Waldenstrom, Hildingsson, Rubertsson, & Radestad, 2004), and health of the infant (Figueiredo & Costa, 2009; Miles, Holditch-Davis, Schwartz, & Scher, 2007) may be related to depression and/or maternal-infant bonding.

Significance of Study

Knowledge gaps in the field

Although pregnancy after loss is marked by increased prevalence of depression (Armstrong, 2002, 2004; Armstrong et al., 2009; Cote-Arsenault, 2003, 2007; Couto et al., 2009; Gong et al., 2013; Lamb, 2002; Yilmaz & Beji, 2013), very little is known about the continuation of these psychological symptoms after the birth of a healthy child. In one study,

Armstrong and colleagues (Armstrong et al., 2009) reported that depression significantly decreased over time across the 3rd trimester of pregnancy, 3 months postpartum, and 8 months postpartum in a small sample of couples with a history of perinatal loss. However, they found that posttraumatic stress levels remained in the moderate range, and depression was significantly related to posttraumatic stress at all time points. These findings suggest that the negative effects of perinatal loss may not be ameliorated with the birth of a healthy infant (Armstrong et al., 2009). In addition to Armstrong's study, three other published studies describe the relationship between perinatal loss and depression longitudinally. Together, these do not provide enough evidence to determine whether women with a history of perinatal loss are at higher risk for depression after the birth of a healthy infant when compared to women without a history of perinatal loss. It is also well documented that postpartum depression in any mother can influence growth and development of the infant (Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001; Deave, Heron, Evans, & Emond, 2008; Field, 2011; Lundy et al., 1999). As such, additional research is necessary to determine the effect of a history of perinatal loss on maternal depression throughout the first year following the birth of a subsequent child.

In addition to a lack of clarity on the longitudinal progression of depression in women with a history of perinatal loss, the extant literature is complicated by a significant selection bias. Many studies have recruited participants with a history of perinatal loss through online or local perinatal bereavement support groups or national perinatal bereavement websites. Those who used only local methods also advertised that the study would examine experiences of perinatal loss. These recruitment methods may bias sample selection because women who feel unaffected by their previous perinatal loss, or who wish to repress or forget about their experiences may not volunteer for such a study. As such, the majority of study samples are biased because they are more likely to consist of women with more extreme responses to

perinatal loss and may not reflect the true range of responses. Two population-based studies, unaffected by this selection bias, offer preliminary support for the idea that negative consequences of a history of perinatal loss may only affect some women (Blackmore et al., 2011; Price, 2008). The effect of previous perinatal loss on maternal depression should be examined further in population-based samples unaffected by this particular sampling bias in order to determine the normative response to perinatal loss in the general population.

There is no consensus on the effect of previous perinatal loss on maternal-fetal bonding during a subsequent pregnancy, as the limited studies in this area have produced conflicting results (Armstrong, 2002; Armstrong & Hutti, 1998; Gaudet et al., 2010). In addition, very little is known about the effect of a history of perinatal loss on maternal-infant bonding after the birth of a healthy infant. Warland and colleagues (Warland, O'Leary, McCutcheon, & Williamson, 2010) concluded that affectional bonds may be disrupted in children whose mothers had a prior pregnancy loss based on the finding that parents deliberately held the child aloof well into early childhood. Women who are parenting children born after a perinatal loss have reported increased concern for their child's health and increased concern regarding differentiation of their child from themselves as they reach preschool age (Theut et al., 1992). They also report greater protectiveness and awareness of vulnerability (Rosenblatt, 2000) and view their children as having more problems (Turton et al., 2009). The effect of these maternal behavioral and cognitive alterations on the long term health and development of the children is unknown. In addition, most of the studies use cross-sectional designs, thus it is unclear how maternal-infant bonding changes over time. This information is essential in order to determine the most appropriate time for providing effective intervention. Moreover, these studies also suffer from the same selection bias found in studies of perinatal loss and depression, suggesting that sample selection that occurs without regard to perinatal loss history, such as in the proposed study, is

needed in order to provide valuable information about the relationship between a history of perinatal loss and maternal-infant bonding.

Significance of the proposed research

The goal of this research study was to begin to address the gaps in knowledge regarding a history of perinatal loss and its effect on maternal depression and maternal-infant bonding. By using prospective data collected in the First Baby Study (FBS) (5R01HD052990-03), the aim was to understand the effect of a history of perinatal loss on mother's mental health (depression) and maternal-infant bonding during and following a subsequent pregnancy. The relationship between a history of perinatal loss and depression was evaluated during pregnancy, and at 1 month, 6 months and 12 months postpartum (Aim 1). This analysis tested the hypothesis that a history of perinatal loss is related to increased risk of depression. By addressing this aim, we anticipated our results would support the recent assertion that intervention in this population should be aimed at depressive symptoms (Blackmore et al., 2011). Data were also analyzed to determine the duration of depression and if the relationship between a history of perinatal loss and depression changes over time. Using a large, prospective cohort that was not recruited for the study purpose should assure that women with a history of perinatal loss were included in the study regardless of how they felt about their previous perinatal loss. This allowed the author to examine the relationship between a history of perinatal loss and depression without the sampling bias found in many other studies in the field.

The second hypothesis (Aim 2) was that women with a history of perinatal loss had decreased maternal-infant bonding at 1 month, 6 months, and 12 months postpartum compared to women without a history of perinatal loss. The study evaluated the effect of a history of perinatal loss on maternal-infant bonding throughout the first year postpartum in a sample of first-time mothers. In order to determine whether the relationship between a history of

perinatal loss and maternal-infant bonding is mediated by depressive symptoms, Sub Aim 2.1 was planned to examine this relationship. This aim was based on the related evidence that although depression and bonding disorders are separate psychological disorders (Klier, 2006), a significant proportion of women with postpartum depression also develop bonding disorders (Brockington et al., 2001). Understanding the degree to which depression mediates the relationship between a history of perinatal loss and maternal-infant bonding will be important in determining intervention strategies in this population. Furthermore, knowledge of the change over time for depression and maternal-infant bonding can also guide the targeted provision of interventions for women with a history of perinatal loss at a time when the largest impact can be made.

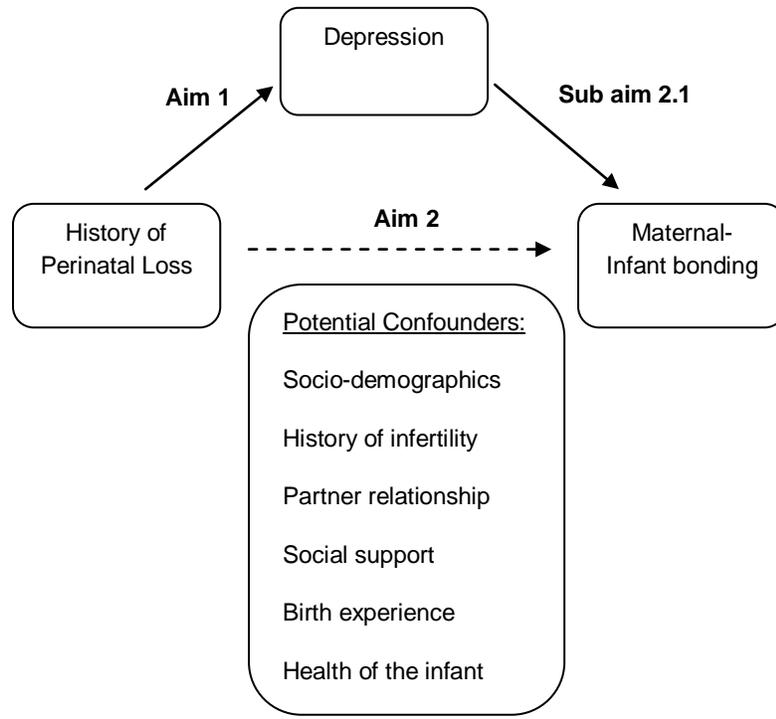
Chapter Summary

In conclusion, it is evident that the research on the effect of a history of perinatal loss is incomplete. This study aimed to understand the effect of a history of perinatal loss on mother's mental health (depression) and maternal-infant bonding during and following a subsequent pregnancy. It also aimed to determine the longitudinal relationship between depression and maternal-infant bonding in this population. The study design allowed a reduction of the selection bias that has plagued previous studies in the field. The outcomes of this analysis provide a basis for future research focused on the design and development of interventions for women with a history of perinatal loss. Successful interventions would improve the health and development of not only the women who experience perinatal loss, but of their families and children born subsequent to loss. Findings from this study contribute to the scientific literature on depression and maternal-infant bonding after perinatal loss and may further help to identify appropriate timing for interventions in order to improve the health of women and children affected by a history of perinatal loss.

Table 1-1. Potential Symptoms of Major Depressive Episode (APA, 2000)

Depressed mood most of the day, nearly every day
Markedly diminished interest or pleasure in all, or almost all, activities
Significant weight loss when not dieting or weight gain or decreased or increased appetite nearly every day
Insomnia or hypersomnia
Psychomotor agitation or retardation
Fatigue or loss of energy
Feelings of worthlessness or excessive or inappropriate guilt
Diminished ability to think or concentrate, or indecisiveness
Recurrent thoughts of death, recurrent suicidal ideation, plans, or attempts

Figure 1-1. Conceptual Framework



Chapter 2: Review of the Literature

Introduction

The following review of the literature provides an understanding of the major concepts in this study: perinatal loss, maternal perinatal depression, and maternal-infant bonding. A brief overview of a woman's immediate emotional response to a perinatal loss is provided for background. This is followed by a description of perinatal depression and a critical review of the literature on the relationship between a history of perinatal loss and depression. Longitudinal progression of perinatal depression is also discussed. Next, a review of the theory of Becoming a Mother provides theoretical support for aim 2, which examines the relationship between a history of perinatal loss and maternal-infant bonding. This is followed by a review of the concept of maternal-infant bonding and a critical review of the literature that indirectly supports the relationship between perinatal loss and maternal-infant bonding. No literature has been found to directly support this relationship. Finally, literature on the longitudinal progression of maternal-infant bonding in the general population, and the relationship between depression and maternal-infant bonding is reviewed. Each of these discussions provides empirical and/or theoretical support for this study.

Emotional Response to Perinatal Loss

A perinatal loss (miscarriage, stillbirth, or neonatal death) is typically followed by intense behavioral and emotional reactions similar in intensity and quality to those following other types of significant loss through death (Brier, 2008). Women experience intense grief that typically contains an element of yearning for the lost future with the baby, with an emphasis on lost hopes and dreams (Brier, 2008). Although symptoms of grief after perinatal loss generally

seem to decrease in intensity around 6 months after the loss (Brier, 2008), grief may exist at a lower level for at least 2 years (Lin & Lasker, 1996). Furthermore, a positive association between grief and depression has been found (Wheeler & Austin, 2000). In fact, reports in the literature show that women experienced high levels of depression and anxiety after a perinatal loss (Adeyemi et al., 2008; Sutan et al., 2010) and even 30 months following the loss, these women experienced twice as many symptoms of depression as matched controls (Vance, Boyle, Najman, & Thearle, 1995). Although some reports show that pregnancy may improve the grief response (Brier, 2008; Lin & Lasker, 1996), perinatal depression remains a concern for women who are pregnant or raising a child subsequent to loss.

Perinatal Depression

This study examined the relationship between a history of perinatal loss and maternal depression during the prenatal and postpartum periods in aim 1. The following is a short discussion of the concept of perinatal depression. Portions of the following review were published in *Neonatal Network* (Bicking & Moore, 2012):

During pregnancy and the first year postpartum, approximately one out of every ten women will experience depression (Dietz et al., 2007). The term *perinatal depression* is used to indicate that onset of symptoms occurred in the antenatal or postpartum period (Austin, 2010). Depression during the perinatal period can have negative short and long term effects on the health of mothers, infants, and families. For example, mothers with antenatal depression have an increased risk of delivering before term, or giving birth to a baby who is low-birth-weight or small for gestational age (Diego et al., 2006; Grote et al., 2010). Babies whose mothers experienced depression during pregnancy are often perceived by their mothers as being more difficult in infancy (McGrath, Records, & Rice, 2008). These babies cry more often (Milgrom, Westley, & McCloud, 1995), may have more sleep difficulties (O'Connor et al., 2007), and are at

higher risk for developmental delay (Deave et al., 2008). An increase in behavior problems has been seen in studies of children up to 9 years old (Luoma et al., 2004; Luoma et al., 2001). Mothers experiencing postpartum depression often feel out of control (Beck, 2002) and may display more harsh parenting behaviors (Lovejoy, Graczyk, O'Hare, & Neuman, 2000; McLearn, Minkovitz, Strobino, Marks, & Hou, 2006).

The DSM-V (APA, 2013), which provides standards for classification of mental health disorders, indicates postpartum-onset of depression if symptoms appear within 4 weeks after birth. However, evidence shows that postpartum onset of depression occurs with greatest frequency around 2 months postpartum (Jones, 2010) and experts in the field have suggested that the specifier for postpartum onset of depression should be extended to include antepartum and longer postpartum periods (Austin, 2004, 2010; Condon, 2010). The DSM-V, does not specify depression during pregnancy separately from major depressive disorder, and the symptoms are comparable to those of postpartum depression (APA, 2013). Therefore, the following discussion includes both postpartum and antenatal depression under the term perinatal depression.

Symptoms of perinatal depression do not differ from those of major depressive episodes in the general population. The most common feature is a period of at least 2 weeks during which a person experiences depressed mood or loss of interest in nearly all activities (APA, 2013). According to the DSM-V, for a diagnosis of major depressive episode to be given, one must exhibit at least five of the symptoms listed in Table 1-1, with at least one of the symptoms being depressed mood or loss of interest or pleasure. Persons with these symptoms must also show significant distress or impaired functioning to receive a diagnosis.

The experience of women with postpartum depression is related to the development of the role of mother and to caring for the infant. In a qualitative research study, mothers with

postpartum depression frequently reported that incongruence between expectations of motherhood and their own experiences as mothers had led them to feel they had failed to be the “perfect mothers” they wanted to be (Beck, 2002). Maternal attitudes towards the infant vary greatly but range from fear of being left alone with the infant or disinterest to overly invasive interaction that interferes with the infant’s sleep patterns (APA, 2013). Mothers with postpartum depression report a range of negative emotions from feeling overwhelmed, isolated and lonely, to extreme anger (Beck, 2002). One woman described her thoughts by saying she “felt like taking a hammer and ‘pinging [the baby] on the head’ but instead banged her own head against the wall and kicked a hole in it” (Wood, 1997). Severe anxiety and intense panic are common as women feel a loss of control (Beck, 2002) and depression is often complicated by co-morbid anxiety disorders (Dietz et al., 2007; Field et al., 2010).

Critical review of the literature on the relationship between perinatal loss and maternal depression during subsequent pregnancy and postpartum

Armstrong (2004) found that 45% of women who were pregnant after a perinatal loss demonstrated high risk of depression according to a self-report questionnaire. No comparison group was used in this study, but when compared to the 12% rate that has been established for the general population (Bennett, Einarson, Taddio, Koren, & Einarson, 2004), this represents a significant increase. Several studies have also found increased depression scores in pregnant women with a history of perinatal loss when compared to women without a history of loss (Armstrong, 2002; Carrera et al., 1998; Couto et al., 2009; Franche & Mikail, 1999; Gong et al., 2013; Hughes, Turton, & Evans, 1999; Wheeler & Austin, 2000; Yilmaz & Beji, 2013). These studies, however, are conflicted by other studies that have found no difference in the levels of depression for these two groups of women (Armstrong, 2007; Bergner, Beyer, Klapp, & Rauchfuss, 2008; Gaudet et al., 2010; Hamama, Rauch, Sperlich, Defever, & Seng, 2010; Hutti,

Armstrong, & Myers, 2011; Marcinko, Marcinko, Dordevic, & Oreskovic, 2011; Theut, Pedersen, Zaslou, & Rabinovich, 1988).

There are several limitations in sampling for many of the studies in the extant literature. First, sample size tended to be small. In over half of the studies described above, the sample of women with a history of perinatal loss was less than 100, and only three of the authors mentioned the use of a power analysis to guide sample size. Small sample size is a reflection of the difficulties in recruitment that stem from studying a relatively difficult event in the lives of many families. In fact, it is plausible that using recruitment methods such as advertisements and flyers that state the study purpose is related to pregnancy loss may deter participants who are not emotionally distressed by the loss and do not wish to further explore the issue. Armstrong and colleagues consistently used recruitment methods that included advertisement of the study in perinatal loss support groups (online or local) (Armstrong, 2002, 2004, 2007). This method may introduce bias because women who seek support after a perinatal loss may be different than those women who do not seek outside support. In fact, Armstrong (2004) reported that parents who attended a support group after a perinatal loss had higher depression scores than those who did not attend. One method of decreasing this selection bias is to study women that are obtained without the aim of selecting women with a history of perinatal loss.

Three recent population-based studies have been published that examine depression in women with a history of perinatal loss. Blackmore and colleagues analyzed the Avon Longitudinal Study of Parents and Children, based in England, to determine whether depression was related to a history of miscarriage or stillbirth (2011). These authors found that the number of perinatal losses significantly predicted depressive symptoms at both prenatal and postpartum time points in a sample of 13,133 women. Gong and colleagues (2013) also found that women with a history of miscarriage had an increased risk of depression in the first trimester of subsequent pregnancy, compared to primigravidae, in the China Anhui Birth Defects and Child

Development cohort study. In contrast, a study using the Early Childhood Longitudinal Study, Birth Cohort based in the United States found no association between a history of one perinatal loss and depression in a large sample of women at 9 months postpartum (Price, 2008). These authors did find that having two or more perinatal losses was associated with higher depression when compared to women with no history of loss; however, the difference averaged 1 point on the utilized scale (range 12-48), which is not likely to be clinically significant. The mixed results of these population-based studies, in combination with the selection bias that may occur through recruitment, call into question the idea that a history of perinatal loss is directly related to negative emotional outcomes for the majority of women. Price (2008) suggests that the normative response to perinatal loss may not be an increased risk for emotional impairment; rather, other social and emotional contextual features may contribute significantly in those women who develop depression or other emotional difficulties after perinatal loss.

Conflicting results on the relationship between perinatal loss and depressive symptoms in a subsequent pregnancy and/or postpartum period are found in both small purposively-sampled studies and population-based studies. The evidence for the impact of perinatal loss on mental health is far from conclusive. This study examined a large sample of women who were recruited independently of perinatal loss status, thus eliminating the specific type of recruitment-related bias common in the existing research in the field. By doing so, the author sought to contribute additional knowledge to the field by clarifying the relationship between perinatal loss and depression.

Longitudinal progression of perinatal depression

This study also extended the extant literature by examining the relationship between a history of perinatal loss and depression longitudinally from pregnancy through the 12th month postpartum. Four published studies were found that examined the relationship between a

history of perinatal loss and depression longitudinally. In a sample of women with a history of perinatal loss, depression was measured in the 3rd trimester and at 3 and 8 months postpartum by Armstrong and colleagues (2009). These authors found that clinical levels of depressive symptoms were present during pregnancy; however, more normal levels were typical after the birth of a healthy infant. In general, levels of depression also decreased over time. Likewise, Hughes and colleagues (1999) found that depression in women with a history of perinatal loss were comparable to controls at 12 months postpartum, despite having been significantly elevated during pregnancy. The same decrease over time was found in the study by Blackmore and colleagues (2011). However, these authors reported no evidence that depression is resolved after the birth of a healthy infant. They reported that depressive symptoms were significantly related to perinatal loss during pregnancy and up to 33 months postpartum. Additionally, Carrera and colleagues (1998) reported that a psychotherapy intervention improved the depressive symptoms of women with a history of perinatal loss to the same level as non-loss comparison women at 12 months postpartum. However, in this study women with a history of perinatal loss who did not receive the intervention continued to have higher depression levels at 12 months postpartum, suggesting that without intervention they did not “return to normal”.

Although the extant literature points to a decrease in depressive symptoms over time for women with a history of perinatal loss, no conclusion has been made regarding whether these women are at higher risk for depression even after the birth of a healthy infant. This study examined the relationship between perinatal loss and maternal depression during pregnancy, at 1 month, 6 months, and 12 months postpartum in order to advance our current understanding of the progression or amelioration of depressive symptoms after the birth of a healthy infant.

Theoretical Discussion

As discussed in Chapter 1, support for aim 2, which examined the relationship between a history of perinatal loss and maternal-infant bonding, comes partially from Ramona Mercer's theory of Becoming a Mother (BAM). The theory is based on the assumption that a disruption during pregnancy, such as perinatal loss, can lead to the mother's failure to fully incorporate the maternal role into her own identity, affecting her relationship with her infant (Mercer, 1995). This disruption may cause a negative effect on the mother's perception of herself as a capable woman (Cote-Arsenault et al., 2001) and of her ability to successfully navigate the process of becoming a mother when she becomes pregnant again after the loss.

