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Mode of Delivery and Maternal and Infant Risk Factors and Health Outcomes

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Mode of Delivery and Maternal and Infant Risk Factors and Health Outcomes

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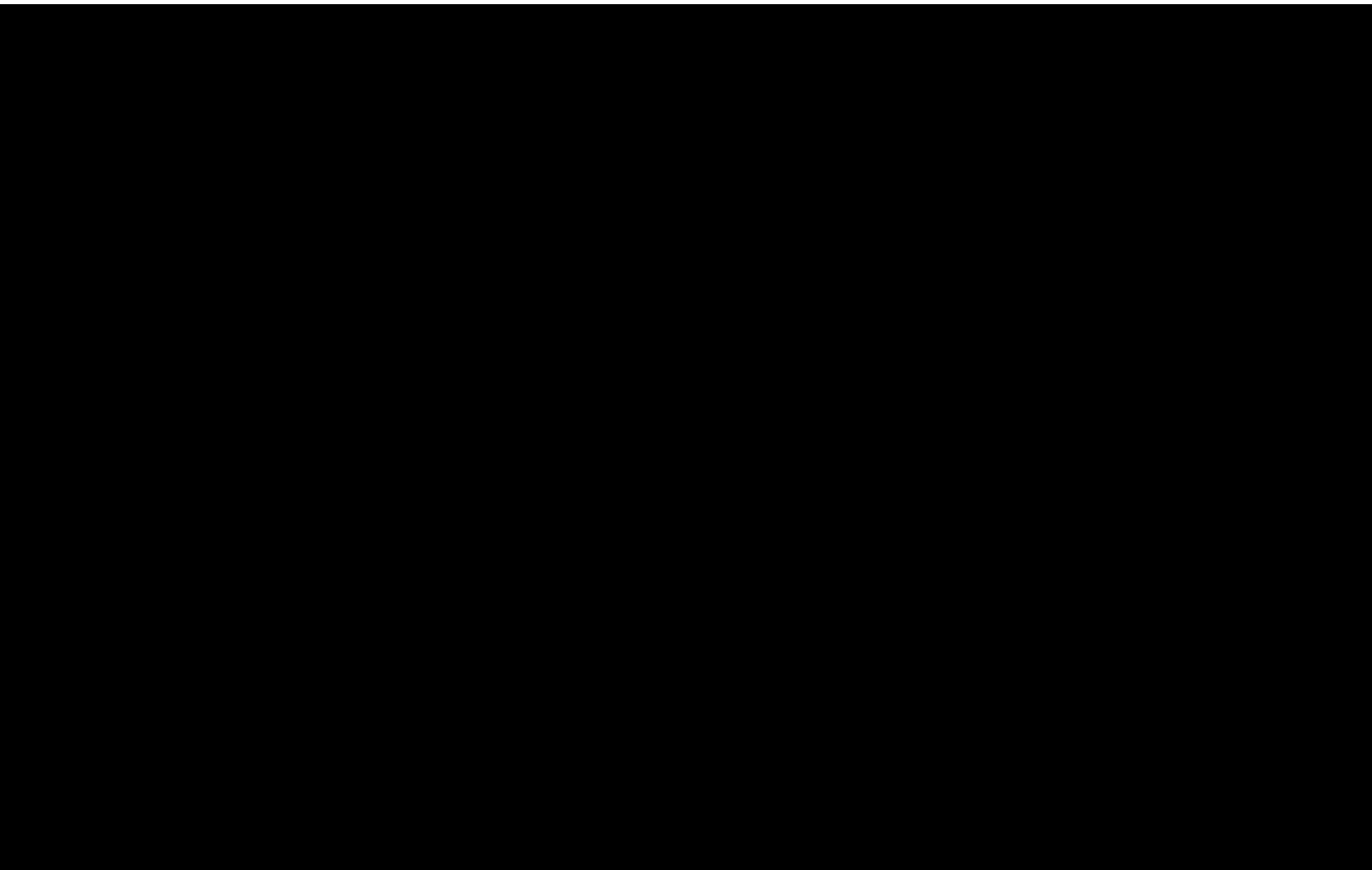

Dedication

This work is dedicated to my children, who taught me the value of peaceful childbirth.

Acknowledgements

I wish to express my gratitude to the entire faculty at University of California, San Francisco, who have been supportive and guided me through the process that has culminated in this dissertation research. Specifically I wish to thank Dr. Kathryn Lee who has encouraged me forward, been an uplifting advisor, and dissertation chair. Additionally, to Dr. Caryl Gay who has put forth extra time and effort to assist me through my research process, data analysis and conclusions, my sincerest appreciation. Special thanks also go to Dr. Audrey Lyndon, who has challenged me to step out of my own perspective and recognize what I was missing, and to Dr. Sandra Weiss, who's caring and depth of knowledge never failed to inspire me.

I wish to thank my family for their loving support these four years, and the birth community at large, which has helped me to question the status quo.

Amanda C. Burke Aaronson

March 8, 2011

MODE OF DELIVERY AND MATERNAL AND INFANT RISK FACTORS AND HEALTH OUTCOMES

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University of California, San Francisco, 2011

Childbirth is a necessary stressor. It prepares the infant for extrauterine life, and prepares the mother for lactation and safe return to the non-pregnant state. However, added stressors can have repercussions. This study aims to describe added stressors (including prenatal maternal socio-demographic and psychological factors) affecting mode of delivery (MOD), and the effect of MOD on mother-infant health at one month postpartum.

Approximately 150 first-time, English-speaking, expectant mothers, at least 18 years of age, recruited from San Francisco, California prenatal clinics, participated in a postpartum intervention sleep study. Women were excluded if they had a sleep or mood disorder, or worked nights. This is a secondary analysis of these data.

Prenatal maternal socio-demographic and risk factors (depression, anxiety, attitudes/adjustment, perceived stress) were evaluated by MOD outcome using analysis of variance (ANOVA), t-tests, Mann Whitney U, and Kruskall-Wallis. Labor induction/augmentation was evaluated by maternal report of non-reassuring fetal status (NRFS) with NRFS as the key outcome, analyzed by Chi-Square and

logistic regression. Lastly, MOD was evaluated for effect on maternal symptoms of depression and anxiety, infant temperament rating, infant sleep, and breastfeeding continuation at one month using ANOVA and Chi-Square statistics.

Prenatal depression and anxiety symptoms were not associated with MOD (normal vaginal, instrument vaginal, cesarean in labor, or scheduled cesarean). Mothers with a prenatal "attitude toward baby" score that was more positive were more likely to have an unplanned cesarean birth. A scheduled cesarean birth was more likely in older women and those with higher pre-pregnancy BMI. Maternal reports of NRFS were associated with induction/augmentation. One month postpartum measures of maternal symptoms, maternal adjustment, infant temperament, and breastfeeding did not differ by MOD. However, according to maternal diary entries, cesarean-born infants slept an average of one hour more during the day than infants born vaginally.

These findings provide preliminary indication that prenatal attitude toward baby plays a role in MOD, induction/augmentation is associated with increased NRFS, and cesarean birth is associated with increased infant sleep at one month. Nurses should develop and test interventions to minimize prenatal and labor factors that unnecessarily add to delivery stress.

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Chapter 1:

Introduction

Background and Significance of Proposed Study

Spontaneous vaginal deliveries are becoming less common. However, in uncomplicated pregnancies, adding medical intervention, such as pitocin for induction or augmentation, instrument deliveries, and cesarean birth, carries risk to the mother and the baby.

Labor induction.

The rate of labor induction is on the rise. According to 2006 data from the Center for Disease Prevention and Control (CDC), inductions increased from the 1990 rate of 9.5% to 22.5% (Nelson, 2009). Labor induction involves external chemical or physical measures to begin a non-spontaneous labor, and adds risk to otherwise uncomplicated labor. For example, Rossen, Okland, Nilson and Eggebo (2006) found that severe postpartum hemorrhage occurred in 5.6% of induced labors compared to 2.4% in spontaneous labors. Feinstein, Sheiner, Levy, Hallak and Mazor (2002) found labor induction to be a risk factor for failure to progress in first stage labor, as well as for arrest of descent in second stage labor. This resulted in a higher incidence of instrument deliveries and cesarean births, as well as significantly lower Apgar scores. Glantz (2005) also found that induced labor was associated with more interventions, more cesarean births, and a longer length of stay. Use of misoprostil (Cytotec) as a cervical ripening agent for labor induction was associated with a significantly increased risk of uterine hyperstimulation and meconium passage (Hofmeyr and Gulmezoglu, 2007).

There is increased risk of trauma to the infant when birth becomes complicated, as a result of labor induction, epidural use, or operative (instrument or abdominal) delivery. Infant trauma may also be anticipated following non-reassuring fetal heart rate tracings or

meconium passage in labor. Gupta, Bhatia and Mishra (1996) found that meconium passage occurs in approximately 14% of births and Aaronson, Gay and Lee (2008) found non-reassuring fetal status present in approximately 17% of births. Short-term problems may include impaired thermoregulation, hypoglycemia, respiratory distress, and resultant transfer to the Neonatal Intensive Care Unit (NICU) for more invasive procedures. Long-term risks from traumatic birth may include increased pain response to noxious stimuli and potential development of trauma-related mental health problems as a result of early rewiring of the rapidly developing brain. Mental health issues arising after traumatic birth have also been reported in epidemiological retrospective descriptive studies (Anand & Scalzo, 2000).