The process of becoming a mother as described by Mercer encompasses the concept of maternal-infant bonding. Maternal-infant bonding refers to the maternal emotional response to the infant. A mother cannot successfully navigate the process of becoming a mother, or achieve the final step of maternal identity without positive maternal-infant bonding. The following discussion of Mercer's theory of becoming a mother serves to clarify the foundation for the hypothesis for aim 2, that a history of perinatal loss will be related to decreased maternal-infant bonding.

Overview of the theory

Mercer's theory of BAM identifies the four stages of establishing a maternal identity as 1) commitment, attachment and preparation for the maternal role during pregnancy 2) acquaintance with and attachment to the infant, learning to care for the infant, and physical healing 3) moving toward a new normal, and 4) achievement of the maternal identity (Mercer & Walker, 2006). Each stage of maternal role identity formation will be briefly described, including a discussion of the theory's utility for supporting the proposed study.

BAM stage 1

Mercer describes the first stage of becoming a mother as the *commitment, attachment, preparation stage* (2004). In this stage, which occurs during the pregnancy, the mother is not only charged with cognitive acceptance of the pregnancy and the new role as mother, but the theory also asserts that she is to accomplish several tasks of pregnancy. These tasks are paraphrased from Rubin's book by Mercer (1995):

1. "To ensure safe passage for herself and the baby through pregnancy and childbirth"
2. "To ensure social acceptance for herself and her child by significant family members."
3. "To increase the affinal ties in the construction of the image and identity of the "I" and the "you". Commitment of self as mother...binding-in to this child."
4. "To explore in depth the meaning of the transitive act of giving/receiving". "Exploration of the meaning...of giving of self in behalf of another." (p. 64).

A woman demonstrates that she is seeking a safe passage for herself and her infant in various ways including seeking prenatal care and ceasing activities that may be harmful to the fetus (Mercer, 1995). Women are strongly influenced by their partners, their own mothers, and previous children during pregnancy (Mercer, 1995). Each of these relationships is drastically restructured during this time period and acceptance by significant others is a major task of the expecting mother (Mercer, 1995). The woman must also achieve a bond to the fetus, which Rubin termed "binding-in" (Mercer, 1995). This bond provides motivation for the mother to achieve the maternal role and also gives her satisfaction in the role (Mercer, 1995). The final task of the first stage of BAM is that the woman will be willing to sacrifice her own self-gratification for the good of the childbearing process (Mercer, 1995).

Some evidence is available in the literature to show that women who are experiencing pregnancy after loss do not fully master stage 1. For example, in a qualitative study of late pregnancy after loss, women reported that they did not emotionally or physically prepare for the

arrival of the baby until late in the pregnancy, while some did not prepare at all (Cote-Arsenault & Donato, 2007). The authors suggested that physical preparation for the baby (i.e. readying the room, buying clothing) would force women to become emotionally prepared, something that they resisted because of their fear that a live baby would not result from the pregnancy. Furthermore, women resisted sharing their emotions regarding the pregnancy with their social support systems (Cote-Arsenault & Donato, 2007) because many outsiders expected them to be happier about the pregnancy than they felt ready to be (Cote-Arsenault et al., 2001; Cote-Arsenault & Freije, 2004). Women in these studies were clearly hesitant to make the emotional commitment to the pregnancy and future infant that is theoretically required to progress through Mercer's stage 1. Furthermore, they did not seem fully comfortable with the support given by their network of family and friends, suggesting that the stage may be disrupted through a disruption in social acceptance.

BAM stage 2

The second stage of BAM, which typically occurs from birth of the newborn to 2-6 weeks postpartum, is referred to as the *acquaintance, learning and physical restoration stage* (Mercer & Walker, 2006). In this stage the mother is becoming acquainted with the infant, learning his or her physical qualities and looking for family resemblances, and practicing how to care for the infant (Mercer, 2004). During this stage, she is also physically recovering from delivery (Mercer, 2004). She tends to use formal care-giving processes for the infant including things she has read in books or that other women have advised her to do, rather than informal care-giving which relies on the mother's knowledge and intuition (Mercer, 1995). No specific evidence could be found in the extant literature to describe the experience of mothers with a history of perinatal loss in stage 2.

BAM stage 3

The third stage of BAM, termed *moving toward a new normal* deals with the mother's transition from caring for the infant according to external rules (formal) to fitting her mothering style in with the needs of herself and her family (informal) (Mercer & Walker, 2006). In this way she forms a mothering style unique to her new reality while also restructuring other relationships with family and friends (Mercer, 2004). This stage usually begins at about 2 weeks postpartum and lasts until 4 months (Mercer, 2004). In this stage, maternal self-concept and maternal health status are positively related to maternal behavior (Mercer, 2004). In addition, research has shown that maternal perception of the infant's behavior is related to mothering behavior (Mercer, 2004).

Extant literature offers some evidence that the maternal self-concept is changed after the experience of perinatal loss. Women who were pregnant after a perinatal loss reported that after the loss, their sense of self was changed (Cote-Arsenault & Morrison-Beedy, 2001), and some doubted their ability as a biologically competent woman (Cote-Arsenault & Mahlangu, 1999). Although these studies examined pregnant women, it is possible that this concept of self as inadequate may continue after the birth of a subsequent infant.

BAM stage 4

In the final stage, the mother achieves the maternal identity by integrating the maternal role into her self-concept (Mercer, 2004). She is intimately familiar with her infant and feels confident in her ability to care for him as well as finding satisfaction in the role (Mercer, 2004). This stage begins around 4 months postpartum and typically lasts 1 month (Mercer, 2004). In a review of the literature in 2004, Mercer found that the study of maternal confidence and competence in mothering as well as in the mother's self-reported feelings about the infant were

consistently used as concepts to measure the achievement of maternal identity in several quantitative studies.

Achievement of the maternal identity according to Mercer's theory in a population of women with a history of perinatal loss has not been explicitly studied, but there is some evidence that these women view their babies as less ideal and report more problems with feeding, sleeping, and crying than women without a history of loss (Hunfeld et al., 1997). These findings suggest that a history of perinatal loss may impact the process of becoming a mother through all stages.

In summary, aim 2 of this study was based on a key theoretical relationship of becoming a mother: that a disruption in one stage of the process will have a continued effect on achievement of subsequent stages. Perinatal loss is a disruption in the first stage of becoming a mother normally achieved during pregnancy. The disruption causes a negative effect on the mother's perception of herself as a capable woman (Cote-Arsenault et al., 2001) and of her ability to successfully navigate the process when pregnant after loss. Some evidence exists to support the idea that this disruption may affect all stages in the process of becoming a mother. Thus, this study examined the relationship between perinatal loss and maternal-infant bonding, a concept contained in all steps of the process of becoming a mother, longitudinally until 12 months postpartum.

Maternal-Infant Bonding

As discussed in Chapter 1, the concept of maternal-infant bonding was examined as an outcome with the hypothesis that a history of perinatal loss would be related to decreased maternal-infant bonding. This hypothesis was based on evidence in the literature that suggests that a history of perinatal loss may disrupt the relationship between mother and child as well as

theoretical support for the hypothesis from Mercer's theory of becoming a mother. In the following introduction to the concept of maternal-infant bonding, a definition is provided. The context in which bonding is promoted, those in which it is hindered, and the outcomes of maternal-infant bonding are then presented.

According to a recent concept analysis, "Maternal-infant bonding is a maternal-driven process that occurs primarily throughout the first year of a baby's life, but may continue throughout a child's life. It is an affective state of the mother; maternal feelings and emotions toward the infant are the primary indicator of maternal-infant bonding." (Bicking Kinsey & Hupcey, 2013)

Promotion of maternal-infant bonding

Van Bussel and colleagues (2010a) asserted that high levels of bonding to the fetus during pregnancy will promote high levels of maternal-infant bonding after delivery. Additionally, support of the woman in labor, either by a doula or a nurse was implicated in the promotion of maternal-infant bonding (Altaweli & Roberts, 2010; IsHak, Kahloon, & Fakhry, 2011). In the current literature, the most frequently reported context in which maternal-infant bonding can be promoted required a physical proximity between mother and infant after birth. For example, holding the baby was described as promoting bonding (Altaweli & Roberts, 2010; Charpak et al., 2005; Crouch, 2002; Tallandini & Scalembra, 2006). Additionally, breastfeeding and rooming-in during the immediate postpartum period promoted bonding (Altaweli & Roberts, 2010). Figueiredo et al. (2007) also asserted that maternal-infant bonding is stimulated by infant crying, smiling, and visual following. Maternal emotional components are also thought to be able to promote bonding. For example, a positive early attitude of the mother (Wittkowski, Wieck, & Mann, 2007) and a mother's realistic expectation of the parenting role may promote maternal-infant bonding (Broedsgaard & Wagner, 2005). Examination of the literature revealed

that in order to promote maternal-infant bonding, health care providers should attempt to promote not only physical proximity of mother and newborn, but also a positive emotional state of the mother at birth.

Hindrance of maternal-infant bonding

Authors that treat maternal-infant bonding disorders most often cited physical and/or emotional separation of the mother from the infant around the time of birth as the primary cause of bonding disorders (Klier, 2006; Madrid, 2005; Madrid, Skolek, & Shapiro, 2006). They reported that physical separation of mother and infant may impair bonding, such as after a premature birth (Broedsgaard & Wagner, 2005) or as a result of maternal incarceration (Chambers, 2009). A non-vaginal or traumatic delivery can also make bonding between mother and infant difficult (Cevasco, 2008; Karacam & Eroglu, 2003; Madrid et al., 2006; Sharan, Yahav, Peleg, Ben-Rafael, & Merlob, 2001), and this was linked to decreased maternal exposure to oxytocin during the birth process (Feldman & Eidelman, 2007; IsHak et al., 2011). Maternal physical complications may make maternal-infant bonding more difficult, and were associated with higher rates of bonding disorders, however, Madrid (2005) reported that mothers in his study who demonstrated high trait resilience overcame physical separation to bond with their infants.

Emotional separation of the mother and the newborn also has the potential to impair maternal-infant bonding. This may occur through a variety of reasons, for example, an unwanted pregnancy or finding out a baby is not the desired gender (Brockington, 2004; Sevil & Coban, 2005). A traumatic event around time of delivery was also associated with bonding impairments. Maternal mental health may also be a hindrance to the development of maternal-infant bonding (Reck et al., 2006; Siu et al., 2010). Finally, infant characteristics, such as being unhealthy or having a difficult temperament, can also make bonding more difficult (Bienfait et

al., 2011; Brockington, 2004; Broedsgaard & Wagner, 2005; Figueiredo, Costa, Pacheco, & Pais, 2007, 2009).

Outcomes of maternal-infant bonding

The importance of maternal-infant bonding lies in the outcomes that occur with positive bonding or negative bonding experiences. Positive bonding facilitated improvement in the mother's parenting skills (Altaweli & Roberts, 2010; Figueiredo et al., 2007; Madrid, 2005). Maternal-infant bonding was helpful for the survival and development of the infant (Sharan et al., 2001) and may form the foundation for the infant's later attachments as well as the basis for the child's sense of self (Madrid et al., 2006). One study specifically showed that positive maternal-infant bonding may prolong breastfeeding duration (Cernadas, Noceda, Barrera, Martinez, & Garsd, 2003). Van Bussel and colleagues (2010b) caution, however, that a high level of maternal-infant bonding is no guarantee of a future healthy mother-infant relationship, nor a promise of healthy child development. Furthermore, many authors described the outcomes of negative or impaired bonding in vague terms and/or referenced the work of Brockington and colleagues (2001). According to Brockington, impairments in bonding have "potentially serious effects on the long-term mother-child relationship, and on child development. It occasionally leads to child abuse or neglect" (2001, p. 133). The specific outcomes of bonding problems were rarely addressed, except as described in a treatment case by Madrid (2005) who found that treatment of maternal-child bonding disorders resulted in elimination of asthma symptoms.

Critical review of the literature on the relationship between perinatal loss and maternal-infant bonding after birth of a healthy infant

A review of the perinatal loss literature did not reveal any studies that specifically examined the relationship between a history of perinatal loss and maternal-infant bonding.

However, several studies examined the relationship between perinatal loss and other related concepts, such as prenatal attachment, mother-infant interaction, and maternal concerns about her baby.

Armstrong and Hutti (1998) and Gaudet and colleagues (2010) found that women with a history of perinatal loss reported lower attachment to their fetus during pregnancy than women without a history of perinatal loss. However, another study did not find a relationship between a history of perinatal loss and prenatal attachment (Armstrong, 2002). Since prenatal attachment is significantly correlated with postpartum bonding in a community sample (Muller, 1996), it is feasible to expect that decreased maternal-infant bonding may be found in women with a history of perinatal loss. Evidence also exists that women with a history of perinatal loss are more concerned with the health of their child (Hutti et al., 2011; Theut et al., 1992) and report more problems with their child both in early infancy (Hunfeld et al., 1997) and at school age (Turton et al., 2009). Hunfeld and colleagues (1997) suggest that maternal perception of problems with the infant born subsequent to loss may be related to the comparison of the lost baby with the new baby. Since the lost baby was only an idealized child that didn't cry or inconvenience the parent, the new baby may never be able to compare to the lost ideal baby.

In a study of mothers of children born subsequent to stillbirth, Turton and colleagues (2009) found that although mothers with a history of stillbirth reported that their children had more difficulties and peer problems than was reported by a control group of mothers, teacher ratings did not show any difference. This suggests that a relationship issue between the child and the mother may exist even when the child is otherwise functioning normally. Furthermore, studies by Hughes and colleagues (2002) and Heller and Zeanah (1999) showed that difficulties in the relationship between the mother and a 12 month old child born subsequent to loss could be explained by the mother's mental representation of her prior perinatal loss. In other words, maternal disorganized thoughts about previous loss may interfere with the development of the

mother-infant relationship. In a qualitative study of men and women parenting a toddler born after a perinatal or infant loss, Warland and colleagues (2010) reported that parents distanced themselves emotionally from their subsequent child in order to protect themselves in case this child would also die. These studies all indirectly describe a disruption in the emotional relationship between the parent and a child born subsequent to perinatal loss. It is likely that these disruptions may begin in infancy with impairments in maternal-infant bonding.

Like studies examining the relationship between perinatal loss and depression, many of the studies mentioned above suffer from recruitment bias. Several studies used online perinatal loss support groups or local bereavement support groups to recruit participants with a history of perinatal loss (Armstrong & Hutti, 1998; Gaudet et al., 2010; Hutti et al., 2011; Warland et al., 2010). Only one population-based study examined a history of perinatal loss and maternal-infant relationship (Price, 2008). In this study, the outcomes examined included mother-infant interaction, parenting perceptions of child difficulty, and parental involvement with the child. The investigator found no difference between women with a history of perinatal loss and those without for any of these outcome variables, except that women with a history of perinatal loss were more likely to sing songs and tell stories to their children. These results potentially contradict other findings from smaller purposively-sampled studies and highlight the need for more research on the relationship between a history of perinatal loss and the maternal-child relationship.

Although some evidence exists that mothers may experience impaired bonding with infants born subsequent to perinatal loss, the evidence is far from definitive. This study used the concept of maternal-infant bonding to further explore this relationship in a large sample of women.

Longitudinal progression of maternal-infant bonding

Longitudinal investigation of maternal-infant bonding or related concepts has not occurred in women with a history of perinatal loss. However, Hunfeld and colleagues (1997) found that in a sample of women with a history of perinatal loss, more problems with the infant were reported at 4 weeks postpartum than at 16 weeks. These problems dealt with crying, sleeping and eating patterns. The authors state that the results may indicate the presence of an adaptation period, during which the mother becomes accustomed to the infant's behavioral pattern. This period of adaptation may be more difficult or take a longer period of time for mothers with a history of perinatal loss due to an increased fear of losing the infant born after previous perinatal loss.

Examination of the longitudinal progression of maternal-infant bonding in the general population revealed that bonding is a time-dependent process. In one study of postpartum women, Taylor and colleagues (2005) found that bonding disorders were prevalent in 18.5%, 22%, and 8.9% of women at 3 days, "the first few weeks", and 12 weeks postpartum, respectively. The authors suggest that maternal-infant bonding is not established immediately, but is established by most women by 12 weeks postpartum. Other studies examining maternal-infant bonding longitudinally confirmed this finding (Edhborg & Lundh, 2005; Yoshida, Yamashita, Conroy, Marks, & Kumar, 2012). However, O'Higgins and colleagues (2013) found that poor bonding in the first few weeks postpartum was highly predictive of poor bonding at 1 year postpartum. In a longitudinal study of maternal-infant bonding over the first 14 months postpartum, Moehler and colleagues (2006) found that bonding scores were highest at 4 months postpartum, the point in infant development where babies tend to be more responsive and playful but are not yet mobile.

This study examined the relationship between a history of perinatal loss and maternal-infant bonding over the first year postpartum. The study design had the potential to reveal

whether an extended adaptation period for women with a history of loss exists or whether patterns of maternal-infant bonding are present that have not been seen in previous studies.

Relationship between Depression and Maternal-Infant Bonding

Two studies were found that discuss depression as a mediating factor between perinatal loss and maternal-child related outcomes in a women with a history of perinatal loss. Gaudet and colleagues (2010) reported that in women with a history of perinatal loss, decreased prenatal attachment was related to depressive symptoms, while Hutti and colleagues (2011) found that an increased use of pediatric health care resources for these women and their babies was also related to depression.

In the general population, it is well established that depression is related to impairments in maternal infant bonding (Edhborg & Lundh, 2005; Edhborg, Nasreen, & Kabir, 2011; Moehler et al., 2006; O'Higgins et al., 2013; Orun, Yalcin, & Mutlu, 2013; Reck et al., 2006; Siu et al., 2010; Taylor et al., 2005; Yoshida et al., 2012). In one study, healthy mothers had a rate of maternal-infant bonding disorder of 13%, while depressed mothers had a rate of bonding disorder of 28% (Edhborg et al., 2011). Furthermore, depression at 4 weeks postpartum predicted impaired bonding at 14 months, suggesting a sensitive window in the mother-infant relationship sometime in the early postpartum period (Moehler et al., 2006) where depression may have the greatest impact. The relationship between depression and maternal-infant bonding in a subset of women with a history of perinatal loss, although likely to exist, has not been confirmed. This study aimed to examine this relationship through sub aim 2.1 with the ability to potentially confirm a point in the postpartum period where depression has the greatest impact on the maternal-infant relationship. Understanding of this critical period in the maternal-infant relationship may reveal the optimal time for intervention.

Conclusion

Critical review of the extant literature has revealed that the relationship between a history of perinatal loss and depression, although supported by several studies, is still not clear. Much of the support for the relationship between perinatal loss and maternal depression comes from studies that may be influenced by recruitment bias. Closer examination of this bias by comparing purposively-sampled studies to population-based studies has suggested that the relationship between a history of perinatal loss and depression may occur only in a certain subset of women. This study examined this relationship using a large, prospective sample unaffected by this selection bias and a longitudinal study design that contributed to our understanding of the relationship between perinatal loss and depression.

Although the theory of becoming a mother, along with studies of the mother-child relationship suggest that a history of perinatal loss may have a negative effect on maternal-infant bonding, no research has been found to address this relationship. As impaired maternal-infant bonding may have a profound effect on the mother-child relationship throughout a child's life and cause significant distress to the mother, it is important to understand the effect that perinatal loss history may have on maternal-infant bonding. This study examined this relationship throughout the first year postpartum. Finally, the study was designed to examine whether the relationship between perinatal loss and maternal-infant bonding is mediated by depression, as suggested in the literature from the general population.

Chapter 3: Methods

This study consisted of secondary analysis of data from the First Baby Study (FBS), a Eunice Kennedy Shriver National Institute of Child Health & Human Development (R01 HD052990) funded cohort study designed to examine mode of first childbirth and relationship to subsequent pregnancy and delivery. This chapter will first describe the structure of the First Baby Study, followed by detailed discussion of the specific methods for this study sample, variables, protection of human subjects, data analysis and study limitations.

The First Baby Study

In the FBS, pregnant women ages 18-35 who were planning to deliver their first baby in Pennsylvania were recruited between January 2009 and April 2011. The study objectives were as follows: 1.) to determine childbearing desires and intentions in women pregnant with their first live-born child that could potentially explain choices for subsequent childbearing; 2.) to obtain the birth certificate data and hospital discharge data for the participating mother and baby pairs to measure complications prior to, during and after delivery for the mother and baby; and 3.) to interview study participants at 1, 6, 12, 18, 24, 30 and 36 months after the first delivery in order to measure sexual relations, use of birth control, childbearing plans, attempts to conceive, miscarriages, stillbirths, use of fertility services, pregnancies/deliveries and related factors over the course of 3 years after the birth of the first child.