Instrument delivery.

Risk to the infant from vacuum extraction includes cephalohematoma, or subgaleal bleeds. Subgaleal bleeds can lead to severe hemorrhage, shock and even death by exsanguination. Subgaleal bleeds are reported in one review to occur at a rate of 26-45 per 1000 (2.6-4.5%) of vacuum extractions (Boo, Foong, Mahdy, Yong & Jaafar, 2005). Some studies report subgaleal hemorrhages in up to 21% of vacuum extractions, and hypovolemic shock in 10% of those infants (Yeomans, 2010; Boo, et al, 2005). Further risk to vacuum delivery includes shoulder dystocia and subsequent risk of clavicular fracture. Forceps carries the risk of facial nerve palsy (approximately 1% of all forceps deliveries), bruising, and intracranial bleeding (Yeomans, 2010).

Cesarean delivery.

According to the CDC's preliminary data, 32.9% of all babies in the United States were delivered by cesarean in 2009 (Hamilton, Martin & Ventura, 2010). Scheduled

cesarean deliveries increase the risk of neonatal respiratory distress syndrome and subsequent NICU triage and admissions (Richardson, Czikk, daSilva, & Natale, 2005). A trial of spontaneous labor allows for the infant to experience hormonal and physiologic cues to transition to external life. Actual vaginal birth decreases the risk of respiratory distress morbidities, including persistent pulmonary hypertension, compared to elective cesarean birth. Transient tachypnea may be found in 6% of infants undergoing elective repeat cesarean birth compared to 3% who undergo a trial of labor (Hook, Kiwi, Amini, Fanaroff & Hack, 1997). Studies show that the rate of persistent pulmonary hypertension after having a cesarean birth can be as high as 4.2%, compared to 1.5% in vaginal birth, with lower gestational age associated with increased risk (Hernández-Díaz, Van Marter, Werler, Louik & Mitchell, 1997; Hansen, Wisborg, Uldbjerg & Henriksen, 2008).

Cesarean delivery and maternal risks.

Uncomplicated vaginal birth also decreases the likelihood of excessive bleeding in the mother and therefore the need for blood products, risk of infection at the wound site, and allows the mother to recover from the birth more quickly. This is especially true if the mother had a previous vaginal birth (Cahill, Stamilio, Odibo, Peipert, Ratcliffe, Stevens, Sammel, & Macones, 2006). In one sample, severe blood loss was experienced by 1.7% of mothers with uncomplicated cesarean compared to 0.4% of mothers who had vaginal deliveries (Sherman, Greenspoon, Nelson, & Paul, 1993), while another sample had 6.5% severe postpartum hemorrhage after cesarean delivery compared to approximately 3% of vaginal deliveries (Rossen, Okland, Nilson & Eggebo, 2006). Placenta previa, and placenta accreta are both additional risks to repeat cesarean deliveries, though a low risk overall (Gielchinskya, Rojansky, Fasouliotis, & Ezra, 2002;

Gilliam, Rosenberg & Davis, 2002; Mahoka, Felimban, Fathuddien, Roomi, & Ghabra, 2004). Cited uterine rupture rates in vaginal birth after cesarean (VBAC) vary from 0.02% to 1% in unmolested labor, and as high as 2.2% in labor induced with cervical ripening agents (Jerbi, Hidar, Ammar & Khairi, 2006; Turner, Agnew & Langan, 2006; Grossetti, Vardon, Creveuil, Herlicoviez & Dreyfus, 2007).

In addition to the physical risks inherent in cesarean delivery, there are emotional risks that result from separation of mother and baby after cesarean birth. Separation of the mother/baby dyad can interrupt the critical bonding period and can make breastfeeding more difficult**,** which adds emotional stress to what should be a joyous time (Hatch & Maietta, 1991; Beck, 2004; Sievers, Haase, Oldigs & Schaub, 2003; Dewey, 2001; Dewey, Nommsen-Rivers, Heining & Cohen, 2003). Specifically, the first hour after birth is a critical time for bonding, and the instinctual initiation of breastfeeding by the newborn (Crenshaw, 2004, Moriceau & Sullivan, 2005), which in turn enhances uterine involution (Anderson, 1989). Moore and Anderson (2007) found that skin-to-skin contact immediately post birth improved breastfeeding outcomes compared to even the simple intervention of swaddling the infant. Bramson, Lee, Moore, Montgomery, Neish, Bahjri and Melcher (2010) found that only 21.4% of mothers exclusively breastfed their infants in the hospital following cesarean delivery compared to 78.6% of mothers who had a vaginal birth. Jack (2005), Beck (2004), and Ayers (2007) found that traumatic birth is a risk factor for postpartum depression (PPD), and post-traumatic stress disorder (PTSD).

Perceived control has been defined as “the perception of personal ability to shape or influence a particularly stressful person-environment relationship” (Knapp, 1996, p. 7). Maternal perceived control in labor has been shown to improve women’s satisfaction

with their birth experience, decrease risk for postpartum depression (Dennis, Janssen & Singer, 2004), and decrease the incidence of labor interventions, pain perception, and therefore epidural use, instrument deliveries, and cesarean birth (Johnson-Robledo, 1998; Green & Baston, 2003; Green, Coupland & Kitzinger, 1990; Slade, MacPherson, Hume & Maresh, 1993; Hodnett & Simmons-Tropea, 1987; Knapp, 1996; Miller, Thorton & Gittens, 2002). Perceived control increases satisfaction and decreases post-partum emotional risk, even when that control results in more interventive deliveries, such as instrument assisted deliveries, and cesareans (Slade et al, 1993; Dennis, 2006).

Cesarean delivery and infant risks.

Cesarean delivery significantly increases the risk of respiratory distress in the infant. Cesarean born infants represented 60% of those with severe respiratory morbidity requiring extracorporeal membranous oxygenation (ECMO) from 1989 to 2005 (Jain & Dudell, 2006). A trial of labor before cesarean delivery decreases rates of respiratory morbidity, and vaginal delivery has the lowest incidence (van den Berg, van Elburg, van Geijn, & Fetter, 2001).

Normal transition from fetus to neonate at birth includes complex changes in multiple physiologic systems. These adaptive changes include the respiratory, circulatory, thermoregulatory, and metabolic systems (Anderson, 1989; Verklan, 2002). There are many circumstances in otherwise healthy term infants where this transition may not go smoothly. Signs of stress exhibited by the newborn include poor muscle tone, low heart rate, and poor spontaneous respiration. Meconium passage can be a sign of non-reassuring fetal status and complicate an otherwise normal delivery. Respiratory distress may result from meconium inhalation, or from difficulty transitioning from delivery.

Cesarean delivery performed prior to onset of labor can interrupt hormonal cues of birth, and can also result in poor respiratory transition. Shoulder dystocia can lead to hypoxia, brachial palsy or even a fractured clavicle (Anderson, 1989; Mercer & Graves, 2007).

The effects of traumatic delivery on infant psychological health have not been addressed in the literature. Immediate behavioral responses, specifically crying and facial expression, have been evaluated, but none have looked beyond the immediate postpartum period. However, two studies of male infants show that pain of circumcision, considered a traumatic event, increased their pain response to routine vaccinations at four or six months, indicating that pain or trauma in the neonatal period may have long-term alterations in an infant's sensitivity to pain (Taddio, Katz, Ilersich & Koren, 1997, Taddio, Goldbach, Ipp, Stevens & Koren, 1994). Of note, one study included a temperament scale administered prior to the vaccination and demonstrated similar temperament characteristics across groups (Taddio et al, 1997).

One previous study has evaluated stress response to vaccination based on mode of delivery (Taylor, Fisk, & Golver, 2000). Their findings indicated that babies born by instrument-assisted delivery (n=20) had the highest cortisol readings and longest crying time at their 8-week vaccination compared to spontaneous vaginal deliveries (n=46) or elective cesarean deliveries (n=10). Babies born by elective cesarean deliveries had the least stress response based on these two measures. Babies born by emergency cesarean were excluded, and stress in labor was not controlled.

Infant Sleep and Feeding

Freudigman and Thoman (1998) found mode of delivery to be associated with sleep organization throughout the infant's hospital stay, and in a previous study to have

found associations between early sleep organization and mental and motor scores at six months (Freudigman & Thoman, 1993). In an older retrospective study, birth stressors (breech birth, transitional respiratory difficulties, and cesarean delivery among others) were found to be associated with sleep difficulties in college students (Coren & Searleman, 1985). This study was limited by maternal recall regarding birth after close to two decades, however illustrated the potential for long-term effects on sleep from stress in delivery. No current studies were located that address delivery factors and outcomes related to continuation of breastfeeding.

Using complications of delivery as surrogate markers for traumatic experience in birth, this study addresses the prenatal factors that may contribute to mode of delivery and how the experience of delivery itself may influence psychological and behavioral adaptation in the mother and in her infant.

Theoretical Underpinnings

The theory of allostatic load, developed by McEwen and Stellar (1993), and revisited by McEwen and Seeman (1999), evaluates the role of accumulated stress on physical health. The authors describe that many factors contribute to how one manages stress, so no two individuals will be alike in what amount of load will lead to physical consequences. Genetic predisposition, age, gender, and learned coping skills as well as behavioral choices can all mediate the effects of stress on health. Levels of mediator neurochemicals such as catecholamines and cortisol also play a role in one's physical load (McEwen & Seeman, 1999).

The key concept of allostasis is differentiated from homeostasis – which implies a static norm – as "the operating range, and the ability of the body to increase or decrease

vital functions to a new steady state on challenge" (McEwen & Stellar, 1993, page 2094). As seen in Figure 1, allostatic load is defined as "the strain on the body produced by repeated ups and downs of physiologic response, as well as by the elevated activity of physiologic systems under challenge, and the changes in metabolism and the impact of wear and tear on a number of organs and tissues, (which can) predispose the organism to disease" (page 2094).

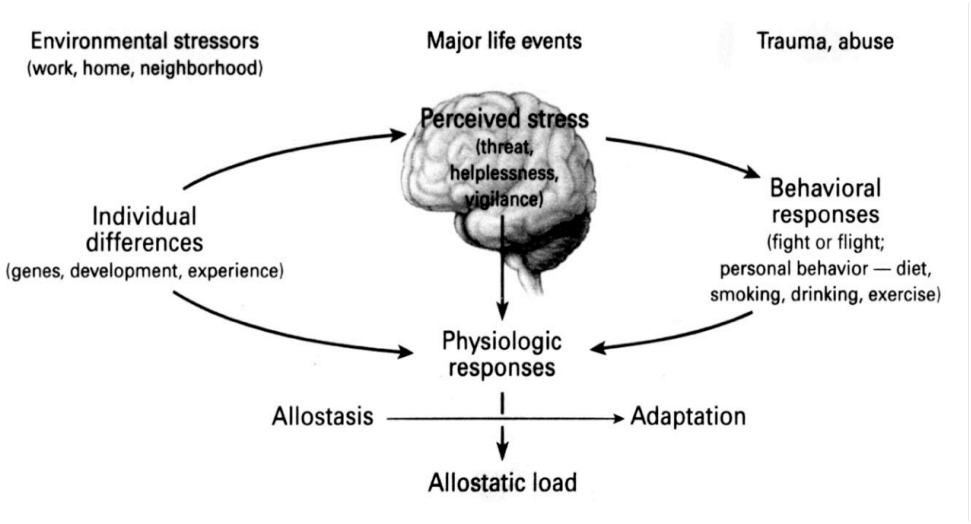

Figure 1. The stress response and development of allostatic load (McEwen & Seeman, 1999, pg. 32).

This graphic representation of the model of allostasis and allostatic load demonstrates how both social context and physical/psychological challenges affect a stimulus. A behavioral as well as biological response to that stimulus then occurs. Genetic predisposition and individual history play a role in how the nervous system processes the stimulus. The stimulus is then interpreted in the brain as either a threat or a non-threat. If it is a non-threat, she does not experience stress and her allostatic load does not increase. If it is a threat, the source of the threat is then assessed. A known threat may provide the

individual with the knowledge of how to cope with the stimulus. However, an unknown threat causes anxiety. Biologically this can then affect the immune system, cardiovascular system, metabolic system and muscular system, leading to conditions such as infection, coronary heart disease, diabetes and hypertension, to name a few.

In 2009, McEwen and a new group of colleagues (Lupien, McEwen, Gunnar & Heim, 2009) published an article regarding allostatic load across the lifespan and specifically recognized the vulnerability of infants to allostatic load, as infancy is a time of rapid brain development. Infants are born with stresses on their physiology. Such stresses may include threats of preterm labor, rises and dips in maternal glucose levels, and stress hormones carried across the placenta from the mother. These stressors affect the hypothalamic-pituitary-adrenal (HPA) axis, and can in turn alter the brain's neurochemistry and function, as well as play a role in gene expression. Labor is a natural and necessary stress for effective transition from the uterus, which alters vital functions for transition to extrauterine life. These authors cited animal studies that demonstrate elevated stress hormones as a response to maternal stress prenatally, and separation from the mother postnatally. Specifically in rat studies, elevated maternal glucocorticoids passed through the placenta, which resulted in elevated activity along the HPA axis in the fetal rat, which in turn altered development of the brain resulting in long-term elevation in stress hormone secretion. Ultimately, in those rats exposed to prenatal stress, decreased receptors in the hippocampus for glucocorticoids are found, as well as other physical changes in the brain. Postnatally, in rats, separation from mother is indicated as one of the greatest stressors they experience. When separated for three hours or more each day, the HPA axis is activated – shown by elevated glucocorticoids and adrenocorticotropic

hormone in the blood and physical changes in the brain.

Knowing that the newborn human infant's brain is in a period of rapid change, and that stressors play a role in brain development, trauma in the newborn period can be recognized to have the potential to rewire the brain such that risky behaviors in adulthood are more likely. This theory provides support for the research aims and hypotheses proposed in this dissertation study. Maternal sociodemographic and psychological factors will influence the major life event (giving birth for the first time) and physiological responses associated with the birth process. This theory also supports the hypotheses that a stressful life event, operationalized as trauma at birth in the form of a more complex mode of delivery can influence both maternal (symptoms of anxiety and depression) and infant health outcomes (infant temperament, eating and sleeping patterns).

Specific Aims

There are two specific aims of this dissertation research. The first aim is to describe associations between mode of delivery and antecedents that include prenatal maternal sociodemographic and psychological health factors. The second aim is to describe the effect of mode of delivery on behavioral health of the mother-infant dyad at one-month post delivery. Modes of delivery being evaluated include uncomplicated normal vaginal delivery as well as more complex modes of either instrument vaginal or cesarean birth. Both elective cesarean and emergency cesarean deliveries will also be differentiated in addressing these specific aims. Thus the four groups to be compared include: 1) uncomplicated vaginal birth, 2) instrument vaginal birth, 3) elective cesarean delivery, and 4) cesarean delivery while in labor.

The seven specific null hypotheses to be tested in this study are as follows:

1. There will be no difference in pregnancy sociodemographic factors, depressive symptoms, adjustment scores, stress scores or anxiety symptoms between mothers who have an uncomplicated vaginal birth and mothers who experience an instrument vaginal birth, elective cesarean, or cesarean while in labor.

2. There will be no significant difference in mother-reported non-reassuring fetal status (NRFS) for women who undergo labor induction or augmentation compared to those who have a spontaneous labor.

3. There will be no significant difference in depressive symptoms, adjustment scores, stress scores or anxiety symptoms between mothers who report NRFS and those who do not at one, two and three months postpartum.

4. There will be no significant difference in infant temperament scores at one month of age between newborns in the four mode of delivery groups (uncomplicated vaginal birth, instrument vaginal birth, elective cesarean delivery, or cesarean while in labor).

5. There will be no significant difference in sleep patterns or continuation of breastfeeding at one month of age between infants in the four mode of delivery groups.

6. There will be no significant difference in perception of maternal adjustment at one month postpartum between mothers in the four mode of delivery groups.

7. There will be no significant difference in stress scores or anxiety or depressive symptoms at one month postpartum between mothers in the four mode of delivery groups.

This dissertation was conducted in three phases. First, prenatal factors, including mother's sociodemographic risk factors and mental health factors (depression, anxiety, attitudes/adjustment, stress) were evaluated with mode of delivery as the key outcome. Secondly, labor induction was evaluated by maternal report of NRFS with both report of NRFS and maternal mental health factors as outcomes of interest. Lastly, mode of delivery was evaluated in relation to mother's rating of her infant's temperament, infant sleep and continuation of breastfeeding at one month of age, and maternal attitudes/adjustment, depressive symptoms, anxiety and perceived stress.

Research Design

This is a secondary analysis of data collected prospectively during a longitudinal clinical trial designed to test an intervention to improve postpartum sleep for mothers (Lee & Gay, 2011).

Sample and setting. As part of a longitudinal study, women were recruited from clinics serving low-income women in San Francisco, California. Included in the study were first-time expectant mothers who were at least 18 years of age and who could read and write English. Women were excluded if they had a sleep or mood disorder, or worked night shift. Women were enrolled in the third trimester and baseline measures were obtained prior to delivery. The participants were contacted by phone after delivery, at which time information about their labor was obtained before scheduling the one-month postpartum data collection visit. The five key questions that pertained to surrogate markers of birth trauma for this secondary analysis included:

1) Did you have any complications during labor or delivery? (if yes, open-ended for description)

2) Did your baby have any complications? (if yes, open ended for description)

3) Was your labor induced? How? Why?