Recruitment occurred across the state of Pennsylvania and the majority of the participants delivered at 7 hospitals (85.7%), while the rest of the participants (14.3%) delivered at a total of 69 additional hospitals in the state. Recruitment included both active and passive methods with the majority of participants recruited through childbirth education classes (42%), hospital-based advertising such as hospital tours, website posting, and flyers (21%) and low-

income clinics or community centers (14%). Recruitment materials were available in English or Spanish and the study excluded women who did not speak either of these languages. The study also excluded women who were carrying more than one fetus, had a previous stillbirth that occurred at more than 20 weeks gestation, had a previous cesarean delivery regardless of length of gestation, were a gestational or surrogate carrier, planned to give the baby up for adoption, planned to have a tubal ligation while hospitalized for delivery, did not have a telephone or were not able to commit to participation in the study for a period of 3 years. The study was approved by the Institutional Review Board at the Penn State Hershey Medical Center and at participating study hospitals and written informed consent was obtained from each participant.

The study team obtained consent from 3080 women who subsequently completed the baseline prenatal interview. Women were not considered to be enrolled in the study until they also completed the 1-month postpartum interview. This resulted in a sample size of 3006 women. The demographic characteristics of the First Baby Study participants are shown in Table 3-1.

Both active and passive methods of recruitment were utilized for this study. Active methods consisted of visits to childbirth classes or hospital information sessions at the 7 main hospital sites by site coordinators trained in a recruitment protocol. These coordinators distributed a study brochure and instructed interested participants to speak with them or call a toll-free number if the woman was interested and wanted more information. Recruitment via passive methods occurred through websites, flyers, and radio advertisements. Women who viewed these advertisements and were interested in participating in the FBS contacted the project director via phone or email. Eligibility screening and obtaining informed consent was performed after 24 weeks gestation by the site coordinator for any woman who planned to deliver her baby at one of the main study sites. For women who planned to deliver elsewhere in

Pennsylvania, the project director performed eligibility screening and obtained informed consent via telephone and mail.

Data collection occurred via telephone interviews conducted at baseline during the third trimester (after 30 weeks gestation) and at 1, 6, 12, 18, 24, 30, and 36 months postpartum. Women received a postcard reminder in the mail one week prior to each interview, and were permitted to reschedule interviews if the initial attempt occurred at an inconvenient time. Interviews were conducted by the Center for Survey Research at the Pennsylvania State University using Computer Assisted Telephone Interviewing (CATI) software that allowed the creation of complex question patterns. The use of CATI software assured that skip logic and other survey branching would not only be seamlessly presented to participants, but also would remain consistent across interviewers. Interviews took an average of 35 minutes to administer. The FBS was designed to minimize any risk that the mother may not be paying attention to her baby while she is being interviewed by telephone. Therefore, the interviewers made every attempt to conduct interviews at a time when the mothers were not engaged in caring for the baby, such as while the baby was napping, or when there was someone else in the home to watch the baby while the interview took place. In order to ensure reliability and validity of data collection, interviewers were trained internally to follow strict protocols for conducting interviews. Shift supervisors monitored calls, produced reports to manage the sample, and coached the interviewing staff. Furthermore, to ensure data quality, a minimum of 10% of completed interviews were verified by shift supervisors.

Retention has been excellent throughout the study. Upon completion of the 12-month postpartum interviews, the retention rate was 98.9%. Several strategies for retention were utilized throughout the study including obtaining contact information for the family and/or friends of participants in case they were lost or could not be reached conventionally; sending regular newsletters about the study, holiday greeting cards, and birthday cards; maintaining an

active study website; and sending small gifts such as refrigerator magnets with the study logo and phone number. Furthermore, participants were enrolled in the study only after completing two interviews, thus reducing drop out after enrollment. Further information about the FBS recruitment and sampling plan is available elsewhere (Kjerulff et al., 2013).

Proposed Study

Study sample

This study utilized secondary data analysis to examine differences between women with a history of perinatal loss and women without a history of perinatal loss, following both groups from pregnancy to 12 months postpartum after the birth of their first baby. Participants were selected if they reported complete data for history of miscarriage, and if this information was congruent with their self-reported number of prior pregnancies. Figure 3-1 describes the designation of participants into perinatal loss or comparison groups based on survey responses. Women who reported previous elective abortion were excluded from the sample. A history of elective abortion, although significant, may not have the same effect as miscarriage (Major et al., 2000). Maintaining this exclusion criterion allowed this study to reduce confounding effects of elective abortion.

Utilizing these inclusion and exclusion criteria, the final sample included 453 women with a history of perinatal loss and 2401 women without a history of perinatal loss. There were 152 women excluded due to a history of abortion. Of these, 29 women also had a history of miscarriage.

Measures

The main outcome variables were maternal depression and maternal-infant bonding for women with a history of perinatal loss and for the comparison group of women experiencing their first pregnancy. Covariates included sociodemographic characteristics, obstetric variables, psychosocial variables, and infant health. Table 3-2 has been provided as a reference for each of the variables analyzed. Furthermore, Table 3-3 details the properties of all variables that were measured with a multi-item scale.

Depression was measured using a slightly modified version of the Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden, & Sagovsky, 1987), an easy to administer, easy to score screening questionnaire with established validity and reliability (Cox et al., 1987). The scale has been shown to be sensitive to changes over time (Cox et al., 1987), making it appropriate for the proposed analysis over the first postpartum year. Depression during pregnancy is a strong predictor for postpartum depression, therefore the EPDS was administered during pregnancy as well as postpartum (Rich-Edwards et al., 2006). Although the scale was initially developed for use postpartum, it has been used with acceptable validity and reliability in the antepartum period as well (Jomeen & Martin, 2007; Rich-Edwards et al., 2006; Rubertsson, Borjesson, Berglund, Josefsson, & Sydsjo, 2011). In this study, two of the original items were modified: “Things have been getting on top of me” was changed to “I have had trouble coping” and “The thought of harming myself has occurred to me” was changed to “The thought of harming myself or others has occurred to me”. The internal reliability of the scale was good at the baseline interview, with a Cronbach’s alpha of 0.787.

Maternal-infant bonding was measured using a shortened and modified version of a screening questionnaire developed by Brockington and colleagues (2001) to detect mother-infant bonding disorders. The Postpartum Bonding Questionnaire (PBQ) has high sensitivity and specificity for detecting maternal-infant bonding disorders and has been validated against a standard clinical interview, the Birmingham Interview for Maternal Mental Health (Brockington

et al., 2006; Brockington et al., 2001). The shortened version of the PBQ used in the proposed study, hereafter referred to as the S-PBQ, utilized a selection of questions from the PBQ scale 1, which identified over 90% of mothers with a bonding disorder, differentiating them from those women with normal bonding and mental health as well as those with clinical depression but normal bonding (Brockington et al., 2001).

While the PBQ contains 25 statements, rated on a five-point scale, the S-PBQ for the FBS was shortened to 10 statements. Furthermore, some statements were modified for clarity. For example, one statement in the original PBQ is, “I love my baby to bits” (Brockington et al., 2006) and was modified for the FBS to say, “I love my baby with all my heart” because we felt the revised statement would be better understood by a U.S. sample. The original PBQ item of “I feel happy when my baby smiles or laughs” was modified to “I feel happy when my baby looks at me” in order to reflect the developmental capabilities of infants at one month old. The modifications were made to reduce the size of the scale and to improve clarity. Reliability analysis for the S-PBQ was completed using the 1-month interview data (n=3005). Analysis revealed that each of these items contributed positively to the overall Cronbach’s alpha. Therefore, the full 10-item scale was utilized. Cronbach’s alpha for the scale was 0.67, indicating acceptable internal reliability. In addition, analyses of the association of the S-PBQ with other measures from the 1 month postpartum interview indicated good construct validity. For example, consistent with extant literature, maternal-infant bonding measured via the S-PBQ was significantly negatively correlated with maternal stress ($r=-0.31$; $p<0.001$), maternal pain frequency ($p<0.001$), infant colic ($p<0.001$) and postpartum depression ($r=-0.474$, $p<0.001$), and positively correlated with maternal health ($r=0.362$; $p<0.001$), partner baby support ($r=0.297$, $p<0.001$), and social support ($r=0.347$; $p<0.001$), confirming construct validity. The S-PBQ is also described elsewhere (Bicking Kinsey, Baptiste-Roberts, Zhu, & Kjerulff, In press).

Appendix A & B contain the Modified Edinburgh Postnatal Depression Scale and the shortened-Postpartum Bonding Questionnaire, respectively.

Selected covariates were included in the analysis based on their theoretical and statistical relationship to independent and dependent variables. Empirical evidence suggests that sociodemographic factors (Beck, 2001; Figueiredo & Costa, 2009; MacDorman & Kirmeyer, 2009; Price, 2006; Whitaker et al., 2010), obstetric variables (Brockington, 1996; Righetti-Veltema et al., 1998; Waldenstrom et al., 2004), psychosocial factors (Bienfait et al., 2011; Crouch, 2002; Dayan et al., 2010), and health of the infant (Figueiredo & Costa, 2009; Miles et al., 2007) may be related to depression and/or maternal-infant bonding. Details of the covariates included in this study can be found in the variables table, Table 3-2 and the table of instrument properties, Table 3-3.

Protection of human subjects

This study was eligible for exemption under the DHHS human subject regulations. Exemption 4 applies because it pertains to the use of previously collected data available to the investigator without identifying information. The principal investigator for the First Baby Study (5R01HD052990-03), Dr. Kristen Kjerulff, provided FBS data for use in this study without access to identifying information.

Furthermore, this study's author has received approval from the Penn State Hershey's Institutional Review Board as a co-investigator for the First Baby Study. Within the FBS, all information obtained during interviews was kept in the strictest confidence. Numbers were used to identify individuals and all data entered in office computers contained only number identifiers. Reference lists connecting names to numbers were held in the principal investigator's office and kept in a locked cabinet. After data collection is complete, records of names and any potentially identifying information will be destroyed. The FBS plan for the

protection of human subjects was approved by the Penn State Hershey's Institutional Review Board (ID 25732EP).

Data analysis

This study analysis began with descriptive analyses to examine the distribution of all study variables (e.g. frequencies, means, and standard deviations) at baseline and during the 1, 6 and 12 month follow up. Attention was given to potential outliers and addressed in cooperation with the FBS team.

Aim 1. The first study aim was to determine the longitudinal relationship between a history of perinatal loss and depression during pregnancy and throughout the first year postpartum. The outcome variable of depression was measured using a slightly modified version of the Edinburgh Postnatal Depression Scale (EPDS) and analyzed as a dichotomous variable using a score of 13 or greater as an indicator of probable depression and scores of 12 or less indicating no probable depression, as suggested by a recent systematic review (Gibson, McKenzie-McHarg, Shakespeare, Price, & Gray, 2009). Analysis was also completed using depression as a continuous variable in order to detect subtle differences that may occur in subclinical depressive symptoms, as was done in a previous study using the EPDS (Moehler et al., 2006). The distribution of depression scores was positively skewed, and a square root transformation of the variable allowed the achievement of normality. However, results of analysis did not differ greatly between transformed and raw depression scores, thus, raw scores were reported for clarity.

For the dichotomous depression outcome variable, Chi-square and Student's t-tests were used to compare variables by perinatal loss status at baseline. Then, a bivariate logistic regression model (model 1) was created for each of the four time points followed by multiple logistic regression models as follows: 2) the addition of factors significantly related to the

independent variable: maternal age and use of fertility advice or treatment; 3) in addition to model 2 factors, sociodemographic factors marital status, race and ethnicity, education and poverty status; 4) in addition to model 3 factors, obstetric factors including mode of delivery, infant hospitalization after birth, and birth experience; and 5) in addition to model 4 factors, psychosocial factors including postpartum mental health visits, history of anxiety or depression, maternal stress, and social support. At baseline, model 4 was not completed because these variables were measured at the 1-month postpartum interview. Next, longitudinal analysis was completed using a generalized estimating equations (GEE) model with probable depression as a repeated outcome measure, and adjusting for maternal age and fertility treatment or advice. Finally, interaction analysis was completed for maternal stress and social support at each time point using a logistic regression model adjusted for maternal age, fertility treatment or advice, maternal stress or social support, and the appropriate interaction term. A similar approach was taken using depression measured continuously with appropriate models for continuous outcome variables (i.e. linear regression models). An outline of the analysis plan is given in Table 3-4.

Aim 2. The second study aim was to evaluate the effect of a history of perinatal loss on maternal-infant bonding throughout the first year postpartum. The outcome variable of maternal-infant bonding was measured using the S-PBQ. A cut-off point for the identification of postpartum bonding disorders was not possible in this study due to the use of a modified instrument and the lack of a clinical validation technique, and therefore bonding was analyzed as a continuous variable. The distribution of bonding scores were negatively skewed and the variable was transformed using a reflected square root transformation, however, the results of analysis using transformed data did not differ from the original analysis and therefore results using the original S-PBQ scores are presented for ease of interpretation. First, Chi-square and Student's t-tests were used to compare variables by perinatal loss status. Second, bivariate logistic regression models were built for each time point to examine the relationship between perinatal

loss and maternal-infant bonding. Then, multivariate linear regression models were built at each time point with adjustment for maternal age, use of fertility advice or treatment, marital status, race/ethnicity, education, poverty status, mode of delivery, infant hospitalization at birth, birth experience, postpartum mental health visits, history of depression, probable postpartum depression, maternal stress, and social support. Finally, longitudinal analysis was completed using mixed models with maternal-infant bonding as a repeated outcome measure, and adjusting for potential confounders maternal age, probable postpartum depression, and fertility treatment or advice.

In addition, the analysis of ***Sub Aim 2.1***, which was designed to determine whether maternal depression could mediate the relationship between a history of loss and maternal-infant bonding, was planned to examine first the relationship between depression and maternal-infant bonding in a bivariate analysis. Subsequently, history of perinatal loss and bonding were analyzed in multivariate analysis adding depression as a covariate. This analytic approach was planned at 1, 6 and 12 months postpartum. This approach is consistent with Baron & Kenny's (1986) well-accepted method of analysis of mediating relationships. If there was variability in depression over the 12 month postpartum period, then a hierarchical linear model for longitudinal data was planned and depression would be entered in the model as a time-varying covariate.

Limitations

The study has limitations related to the analysis of data that were not designed or collected specifically for the aims outlined here. First, the inclusion criteria for the FBS did not allow participation by women who had experienced the previous death of a neonate or loss via stillbirth. Regretfully, these perinatal losses will not be captured, although they do represent a very small portion of the overall prevalence of perinatal loss reported in previous studies (about

5-8% of all perinatal losses) (MacDorman & Kirmeyer, 2009; Scotchie & Fritz, 2006) and there is some evidence to support the idea that the gestational age of a pregnancy loss is not associated with intensity of grief or depressive symptoms (Armstrong, 2002; Hutti, Armstrong, & Myers, 2013). These data also do not identify women with a history of medical termination of pregnancy for fetal anomalies. Emerging research suggests that this experience may have a negative effect similar to miscarriage (Korenromp et al., 2007). With regard to the questionnaires used to measure depression and maternal-infant bonding, both are screening tools, and are therefore unable to provide definitive information on specific types of depression, symptoms, or detailed information on the maternal-infant relationship. Furthermore, no measure of maternal-fetal bonding was included in the baseline interview for the FBS. The proposed study would have benefited from analysis of the relationship between prenatal bonding and maternal-infant bonding postpartum but this will not be possible. The final identified limitation is that the sample obtained from the First Baby Study was not fully representative of the state of Pennsylvania for income and education level; the sample has higher income and education levels when compared to average state-wide data. The study investigator is confident that these limitations do not minimize the value of this study to the field of perinatal loss.

Table 3-1. First Baby Study Participant Sociodemographic Factors

	N (%)
Age	
18 - 24	811 (27.0)
25 - 29	1193 (39.7)
30 - 36	1002 (33.3)
Age [Mean (SD)]	27.2 (4.4)
Race/Ethnicity	
White	2502 (83.3)
Black	221 (7.4)
Hispanic	166 (5.5)
Other	115 (3.8)
Education	
HS Degree or Less	501 (16.7)
Some College or Technical	804 (26.7)
College Grad or Higher	1701 (56.6)
Marital Status	
Married	2117 (70.4)
Living with partner	536 (17.8)
Not living with Partner/Divorced/Single	353 (11.7)
Poverty	
Poverty	246 (8.7)
Near Poverty	248 (8.8)
Not Poverty	2332 (82.5)

Table 3-2. Descriptions of Each Variable Used in Analysis

Variable	Instrument	Type of Variable	Description
History of perinatal loss	See Figure 3-1 for question scheme; baseline interview	Dichotomous	History of Loss
			No history of loss
Maternal Depression	Modified Edinburgh Postnatal Depression Scale (Cox et al., 1987)	Dichotomous	Score \leq 12 (not depressed)
			Score $>$ 12 (probable depression)
		Continuous	Range 10 - 40
Maternal-infant Bonding	Modified Postpartum Bonding Questionnaire	Continuous	Range 13 - 65
Covariates			
Age	Baseline interview	Continuous	
Marital Status	Baseline interview	Dichotomous	Married
			Unmarried
Race/ethnicity	Baseline interview	Nominal	Non-Hispanic White
			Non-Hispanic Black
			Hispanic
			Other
Poverty status	Baseline interview	Ordinal	Poverty
			Near Poverty
			Non-poverty
Education	Baseline interview	Ordinal	High school graduate or GED or less
			Some college or vocational programs
			Completed 4 year college degree or greater
Fertility advice or treatment for woman or partner	Baseline interview	Dichotomous	No
			Yes
Mode of Delivery	1 month interview	Dichotomous	Vaginal delivery
			Cesarean delivery
Maternal Stress	Time varying variable; measured at each time point Modified <i>Psychosocial Hassles Scale</i> (Misra, O'Campo, & Strobino, 2001), 12 items	Continuous	Range 12 - 48
Postpartum mental health visits	1 month interview Since question: "Since you had your baby, how many counseling or mental health visits have you had for psychological or emotional issues such as anxiety or depression?"	Dichotomous	No
			Yes
History of Anxiety	Baseline interview	Dichotomous	No

or Depression			Yes
Social Support	Time varying variable; measured at each time point Modified MOS Social Support Survey (Sherbourne & Stewart, 1991)	Continuous	Range 9 - 40
Birth Experience	1 month interview; FBS- designed 16-item scale	Continuous	Range 16-80
Infant hospitalization at Birth	1 month interview; hospital admissions since the original admission for birth	Dichotomous	No Yes

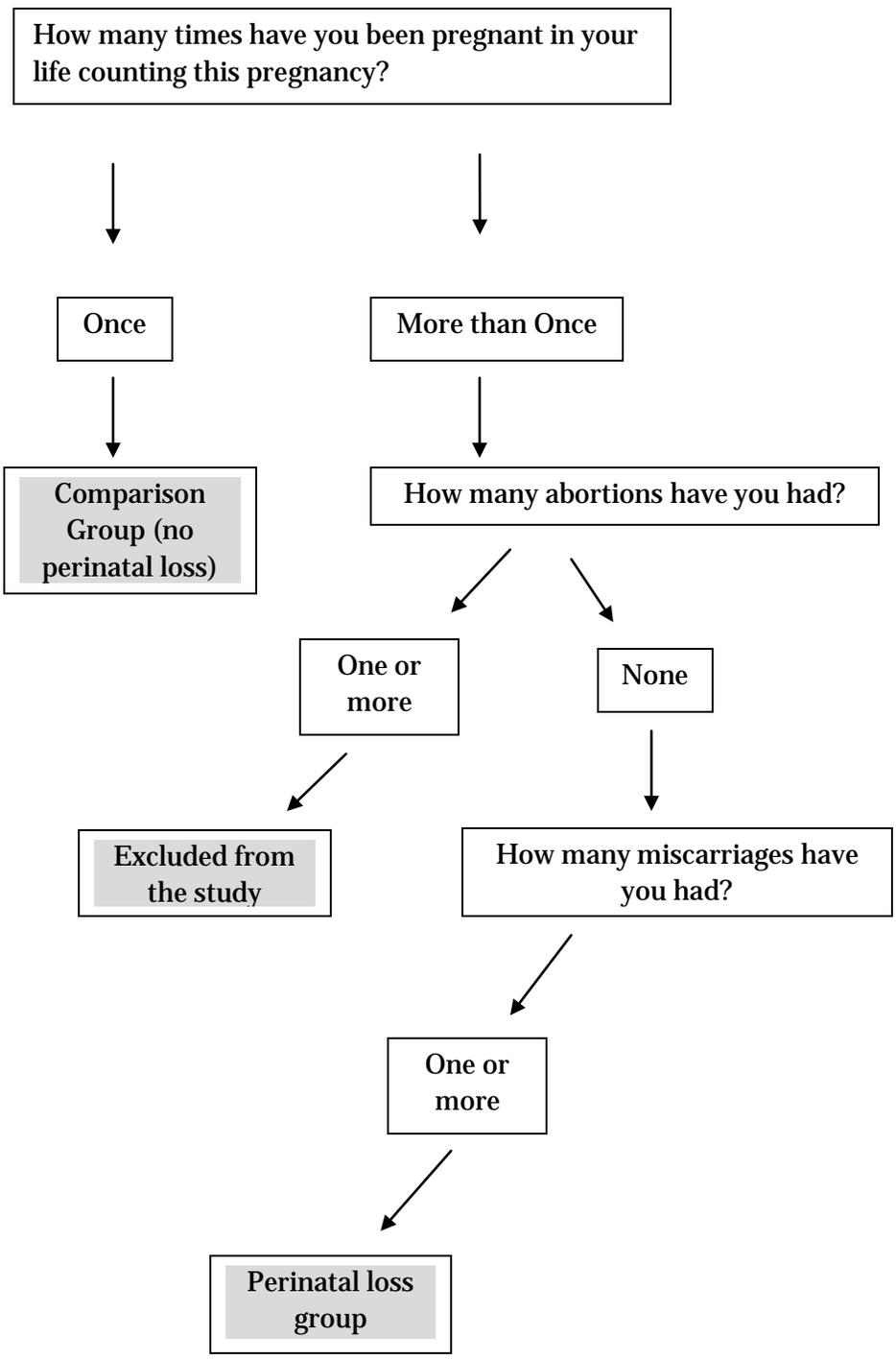
Table 3-3. Select Properties of Instruments Utilized in the Proposed Study