4) Did you have an epidural?

5) Did you have a vaginal birth or a c-section? If vaginal did they need to use vacuum/forceps (circle one)? If c-section was it scheduled/emergency (circle one)? (reason for cesarean birth was open ended for explanation).

Data were coded by this researcher (a neonatal nurse and neonatal resuscitation team member) for NRFS based on the mother's own words. For example "baby's heart rate was falling", "his heart rate dropped a lot" and "baby was having heart decels" were coded as NRFS. One limitation of this secondary analysis is that NRFS may be underreported due to ambiguous data, as only statements regarding fetal heart rate in labor have been coded as NRFS. Coding was blind to induction status. Induction status was a dichotomous variable from maternal self-reports. The actual method of induction (for example using cervical ripening agents, intravenous pitocin infusion, or other mechanical methods) was not part of the data collection process and can not be controlled in this secondary analysis project.

Measures. Measures are listed in Table 1 and were collected as part of the larger studies. Table 1 includes the independent or predictor variables in the first column. The second column contains the outcome variables as well as the statistical analysis planned for each question.

Procedures. Statistical analyses were done using SPSS statistical software, version 18. Correlations and Chi-square analyses were done to test relationships between sociodemographic factors, prenatal symptoms of depression and anxiety, and four modes

of delivery. Analysis of variance was used to test for group differences (spontaneous vaginal birth, instrument vaginal birth, elective cesarean, and cesarean while in labor) and post-hoc unpaired t-test were used to determine which group differs significantly from the others. Mann-Whitney U and Kruskall-Wallis tests were used when variances were found to be unequal.

Chi-square analysis was used to evaluate the association between labor induction and NRFS, and analysis of variance was used to evaluate maternal mood outcomes at one month. Analysis of variance was run to test how mode of delivery impacted maternal mood symptoms as well as the three infant outcomes of interest (infant temperament, sleep-wake patterns, and feeding patterns).

Limitations

The major limitation to this study is that it is a secondary data analysis. While the study was prospective, the data for birth circumstances were limited and only available from the mother's self-report. With a sample of approximately 150 dyads, any effect size would need to be greater than 0.3 (standard deviation units) or a moderate effect size to be statistically significant at a two-tailed alpha of .05. As no studies have examined temperament related to birth trauma or adverse birth circumstances, these data will be useful in estimating the sample size needed for future research on this phenomenon. Finally, infant sleep and feeding data were obtained from diaries kept by the mothers. Diaries as a sole source of data are recognized as a potential threat to validity. These diaries were completed by mothers for only three days at one month after the birth of their first baby. A sleep diary completed by a sleep deprived new mother may pose an

even greater challenge to validity and reliability, but not necessarily any higher threat than for new mothers who already have young children at home.

Table 1. Adverse Birth Circumstances and Outcome Variables

Independent Variables	**Outcome Variables and Statistical Analyses**
1. Antepartum depressive symptom scores (Center for Epidemiological Studies – Depression - CES-D) 2. Antepartum anxiety symptoms scores (Profile of Mood States – POMS) 3. Antepartum stress scores (Cohen's Perceived Stress Scale - PSS) 4. Antepartum adjustment scores (Maternal Attitudes and Maternal Adjustment - MAMA)	Mode of birth: spontaneous vaginal instrument vaginal planned cesarean cesarean after labor onset **ANOVA, post-hoc t-tests (Mann Whitney U, and Kruskall-Wallis for unequal variances)**
1. Labor induction (postpartum self-report) 2. Non reassuring fetal status (NRFS) in labor	1. Non reassuring fetal status (NRFS) in labor 2. Maternal adjustment scores at one month 3. Maternal depressive symptoms at one month 4. Maternal anxiety symptoms at one month **Chi-Square, ANOVA, logistic regression**
Mode of birth: spontaneous vaginal instrument vaginal planned cesarean cesarean after labor onset	1. Infant temperament at one month 2. Infant sleep patterns at one month 3. Continuation of breastfeeding at one month 4. Maternal adjustment scores at one month 5. Maternal stress scores at one month 6. Maternal depressive symptoms at one month 7. Maternal anxiety symptoms at one month **ANOVA, Chi-Square for breastfeeding continuation**

Chapter 2

Evaluating Sociodemographic and Psychological Risk Factors for Mode of Delivery

Introduction

Prenatal depression can be a result of chronic depression, or may be new in a childbearing woman's life due to bodily changes, previous sexual history, sleep deprivation or fears of childbirth. Unlike postpartum depression, which has received attention in the research literature and in the media, prenatal depression is not routinely assessed. Prenatal stress and anxiety may be due to some of the same factors, and may include anxiety over caring for the new baby, and the ability to be a good mother. These psychological factors may play a role in mode of delivery (Wiklund, Edman, & Andolf, 2007). Mode of delivery can be an important issue as the physiologic risks for both mother and infant, and psychological risks to mother are greater in operative delivery (Carter, Frampton & Mulder, 2006; DiMatteo, Morton, Lepper, Damush, Carney, Pearson & Kahn, 1996).

Developmental infant outcomes are unknown, however preliminary data indicate that traumatic delivery can have lasting effects (Anand & Scalzo, 2000). Additionally, operative delivery results in longer length of hospital stay and increased cost of health care (Lancaster, Flynn, Johnson, Marcus & Davis, 2010; Sjogren & Thomassen, 1997).

The purpose of this study was to examine sociodemographic and psychological factors for modes of delivery that are not spontaneous vaginal birth. Mode of delivery in this study was differentiated into four possible categories: spontaneous vaginal, instrument vaginal, scheduled cesarean, and emergency cesarean with labor.

Review of Literature

Prenatal depression and delivery.

Length of hospital stay for delivery was compared between depressed and non-depressed women in a secondary analysis by Lancaster and colleagues (Lancaster, et al, 2010). They found that women with depression, as defined by a score ≥16 on the Centers for Epidemiologic Studies -Depression Scale (CES-D) at a prenatal visit had a longer postpartum hospital stay and higher hospital charges. Women who were depressed were more likely to be smokers, problem drinkers, single, younger, unemployed and publicly insured. Neither previous history of depression nor use of antidepressant medication was significantly associated with length of stay. Authors theorized that the increased length of stay may be related to labor management, including induction and pain management, and that altered neuroendocrine function in depressed women may alter the path of normal labor. This was a large sample of 867 women and a prospective study design, however, no mention was made of the refusal rate, and women who refused to participate may have been depressed and less likely to participate.

In a large descriptive study evaluating hospital discharge data from the Nationwide Inpatient Sample from 1998-2005, depression rose from 2.73 per 1000 women in 1998 to 14.1 women per 1000 in 2005(Bansil, Kuklina, Meikle, Posner, Kourtis, Ellington & Jamieson, 2010). The authors realized that a rise in recognition, screening practices, and acknowledgement of depression might have been contributing factors. Further, the authors indicate that this is likely an underreporting of the true incidence of depression in pregnancy, as only depression severe enough to be included in billing codes was counted, and subclinical or undiagnosed depression was not accounted

for. Included in this study were all women aged 15-44 years hospitalized for delivery. Out of 32,156,438 hospitalizations for delivery in women 15-44 years of age, diagnosis of depression had an overall rate of 7.62 per 1000 delivery hospitalizations. Rate of depression diagnosis increased with age, and was highest in the Northeast (10/1000 deliveries) and Midwest (9.5/1000 deliveries). Rates were also higher in the uninsured, those with other mental illness, and those with substance abuse problems. Women with depression had a significantly longer length of stay, and higher hospital financial charges, resulting from poorer maternal outcomes (preterm labor and delivery, preeclampsia, diabetes, anemia, placental abnormalities, infections and cesarean birth) and neonatal outcomes (fetal abnormalities, intrauterine growth restriction, non-reassuring fetal status and fetal death). Strengths of this study included a large sample size, billing codes for specificity of diagnosis, and a multi-institutional review. Limitations include lack of sensitivity of measuring depression, and retrospective study design.

One study addressed psychosocial factors and mode of delivery (van de Pol, de Leeuw, van Brummen, Bruinse, Heintz, & van der Vaart, 2006) in a secondary data analysis of a larger study in which participants completed the CES-D twice during pregnancy (at 24 and 36 weeks of gestation). Women were excluded if they had an elective cesarean, had unknown mode of delivery, induced labor, preterm labor, or breech presentation. The final sample consisted of 354 women from ten urban midwifery groups in the Netherlands. Data regarding delivery were obtained from the healthcare providers. Depression scores were not a risk factor for operative delivery (emergency cesarean delivery or instrument vaginal delivery), although they did find that women with greater emotional support and better perception of their relationship with their partners were

more likely to have operative deliveries, a finding contrary to expectations. Strengths of this study include sample size, multi-site recruitment, and multiple time points for assessing depression. Limitations include using only urban participants, and addressing emergency deliveries only, while not addressing choice of mode of delivery.