Variable	Instrument	Scale properties	Sample for instrument analysis	Score Range	Cronbach's alpha
Maternal Depression	Edinburgh Postnatal Depression Scale (Cox et al., 1987)	10-item scale 4 item-specific responses per item	Sample for proposed study at 1-month postpartum N=2854 women	0 - 30	0.814
Maternal-infant bonding	Shortened-Postpartum Bonding Questionnaire (Bicking Kinsey et al., In press)	10-item scale 5 point Likert responses	1 month interview n=3006	10-50	0.67
Psychosocial Stress	Modified Psychosocial Hassles Scale (Misra et al., 2001)	12 items 4-point Likert responses	1 month interview; sample for proposed study; n=2853	12 - 48	0.731
Social Support	Modified MOS Social Support Survey (Sherbourne & Stewart, 1991)	9 item scale 5-point Likert responses	1 month interview, sample for proposed study; n=2843	9 - 45	0.878
Birth Experience	FBS-designed instrument (Bicking Kinsey, Baptiste-Roberts, Zhu, & Kjerulff, 2013)	16-item scale 5-item Likert response	1 month interview N=3001	16-80	0.739

Table 3-4. Planned Statistical Analysis for Each Study Aim

Analysis level	Outcome Variables	Type of Data	Analysis Strategy
Aim 1: To determine the longitudinal relationship between a history of perinatal loss and depression during pregnancy and throughout the first year postpartum in a sample of women giving birth for the first time.			
Bivariate analysis (completed for depression score at each time point: baseline, 1, 6 and 12 mo PP)	Depression	Dichotomous	Pearson Chi-square
	Depression	Continuous	2-sample Student's t-test
Multivariate analysis (completed for depression score at each time point: baseline, 1, 6 and 12 mo PP)	Depression Covariates	Dichotomous	Multiple logistic regression models
	Depression Covariates	Continuous	Multiple linear regression models
Longitudinal analysis	Depression at 4 time points Covariates	Dichotomous	Generalized estimating equations with repeated measures
	Depression at 4 time points Covariates	Continuous	Linear mixed model with repeated measures
Aim 2: To evaluate the effect of a history of perinatal loss on maternal-infant bonding throughout the first year postpartum in a sample of first-time mothers.			
Bivariate analysis (completed for maternal-infant bonding score at each time point: 1, 6 and 12 mo PP)	Maternal-infant Bonding	Continuous	2-sample Student's t-test
Multivariate analysis (completed for maternal-infant bonding score at each time point: 1, 6 and 12 mo PP)	Maternal-infant Bonding Covariates	Continuous	Multiple linear regression
Longitudinal analysis	Maternal-infant Bonding at 3 time points Covariates	Continuous	Linear mixed model with repeated measures
Subaim 2.1 To evaluate the relationship between depression and maternal-infant bonding throughout the first year postpartum and to determine whether depression mediates the relationship between a history of perinatal loss and maternal-infant bonding.			
Bivariate analysis (completed for maternal-infant bonding score at each time point: 1, 6 and 12 mo PP)	Depression (IV) Maternal-infant bonding	Dichotomous Continuous	2-sample t-test
	Depression Maternal-infant bonding	Continuous Continuous	Pearson correlation
Multivariate analysis (completed for maternal-infant bonding score at each time point: 1, 6 and 12 mo PP)	Maternal-infant bonding	Continuous	Multivariate linear regression
	Depression Covariates	Dichotomous Continuous	
Longitudinal analysis	Maternal-infant bonding at 3 time points Depression Covariates	Continuous Dichotomous Continuous	General linear model with repeated measures

Figure 3-1. Description of Group Assignment for the Independent Variable: History of Perinatal Loss



Chapter 4: Effect of Previous Perinatal Loss on Depressive Symptoms during Subsequent Pregnancy and Postpartum in the First Baby Study

The following pages contain a completed manuscript submitted to *Maternal and Child Health Journal* on September 14, 2013 and then revised and resubmitted on February 5, 2014. The manuscript contains the results of the dissertation study for aim 1 as detailed in previous chapters. However, the analysis submitted for publication includes only the abbreviated results of the dichotomous measure of probable depression. The full results of the analysis of probable depression for each model, and the results for depression measured continuously are included in the dissertation in Appendix C.

Effect of Previous Perinatal Loss on Depressive Symptoms during Subsequent Pregnancy and Postpartum in the First Baby Study

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Abstract

Objectives. Our objective was to test the hypothesis that nulliparous women with a history of perinatal loss (prior miscarriage) have an increased risk of depression during late pregnancy, and at 1, 6, and 12 months postpartum compared to women without a history of perinatal loss. **Methods.** We conducted secondary analysis of a longitudinal cohort study, the First Baby Study, and compared 448 pregnant women with a history of perinatal loss to 2343 pregnant women without a history of perinatal loss on risk of probable depression (score >12 on the Edinburgh Postnatal Depression Scale). Logistic regression models were used to estimate odds ratios at each time point and generalized estimating equations were used to obtain estimates in longitudinal analysis. **Results.** Women with a history of perinatal loss were not more likely than woman without a history of perinatal loss to score in the probable depression range during the third trimester or at 6 or 12 months postpartum but were more likely at 1 month postpartum, after adjustment for sociodemographic factors (OR 1.66, 95% CI 1.03 – 2.69). **Conclusions.** Women with a history of perinatal loss may be more vulnerable to depression during the first month postpartum than women without prior loss, but this effect does not appear to persist beyond this time period. We support the promotion of awareness surrounding this issue and recommend that research is planned to identify risk factors that may position a woman with a history of perinatal loss to be at higher risk for depression.

Keywords

Perinatal loss; Perinatal depression; Pregnancy; Postpartum depression

Introduction

In the United States, perinatal loss occurs in 12-20% of confirmed pregnancies (1). The immediate reaction to perinatal loss for women and their partners is commonly one of grief comparable in intensity to the grief following other types of loss via death (2). After experiencing a perinatal loss, over 85% of women will become pregnant again within 18 months (3). Depressive symptoms can continue to manifest for women with a history of perinatal loss even during a subsequent pregnancy (4, 5). For example, several researchers found that women who are pregnant following a perinatal loss have increased levels of depressive symptoms compared to women who have not experienced such loss (4-12). Women with a history of perinatal loss may perceive a subsequent pregnancy as a threat (13), stress is increased (7), and they describe alterations in their concept of self (14). In contrast, others found no difference in the levels of depression for these two groups of women (15-22).

Although the relationship between a history of perinatal loss and depressive symptoms in subsequent pregnancy has some supportive evidence, it is even more unclear whether depressive symptoms may ameliorate after the birth of a healthy infant. In a sample of women with a history of perinatal loss, Armstrong and colleagues (23) found that clinical levels of depressive symptoms were present during the 3rd trimester of pregnancy; however, more normal levels were typical after the birth of a healthy infant (at 3 and 8 months postpartum), and symptoms of depression decreased over time. Hughes and colleagues (11) found that depression rates in women with a history of perinatal loss were comparable to controls at 12 months postpartum. However, Blackmore and colleagues (8) reported that depressive symptoms were significantly related to perinatal loss during pregnancy and up to 33 months postpartum.

Not only is perinatal depression a concern for the health of the woman affected, it can also have a substantial negative impact on the health of her fetus or newborn. For example, depression during pregnancy may put a woman at greater risk for preterm birth and a low birth weight or small for

gestational age baby (24, 25). In the postpartum period, mothers with depression report a wide range of negative emotions and may be fearful or overly intrusive in their interactions with their infant (26, 27). These suboptimal interactions may also have long term consequences for the children, including deficits in cognitive-linguistic functioning and an increase in negative affect or behavior (28, 29). Reduction of depression in the perinatal time period is of utmost importance to assuring the health of childbearing women and their children.

Although the available literature points to a decrease in depressive symptoms over time for pregnant and postpartum women with a history of perinatal loss, no conclusion can be made regarding whether these women are at higher risk for depression after the birth of a healthy infant. The objective of our study was to determine the longitudinal relationship between a history of perinatal loss and probable depression during pregnancy and throughout the first year postpartum in a sample of women giving birth for the first time. Our hypothesis was that women with a history of perinatal loss have an increased risk of depression during late pregnancy, and at 1 month, 6 months, and 12 months postpartum compared to women without a history of perinatal loss. An exploratory secondary objective of our study was to examine the potential moderating effects of social support and maternal stress on the relationship between perinatal loss and probable depression.

Methods

Study Design and Population

This study utilized secondary analysis of a longitudinal cohort study, the First Baby Study (FBS). The FBS enrolled 3006 pregnant women planning to deliver their first live-born baby in the state of Pennsylvania, USA from January 2009-April 2011. Exclusion criteria were not speaking English or Spanish, more than one fetus, a previous stillbirth that occurred at more than 20 weeks gestation, a previous cesarean delivery regardless of length of gestation, a gestational or surrogate carrier, planned to give the baby up for adoption, planned to have a tubal ligation while hospitalized for delivery, did not

have a telephone or were not able to commit to participation in the study for a period of 3 years. These exclusion criteria were related to the primary aim of the FBS, to examine mode of first childbirth and relationship to subsequent pregnancy and delivery. The study was approved by the Institutional Review Board at the Penn State Hershey Medical Center and at participating study hospitals and written informed consent was obtained from each participant. A detailed description of the sampling design and recruitment is described elsewhere (30).

This study utilized data collected during four telephone interviews with participants during the third trimester of pregnancy (at least 30 weeks gestation- baseline interview), and at 1, 6, and 12 months postpartum. At 12 months postpartum, 6.6% of the participants were lost to follow-up.

Measures

The independent variable, a history of perinatal loss, was measured via self-reported history of miscarriage during a prior pregnancy. Women who were enrolled in the FBS and reported a history of elective abortion were excluded from analysis, and no other types of perinatal loss were present in the sample. Women with one or more missing responses for the variables of interest at 1 month postpartum (n= 63) were also excluded. The analytic sample included 448 women with a history of one or more perinatal losses and 2343 women experiencing their first pregnancy.

Sociodemographic variables were obtained during the baseline interview. Poverty was measured using the US Census Bureau classification system to categorize participants based on household income and family composition – poverty, near poverty and not poverty. Those with household income \geq 200% above the threshold are classified as “not poverty”, those with household incomes that are 100% to 200% of the poverty threshold are “near poverty”, and those with household incomes $<$ 100% of the poverty threshold are classified as “poverty”. For 127 women, regression methods were used to impute missing income values and create a poverty status category. Analysis completed with and without the imputed values revealed no difference in the results. Thus, imputed values were retained in the analysis.

During the baseline interview, data were also collected on the following potential confounding variables: Use of fertility advice or treatment, and history of anxiety or depression. Women were said to have used fertility advice or treatment if they had planned the pregnancy and responded affirmatively to the question, “Did you and/or your partner use any type of fertility advice, testing, or treatment before you became pregnant?” Women who reported that they had a doctor or nurse tell them that they had anxiety or depression prior to this pregnancy were considered to have a history of anxiety or depression.

At the 1-month postpartum interview, potential confounding factors of mode of delivery, infant hospitalization after birth, postpartum mental health visits, and birth experience were measured. Birth experience was measured using a 16-item scale with a potential range of scores from 16-80. A higher score indicates a more positive birth experience (31).

Potential confounding factors of maternal stress and social support were measured at each time point and were utilized as time-varying covariates. Maternal stress was measured using the *Psychosocial Hassles Scale* (32), an 11-item instrument which measures perceived maternal stress due to common stressors, such as “money worries like paying bills”. Several of the items were modified to fit the study population and one item was added, “Problems with the baby”, for a total of 12 items. In this study, the Cronbach’s alpha was 0.71 at 1 month postpartum and higher scores indicated higher levels of stress. Social support was measured using 5 items from the *MOS Social Support Survey* (33) and 4 items were added specifically concerning support for a new mother (i.e. “Someone to help you take care of the baby”). The Cronbach’s alpha was 0.88 at 1 month postpartum and higher scores indicated higher levels of social support.

The outcome variable, probable depression, was measured at each time point using the Edinburgh Postnatal Depression Scale (EPDS) (34). Two of the original items were modified: “Things have been getting on top of me” was changed to “I have had trouble coping” and “The thought of harming myself has occurred to me” was changed to “The thought of harming myself or others has occurred to me”. The

Cronbach's alpha in this study was 0.82 at 1 month postpartum. A dichotomous variable was created with probable depression defined as EPDS >12, as suggested by a recent systematic review (35).

Our relatively large sample size enabled us to detect the difference in proportion of probable depression between the two groups of women as small as 3.6% with at least 80% statistical power. A difference more than 4.3% between groups could be detected with at least 90% statistical power.

Analytic Approach

Data analysis was completed using SPSS 20 and verified independently by the study statistician (JZ) using SAS 9.3. Chi-square and Student's t-tests were used to compare variables by perinatal loss status at baseline. Then, a univariate logistic regression model (model 1) was created for each of the four time points followed by multiple logistic regression models as follows: 2) the addition of factors significantly related to the independent variable: maternal age and use of fertility advice or treatment; 3) in addition to model 2 factors, sociodemographic factors marital status, race and ethnicity, education and poverty status; 4) in addition to model 3 factors, obstetric factors including mode of delivery, infant hospitalization after birth, and birth experience; and 5) in addition to model 4 factors, psychosocial factors including postpartum mental health visits, history of anxiety or depression, maternal stress, and social support. At baseline, model 4 was not completed because these variables were measured at the 1-month postpartum interview. Next, longitudinal analysis was completed using generalized estimating equations (GEE) with probable depression as a repeated outcome measure, and adjusting for maternal age and fertility treatment or advice. Finally, interaction analysis was completed for maternal stress and social support at each time point using a logistic regression model adjusted for maternal age, fertility treatment or advice, maternal stress or social support, and the appropriate interaction term.

Results

Women in our sample were a mean age of 27.3 years old (SD= 4.3) at the baseline interview. The majority of women were married (72.1%), non-Hispanic White (84.8%), not living in poverty (80.8%),

and had completed a 4-year degree or greater (57.8%). Characteristics of the study sample by perinatal loss history are shown in Table 4-1. Compared to women without a history of perinatal loss, women with a history of perinatal loss were older (27.1 vs. 28.2 years) and more likely to have received fertility advice or treatment (9.7% vs. 20.3%). The two groups of women did not differ significantly on any other variables.

During pregnancy, 5.7% of women without a history of perinatal loss and 4.9% of women with a history of perinatal loss reported symptoms of probable depression. Mean EPDS scores at baseline are shown in Table 4-1 and did not differ significantly between groups. Mean EPDS scores at 1 month postpartum were 4.3 (SD 3.9) for women without a history of perinatal loss and 4.5 (SD 4.1) for women with a history of perinatal loss, and did not differ significantly between groups. Likewise, scores did not differ significantly between groups at 6 months or 12 months postpartum and were similar in value to the 1 month postpartum scores. Analysis of the relationship between a history of perinatal loss and probable depression during pregnancy revealed no significant relationship in any of the five models (all $p > 0.05$) (Table 4-2). Likewise, at 6 months postpartum and 12 months postpartum, a history of perinatal loss was not significantly associated with risk of probable depression (all $p > 0.05$).

We found a significant relationship between a history of perinatal loss and probable depression at 1 month postpartum where women with a history of perinatal loss were 1.69 times (95% CI 1.05-2.70) more likely to report symptoms of probable depression than the comparison group of women (Table 4-2). This increased odds remained significant after adjustment for sociodemographic factors (models 2 & 3). After further adjustment for obstetric and psychosocial factors (models 4 & 5), the odds ratio was no longer significant. However, even after full adjustment, the odds ratio remained stable across all models and still indicated a 1.70 times higher odds (95% CI 0.99-2.92) of probable depression for women with a history of perinatal loss.

Longitudinal analysis of the relationship between a history of perinatal loss and probable depression revealed no significant relationship over time (Table 4-3). Notably, interview time was a significant predictor of probable depression, as all postpartum time periods were associated with reduced odds of probable depression compared to during pregnancy. Additionally, there was no evidence that the pattern of probable depression risk differed between the two groups of women over the four time periods, as the interaction between perinatal loss and interview time was not significant (data not shown). In women with a history of perinatal loss, the highest risk for depression occurred at the 1 month postpartum period (Figure 4-1).

Analysis of interaction between a history of perinatal loss and either maternal stress or perceived social support at each time period did not reveal significant interaction (data not shown). This indicates that the relationship between perinatal loss and probable depression does not differ significantly based on a woman's level of social support or stress.

Discussion

We did not observe any difference in odds of probable depression between the women with a history of perinatal loss when compared to women without a history of perinatal loss over time, however, women with a history of perinatal loss were 1.66 times more likely to have probable depression at 1 month postpartum compared to women with no history of perinatal loss.

For both groups of women, depressive symptoms followed the same pattern over time and were highest during pregnancy and remained consistently low after the birth of the infant. Our results concur with those of Blackmore and colleagues, although these authors examined perinatal loss including both miscarriage and stillbirth (8). The idea that depressive symptoms are highest during pregnancy and lower in the postpartum period was also reported in studies by Armstrong and colleagues (23) and Hughes and colleagues (11).

We found that at 1 month postpartum, women with a history of perinatal loss were 1.66 times more likely to report probable depression compared to women without a history of perinatal loss. Although this relationship did not maintain significance after adjustment for all potential confounders, we believe the result deserves comment. Results of similar studies during the early postpartum period were mixed. Blackmore and colleagues (8) found higher rates of depression in women with a history of perinatal loss compared to controls at 2 months postpartum, while Hughes and colleagues (11) found no difference between these two groups of women at 6 weeks postpartum. It is possible that the increased risk of depression we found at 1 month postpartum may not be of strong clinical significance, as the mean EPDS scores differed only by 0.2 points between groups.

In our study, we found no evidence that women with a history of perinatal loss had increased risk of depression at 6 months or 12 months postpartum compared to women without a history of perinatal loss. This is consistent with much of the published research in this population during the second half of the postpartum year. Although Carerra and colleagues (36) found a positive association between a history of stillbirth and increased depressive symptoms at 6 and 12 months postpartum, several other researchers found no difference during this same time period (11, 15, 37).

We found that women with a history of perinatal loss did not differ from women without a history of perinatal loss with respect to probable depression during pregnancy. There is much reported in the literature on depression in pregnancy subsequent to perinatal loss, however, there is no clear consensus. Nearly half of the studies that we reviewed reported that women with a history of perinatal loss have increased levels of depressive symptoms in a subsequent pregnancy compared to pregnant women without a history of perinatal loss (4, 5, 7-12) while the other half report no difference in depressive symptoms (16-22). The heterogeneity of these studies is great, as they differ on the definition of perinatal loss, the timing of measurement of depressive symptoms, the type of instrument used to measure

depression, and sample parity. However, one factor that we believe may specifically impact the validity of studies of perinatal loss is the potential problem of sample selection bias.