Prenatal depression, anxiety, fear of childbirth and mode of delivery.

Maternal request for cearean delivery.

Prenatal depression and anxiety may be associated with a fear of childbirth, and therefore result in birthing choices that are more costly and result in poorer outcomes for mother and baby, such as cesarean delivery (Saisto, Samela-Aro, Nurmi, Kononen, & Halmesmaki, 2001; Nerum, Halvorsen, Sorlie & Oian, 2006; Wiklund et al, 2007). Specifically, trait anxiety is linked with fear of childbirth (Spice, Jones, Hadjistravropoulos, Kowalyk & Stewart, 2009).

Regarding birth choices, researchers found in one sample of 310 Australian women (in a mix of public and private practice obstetrical care) 20 women (6.4%) preferred a cesarean section (Gamble, Health & Creedy, 2001). Those women had significantly higher State-Trait Anxiety Index (STAI) scores (mean of 40.44 in those who were already scheduled, and 43.3 in those who preferred a cesarean but did not schedule yet) than women who preferred a vaginal delivery (mean of 36.04 in women planning minimal pharmacologic pain relief, and 35.64 in those planning no analgesia in labor). Despite significant findings, there were only 20 women in this study who prefer a cesarean delivery. One major limitation to this study is that there was no differentiation between women who experienced trait anxiety and women who were anxious specifically

about childbirth. While this issue may not be critical to enlighten the findings, it may be important when looking forward to interventions for these individuals.

Emergency cesarean delivery.

With regard to emergency deliveries, a prospective study in Sweden from the early 1990s found prenatal anxiety, fear and stress to be significantly related to emergency cesarean delivery (Ryding, Wijma, Wijma, & Rydhstrom, 1998). Study participants were recruited in antenatal clinics over a 13-month period and completed the following three study questionnaires: 1) the Wijma Delivery Expectancy/Experience Questionnaire (W-DEQ), 2) the State-Trait Anxiety Inventory (STAI), and 3) the Stress and Coping Inventory (SCI). Of 2,361 who were eligible, there was an 84% response rate. The final sample of 1,981 women included 97 who had an emergency cesarean and they were matched with a control group of 194 women on age and parity. After controlling for statistically significant potential confounding variables of pre-pregnancy weight, history of infertility, previous history of emergency cesarean delivery, twin pregnancies, pre-eclampsia and small-for-gestational-age babies, all three of the questionnaires were statistical different between women who had emergency cesarean deliveries and those with vaginal deliveries. This finding indicated that women with emergency cesarean delivery were more likely to be anxious, stressed and scared of childbirth than those with vaginal deliveries.

In contrast, Johnson and Slade (2002) found no significant difference in mode of delivery based on fear of childbirth or anxiety scores. Of 396 participants, 48 were emergency cesareans, 243 were spontaneous vaginal births, 58 were instrument assisted vaginal births, and 47 were elective cesarean sections. These authors found no significant

difference in state or trait anxiety scores between women in any of these four groups. The authors acknowledge a likely response bias in these findings, with only a 35% response rate to a postal recruitment.

Prenatal stress and mode of delivery.

One study was located pertaining to the increase in emergency cesarean delivery with greater maternal prenatal stress (Saunders, Lobel, Veloso & Meyer, 2006). Researchers in New York and Massachusettes recruited 298 women between 10 and 25 weeks gestation to participate. Planned cesarean delivery was the only noted exclusion criteria. Prenatal stress was operationalized as state anxiety as well as life stress and pregnancy-specific stress, and all were measured using well-validated and reliable instruments (Prenatal Distress Questionnaire, Prenatal Life Events Scale, State Anxiety Subscale of the STAI, and the Perceived Stress Scale). Outcome variables were dichotomized and included fetal heart rate abnormalities, use of analgesia and unplanned cesarean delivery. Analgesia was further coded into epidural, meperidine, or both. Delivery information was obtained from medical records. Using structural equation modeling, the authors were able to significantly correlate higher prenatal stress with analgesia usage, which in turn correlated with unplanned cesarean delivery, often with fetal heart rate abnormalities as the indicator for emergency delivery. Strengths to this study included sample size, valid and reliable measures, and multiple assessment points throughout the pregnancy. No comparison group was used, and medication used in the epidural was not considered. A non-reassuring fetal heart rate tracing (a risk with some epidural medications) was frequently the indicator for the cesarean delivery (Van de Velde, Teunkens, Hanssens, Vandermeersch & Verhaeghe, 2004).

Prenatal maternal adjustment or attitude.

Maternal adaptation or adjustment in the prenatal period has not been explored in the literature as it relates to mode of delivery. This variable will be explored for its potential contribution to mode of delivery as a factor that could play a role in stress perception and allostatic load.

Theoretical Model

While a healthy adaptation to pregnancy and birth is associated with lower perceived stress, women are exposed to many stressors during pregnancy. In addition to sociodemographic factors present even before the pregnancy, depression, anxiety, and stress can increase allostatic load, or the wear and tear on the body due to stressful stimuli. The level of stress any one individual can manage before experiencing adverse physical consequences will differ based on genetic predisposition, age, and learned coping skills (McEwen & Seeman, 1999). These can affect behavioral choices (including choices in labor) as well as physical sequelae during labor.

Allostatic load can affect the unborn child as well. Allostatic load has been theorized to begin accumulating in the rapidly developing brain of the fetus (McEwen & Stellar, 1993; Lupien et al, 2009). Normal spontaneous vaginal delivery carries inherent stress due to contractions, labor hormones, and birth transition itself. Additional stress is placed on the infant in instrument vaginal or cesarean deliveries, and therefore risk of adverse outcomes for the newborn is increased.

Research Question

It was hypothesized that women who experienced different modes of birth would differ significantly on sociodemographic variables, prenatal depression, prenatal anxiety,

prenatal stress, or prenatal maternal adaptation. Specifically prenatal measures would indicate that women who proceed to have non-spontaneous vaginal deliveries would be more likely to be depressed, anxious, stressed or have a lower score on the "attitude toward baby" subscale.

Study Designs and Methods

Sample and setting.

Data were obtained as part of a secondary analysis of a larger postpartum study of women recruited from clinics serving low-income women in San Francisco, California. Included in the study were first-time expectant mothers who were at least 18 years of age and who could read and write English. Women were excluded if they ever had a sleep or mood disorder diagnosed, or worked night shifts. In the third trimester, participants were asked to give responses to questionnaires that included the Center for Epidemiologic Studies Depression scale (CES-D), Profile of Mood States (POMS) anxiety subscale, Perceived Stress Scale (PSS) and Maternal Adjustment Maternal Adaptation (MAMA). Women were again contacted by phone after delivery, at which time information about their labor and delivery experience was obtained. Further details about the design and sample for both original studies can be found elsewhere (Lee & Gay, 2011).

Measures

Depressive Symptoms.

The Center for Epidemiologic Studies Depression scale (CES-D) is a 20-item self-report questionnaire that was developed to assess depressive symptoms in the general population. It has since been validated with specific populations (Radloff, 1977). The CES-D assesses frequency of symptoms over the past week, using a 0-3 categorical scale

where zero equals “Rarely or None of the Time (Less than 1Day)”, one means “Some or a Little of the Time (1-2 Days), two is “Occasionally or a Moderate Amount of Time (3-4 Days)”, and 3 equals “Most or All of the Time (5-7 Days)”. Four questions were worded in a positive direction, to break up response sets. For example, question eight states “I felt hopeful about the future”. This measure takes less than 5 minutes to complete, and a score of 16 or greater is indicative of risk for depression.

Factor analysis yielded four factors and kept items with factor loadings greater than .4, depressed affect (blues, depressed, lonely, cry, sad), positive affect (good, hopeful, happy, enjoy), somatic and retarded activity (bothered, appetite, effort, sleep, get going), and interpersonal (unfriendly, dislike). Comparing across three samples, the correlation coefficients for like items were very high (.87 to .99) and very low for differing items (the largest being .13). This indicates that the factor structure holds across groups (Radloff, 1977).

Characteristics of the 121 women studied by Mosack and Shore (1987) included 15-42 year old White, African-American, and Hispanic pregnant and postpartum women. Nineteen women were pregnant, 40 were early postpartum and 39 were late postpartum (6 months to 2 ½ years following delivery). These authors were comparing the effectiveness of the CES-D and the Edinburgh Postnatal Depression scale (EDPS). Data were archival, and only 98 women had completed both depression-screening tools. Cronbach alpha for the CES-D in this group was .87. In their sample, the CES-D was more sensitive, screening 31.6% of participants as at risk for depression (scoring 16 or greater), whereas only 14.3% of participants scored at risk for depression (12 or greater) using the EPDS. Further, the CES-D identified six of the pregnant women as at risk for

depression, and the EPDS did not identify any (Mosack & Shore, 1984). This would indicate that the CES-D is an appropriate measure for use in the pregnant and postpartum population.