Armstrong and colleagues, whose publications provide much of the support for a relationship between perinatal loss and depression in subsequent pregnancy, consistently used recruitment methods that included advertisement of the study in perinatal loss support groups (online or local) (4, 7, 15). This method may introduce bias because women who seek support after a perinatal loss may be different from those women who do not. For example, it is plausible that using recruitment methods such as advertisements and flyers that state the study purpose may deter participants who are not emotionally distressed by the loss and do not wish to further explore the issue. Conversely, women who experience severe emotional distress may not be willing to participate in a research study. However, Armstrong (2004) reported that parents who attended a support group after a perinatal loss had higher depression scores than those who did not, suggesting that the former explanation may be more likely. Therefore, it is possible that studies using this potentially biased sampling method may overestimate the impact of previous perinatal loss. One method of decreasing this selection bias is to study these women through samples that are obtained without the aim of selecting women with a history of perinatal loss.

Two recent population-based studies examined depression in women with a history of perinatal loss. Blackmore and colleagues analyzed the Avon Longitudinal Study of Parents and Children, based in England, to determine whether depression was related to a history of miscarriage or stillbirth (8). These authors found that the number of perinatal losses significantly predicted depressive symptoms at both prenatal and postpartum time points. In contrast, a study using the Early Childhood Longitudinal Study, Birth Cohort based in the United States found no association between a history of one perinatal loss and depression at 9 months postpartum (37). These authors found that having two or more perinatal losses was associated with higher depression when compared to women with no history of loss; however, the difference amounted to 1 point on the depression scale (range 12-48), which may not be clinically

significant. The results of our study, along with the results of these population-based studies, suggest that a history of perinatal loss may not be directly related to negative emotional outcomes for the majority of women. Price (2008) suggests that the normative response to perinatal loss may not be an increased risk for emotional impairment; rather, other social and emotional contextual features may contribute significantly in those women who develop depression or other emotional difficulties after perinatal loss.

We examined two of these potential contextual factors by investigating the effect of the interaction between perinatal loss history and a woman's level of stress and her perceived available social support. Neither maternal stress nor perceived social support affected the relationship between a history of perinatal loss and depressive symptoms. Although to our knowledge general stress and social support have not been examined in this context previously, Armstrong and colleagues (15) found that the more stress women associated with their previous perinatal loss, the higher their depressive symptoms in a subsequent pregnancy. This suggests that perinatal loss-specific stress, rather than general stress as measured in our study, may contribute to a woman's increased risk of depression in subsequent pregnancy after perinatal loss.

To our knowledge, our study is only the second study to examine the pattern of depression over time in women with a history of perinatal loss during subsequent pregnancy and postpartum. Our results confirm that women with a history of perinatal loss experience depressive symptomatology during and after a subsequent pregnancy to a similar degree as women without a history of perinatal loss. Our study is also one of only a few studies of depression in this population utilizing a large sample size and adjusting for many potential confounders of depression.

Despite the strengths of our study design, there are also some limitations that deserve comment. First, although studies of perinatal loss vary greatly in their definition of loss, our study did not include women with other types of perinatal loss besides miscarriage including stillbirth, neonatal death, or medically-indicated abortion. It is unclear whether the type of perinatal loss has a significant impact on a

woman's emotional health during a subsequent pregnancy, but Armstrong and colleagues (2002) found that the gestational age of a previous perinatal loss was not associated with depressive symptoms during subsequent pregnancy. Also, our version of the EPDS has been slightly modified from the original, and although modifications were minor, validity testing has not been completed on this new version.

Given that women excluded from our sample due to missing data were younger, less likely to be married, non-Hispanic White, educated, or to have a history of perinatal loss, and more likely to be living in poverty or depressed, our results may have some selection bias. Additionally, there was selection bias due to differential loss to follow up such that mothers included at 12 months postpartum were older, more likely to be educated, married, non-Hispanic White, and less likely to live in poverty. However, those who were lost to follow-up did not differ from those included on perinatal loss history or probable depression and comprised a very small portion of our sample. Also, our study participants were older, more likely to be non-Hispanic White, had higher levels of education and higher household income than the overall population of Pennsylvania (30). Our study population also had a relatively low rate of postpartum depression (6%) compared to other studies (38-40). These differences are indicative of a selection bias that is common in longitudinal research studies where participation is voluntary. As such, although our sample size was large and relatively diverse, the results of the study may not be generalizable to the entire population.

We conclude that although a history of perinatal loss may have implications for mental health in subsequent pregnancy and postpartum, it is unlikely that these effects are universal. Each woman who experiences a perinatal loss may react to a subsequent pregnancy differently. As depression in the perinatal period may be associated with adverse pregnancy outcomes (24, 25, 41), impairments in maternal-infant bonding (41-46), and developmental impairments in the child (47-53), it is important for researchers to further examine the relationship between a history of perinatal loss and depression. Future research should aim to identify risk factors that may position a woman with a history of perinatal loss to

be at higher risk for depression during a subsequent perinatal period. It will also be important for researchers to be mindful of recruitment methods to reduce selection bias. Population-based samples may be ideal.

Based on what is now known about the effect of a history of perinatal loss on depression in a subsequent pregnancy, we recommend that providers for pregnant women remain aware of a woman's history of previous losses at any gestation. Albeit limited, research has shown that the value a woman places on a pregnancy that is lost, more so than the gestation of the pregnancy, is the most important indicator of her emotional response (4, 14, 22). It is important for providers to openly discuss previous perinatal losses with women who are pregnant, so that they can receive appropriate intervention if they appear to struggle with the experience of subsequent pregnancy. Interventions may include mental health consultation for depressive symptoms and/or bereavement support through local or online support groups. Intervention may be especially valuable in the early postpartum period. Finally, although the research on the effect of a history of perinatal loss on depression in subsequent pregnancy is not definitive, it is clearly evident that many women struggle with the experience, and increasing awareness in the public health and medical communities is an essential primary step in the improvement of health for affected women.

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Table 4-1. Baseline Demographic and Obstetric Characteristics of Study Participants

	Total N=2791	No History of Perinatal Loss N=2343	History of Perinatal Loss N=448	P-value
Maternal Age	27.3 ±4.3	27.1 ±4.3	28.2 ±4.3	p<0.001***
Marital Status				p=0.063
Married	2011 (72.1)	1672 (71.4)	339 (75.7)	
Not Married	780 (27.9)	671 (28.6)	109 (24.3)	
Fertility Advice or Treatment				p<0.001***
No	2473 (88.6)	2116 (90.3)	357 (79.7)	
Yes	318 (11.4)	227 (9.7)	91 (20.3)	
Race/Ethnicity				p=0.477
Non-Hispanic White	2366 (84.8)	1982 (84.6)	384 (85.7)	
Non-Hispanic Black	180 (6.4)	148 (6.3)	32 (7.1)	
Hispanic	144 (5.2)	127 (5.4)	17 (3.8)	
Other	101 (3.6)	86 (3.7)	15 (3.3)	
Education				p=0.814
High school graduate or GED or less	452 (16.2)	376 (16.0)	76 (17.0)	
Some college or vocational programs	726 (26.0)	614 (26.2)	112 (25.0)	
Completed 4 year college degree or greater	1613 (57.8)	1353 (57.7)	260 (58.0)	
Poverty				p=0.905
Poverty	227 (8.1)	190 (8.1)	37 (8.3)	
Near Poverty	308 (11.0)	256 (10.9)	52 (11.6)	
Non-poverty	2256 (80.8)	1897 (81.0)	359 (80.1)	
Mode of delivery†				p=0.130

Vaginal delivery	1977 (70.8)	1673 (71.4)	304 (67.9)	
Cesarean delivery	814 (29.2)	670 (28.6)	144 (32.1)	
Infant Hospitalization after Birth†				p=0.089
No	2723 (97.6)	2291 (97.8)	432 (96.4)	
Yes	68 (2.4)	52 (2.2)	16 (3.6)	
Postpartum Mental Health Visits†				p=0.292
No	2662 (95.4)	2239 (95.6)	423 (94.4)	
Yes	129 (4.6)	104 (4.4)	25 (5.6)	
History of Anxiety or Depression				p=0.161
No	2152 (77.1)	1818 (77.6)	334 (74.6)	
Yes	639 (22.9)	525 (22.4)	114 (25.4)	
Edinburgh Postnatal Depression Scale				p=0.495
No probable depression	2635 (94.4)	2209 (94.3)	426 (95.1)	
Probable depression	156 (5.6)	134 (5.7)	22 (4.9)	
EPDS Continuous Score (Range 0-27)	5.8 ±3.7	5.8 ±3.9	5.8 ±3.7	p=0.987
Birth Experience†	68.7 ±6.4	68.7 ±6.4	68.5 ±6.4	p=0.512
Maternal Stress	18.6 ±4.4	18.6 ±4.4	18.5 ±4.4	p=0.750
Social Support	22.3 ±2.9	22.3 ±2.9	22.3 ±2.9	p=0.920

All results reported as n (%) or mean ± SD.

* p<0.05, ** p<0.01, *** p<0.001

† Measured at 1 month postpartum

Table 4-2. Relationship between Perinatal Loss and Probable Depression from logistic regression models at baseline, 6 month postpartum, and 12 months postpartum

	Model 1	Model 2	Model 3	Model 4	Model 5
Baseline:					
History of no losses	Ref	Ref	Ref	-	Ref
History of 1 or more losses	0.85 (0.54-1.35)	0.99 (0.62-1.58)	0.89 (0.55-1.44)		0.84 (0.50-1.42)
1 month Postpartum:					
History of no losses	Ref	Ref	Ref	Ref	Ref
History of 1 or more losses	1.69 (1.05-2.70)	1.70 (1.05-2.75)	1.66 (1.03-2.69)	1.63 (0.99-2.69)	1.70 (0.99-2.92)
6 Months Postpartum:					
History of no losses	Ref	Ref	Ref	Ref	Ref
History of 1 or more losses	1.02 (0.59-1.77)	1.18 (0.68-2.05)	1.08 (0.61-1.88)	1.06 (0.60-1.88)	0.90 (0.46-1.78)
12 Months Postpartum:					
History of no losses	Ref	Ref	Ref	Ref	Ref
History of 1 or more losses	1.17 (0.69-2.01)	1.40 (0.81-2.41)	1.25 (0.72-2.17)	1.25 (0.71-2.19)	1.35 (0.72-2.53)

All results reported as OR (95% CI)

Model 1 is unadjusted

Model 2 adjusted for maternal age and use of fertility advice or treatment

Model 3 adjusted for variables in model 2 plus marital status, race/ethnicity, education, and poverty status

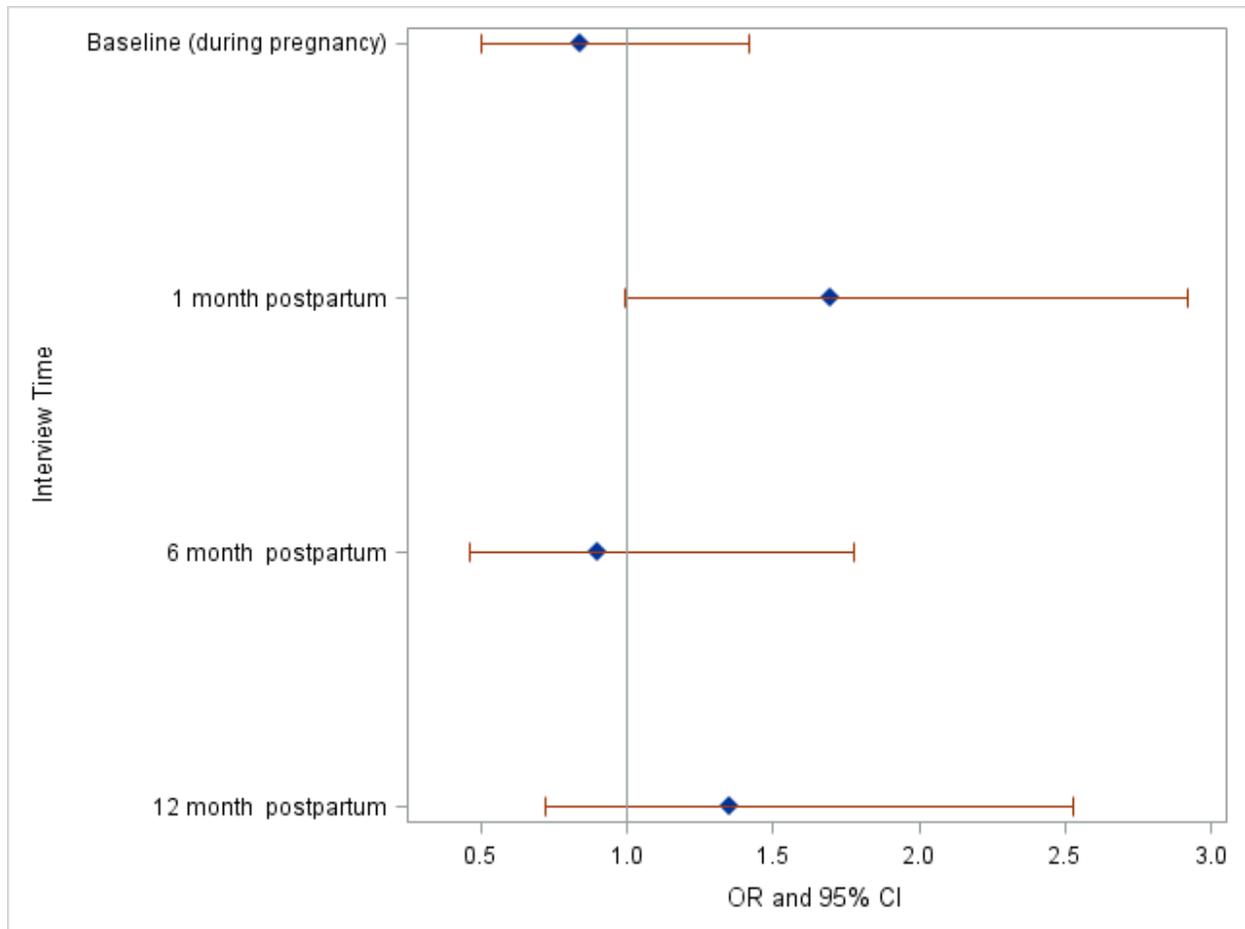
Model 4 adjusted for variables in model 3 plus mode of delivery, infant hospitalization after birth, and birth experience

Model 5 adjusted for variables in model 4 plus postpartum mental health visits, history of anxiety or depression, maternal stress, and social support

Table 4-3. Longitudinal Relationship between Previous Perinatal Loss and Probable Depression from Generalized Estimating Equations

	OR (95% CI)
Perinatal Loss	
History of no losses	Ref
History of 1 or more losses	1.27 (0.93-1.75)
Time	
Pregnancy	Ref
1 month	0.63 (0.49-0.79)
6 months	0.64 (0.51-0.80)
12 months	0.64 (0.50-0.81)
Age	0.90 (0.87-0.93)
Fertility Advice or Treatment	
No	Ref
Yes	0.90 (0.59-1.36)

Figure 4-1. Odds ratio and 95% confidence interval of risk of probable depression at each time point for women with a history of perinatal loss obtained using logistic regression model 5.



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Chapter 5: Effect of Previous Perinatal Loss on Maternal-Infant Bonding during the First Year Postpartum in the First Baby Study: A Longitudinal Cohort Study

The following pages contain a completed manuscript submitted to *BMC Women's Health* on February 3, 2014. The manuscript contains the results of the dissertation study for aim 2 as detailed in previous chapters. The analysis of subaim 2.1 was not explicitly completed because the results of aim 2 were not statistically significant, negating the need to investigate subaim 2.1.

Effect of previous perinatal loss on maternal-infant bonding during the first year postpartum in the First Baby Study: A longitudinal cohort study

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Abstract

Background: Perinatal loss, the unexpected loss of pregnancy, may have a negative effect on a mother's perception of herself as a capable woman and on her emotional health when she is pregnant again subsequent to the perinatal loss. As such, a mother with a history of perinatal loss may be at greater risk for difficulties navigating the process of becoming a mother and achieving positive maternal-infant bonding with an infant born subsequent to perinatal loss. The aim of this study was to examine the effect of perinatal loss history on maternal-infant bonding after the birth of a healthy infant to test the hypothesis that women with a history of perinatal loss have decreased maternal-infant bonding compared to women without a history of perinatal loss.

Methods: We completed secondary analysis of the First Baby Study, a longitudinal cohort study, to examine the effect of a history of perinatal loss on maternal-infant bonding at 1 month, 6 months, and 12 months after women experienced the birth of their first live-born baby. In a sample of 2798 women living in Pennsylvania, USA, we tested our hypothesis using linear regression analysis of Shortened Postpartum Bonding Questionnaire (S-PBQ) scores, followed by longitudinal analysis using a generalized estimating equations model with repeated measures.

Results: We found that women with a history of perinatal loss had similar S-PBQ scores as women without a history of perinatal loss at each of the three postpartum time points. Likewise, longitudinal analysis revealed no difference in the pattern of maternal-infant bonding scores between women with and without a history of perinatal loss.

Conclusions: Women in the First Baby Study with a history of perinatal loss did not differ from women without a history of perinatal loss in their reported level of bonding with their subsequently born infants. It is important for clinicians to recognize that even though some women may experience impaired bonding related to a history of perinatal loss, the majority of women form a healthy bond with their infant despite a history of perinatal loss.

Keywords

Maternal-infant bonding; Perinatal loss; Miscarriage; Parenting; Postpartum Bonding Questionnaire

Background

The developmental process of becoming a mother is one of the most challenging experiences in a woman's life [1] and although most women navigate the process successfully, a small percentage may develop impaired relationships with their infants. Maternal-infant bonding is one aspect of the developmental process that successfully achieved leads to a strong, healthy relationship between mother and infant. These healthy relationships promote infant growth and development as well as help to form a positive self-concept for the child later in life [2-4]. The concept of maternal-infant bonding is described in the literature as "an affective state of the mother; maternal feelings and emotions toward the infant are the primary indicator of maternal-infant bonding" [5]. Although impairments in maternal-infant bonding can lead to developmental disruptions for the child, and occasionally abuse and neglect, it remains unclear which sociodemographic, psychosocial, or other factors may place a woman at risk for impairments in maternal-infant bonding.

The developmental process of becoming a mother, and the many potential obstacles to this process, were described in detail in Ramona Mercer's theory of Becoming a Mother (BAM) [6, 7]. The theory generally describes the process of becoming a mother in four stages 1) commitment, attachment and preparation for the maternal role during pregnancy 2) acquaintance with and attachment to the infant, learning to care for the infant, and physical healing 3) moving toward a new normal, and 4) achievement of the maternal identity [8]. The theory provides some guidance for how impairments in the maternal-infant bond may develop, based on one key tenet of the theory: that a disruption in one stage of the process of becoming a mother will have a continued adverse effect on achievement of subsequent stages.

Perinatal loss, defined here as an unexpected loss of pregnancy, can be considered a disruption in the first stage of becoming a mother. The disruption causes a negative effect on the mother's perception of herself as a capable woman [9] and of her ability to successfully navigate the process when pregnant again subsequent to the perinatal loss. Some evidence exists to support the idea that this disruption during pregnancy may affect all stages in the process of becoming a mother [9-11]. A mother with a previous

history of perinatal loss may therefore be at greater risk for difficulties navigating the process of becoming a mother and subsequently achieving positive maternal-infant bonding with an infant born subsequent to perinatal loss.

Although we found no research studies that specifically examined the relationship between a history of perinatal loss and maternal-infant bonding, two research groups [12, 13] found that women with a history of perinatal loss reported lower attachment to their fetus during pregnancy than women without a history of perinatal loss. However, another study did not find a relationship between a history of perinatal loss and prenatal attachment [14]. Since prenatal attachment has been significantly correlated with postpartum bonding [15], it is reasonable to expect that women with a history of perinatal loss may have an increased risk of impaired maternal-infant bonding. Evidence also exists that women with a history of perinatal loss are more concerned with the health of their child [16, 17] and report more problems with their child both in early infancy [18] and at school age [19]. However, Price [20] found no difference in the way mothers with a history of perinatal loss interacted with or perceived the behavior of their infants born subsequent to perinatal loss.

In a study of mothers of children born subsequent to stillbirth, Turton and colleagues [19] found that although mothers with a history of stillbirth reported that their children had more difficulties and peer problems than was reported by a control group of mothers, teacher ratings did not show any difference. This suggests that a relationship issue between the child and the mother may exist even when the child is otherwise perceived by others as functioning normally. Furthermore, studies by Hughes and colleagues [21] and Heller and Zeanah [22] showed that difficulties in the relationship between the mother and a 12 month old child born subsequent to perinatal loss could be explained by the mother's mental representation of her prior perinatal loss. In other words, maternal thoughts about previous loss may interfere with the development of the mother-infant relationship. In a qualitative study of men and women parenting a toddler born after a perinatal or infant loss, Warland and colleagues [23] reported that parents distanced themselves emotionally from their subsequent child in order to protect themselves in case this child would also die. These studies all indirectly describe a disruption in the emotional relationship

between the parent and a child born subsequent to perinatal loss. It is reasonable to hypothesize that these disruptions may begin in infancy with impairments in maternal-infant bonding.