Anxiety Symptoms

The Profile of Mood States (POMS) is a 65-item scale with six subscales including Tension-Anxiety, Depression-Dejection, Anger-Hostility, Vigor, Fatigue, and Confusion-Bewilderment. The timeframe referenced in the scale is the previous week, including the current day. The questions inquire how an activity or mood state indicated has been experienced, and the response range is 0 (not at all) to 4 (extremely). Scores are sums of responses (Tunis, Golbus, Copeland, Fine, Rosinsky, & Seely, 1990).

In a group of 705 pregnant women in their first trimester of pregnancy seeking genetic counseling for advanced maternal age, the POMS scale was administered and analyzed for psychometric properties (Tunis, et al 1990). Average age of these women was 36.7 years (SD, 2.1, range 33-44 years). Average gestational age was 9.2 weeks (range 6-12 weeks). The women in this sample were predominantly white, well educated, and partnered. The authors performed a factor analysis and found that a seven-factor solution fit this group. The included factors were “Depression”, “Vigor”, “Alert-Friendly, or Sociable”, “Relaxed-Unafraid” (an inverse of the original Tension-Anxiety subscale), “Nonirritable”, “Negative Regard for Self and Others”, and “Distracted”.This current dissertation study used the 9-item “Relaxed-Unafraid” subscale, which includes tense, shaky, on edge, panicky, relaxed, uneasy, restless, nervous and anxious. Higher scores indicate more fear/anxiety.

Perceived Stress.

Prior to the development of the Perceived Stress Scale (PSS), stress was measured on number of assumed stressful events one was managing. This did not address the subjective nature of the perception of events as stressful. The advent of the PSS answered this need (Cohen, Kamarck & Mermelstein, 1983). The original PSS was a 14-item scale that measures situational (non-specific) stress – as the concept of global stress is too highly correlated with number of stressful situations experienced. Validation was done using three samples, two college student groups, and one a group enrolled in a smoking-cessation program for heterogeneity. Questions are stated both positively and negatively, with reverse scoring needed on seven items. The PSS is aimed at a minimum of a junior high school education level, though it was validated in a younger, more highly educated sample with fewer minorities than the general population. Cronbach alpha for reliability for the PSS in the three groups were .84 (college 1), .85 (college 2) and .86 (smoking cessation). Test-retest correlations were done at two days and at six weeks, as short and long interval reliability findings indicate measurement of a state (should be much higher in short intervals than for long intervals). This was found to be the case, where the test-retest correlation was .85 at two days and .55 at six weeks. Concurrent validity was shown via correlations between the PSS and scores of life event stressors, and impact of event ratings.

Validity for the PSS's ability to predict health outcomes was established by comparing outcomes with symptomatology of the individuals. This correlation is predictive, but not causal, therefore whether the symptoms caused the stress, or the stress caused the symptoms is not indicated. The PSS has also been validated as a predictor of

utilization of health services, with significant correlations in the college samples. PSS was also validated as a predictor of social anxiety with moderate, but significant, correlations in the college samples. Lastly, the PSS was validated as predictive of smoking reduction in the smoking cessation group (Cohen et al, 1983). The 10-item version, also valid and reliable for women during the childbearing years was used in this current dissertation study (Cohen et al 1983).

Maternal Adjustment and Attitudes.

The Maternal Adjustment Maternal Attitudes (MAMA) questionnaire is a self-administered tool designed to estimate changes in maternal adjustment, spousal relationships, and attitudes toward the baby. This tool was developed using focus groups of pregnant women with researchers in attendance. Six categories of maternal attitudes, self-perception, and behavior were identified (body image, somatic symptoms, the marital relationship, attitudes and feelings about sex, sexual activity, and attitudes to the pregnancy and the baby). The entire 60-item questionnaire requires about 10 minutes to complete (Kumar, Robsen & Smith, 1984). This current dissertation study used the "attitude toward pregnancy and the baby" subscale with 12 items.

The MAMA responses are on a four-point scale, using the words "Never", "Rarely", "Often" and "Very often" to refer to the past month. Questions were randomly reverse-coded to avoid response bias. An item analysis was done and if individual questions correlated with the overall sub-score at greater than .7, they were removed from the questionnaire. Further questions were removed if they received a score of 3-4 from fewer than 10% or more than 90% of participants. The questionnaire was also worded appropriately for postpartum use. Psychometric analysis was conducted with 119 women.

The tests used for reliability of the MAMA questionnaire were test-retest and split half reliability. Test-retest evaluation was challenging because this questionnaire is intended to measure change. To minimize this change as well as decrease the likelihood of recall, the test was administered twice, one week apart. This testing was done in a subsample of 38 women. Split half analysis was done in the entire sample of 119. Test-retest correlations for all sections were .81-.95. Using split half, correlations were .58 (somatic symptoms) to .82 (attitudes to sex). All correlations were statistically significant.

For evaluation of the MAMA questionnaire's criterion-related validity each subscale compared women's responses on presumed representative questions for that subscale. T-tests were run between groups who responded to these questions in differing fashion, and all were found statistically significant. Additionally questionnaire results were compared to interview results as further evidence of criterion-related validity. It continues to be used in the literature as a valid and reliable measure of maternal attitude and adjustment (Wan, Sharp, Howard & Abel, 2011).

Data Analysis

Data were analyzed using SPSS version 18. Chi-Square statistics were conducted for categorical data (Work Status, Education, Partner Status, Race and Household Income). Analyses of variance were conducted for maternal age, pre-pregnancy BMI, length of labor, birthweight, and symptoms of depression, anxiety, and perceived stress. Tukey post-hoc statistics were calculated for significant continuous variables, with non-parametric measures of Kruskall-Wallis and Mann-Whitney U used to verify findings when variances were not equal.

Results

Demographic characteristics of the sample are presented in Table 1. Analysis of variance output indicated that maternal age (F=4.057, p=.008) and maternal prepregnancy BMI (F=3.978, p=.009) were significantly different across the four modes of delivery. The scheduled cesarean delivery group, though small (n=6) was significantly older than the normal spontaneous vaginal delivery (NSVD) group (mean = 33.3 $\pm$ 10.2, p=.008) and had a higher pre-pregnancy body mass index (BMI) (30.9 $\pm$ 8.4. p=.009). There was no difference between women who experienced cesarean birth in labor and women with NSVD. No other significant differences were seen for mode of delivery based on sociodemographic variables (Table 1).

No significant differences in mean scores for prenatal depressive symptoms, stress or anxiety were seen between the different groups (Table 2). This remained true when the women who scheduled a cesarean birth were included in other groups. Sample size may have been too small for adequate power to detect a potential effect. However, maternal attitude toward baby scores differed significantly between the four mode of delivery groups (F=3.029, p=.03; Kruskall-Wallis p=.046 for unequal variances). Lower scores reflect a more positive attitude toward baby, and mothers who went on to have a cesarean delivery during labor scored significantly lower than those who had a NSVD.

When all vaginal births (spontaneous and assisted) were compared with all cesarean births (scheduled and emergency), scores from mothers who had cesarean births remained significantly lower than those delivering vaginally (variances assumed not equal, t=2.969, p=.004; Mann-Whitney U p=.021).

Discussion

Sociodemographics did not differ by mode of delivery, with the exception of women who were scheduled for a cesarean birth (n = 6). The scheduled cesarean delivery group was significantly older and had higher pre-pregnancy BMI than the NSVD group . This is somewhat inconsistent with current research that shows that with an increase in BMI; there is an increased risk of cesarean deliveries of all types (Lynch, Sexton, Hession & Morrison, 2008; Crane, Wojtowycz, Dye, Aubry & Artal, 1997).

No significant differences were found between mode of delivery groups for pregnancy scores on symptoms of depression, anxiety, or perceived stress. Third trimester depression and anxiety scores were highest in the scheduled cesarean group and the instrument vaginal group, whereas perceived stress scores were highest in the NSVD group. Depressive symptom scores were high in this sample during the third trimester (30% of women had a CES-D score of 16 or higher). This may be due to sampling from low-income clinics, as lower socio-economic status is a risk factor for depression, especially in pregnancy (Lancaster, Gold, Flynn, Yoo, Marcus & Davis, 2010). Therefore low income may be a contributing factor for depressive symptoms, and for anxiety and stress as well.

Prenatal maternal adjustment was significantly different between mode of delivery groups. Women who went on to have a cesarean in labor had significantly lower attitude scores at the third trimester assessment, indicating a more positive attitude. There is no current literature exploring the relationship between the labor process and having a more positive attitude toward the pregnancy and baby.According to some literature, however women who have greater maternal-fetal attachment (not the concept measured

here, though likely similar) are more likely to have used technology, such as high level ultrasounds, during the pregnancy (Boukydis, Treadwell, Delaney-Black, Boyes, King, Robinson & Sokol, 2006; Pretorius, Gattu, Ji, Hollenbach, Newton, Hull, Carmona, D'Agnostini & Nelson, 2006; Ji, Pretorius, Newton, Uyan, Hull, Hollenbach & Nelson, 2005). This acceptance may carry over to accepting other interventions toward the end of pregnancy. Specifically, mothers with a more positive attitude toward baby may be more likely to accept interventions that allow them to meet their baby sooner, such as labor induction, rather than waiting for spontaneous labor. This in turn may place the mother-infant dyad at increased risk for emergency cesarean delivery (Choudhury & Dawson, 2009).