As perinatal loss occurs in 12-20% of all confirmed pregnancies in the United States [24], and the majority of women will become pregnant again within 18 months [25], the effect of perinatal loss on subsequent pregnancy and the subsequent maternal-infant relationship is of great concern. A history of perinatal loss may affect not only women and their partners, but may also negatively affect the subsequently born healthy infant. The aim of this study is to examine the effect of perinatal loss history on maternal-infant bonding after the birth of a healthy infant by longitudinally examining the relationship at 1 month, 6 months, and 12 months postpartum in a sample of women who have given birth to their first baby. Our hypothesis is that women with a history of perinatal loss have decreased maternal-infant bonding at each time point compared to women without a history of perinatal loss.

Methods

Study Design and Population

We completed secondary analysis of a multi-site longitudinal cohort study, the First Baby Study (FBS). Between January 2009 and April 2011, the FBS enrolled 3006 pregnant women planning to deliver their first live-born baby in the state of Pennsylvania. Women were excluded from the study if they did not speak English or Spanish, were carrying more than one fetus, had a previous stillbirth that occurred at more than 20 weeks gestation, had a previous cesarean delivery regardless of length of gestation, were a gestational or surrogate carrier, planned to give the baby up for adoption, planned to have a tubal ligation while hospitalized for delivery, did not have a telephone or were not able to commit to participation in the study for a period of 3 years. The study was approved by the Institutional Review Board at the Penn State Hershey Medical Center and at participating study hospitals and written informed consent was obtained from each participant. A detailed description of the sampling design and recruitment plan is published elsewhere [26].

Measures

Data were collected during telephone interviews at four time points. Sociodemographic and other background data were collected in the third trimester of pregnancy (baseline interview). Interviews were then conducted at 1 month, 6 months, and 12 months postpartum.

The independent variable, a history of perinatal loss, was measured via self-reported history of miscarriage during a prior pregnancy. Women who were enrolled in the FBS and reported a history of elective abortion were excluded from analysis, and no other types of perinatal loss were present in the sample. Women with missing data at 1 month postpartum ($n= 54$) were also excluded from the present analysis. The resulting sample included 449 women with a history of one or more perinatal losses (miscarriage) and 2349 women with no history of perinatal loss.

Sociodemographic variables (maternal age, marital status, race and ethnicity, education, and poverty status) were obtained during the baseline interview. Poverty was measured using the US Census Bureau classification system to categorize participants based on household income and family composition. Those with household incomes $\geq 200\%$ above the threshold are classified as “not poverty”, those with household incomes that are 100% to 200% of the poverty threshold are “near poverty”, and those with household incomes $< 100\%$ of the poverty threshold are classified as “poverty”. For 127 women, regression methods were used to impute missing income values and create the poverty status category. Analysis completed with and without the imputed values revealed no difference in the results. Thus, imputed values were retained in the analysis.

Potential confounding variables including a reported use of fertility advice or treatment and history of anxiety or depression were also obtained during the baseline interview. Women were said to have used fertility advice or treatment if they had planned the pregnancy and responded affirmatively to the question, “Did you and/or your partner use any type of fertility advice, testing, or treatment before you became pregnant?” Women who reported that they had a doctor or nurse tell them that they had anxiety or depression prior to this pregnancy were considered to have a history of anxiety or depression.

At the 1-month postpartum interview, potential confounding factors of mode of delivery, infant hospitalization at birth, postpartum mental health visits, probable postpartum depression, and birth experience were measured. Probable postpartum depression was measured using the Edinburgh Postnatal Depression Scale (EPDS) [27]. Cronbach's alpha for the EPDS in this study was 0.813. Participants were dichotomized as probable depression for EPDS >12 and not probable depression for EPDS scores \leq 12, according to a systematic review [28]. Birth experience was measured using a 16-item scale with a potential range of scores from 16-80. A higher score indicates a more positive birth experience [29].

Potential confounding factors of maternal stress and social support were measured at each of the four time points and utilized as time-varying covariates. Maternal stress was measured using the *Psychosocial Hassles Scale* [30], an 11-item instrument which measures perceived maternal stress (from "no stress" to "severe stress") due to common stressors, such as "money worries like paying bills". We modified several of the items to fit the study population and added one item, "Problems with the baby", for a total of 12 items. In this study, Cronbach's alpha was 0.723 at 1 month postpartum and higher scores indicated higher levels of maternal stress. Social support was measured using 5 items from the *Medical Outcomes Study Social Support Survey* [31] and we added 4 items specifically concerning support for a new mother (i.e. "Someone to teach you what you need to know about taking care of a new baby" and "Someone to help you take care of the baby"). Cronbach's alpha was 0.875 at 1 month postpartum and higher scores indicated higher levels of social support.

The outcome variable, maternal-infant bonding, was measured using a ten-item shortened version of the Postpartum Bonding Questionnaire [32, 33]. The instrument measures bonding on a continuous scale with scores ranging from 10-50. Cronbach's alpha in this study was 0.672 at 1 month postpartum. Further details about the scale development and psychometric properties can be found elsewhere [34].

Analytic Approach

Data analysis was completed using SPSS 20 and verified independently by the study statistician using SAS 9.3. First, Student's t-tests were used to compare variables by perinatal loss status. Second,

univariate logistic regression models were built for each time point to examine the bivariate relationship between perinatal loss and maternal-infant bonding. Then, multivariate linear regression models were built at each time point with adjustment for maternal age, use of fertility advice or treatment, marital status, race/ethnicity, education, poverty status, mode of delivery, infant hospitalization at birth, birth experience, postpartum mental health visits, history of depression, probable postpartum depression, maternal stress, and social support. The data was examined for potential violations of the assumptions of linear regression, and none were found except that S-PBQ scores were not normally distributed due to a negative skew. Normality was achieved using a reflected square root transformation of the data. However, the results of analysis using transformed data did not differ from the original analysis and therefore results using the original S-PBQ scores are presented for ease of interpretation. Finally, longitudinal analysis was completed using a generalized estimating equation model with maternal-infant bonding as a repeated outcome measure, adjusting for potential confounders maternal age, probable postpartum depression, and fertility treatment or advice.

Results

Our participants were mostly married (72%), non-Hispanic White (85%), did not live in poverty (92%), and had completed a 4 year college degree or greater (58%). They had a mean age of 27.6 years. The characteristics of women in our sample by perinatal loss history are shown in Table 5-1. Women with a history of perinatal loss were on average 1 year older than those without a history of perinatal loss (28.1 vs. 27.1 years, respectively, $p < 0.001$) and were more likely to have sought fertility treatment or advice prior to or during their pregnancy (20.3% of women with a history of perinatal loss vs. 9.7% of women without a history of perinatal loss, $p < 0.001$). Women with a history of perinatal loss were also more likely to report symptoms of probable postpartum depression than women without a history of perinatal loss (5.3% vs. 3.4%, respectively, $p = 0.041$). Women did not differ by perinatal loss history on any other characteristics.

In univariate linear regression analysis, we found that perinatal loss history was not significantly associated with maternal-infant bonding scores at each of the three postpartum time points (all $p>0.05$) (Table 5-2). Likewise, when multiple linear regression analysis was completed, adjusting for variables that are theoretically related to perinatal loss history and/or maternal-infant bonding, there was no statistically significant relationship between perinatal loss history and maternal-infant bonding scores (all $p>0.05$).

Longitudinal analysis revealed no statistically significant difference in the pattern of maternal-infant bonding scores over time between women with a history of perinatal loss and those without. This is indicated by p-values greater than 0.05 for all perinatal loss by time interaction terms (Table 5-3). In this analysis, a statistically significant relationship was revealed between interview time and maternal-infant bonding scores, as the lowest bonding scores occurred at 1 month postpartum and the highest scores at 6 months postpartum (Figure 5-1). This pattern of change over time in bonding scores did not differ by perinatal loss history.

Discussion

Our results indicate that women with a history of perinatal loss report levels of maternal-infant bonding with their subsequently-born infants comparable to women without a history of perinatal loss. In terms of Mercer's theory of Becoming a Mother, our findings may indicate that when a perinatal loss occurs, providing disruption in the first stage of the process of becoming a mother, most women are able to cope in such a way that they achieve all four stages in a healthy manner during a subsequent pregnancy. Our study indicates that women with a history of perinatal loss are resilient and able to form a healthy bond with their subsequent infant.

Although previous studies have not specifically measured maternal-infant bonding in the context of a history of perinatal loss, several have examined maternal reports of perceptions towards their subsequently-born children or maternal parenting behaviors. In one study, mothers of 16 month old children born subsequent to perinatal loss reported that they were more concerned about the child's

health, and more concerned with the psychological separation between mother and child as the child developed [17]. However, in another study, Price [20] reported that mothers with a history of perinatal loss did not perceive their 9 month old child as more difficult to raise than other children.

Hunfeld et al. [18] reported that mothers with a history of perinatal loss in their study were more likely to indicate that their healthy baby experienced problems with eating, sleeping, crying and acquiring a regular pattern of behavior compared to ideal babies at 4 weeks old. These researchers suggest that maternal perception of problems with the infant born subsequent to loss may be related to the comparison of the lost baby with the new baby. Since the lost baby was only an idealized child that didn't cry or inconvenience the parent, the new baby may never be able to compare to the lost ideal baby. Although the results of extant research on parental perceptions of the child born subsequent to perinatal loss are mixed, there is some indication that maternal perceptions of the child may differ from those of women without a history of perinatal loss. The results of our study add to the current knowledge of the relationship between mother and infant born subsequent to perinatal loss, as they indicate that a mother's emotional response to the healthy infant, though it may differ from that of a woman without a history of perinatal loss, leads to healthy maternal-infant bonding.

The question that remains for researchers in this area of study is whether or not the alteration in perceptions of the child or overprotective parenting experienced by women with a history of perinatal loss is indeed a clinical concern that will affect the health of the mother or the child. Additionally, according to Price [20], studies in this area of research are often completed using a self-selection of participants based on their willingness to discuss previous perinatal loss experiences. This can create a selection bias where only women with the strongest emotional reaction to perinatal loss are included in the research study. In fact, in the only population-based study we found comparing women with a history of perinatal loss to those without on parenting outcomes, Price [20] found no association between perinatal loss status and observable measures of mother-infant interaction, or parental involvement with the child at 9 months of age. The only statistically significant difference by maternal perinatal loss history in Price's study was that women with a history of perinatal loss reported that they sang songs and told stories to their infants

more often than women without a history of perinatal loss. Our results concur with those of Price and support her assertion that the experience of parenting after a perinatal loss is a very individual and personal experience, and difficulties with maternal-infant bonding or other parenting tasks should not be assumed to be strongly influenced by perinatal loss history.

Our study has some limitations that deserve comment. First, although the definition of perinatal loss varies greatly across research studies, our study does not include women with a history of other types of perinatal loss including stillbirth, neonatal death, or medically-indicated abortion. It is unclear whether the type of perinatal loss has a significant impact on a woman's emotional health during a subsequent pregnancy, but Armstrong and colleagues [14] found that the gestational age of a previous perinatal loss was not significantly associated with depressive symptoms during subsequent pregnancy.

Women excluded from our sample due to missing data were younger, less likely to be married, non-Hispanic White, educated, and more likely to be living in poverty or depressed. As such, our results may be influenced by selection bias. Additionally, there was some selection bias due to differential loss to follow up such that mothers included at 12 months postpartum were older, more likely to be educated, married, non-Hispanic White, have postpartum depression, and less likely to live in poverty. However, those who were lost to follow-up did not differ from those included by perinatal loss history and comprised a very small portion of our sample (6.4%). Also, our study participants were older, more likely to be non-Hispanic White, had higher levels of education and higher household income than the overall population of Pennsylvania [26]. These differences are common in longitudinal research studies where participation is voluntary, as healthy and well-educated women may be more willing to participate. As such, although our sample size was large and relatively diverse, the results of the study may not be generalizable to the all populations of women.

Conclusion

In conclusion, we found no evidence that women in the FBS with a history of perinatal loss show any difference in maternal-infant bonding with their subsequently born infant across the first year

postpartum compared to women without a history of perinatal loss. Although it is important for clinicians to recognize a history of perinatal loss as a potential risk factor for disruption in the bond between mother and child, our study results indicate that clinicians should not assume that a history of perinatal loss will definitely have a negative effect on the mother-infant relationship. Further research is necessary to determine the normative response to bonding with a healthy infant after a previous perinatal loss. Future research should focus on the risk factors that may make women more vulnerable to a negative outcome related to a history of perinatal loss. Additionally, future research studies should be designed using population-based samples if possible in order to reduce selection bias related to self-selection of women with a history of perinatal loss.

List of Abbreviations

EPDS: Edinburgh Postnatal Depression Scale; FBS: First Baby Study; S-PBQ: Shortened Postpartum Bonding Questionnaire

Competing Interests

The authors declare they have no competing interests.

Author Contributions

KHK planned the FBS study and completed data collection. CBK designed this secondary analysis, carried out literature research, and drafted the manuscript. CBK, KBR and JZ analyzed the data while KHK provided data management and oversight. All authors assisted with drafting and the critical revision of the manuscript and read and approved the final manuscript.

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Table 5-1. Demographic and Obstetric Characteristics of Study Participants

	Total N=2798	No history of perinatal loss N=2349	History of Perinatal Loss N=449	P-value
Maternal Age	27.6 ±4.3	27.1 ±4.3	28.1 ±4.3	p<0.001***
Marital Status				p=0.065
Married	2012 (71.9)	1673 (71.2)	339 (75.5)	
Not Married	786 (28.1)	676 (28.8)	110 (24.5)	
Fertility Advice or Treatment				p<0.001***
No	2480 (88.6)	2122 (90.3)	358 (79.7)	
Yes	318 (11.4)	227 (9.7)	91 (20.3)	
Race/Ethnicity				p=0.442
Non-Hispanic White	2370 (84.7)	1986 (84.5)	384 (85.5)	
Non-Hispanic Black	182 (6.5)	149 (6.3)	33 (7.3)	
Hispanic	144 (5.1)	127 (5.4)	17 (3.8)	
Other	102 (3.6)	87 (3.7)	15 (3.3)	
Education				p=0.828
High school graduate or GED or less	459 (16.4)	382 (16.3)	77 (17.1)	
Some college or vocational programs	725 (25.9)	613 (26.1)	112 (24.9)	
Completed 4 year college degree or greater	1614 (57.7)	1354 (57.6)	260 (57.9)	
Poverty				p=0.896
Poverty	230 (8.2)	192 (8.2)	38 (8.5)	
Near Poverty	309 (11.0)	257 (10.9)	52 (11.6)	
Non-poverty	2259 (80.7)	1900 (80.9)	359 (80.0)	
Mode of delivery				p=0.115
Vaginal delivery	1981 (70.8)	1677 (71.4)	304 (67.7)	
Cesarean delivery	817 (29.2)	672 (28.6)	145 (32.3)	
Infant Hospitalization at Birth				p=0.089
No	2730 (97.6)	2297 (97.8)	433 (96.4)	
Yes	68 (2.4)	52 (2.2)	16 (3.6)	
Postpartum Mental Health				p=0.225

Visits					
No	2667 (95.3)	2244 (95.5)	423 (94.2)		
Yes	131 (4.7)	105 (4.7)	26 (5.8)		
History of Depression					p=0.132
No	2158 (77.1)	1824 (77.7)	334 (74.4)		
Yes	640 (22.9)	525 (22.3)	115 (25.6)		
Probable Postpartum Depression					p=0.041*
No probable depression	2695 (96.3)	2270 (96.6)	425 (94.7)		
Probable depression	103 (3.7)	79 (3.4)	24 (5.3)		
Postpartum Bonding Score (S-PBQ)					p=0.261
	47.7 ±2.6	47.7 ±2.6	47.5 ±2.7		
Birth Experience	68.7 ±6.4	68.7 ±6.4	68.5 ±6.4		p=0.523
Maternal Stress	15.5 ±3.3	15.5 ±3.3	15.5 ±3.4		p=0.780
Social Support	38.9 ±5.7	38.9 ±5.6	38.7 ±5.7		p=0.501

All results reported as n (%) or mean ± SD.

* p<0.05, ** p<0.01, *** p<0.001

Table 5-2. Relationship between Perinatal Loss and S-PBQ Score from linear regression models at 1 month, 6 month postpartum, and 12 months postpartum

	Unadjusted Model		Model Adjusted for Multiple Factors‡	
	β (95% CI)	p-value	β (95% CI)	p-value
1 Month Postpartum:				
History of no losses	Ref		Ref	
History of 1 or more losses	-0.15 (-0.41, 0.11)	0.268	-0.10 (-0.32, 0.13)	0.409
6 Months Postpartum:				
History of no losses	Ref		Ref	
History of 1 or more losses	0.02 (-0.19, 0.23)	0.858	0.04 (-0.16, 0.23)	0.725
12 Months Postpartum:				
History of no losses	Ref		Ref	
History of 1 or more losses	-0.01 (-0.24, 0.21)	0.907	-0.05 (-0.25, 0.15)	0.593

‡Model 2 adjusted for maternal age, use of fertility advice or treatment, marital status, race/ethnicity, education, poverty status, mode of delivery, infant hospitalization at birth, birth experience, postpartum mental health visits, history of depression, probable postpartum depression, maternal stress, and social support

Table 5-3. Longitudinal Relationship between Previous Perinatal Loss and S-PBQ Score from Generalized Estimating Equations with Repeated Measures

	β (95% CI)	p-value
Perinatal Loss		
History of no losses	Ref	
History of 1 or more losses	0.01 (-0.17, 0.20)	0.886
Time		
1 month	Ref	
6 months	0.48 (0.39, 0.57)	<0.001
12 months	0.37 (0.28, 0.47)	<0.001
Age	-0.03 (-0.05, -0.01)	0.001
Fertility Advice or Treatment		
No	Ref	
Yes	0.15 (-0.05, 0.35)	0.151
Probable Postpartum Depression		
No	Ref	
Yes	-2.45 (-3.01, -1.89)	<0.001

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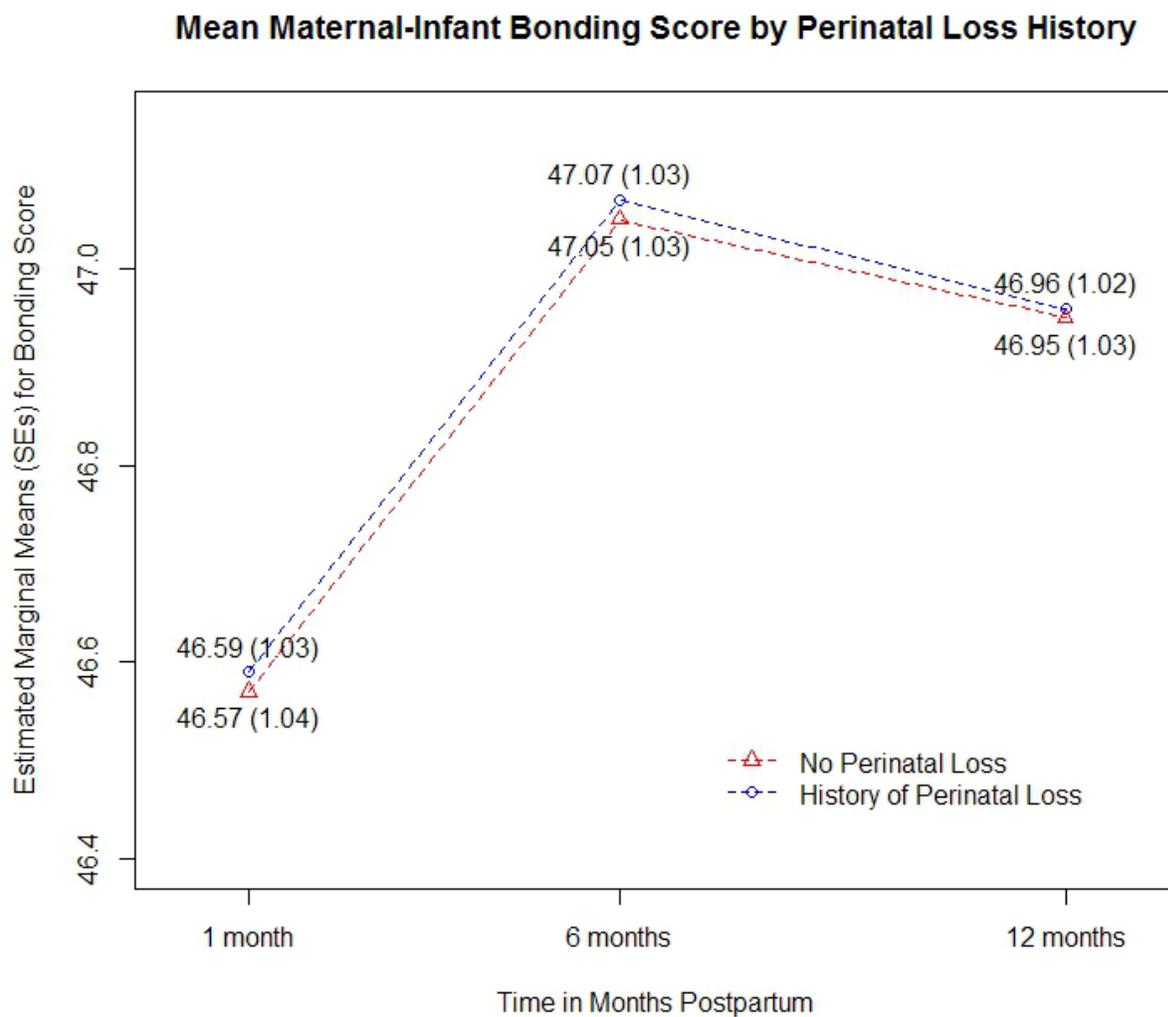
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Figure 5-1. Estimated Marginal Means of S-PBQ Score at Each Time Point using Generalized Estimating Equations



Chapter 6: Conclusion

In this final chapter, a brief discussion and reflection on the results of this research study is provided in terms of how the results relate to the original study hypotheses. This is followed by a discussion of the overall implications for nursing practice and for researchers involved in the study of women's emotional response to pregnancy loss.