A major limitation to this study is the small sample size for two of the mode of delivery groups, specifically only six women in the scheduled cesarean birth group and 14 women in the instrument vaginal delivery group. While findings from this study are inconsistent with much of the previous literature showing that prenatal mental health problems are a risk factor for cesarean delivery, is very likely due to a lack of adequate statistical power. Effect sizes in standard deviation units were calculated for differences in CES-D, POMS and PSS scores between the NSVD group and the cesarean in labor group. Effect sizes were small for both the CES-D (.166 SD units) and PSS (.23 SD units). For the POMS, the effect size was more moderate (.33 SD units), indicating that at least 135 women per group would be needed in order for the difference to be statistically significant at $p < .05$ with power of .80 (Cohen, 1988, page 55).

An additional limitation was that fear of childbirth was not measured in the original study. Therefore an assumption for this secondary analysis was that prenatal

anxiety might serve as a conceptual proxy measure for fear of childbirth. Anxiety in this case was measured as a general concept and was not differentiated into state or trait anxiety. With an adequate sample size and confirming the concepts in question and choosing measurement tools that match those concepts, there would be value to replicating the study to understand better the role of prenatal maternal mood in mode of delivery.

Lastly, the data for mode of delivery were maternal self-report. No chart review was done to verify mode of birth or health care providers' documentation of the birthing process. Length of labor was reported in two of six scheduled cesarean births; one woman had gone into labor prior to her scheduled delivery for breech presentation. The other had requested a cesarean delivery, as she "didn't want the pain." but she reported having 20 hours of labor. These were included in the cesarean delivery group for the analysis of length of labor.

Table 1. Chi-Square and ANOVA output for sample demographics by Mode of Delivery (n =148 nullipara)

		Spontaneous Vaginal (n = 89)	Instrument Vaginal (n=14)	Scheduled Cesarean (n=6)	Cesarean in Labor (n=39)	p value
Work Status	Full Time	3 (2%)	0 (0%)	0 (0%)	2 (1.5%)	p =.44
	Part Time	12 (8%)	4 (3%)	0 (0%)	3 (2%)	
	Not Employed	73 (50%)	10 (7%)	6 (4%)	34 (23%)	
Education	</=High School	36 (24%)	4 (3%)	2 (1.5%)	11 (8%)	p =.17
	Some College	43 (30%)	8 (6%)	3 (2%)	28 (19%)	
	Some Grad School	10 (7%)	2 (.5%)	1 (1%)	0 (0%)	
Partner Status	Unpartnered	14 (10%)	2 (1.5%)	2 (1.5%)	8 (5.5%)	p =.67
	Partnered	75 (51%)	12 (8%)	4 (3%)	31 (21%)	
Race	Asian	22 (15%)	8 (6%)	2 (1.5%)	14 (10%)	p =.13
	African American	11 (8%)	3 (2%)	2 (1.5%)	5 (3.5%)	
	Caucasian	28 (19%)	1 (1%)	0 (0%)	7 (5%)	
	Other**	28 (19%)	2 (1.5%)	2 (1.5%)	13 (9%)	
Household Income (per month)	<$1,000	31 (21%)	5 (3.5%)	2 (1.5%)	13 (9%)	p =.93
	$1,000-$1,999	26 (18%)	4 (3.0%)	2 (1.5%)	11 (8%)	
	$2,000-$2,999	12 (8%)	2 (1.5%)	2 (1.5%)	8 (6%)	
	>$3,000	15 (10%)	1 (1%)	0 (0%)	4 (3%)	
	don't know	3 (2%)	1 (1%)	0 (0%)	3 (2%)	

Age (years)	Mean ± SD	25.5±6	29.5±7.5	33.3±10.2	26.8±6	p =.008*
BMI pre-pregnancy	Mean±SD	23.8±4.7	22.9±3.3	30.9±8.4	25.1±5.4	p =.009*
Length of labor (hrs)	Mean±SD	16.2±11.7	14.6±8.9		19.3±15.0	p =.33
Birth-weight (kg)	Mean±SD	3.24±.5	3.25±.6	3.36±.5	3.55±.5	p =.11

*statistically significant

**including Native American, Pacific Islander, Latina and multi-racial

Table 2. ANOVA output for depressive symptoms (CES-D), anxiety (POMS), stress (PSS) and attitude toward baby (MAMA)

		Spontaneous Vaginal (n = 89)	Instrument Vaginal (n = 14)	Scheduled Cesarean (n=6)	Cesarean in Labor (n=39)	p value
CES-D	Mean±SD	14.7±8.9	15.7±10.5	16.7±8.4	13.2±9.6	p=.83
POMS	Mean±SD	8.9±6.2	9.4±6.7	10.2±6.9	6.7±5.9	p=.24
PSS	Mean±SD	16.3±6.5	15.1±8.1	15.8±3.3	14.8±6.7	p=.66
MAMA	Mean±SD	2.02±.36	2.08±.47	2.05±.21	1.84±.26	p=.03*

*statistically significant

Chapter 3

Maternal Report of Non-Reassuring Fetal Status Is More Common in Induced or Augmented Labors, and Long-term Maternal Mood Outcomes

Background

The rate of labor induction is on the rise. According to the Center for Disease Prevention and Control (CDC), inductions increased from 9.5% in 1990 to 22.5% in 2006 (Nelson, 2009). However, these statistics may under-report induction rates due to varying methods of differentiating labor induction and augmentation, and the rate likely does not include rates of labor augmentation. Further, using a chart review (medical records, birth certificate, and discharge data) researchers found that 15% of 1473 women who underwent inductions in Washington State in 2000, did so without medical indication (Lydon-Rochelle et al, 2007). Labor induction involves external chemical or physical measures to begin a non-spontaneous labor. Labor augmentation uses these same measures to encourage or speed a labor that has already begun. This carries risk to both mother and baby. For example, Feinstein, Sheiner, Levy, Hallak and Mazor (2002) found labor induction to be a risk factor for failure to progress in first stage labor, as well as for arrest of descent in second stage labor. This resulted in a higher incidence of instrument deliveries and cesarean births, as well as significantly lower Apgar scores. Glantz (2005) also found that induced labor was associated with more interventions, more cesarean births, and a longer length of stay. Use of misoprostil (Cytotec) as a cervical ripening agent for labor induction was associated with a significantly increased risk of uterine hyperstimulation and meconium passage (Hofmeyr and Gulmezoglu, 2007).

These outcomes are not only suboptimal for the neonate as they adjust to the outside world, but for the mother as well**.** Separation of the mother/baby dyad for neonatal resuscitation team intervention interrupts the critical bonding period, can make

breastfeeding more difficult**,** and adds emotional stress to what should be a joyous time (Beck, 2004; Dewey, 2001; Dewey, Nommsen-Rivers, Heining & Cohen, 2003; Hatch & Maietta, 1991; Sievers, 2003). Soet, Brack, and Dilorio (2003) found that 34% of the 112 women in their study had symptoms of post-traumatic stress (PTSD) after delivery. Contributing factors to experiencing trauma during labor and delivery included feeling powerless, lack of social support, unexpected pain in labor, and medical interventions.

The purpose of this secondary analysis was to better understand the potential effects of labor induction or augmentation, women's understanding if their unborn child is at risk during labor, and resultant emotional outcomes of this potentially traumatic birth experience. A second purpose of this study was to evaluate if mother's understanding of risk to her unborn child in labor could be used as a proxy measure for mother's experience of traumatic birth.

Literature Review

Beck and Watson (2008) performed a qualitative phenomenological study of 52 women who shared their birth experiences online with researchers who perceived their births to be traumatic, and who experienced an alteration in her choice or experience of breastfeeding. Birth trauma was either physical, emotional or both. The most common types of trauma included emergency cesarean delivery, postpartum hemorrhage, premature delivery, infant in the neonatal intensive care unit (NICU), instrument delivery, preeclampsia, and third- or fourth-degree lacerations. Nineteen participants (37%) were diagnosed with PTSD and sixteen were currently seeing a therapist. Women typed their own responses, and authors used Colaizzi's method of analysis to gain the essence of the experience of breastfeeding after traumatic delivery. Themes that arose

included those that promoted breastfeeding success (“proving oneself as a mother”, “atonement to the infant”, and “healing mentally”) as well as those that inhibited breastfeeding success (“intruding flashbacks”, “disturbing detachment”, “enduring physical pain”, “feeling violated”, and “insufficient milk supply”).