Summary of Findings

The goal of this research study was to address the gaps in the current available literature on the relationship between a history of perinatal loss and the maternal emotional state during and following a subsequent pregnancy. It was hypothesized that because women with a history of perinatal loss appear to have an increased risk of depression during pregnancy subsequent to perinatal loss, according to research studies already conducted (Armstrong, 2002, 2004; Armstrong et al., 2009; Couto et al., 2009; Franche & Mikail, 1999; Yilmaz & Beji, 2013), that they would also have an increased risk of postpartum depression after the birth of a healthy infant. Likewise, it was hypothesized that because perinatal loss represents a disruption in the first stage of Becoming a Mother (as described by Ramona Mercer, 1995), women with a history of perinatal loss may have impaired maternal-infant bonding with healthy infants born subsequent to the loss.

The results of this study overall do not provide empirical support for these hypotheses. Specifically, for aim 1, it was revealed that women with a history of perinatal loss in our sample did not differ on risk of probable depression compared to women without a history of perinatal loss. The exception to this is the one-month time period, where women with a history of perinatal loss had a 1.68 greater risk of probable depression compared to women without a history of perinatal loss after adjustment for sociodemographic factors. However, this increased risk did not remain significant after adjustment for all potential confounders. For aim 2, we

found that women with a history of perinatal loss had maternal-infant bonding scores that were comparable to women without a history of perinatal loss at all time points.

Implications

There are several potential explanations and implications for the study findings which deserve comment. First, it is possible that the recruitment of women into the First Baby Study during pregnancy limited the inclusion of women who were most profoundly impacted by their previous perinatal losses. It is possible that the women with a previous perinatal loss who were depressed during pregnancy did not wish to enroll in a large research study, thus resulting in the recruitment of only healthy women to participate. Although this is a possible scenario, it is unlikely to be the cause of our negative findings because a reduced desire to participate in the First Baby Study should have impacted depressed women equally, regardless of their previous perinatal loss history. Second, as discussed at length in the previous chapters of the dissertation, our study results along with previous population-based studies may indicate that women with a history of perinatal loss are simply not universally adversely affected to the extent that they show clinical levels of depression and/or impaired maternal-infant bonding in the peripartum period of a subsequent pregnancy.

Specifically, in terms of Ramona Mercer's Theory of Becoming a Mother, which provided theoretical support for the hypothesis that women with a history of perinatal loss would show reduced maternal-infant bonding with the subsequently-born infant, the study results provide some suggestion for re-thinking the role of the theory in this population of women. When a mother experiences a perinatal loss, she experiences a disruption in the first stage of Becoming a Mother, the *commitment, attachment, and preparation stage* (Mercer, 1995). However, when she experiences a subsequent pregnancy, it is possible that this previous disruption may not directly impact the subsequent pregnancy. A subsequent pregnancy, for some women, may be a fresh start. It may represent a new chance to accomplish the tasks of pregnancy according to the

theory, such as committing to the fetus, finding satisfaction in the maternal role, and finding social acceptance of the pregnancy. If a woman successfully completes these tasks in the first stage of the process, according to the theory she will continue to successfully complete subsequent stages of the process, thus developing a healthy bond with the subsequent infant. Women participating in qualitative research studies have reported difficulties with the tasks of Mercer's first stage of Becoming a Mother even into late pregnancy (i.e. hiding the pregnancy; reporting emotional distance; not preparing for the baby's arrival) (Cote-Arsenault et al., 2001; Cote-Arsenault & Donato, 2007; Cote-Arsenault & Freije, 2004). However, there are two potential explanations for the discrepancy between qualitative research results and the results of this study. First, women with a history of perinatal loss may experience delayed achievement of the first stage of Becoming a Mother, but generally achieve the process by the time of delivery, thus allowing the process to continue uninterrupted. Alternatively, it is possible that the women sampled in these qualitative studies are not representative of the general population, but rather represent those women struggling with the process in a manner that is related to their perinatal loss history.

If women are not universally adversely impacted by previous perinatal loss during subsequent pregnancy and postpartum, then the question remains, "Who is impacted?" Although this research cannot provide a definitive answer to this question, I am able to offer some insights that may have implications for nurses and other health care practitioners caring for women with a history of perinatal loss, and for researchers interested in clarifying this question.

The results of this study seem to indicate that many of the external contextual features of women's lives that could be hypothesized to have an impact on her response to perinatal loss, may not in fact have such an impact. This study demonstrated that factors such as education, race, social support, and maternal stress, were not related to the emotional impact of a history of

perinatal loss. It is possible that more innate characteristics of individual women may be more critical to the emotional process of navigating pregnancy and postpartum after a previous perinatal loss. For example, Herrmann and colleagues (2011) reported that resilience was associated with quality of life among both men and women who were experiencing infertility; those couples who had higher resilience also had a higher quality of life. It is possible that although most women who experience perinatal loss are generally resilient and do not experience negative consequences, perhaps women with low resiliency, or some other similar innate characteristic, are at higher risk of negative emotional consequences in pregnancy subsequent to perinatal loss.

For researchers interested in further exploring the relationship between perinatal loss history and negative emotional outcomes during subsequent childbearing experiences, I suggest that resiliency and other innate characteristics of women be measured as a potential influential factor in the relationship. Other potential characteristics of interest could include trait anxiety, coping skills, self-esteem, and a mother's attachment to her own parents.

It is also possible that instead of an innate characteristic of the mother, the risk of adverse emotional impact after perinatal loss could be related to the value that a woman places on the pregnancy that was lost, as was reported in a study by Armstrong (2007). This issue may also be closely related to a couple's age and history of infertility, which are interrelated. It is possible that the more a couple struggles to conceive a child, and the less time they perceive they have to do so, the greater the value they place on a pregnancy. These women may be at greater risk for negative emotional consequences when they successfully conceive and carry a baby to term after a previous perinatal loss. Future research should examine fertility and age in the context of value placed on a pregnancy in studies of the emotional impact of a history of perinatal loss.

Finally, although the results of this study did not confirm that women with a history of perinatal loss are at greater risk for negative emotional health during and following subsequent pregnancy, there are notable implications for nurses and other health care practitioners who care for these women. First, anecdotal evidence from experience discussing this research with others has highlighted the need for greater awareness surrounding the issue of perinatal loss. Although perinatal loss occurs often, women often feel isolated in their experience, as the significance of a pregnancy loss is often dismissed, especially for losses that occur early in pregnancy. There is some evidence in qualitative studies that most women would prefer to discuss their previous perinatal loss and prefer to honor their lost child, rather than to forget about him or her. It is essential that nurses and other practitioners recognize a woman's need to have her pregnancy history acknowledged. As it is currently not known which types of women with a history of perinatal loss might be at risk for adverse outcomes during a subsequent pregnancy, it is essential that nurses and other practitioners are the ones to broach the topic of conversation with pregnant women and their families. Only when a woman feels she can openly communicate her feelings about a previous perinatal loss, will nurses and other practitioners be able to identify whether she is greatly impacted by that loss, and whether that previous perinatal loss may lead to adverse emotional effects in the subsequent pregnancy. Discussion of the issue with a woman is currently the only way to identify whether she may be in need of intervention, such as psychological counseling or bereavement support. This awareness of the potential impact of previous perinatal loss on subsequent pregnancy, coupled with the willingness of nurses and other practitioners to openly discuss an individual woman's concerns, or lack of concern, is currently the best way to reduce the negative emotional impact that a history of perinatal loss may have on the health of women, infants, and families during a time of childbearing after perinatal loss.

Appendix A: Modified Edinburgh Postnatal Depression Scale

D3 A- J. As you are pregnant, we would like to know how you are feeling. Please choose the answer that comes closest to how you have felt in the past 7 days, not just how you are feeling today.

D3A Please choose the answer that comes closest to how you have felt in the past 7 days, not just how you are feeling today.

I have been able to laugh and see the funny side of things.

- As much as I always could..... 1
- Not quite so much now.....2
- Definitely not so much now3
- Not at all.....4
- Don't know.....8
- Declined to answer9

D3B Please choose the answer that comes closest to how you have felt in the past 7 days, not just how you are feeling today.

I have looked forward with enjoyment to things.

- As much as I ever did..... 1
- Rather less than I used to.....2
- Definitely less than I used to.....3
- Hardly at all4
- Don't know.....8
- Declined to answer9

D3C Please choose the answer that comes closest to how you have felt in the past 7 days, not just how you are feeling today.

I have blamed myself unnecessarily when things went wrong.

- Yes, most of the time 1
- Yes, some of the time.....2
- Not very often3
- No, never4
- Don't know.....8
- Declined to answer9

D3D Please choose the answer that comes closest to how you have felt in the past 7 days, not just how you are feeling today.

I have been anxious or worried for no good reason.

No, not at all.....	1
Hardly ever.....	2
Yes, sometimes	3
Yes, very often.....	4
Don't know.....	8
Declined to answer	9

D3E Please choose the answer that comes closest to how you have felt in the past 7 days, not just how you are feeling today.

I have felt scared or panicky for no very good reason.

Yes, quite a lot.....	1
Yes, sometimes	2
No, not much	3
No, not at all.....	4
Don't know.....	8
Declined to answer	9

D3F Please choose the answer that comes closest to how you have felt in the past 7 days, not just how you are feeling today.

You may clarify this question by saying "are you feeling overwhelmed".

I have had trouble coping.

Yes, most of the time I haven't been able to cope at all.....	1
Yes, sometimes I haven't been coping as well as usual	2
No, most of the time I have coped quite well.....	3
No, I have been coping as well as ever.....	4
Don't know.....	8
Declined to answer	9

D3G Please choose the answer that comes closest to how you have felt in the past 7 days, not just how you are feeling today.

I have been so unhappy that I have had difficulty sleeping.

Yes, most of the time	1
Yes, sometimes	2
Not very often	3
No, not at all.....	4
Don't know.....	8
Declined to answer	9

D3H Please choose the answer that comes closest to how you have felt in the past 7 days, not just how you are feeling today.

I have felt sad or miserable.

- Yes, most of the time 1
 Yes, quite often 2
 Only occasionally 3
 No, never 4
 Don't know 8
 Declined to answer 9

D3I Please choose the answer that comes closest to how you have felt in the past 7 days, not just how you are feeling today.

I have been so unhappy that I have been crying.

- Yes, most of the time 1
 Yes, quite often 2
 Only occasionally 3
 No, never 4
 Don't know 8
 Declined to answer 9

D3J Please choose the answer that comes closest to how you have felt in the past 7 days, not just how you are feeling today.

The thought of harming myself or others has occurred to me.

- Yes, quite often 1
 Sometimes 2
 Hardly ever 3
 Never 4
 Don't know 8
 Declined to answer 9

Appendix B: Shortened 10-Item PBQ at 1 Month Postpartum

Please indicate whether the following are true for you, using the answers: all of the time, most of the time, some of the time, a little of the time, and none of the time. There are no right or wrong answers, just choose the answer which seems right for you, based on your recent experience.

		All of the time	Most of the time	Some of the time	A little of the time	None of the time
1	I feel close to my baby	1	2	3	4	5
2	I wish the old days when I had no baby would come back	1	2	3	4	5
3	I feel distant from my baby	1	2	3	4	5
4	I love to cuddle my baby	1	2	3	4	5
5	I wish that I had never had this baby	1	2	3	4	5
6	I feel happy when my baby looks at me	1	2	3	4	5
7	My baby cries too much	1	2	3	4	5
8	I love my baby with all my heart	1	2	3	4	5
9	My baby annoys me	1	2	3	4	5
10	I feel confident when changing my baby's diapers	1	2	3	4	5

Appendix C: Complete Results of the Analysis of Aim 1

Table C-1. Baseline Relationship between Perinatal Loss and Probable Depression from Logistic Regression Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Perinatal Loss					
History of no losses	Ref	Ref	Ref		Ref
History of 1 or more losses	0.85 (0.54-1.35)	0.90 (0.62-1.58)	0.89 (0.55-1.44)		0.84 (0.50-1.42)
Maternal Age					
		0.89 (0.84-0.90)	0.97 (0.92-1.02)		0.96 (0.91-1.02)
Fertility Advice or Treatment					
No		Ref	Ref		Ref
Yes		0.88 (0.45-1.74)	1.05 (0.53-2.08)		1.10 (0.53-2.27)
Marital Status					
Married			Ref		Ref
Not Married			2.65 (1.65-4.25)		1.80 (1.10-2.94)
Race/Ethnicity					
Non-Hispanic White			Ref		Ref
Non-Hispanic Black			1.38 (0.82-2.30)		1.31 (0.72-2.38)
Hispanic			0.97 (0.51-1.85)		1.04 (0.50-2.16)
Other			1.39 (0.65-3.01)		1.72 (0.74-4.00)
Education					
High school graduate or GED or less			1.18 (0.65-2.12)		1.04 (0.55-1.96)
Some college or vocational programs			1.06 (0.65-1.72)		0.72 (0.42-1.22)
Completed 4 year college degree or greater			Ref		Ref
Poverty					
Poverty			1.68 (0.99-2.85)		1.17 (0.65-2.12)
Near Poverty			1.42 (0.87-2.31)		1.05 (0.62-1.77)
Non-poverty			Ref		Ref
History of Depression					
No					Ref
Yes					2.14 (1.47-3.13)
Maternal Stress					
					1.20 (1.16-1.24)
Social Support					
					0.89 (0.85-0.94)

Model 1 is unadjusted

Model 2 adjusted for maternal age and use of fertility advice or treatment

Model 3 adjusted for variables in model 2 plus marital status, race/ethnicity, education, and poverty status

Model 5 adjusted for variables in model 3 plus history of depression, maternal stress, and social support

Table C-2. 1- Month Postpartum Relationship between Perinatal Loss and Probable Depression from Logistic Regression Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Perinatal Loss					
History of no losses	Ref	Ref	Ref	Ref	Ref
History of 1 or more losses	1.69 (1.05-2.70)	1.70 (1.06-2.75)	1.66 (1.03-2.69)	1.63 (0.96-2.69)	1.70 (0.99-2.92)
Maternal Age					
		0.98 (0.93-1.02)	1.01 (0.95-1.08)	1.00 (0.93-1.07)	0.99 (0.92-1.06)
Fertility Advice or Treatment					
No		Ref	Ref	Ref	Ref
Yes		1.17 (0.63-2.17)	1.29 (0.69-2.43)	1.46 (0.76-2.83)	1.36 (0.67-2.75)
Marital Status					
Married			Ref	Ref	Ref
Not Married			1.20 (0.66-2.19)	1.17 (0.64-2.15)	0.64 (0.33-1.25)
Race/Ethnicity					
Non-Hispanic White			Ref	Ref	Ref
Non-Hispanic Black			1.34 (0.62-2.93)	1.41 (0.63-3.16)	1.41 (0.58-3.45)
Hispanic			1.32 (0.57-3.08)	1.48 (0.62-3.55)	1.64 (0.62-4.35)
Other			3.52 (1.78-6.97)	3.01 (1.46-6.17)	3.71 (1.66-8.32)
Education					
High school graduate or GED or less			0.65 (0.30-1.40)	0.69 (0.31-1.55)	0.54 (0.22-1.32)
Some college or vocational programs			0.81 (0.46-1.43)	0.87 (0.48-1.55)	0.71 (0.38-1.32)
Completed 4 year college degree or greater			Ref	Ref	Ref
Poverty					
Poverty			2.39 (1.18-4.85)	2.63 (1.26-5.46)	2.03 (0.89-4.58)
Near Poverty			2.15 (1.14-4.05)	1.98 (1.03-3.78)	1.51 (0.76-3.04)
Non-poverty			Ref	Ref	Ref
Mode of delivery					
Vaginal delivery				Ref	Ref
Cesarean delivery				0.87 (0.55-1.37)	0.87 (0.53-1.42)
Infant Hospitalization at Birth					
No				Ref	Ref
Yes				0.49 (0.19-	0.48 (0.17-

	1.24)	1.36)
Birth Experience	0.90 (0.87-	0.92 (0.90-
	0.92)	0.95)
Postpartum Mental Health Visits		
No		Ref
Yes		4.71 (2.57-
		8.61)
History of Depression		
No		Ref
Yes		1.64 (1.00-
		2.69)
Maternal Stress		1.22 (1.15-
		1.29)
Social Support		0.96 (0.92-
		0.99)

Model 1 is unadjusted
 Model 2 adjusted for maternal age and use of fertility advice or treatment
 Model 3 adjusted for variables in model 2 plus marital status, race/ethnicity, education, and poverty status
 Model 4 adjusted for variables in model 3 plus mode of delivery, infant hospitalization at birth, and birth experience
 Model 5 adjusted for variables in model 4 plus postpartum mental health visits, history of depression, maternal stress, and social support

Table C-3. 6- Month Postpartum Relationship between Perinatal Loss and Probable Depression from Logistic Regression Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Perinatal Loss					
History of no losses	Ref	Ref	Ref	Ref	Ref
History of 1 or more losses	1.02 (0.59-1.77)	1.18 (0.68-2.05)	1.08 (0.61-1.89)	1.06 (0.60-1.88)	0.90 (0.46-1.78)
Maternal Age					
		0.89 (0.85-0.93)	1.00 (0.94-1.06)	0.99 (0.93-1.06)	1.00 (0.93-1.08)
Fertility Advice or Treatment					
No		Ref	Ref	Ref	Ref
Yes		0.86 (0.38-1.93)	0.928 (0.41-2.10)	0.96 (0.42-2.21)	0.85 (0.34-2.16)
Marital Status					
Married			Ref	Ref	Ref
Not Married			1.51 (0.90-2.75)	1.59 (0.90-2.80)	0.81 (0.43-1.55)
Race/Ethnicity					
Non-Hispanic White			Ref	Ref	Ref
Non-Hispanic Black			1.27 (0.64-2.50)	1.26 (0.63-2.52)	1.29 (0.56-2.98)
Hispanic			1.52 (0.75-3.07)	1.51 (0.73-3.12)	1.58 (0.68-3.69)
Other			1.09 (0.38-3.13)	0.92 (0.32-2.68)	1.27 (0.36-4.52)
Education					
High school graduate or GED or less			2.01 (0.97-4.18)	2.15 (1.02-4.56)	2.43 (0.99-6.00)
Some college or vocational programs			2.69 (1.53-4.72)	2.92 (1.65-5.17)	2.308 (1.19-4.48)
Completed 4 year college degree or greater			Ref	Ref	Ref
Poverty					
Poverty			1.88 (0.97-3.61)	2.02 (1.04-3.92)	1.24 (0.55-2.79)
Near Poverty			1.43 (0.79-2.61)	1.46 (0.78-2.68)	0.97 (0.48-1.96)
Non-poverty			Ref	Ref	Ref
Mode of delivery					
Vaginal delivery				Ref	Ref
Cesarean delivery				1.32 (0.85-2.06)	1.49 (0.88-2.50)
Infant Hospitalization at Birth					
No				Ref	Ref
Yes				1.30 (0.32-)	1.23 (0.24-)

	5.21)	6.28)
Birth Experience	0.92 (0.90-	0.99 (0.95-
	0.95)	1.02)
Postpartum Mental Health Visits		
No		Ref
Yes		1.31 (0.63-
		2.72)
History of Depression		
No		Ref
Yes		1.78 (1.07-
		2.95)
Maternal Stress		1.30 (1.24-
		1.37)
Social Support		0.94 (0.91-
		0.97)

Model 1 is unadjusted

Model 2 adjusted for maternal age and use of fertility advice or treatment

Model 3 adjusted for variables in model 2 plus marital status, race/ethnicity, education, and poverty status

Model 4 adjusted for variables in model 3 plus mode of delivery, infant hospitalization at birth, and birth experience

Model 5 adjusted for variables in model 4 plus postpartum mental health visits, history of depression, maternal stress, and social support

Table C-4. 12- Month Postpartum Relationship between Perinatal Loss and Probable Depression from Logistic Regression Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Perinatal Loss					
History of no losses	Ref	Ref	Ref	Ref	Ref
History of 1 or more losses	1.17 (0.69-2.01)	1.40 (0.81-2.41)	1.25 (0.72-2.17)	1.25 (0.71-2.19)	1.35 (0.72-2.53)
Maternal Age					
		0.89 (0.85-0.94)	1.01 (0.95-1.08)	1.01 (0.94-1.08)	1.01 (0.94-1.09)
Fertility Advice or Treatment					
No		Ref	Ref	Ref	Ref
Yes		0.59 (0.23-1.50)	0.64 (0.25-1.63)	0.67 (0.26-1.74)	0.75 (0.28-2.02)
Marital Status					
Married			Ref	Ref	Ref
Not Married			1.36 (0.75-2.47)	1.36 (0.74-2.47)	0.87 (0.46-1.62)
Race/Ethnicity					
Non-Hispanic White			Ref	Ref	Ref
Non-Hispanic Black			1.36 (0.68-2.73)	1.38 (0.68-2.78)	1.73 (0.78-3.83)
Hispanic			1.80 (0.88-3.69)	1.76 (0.85-3.66)	2.32 (1.01-5.37)
Other			0.49 (0.12-2.10)	0.42 (0.10-1.82)	0.40 (0.08-2.02)
Education					
High school graduate or GED or less			2.33 (1.13-4.81)	2.56 (1.23-5.36)	2.41 (1.05-5.56)
Some college or vocational programs			1.75 (0.97-3.15)	1.90 (1.05-3.44)	1.34 (0.70-2.58)
Completed 4 year college degree or greater			Ref	Ref	Ref
Poverty					
Poverty			2.43 (1.24-4.74)	2.49 (1.26-4.91)	1.66 (0.70-3.64)
Near Poverty			1.69 (0.90-3.17)	1.76 (0.94-3.30)	1.26 (0.64-2.51)
Non-poverty			Ref	Ref	Ref
Mode of delivery					
Vaginal delivery				Ref	Ref
Cesarean delivery				1.02 (0.64-1.64)	1.16 (0.69-1.95)
Infant Hospitalization at Birth					
No				Ref	Ref
Yes				1.99 (0.40-)	1.30 (0.26-)

	9.83)	6.51)
Birth Experience	0.93 (0.90-	0.97 (0.94-
	0.95)	1.00)
Postpartum Mental Health Visits		
No		Ref
Yes		1.59 (0.78-
		3.25)
History of Depression		
No		Ref
Yes		2.03 (1.23-
		3.35)
Maternal Stress		1.24 (1.18-
		1.30)
Social Support		0.95 (0.92-
		0.98)

Model 1 is unadjusted

Model 2 adjusted for maternal age and use of fertility advice or treatment

Model 3 adjusted for variables in model 2 plus marital status, race/ethnicity, education, and poverty status

Model 4 adjusted for variables in model 3 plus mode of delivery, infant hospitalization at birth, and birth experience

Model 5 adjusted for variables in model 4 plus postpartum mental health visits, history of depression, maternal stress, and social support

Table C-5. Baseline Relationship between Perinatal Loss and Depression from Linear Regression Models

	Model 1	Model 2	Model 3	Model 5
Perinatal Loss				
History of no losses	Ref	Ref	Ref	Ref
History of 1 or more losses	-0.00 (-0.40, 0.39)	0.15 (-0.24, 0.55)	0.06 (-0.33, 0.45)	0.01 (-0.32, 0.36)
Maternal Age				
		-0.13 (-0.16, -0.10)	-0.03 (-0.07, 0.02)	-0.02 (-0.06, 0.02)
Fertility Advice or Treatment				
No		Ref	Ref	Ref
Yes		-0.13 (-0.60, 0.33)	-0.04 (-0.50, 0.42)	0.02 (-0.36, 0.41)
Marital Status				
Married			Ref	Ref
Not Married			0.86 (0.44-1.29)	0.08 (-0.30, 0.44)
Race/Ethnicity				
Non-Hispanic White			Ref	Ref
Non-Hispanic Black			0.48 (-0.16, 1.12)	0.49 (-0.05, 1.03)
Hispanic			-0.15 (-0.82, 0.52)	0.04 (-0.52, 0.60)
Other			0.89 (0.13, 1.65)	1.15 (0.51, 1.79)
Education				
High school graduate or GED or less			0.30 (-0.24, 0.83)	0.39 (-0.06, 0.84)
Some college or vocational programs			0.34 (-0.04, 0.72)	0.05 (-0.26, 0.37)
Completed 4 year college degree or greater			Ref	Ref
Poverty				
Poverty			0.67 (0.07, 1.27)	0.02 (-0.49, 0.52)
Near Poverty			0.57 (0.07, 1.10)	-0.06 (-0.50, 0.37)
Non-poverty			Ref	Ref
History of Depression				
No				Ref
Yes				-1.03 (-1.32, -0.73)
Maternal Stress				
				0.40 (0.37, 0.43)
Social Support				
				-0.18 (-0.23, -0.14)

All results reported as B (95% CI)

Model 1 is unadjusted

Model 2 adjusted for marital status and use of fertility advice or treatment

Model 3 adjusted for variables in model 2 plus marital status, race/ethnicity, education, and poverty status

Model 5 adjusted for variables in model 3 plus history of depression, maternal stress, and social support

Table C-6. 1- Month Postpartum Relationship between Perinatal Loss and Depression from Linear Regression Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Perinatal Loss					
History of no losses	Ref	Ref	Ref	Ref	Ref
History of 1 or more losses	0.15 (-0.23, 0.54)	0.10 (-0.28, 0.49)	0.11 (-0.28, 0.49)	0.04 (-0.31, 0.40)	0.01 (-0.30, 0.33)
Maternal Age		0.05 (0.01, 0.08)	0.04 (-0.00, 0.09)	0.04 (-0.01, 0.08)	0.02 (-0.02, 0.06)
Fertility Advice or Treatment					
No		Ref	Ref	Ref	Ref
Yes		0.10 (-0.45, 0.47)	0.05 (-0.40, 0.51)	0.22 (-0.20, 0.65)	0.17 (-0.20, 0.54)
Marital Status					
Married			Ref	Ref	Ref
Not Married			0.12 (-0.31, 0.54)	0.09 (-0.32, 0.48)	-0.44 (-0.79, -0.10)
Race/Ethnicity					
Non-Hispanic White			Ref	Ref	Ref
Non-Hispanic Black			-0.19 (-0.83, 0.45)	-0.24 (-0.83, 0.35)	-0.15 (-0.67, 0.37)
Hispanic			-0.39 (-1.02, 0.31)	-0.34 (-0.96, 0.27)	-0.36 (-0.90, 0.18)
Other			1.16 (0.41, 1.92)	0.81 (0.12, 1.51)	0.85 (0.23, 1.46)
Education					
High school graduate or GED or less			-0.58 (-1.11, -0.05)	-0.31 (-0.80, 0.18)	-0.34 (-0.77, 0.09)
Some college or vocational programs			-0.25 (-0.62, 0.12)	-0.08 (-0.43, 0.27)	-0.28 (-0.59, 0.02)
Completed 4 year college degree or greater			Ref	Ref	Ref
Poverty					
Poverty			0.57 (-0.03, 1.16)	0.62 (0.07, 1.17)	0.18 (-0.30, 0.66)
Near Poverty			0.61 (0.10, 1.13)	0.52 (0.05, 1.00)	0.12 (-0.30, 0.53)
Non-poverty			Ref	Ref	Ref
Mode of delivery					
Vaginal delivery				Ref	Ref
Cesarean delivery				-0.20 (-0.49, 0.10)	-0.13 (-0.39, 0.13)
Infant Hospitalization at Birth					
No				Ref	Ref
Yes				-0.46 (-1.30, 0.38)	-0.23 (-0.96, 0.50)

		0.38)	0.51)
Birth Experience		-0.23 (-0.25,	-0.14 (-0.16,
		-0.21)	-0.12)
Postpartum Mental Health Visits			
No			Ref
Yes			2.22 (1.66,
			2.79)
History of Depression			
No			Ref
Yes			-0.61 (-0.89,
			-0.32)
Maternal Stress			0.40 (0.36,
			0.44)
Social Support			-0.09 (-0.12,
			-0.07)

All results reported as B (95% CI)

Model 1 is unadjusted

Model 2 adjusted for maternal age and use of fertility advice or treatment

Model 3 adjusted for variables in model 2 plus marital status, race/ethnicity, education, and poverty status

Model 4 adjusted for variables in model 3 plus mode of delivery, infant hospitalization at birth, and birth experience

Model 5 adjusted for variables in model 4 plus postpartum mental health visits, history of depression, maternal stress, and social support

Table C-7. 6- Month Postpartum Relationship between Perinatal Loss and Depression from Linear Regression Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Perinatal Loss					
History of no losses	Ref	Ref	Ref	Ref	Ref
History of 1 or more losses	-0.15 (-0.53, 0.24)	-0.10 (-0.48, 0.29)	-0.16 (-0.55, 0.22)	-0.20 (-0.57, 0.17)	-0.24 (-0.54, 0.06)
Maternal Age					
		-0.05 (-0.08, 0.01)	0.04 (-0.01, 0.08)	0.03 (-0.01, 0.08)	0.04 (0.00, 0.07)
Fertility Advice or Treatment					
No		Ref	Ref	Ref	Ref
Yes		-0.01 (-0.46, 0.44)	0.05 (-0.40, 0.50)	0.17 (-0.27, 0.60)	0.07 (-0.28, 0.42)
Marital Status					
Married			Ref	Ref	Ref
Not Married			0.59 (0.16, 1.01)	0.57 (0.16, 0.98)	-0.07 (-0.40, 0.27)
Race/Ethnicity					
Non-Hispanic White			Ref	Ref	Ref
Non-Hispanic Black			0.20 (-0.45, 0.86)	0.18 (-0.46, 0.81)	0.33 (-0.18, 0.84)
Hispanic			0.27 (-0.40, 0.95)	0.29 (-0.36, 0.94)	0.35 (-0.18, 0.87)
Other			-0.08 (-0.83, 0.68)	-0.33 (-1.06, 0.40)	0.15 (-0.44, 0.74)
Education					
High school graduate or GED or less			0.12 (-0.42, 0.65)	0.31 (-0.21, 0.82)	0.36 (0.06, 0.77)
Some college or vocational programs			0.34 (-0.04, 0.71)	0.47 (0.11, 0.83)	0.17 (-0.12, 0.46)
Completed 4 year college degree or greater			Ref	Ref	Ref
Poverty					
Poverty			0.82 (0.22, 1.43)	0.85 (0.27, 1.43)	0.24 (-0.23, 0.71)
Near Poverty			0.72 (0.21, 1.23)	0.65 (0.16, 1.15)	-0.15 (-0.55, 0.25)
Non-poverty			Ref	Ref	Ref
Mode of delivery					
Vaginal delivery				Ref	Ref
Cesarean delivery				-0.10 (-0.41, 0.20)	-0.09 (-0.33, 0.16)
Infant Hospitalization at Birth					
No				Ref	Ref
Yes				-0.30 (-1.17, 0.57)	-0.36 (-1.07, 0.35)

	0.57)	0.34)
Birth Experience	-0.16 (-0.18,	-0.06 (-0.07,
	-0.14)	-0.04)
Postpartum Mental Health Visits		
No		Ref
Yes		0.41 (-0.13,
		0.94)
History of Depression		
No		Ref
Yes		-0.99 (-1.26,
		-0.71)
Maternal Stress		0.41 (0.38,
		0.44)
Social Support		-0.11 (-0.13,
		-0.09)

All results reported as B (95% CI)

Model 1 is unadjusted

Model 2 adjusted for maternal age and use of fertility advice or treatment

Model 3 adjusted for variables in model 2 plus marital status, race/ethnicity, education, and poverty status

Model 4 adjusted for variables in model 3 plus mode of delivery, infant hospitalization at birth, and birth experience

Model 5 adjusted for variables in model 4 plus postpartum mental health visits, history of depression, maternal stress, and social support

Table C-8. 12- Month Postpartum Relationship between Perinatal Loss and Depression from Linear Regression Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Perinatal Loss					
History of no losses	Ref	Ref	Ref	Ref	Ref
History of 1 or more losses	-0.04 (-0.44, 0.36)	0.04 (-0.36, 0.44)	-0.04 (-0.43, 0.36)	-0.06 (-0.44, 0.33)	0.05 (-0.27, 0.36)
Maternal Age					
		-0.05 (-0.09, -0.02)	0.05 (0.01, 0.10)	0.05 (0.01, 0.10)	0.04 (-0.00, 0.08)
Fertility Advice or Treatment					
No		Ref	Ref	Ref	Ref
Yes		-0.21 (-0.67, 0.25)	-0.14 (-0.60, 0.32)	-0.02 (-0.46, 0.43)	0.03 (-0.34, 0.40)
Marital Status					
Married			Ref	Ref	Ref
Not Married			0.75 (0.31, 1.19)	0.72 (0.29, 1.15)	0.04 (-0.31, 0.40)
Race/Ethnicity					
Non-Hispanic White			Ref	Ref	Ref
Non-Hispanic Black			0.62 (-0.08, 1.31)	0.64 (-0.04, 1.31)	0.92 (0.36, 1.48)
Hispanic			-0.03 (-0.75, 0.70)	-0.02 (-0.73, 0.68)	0.19 (-0.39, 0.78)
Other			0.01 (-0.78, 0.80)	-0.19 (-0.95, 0.58)	0.15 (-0.48, 0.79)
Education					
High school graduate or GED or less			0.47 (-0.08, 1.02)	0.65 (0.12, 1.19)	0.62 (0.17, 1.06)
Some college or vocational programs			0.36 (-0.02, 0.74)	0.48 (0.11, 0.85)	0.19 (-0.12, 0.50)
Completed 4 year college degree or greater			Ref	Ref	Ref
Poverty					
Poverty			0.54 (-0.09, 1.18)	0.53 (-0.09, 1.14)	-0.10 (-0.61, 0.41)
Near Poverty			0.77 (0.24, 1.31)	0.73 (0.21, 1.25)	-0.08 (-0.52, 0.35)
Non-poverty			Ref	Ref	Ref
Mode of delivery					
Vaginal delivery				Ref	Ref
Cesarean delivery				-0.19 (-0.51, 0.12)	-0.15 (-0.41, 0.11)
Infant Hospitalization at Birth					
No				Ref	Ref
Yes				0.04 (-0.87, 0.95)	-0.05 (-0.80, 0.70)
Birth Experience					
				-0.15 (-0.17, -0.12)	-0.06 (-0.08, -0.04)
Postpartum Mental Health Visits					

No	Ref
Yes	0.90 (0.32, 1.48)
History of Depression	
No	Ref
Yes	-1.03 (-1.33, -0.74)
Maternal Stress	
	0.37 (0.34, 0.40)
Social Support	
	-0.11 (-0.13, -0.09)

All results reported as B (95% CI)

Model 1 is unadjusted

Model 2 adjusted for maternal age and use of fertility advice or treatment

Model 3 adjusted for variables in model 2 plus marital status, race/ethnicity, education, and poverty status

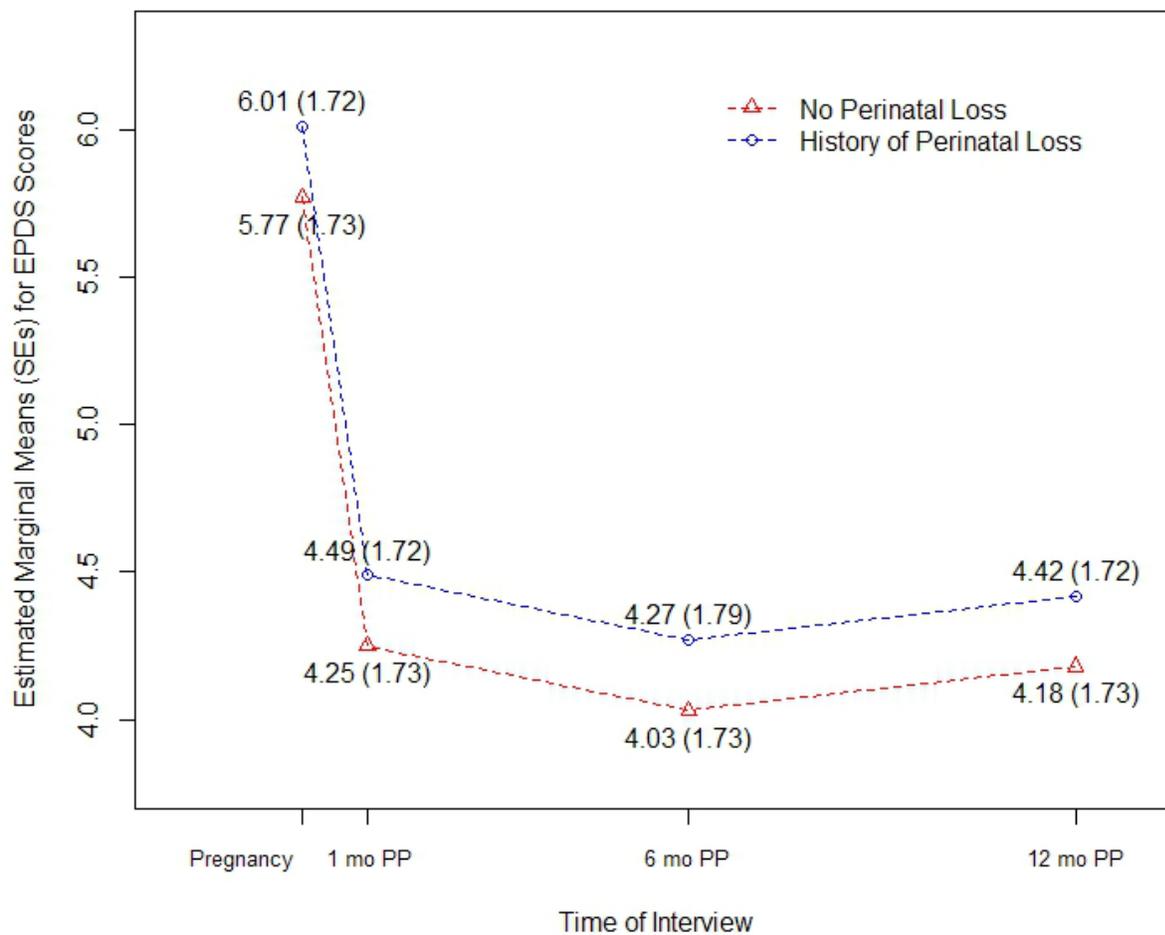
Model 4 adjusted for variables in model 3 plus mode of delivery, infant hospitalization at birth, and birth experience

Model 5 adjusted for variables in model 4 plus postpartum mental health visits, history of depression, maternal stress, and social support

Table C-9. Longitudinal Relationship between Previous Perinatal Loss and EPDS Score from Mixed Models with Repeated Measures

	β (95% CI)	p-value
Perinatal Loss		
History of no losses	Ref	
History of 1 or more losses	0.24 (-0.04, 0.52)	0.093
Time		
	Ref	
1 month	-1.52 (-1.67, -1.38)	<0.001
6 months	-1.74 (-1.87,-1.60)	<0.001
12 months	-1.59 (-1.73, -1.45)	<0.001
Age	-0.06 (-0.09, -0.03)	<0.001
Fertility Advice or Treatment		
No	Ref	
Yes	-0.18 (-0.50, 0.14)	0.271

Figure C-1. Estimated marginal means of EPDS score according to perinatal loss group at each of the four time points: 3rd trimester of pregnancy, 1 month postpartum, 6 months postpartum, and 12 months postpartum.



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