In a prospective investigation of incidence of PTSD as a result of childbirth, Ayers and Pickering (2001) sent out questionnaires to 289 women in the United Kingdom at three time points, including the third trimester, in order to control for signs of PTSD prior to birth. Response rate varied at different time points, with 77% responding in the third trimester, 75% at six weeks postpartum, and 70% at six months postpartum. Women who showed signs of PTSD in pregnancy were excluded from the final analysis. Prenatal PTSD was measured using the MMPI-2-Post-traumatic Stress Disorder Scale (adapted from the Minnesota Multiphasic Personality Inventory), a non-event specific questionnaire. Postpartum PTSD was measured using the Post-traumatic Stress Disorder Symptom Scale (which follows the DSM-IV criteria, and is specific to childbirth). Reliability for both scales was good. Sensitivity was low and specificity was high, making it a conservative measure less likely to create false positives and a reasonable measure for postpartum PTSD, as PTSD in this population can be controversial Depression was also measured with a valid and reliable instrument (the General Health Questionnaire). The incidence of responders who fulfilled criteria for PTSD at 6 weeks postpartum was 2.8%. Conservative and aggressive estimates were made for non-responders on the assumption that they either did or did not exhibit PTSD, which resulted in a range of 2%-27% at 6 weeks. Limitations to this study included a relatively small sample size, and a sample not broad enough in general characteristics to be representative

of the larger population, and not addressing women who exhibited PTSD symptoms in the absence of full PTSD. However, this study was the first prospective study that controlled for previous PTSD and still demonstrated PTSD related to childbirth. The well-validated and reliable tools, with 100% sensitivity for postpartum PTSD, contribute to the validity that PTSD does exist as a result of childbirth.

Soet and colleagues (2003) looked at the possible causal factors of trauma in childbirth while also examining rates of trauma in childbirth in women with similar births who did and did not develop PTSD symptoms. This study was conducted in Atlanta, Georgia, and women were recruited in late pregnancy from childbirth education classes. They completed an initial questionnaire regarding demographics, their pregnancy history, and any past psychological trauma. They were then contacted by telephone four weeks after their due date (this timing allowed for them to meet the DSM-IV criteria of symptoms for at least four weeks for a diagnosis of PTSD). The questionnaires used in the pretest included the Pregnancy Attitude Index, a locus of control scale, the Wijma Delivery Expectancy/Experiences Questionnaire (W-DEQ), the Childbirth Self-Efficacy Inventory to evaluate self-efficacy for coping with the birth experience, the Medical Outcomes Study Social Support Survey, which measured women's perception of social support during the pregnancy, the State-Trait Anxiety Inventory, and the Sense of Coherence Scale. All measures had good reliability. In the postpartum interview, researchers used the Traumatic Event Scale based on DSM-IV criteria for PTSD, which included subsets to assess trauma specific to birth, symptoms of PTSD, and one open-ended question stating "In general my childbirth experience was…" (p. 39). The Medical Intervention Scale, and an adapted scale to measure the woman's perception of her

interactions with medical personnel were also used. Again, all measures had good reliability. Participants who completed the postpartum questionnaire were more likely to be White, but did not differ on any other demographic variables. One-third (34%) of the final sample reported their birth as a traumatic event, and of those, 40% had PTSD symptoms.

Significant antecedent variables of perception of childbirth as traumatic included history of sexual trauma, less social support, increased trait anxiety, and lower coping scores. Significant event variables of perception of childbirth as traumatic included cesarean birth, medical interventions, pain in first stages, long labor, negative expectation differences, feelings of powerlessness, and inadequate information. Characteristics of the women that were significantly different between those who developed PTSD symptoms and those who did not included a stronger internal locus of control, lower self-efficacy for the birth, increased state and trait anxiety, and lower coping capacity. The major limitation of this study was lack of accounting for PTSD symptoms prior to the birth, as some women did not perceive their birth as traumatic but reported PTSD symptoms postpartum. Subject burden due to the number of measures (and possibly resultant attrition) may have threatened the findings in this study as well. Additionally, this sample included a majority of upper-middle class Caucasian women from the South, limiting generalizability, though 30% of the women were African American, allowing the first evaluation of women from that population. Other strengths included well-validated and reliable measures, and prospective study design.

The Traumatic Events Scale was used in a Swedish study to evaluate a sample of 1640 women for incidence of PTSD. Women who exhibited symptoms of PTSD, but did

not meet criteria for PTSD were included in the non-PTSD group for analysis (Wijma, Soderquist & Wijma, 1997). The researchers hypothesized that PTSD would be associated with a negative perception of birth experience, and that it would be further associated with nulliparity. Perception of birth was measured using the W-DEQ. In this sample, 28 women (1.7%) were considered as having PTSD related to childbirth. Demographic factors did not differ between the PTSD and non-PTSD group, however the PTSD group had a higher proportion of nulliparous women, and women who had undergone previous psychological treatment. Women in the PTSD group also indicated a more negative experience with the staff at delivery, though both groups were similar on their satisfaction with postpartum staff. Authors included in the discussion their thought that the core of postpartum PTSD was the life-threatening aspect to both the woman and the child when things do not go smoothly. The discussion also stated the possibility of women perceiving the birth as a threat to their personal integrity. Strengths of this study included a large representative sample, addressing the DSM-IV criteria for PTSD, a well-validated tool for measuring trauma in birth, and the findings are well described. Limitations include the use of a non-validated tool and mailed questionnaires.

An Australian study recruited women in the third trimester of a low-risk pregnancy, and obtained consent from 592 women who completed prenatal questions regarding demographic information, preparation for childbirth, obstetric history, and a State-Trait Anxiety Inventory. They were not asked about previous trauma. Four to six weeks after delivery, the researchers interviewed participants by telephone (to minimize attrition and optimize validity of responses). Included were questions about the delivery, the Perception of Care Questionnaire, and questions from the Posttraumatic Stress

Symptoms interview. A chart audit was used to validate women's reports of incidences in their labor. In this study, 33% of women indicated a stressful birth, and three or more trauma symptoms. Stressors included extreme pain, fear for her life, her baby's life or both, and a perceived lack of care. Symptoms of trauma were reported by 113 (22.6%) women, although they did not meet the full criteria (six trauma symptoms) for PTSD and 28 (5.6%) of the women met the DSM-IV diagnostic criteria for acute PTSD. Parity was not related to PTSD symptoms. Contributing factors to symptoms of acute trauma included obstetric interventions (including emergency cesarean delivery, forceps or vacuum, and amount of postpartum analgesia), concern for baby's life, dissatisfaction with care at delivery, and perception of partner support. Lack of satisfaction with care at delivery was additive to interventions in labor, rather than being a mediator. Strengths of this study include addressing those women who exhibit post-traumatic symptoms, but did not meet all of the DSM-IV criteria, as well as evaluating the traumatic effects of instrument delivery – largely dismissed in previous literature.

Theoretical framework

The accumulation of stress throughout labor can increase a mother's allostatic load, or her body's ability to adapt and cope with fluctuations in physical and emotional stressors (McEwen & Stellar, 1993). The stress of induction, as well as the stress of perception of threat to a woman's unborn child, has potential for negative emotional as well as physical effects. Perception of an experience as stressful is subjective, and no two individuals will interpret an experience the same way based on their knowledge, history, choices and the social context of the potential stressor (McEwen & Seeman, 1999). Evaluating these stressors as contributors to allostatic load, and postpartum emotional

outcomes, places emphasis on the need to use patient education (knowledge), and active participation in one's own care (choices and social context), to decrease perception of these experiences as stressors and optimize emotional health outcomes.

Research Question

In order to better understand the potential effects of labor induction or augmentation, and resultant traumatic birth experience, it is important to know if women perceive risk to their unborn child during labor. The two-part study question was: After labor induction/augmentation, did women perceive their unborn children to have non-reassuring fetal heart tones during labor; and could this perception be used as a proxy measure of traumatic delivery experience? If risk to the infant was perceived, did it them affect postpartum emotional symptoms at one month postpartum?

Study Designs and Methods

Sample and setting.

Data were obtained as part of a larger clinical trial designed to test an intervention to improve postpartum sleep (Lee & Gay, 2011). As part of this longitudinal study, women were recruited from clinics serving low-income women in San Francisco, California. Included in the study were first-time expectant mothers who were at least 18 years of age and who could read and write English. Women were excluded if they had a diagnosis at any time of sleep or mood disorder, or worked night shift.

Methods of data collection.

Women were contacted by telephone after delivery, at which time information about their labor was obtained. Questions that pertained to induction or augmentation and resulted in information regarding fetal status included:

Did you have any complications during labor or delivery? (if yes, open ended for description)

Did your baby have any complications? (if yes, open ended for description)

Was your labor induced? How? Why? (descriptions of labor induction and augmentation were both included in the results of this question)

Data were coded by the first author. Non-reassuring fetal status (NRFS) was assessed based on mother's own words (for example "baby's heart rate was falling", "his heart rate dropped a lot" and "baby was having heart decels"). NRFS may be underreported due to ambiguous data, as only statements regarding fetal heart rate during labor were coded as NRFS. Coding was blind to induction/augmentation status. Induction or augmentation status was a dichotomous variable from maternal self-report, and was coded as induction (yes or no).

Post-partum measures were administered during home visits and included the 20-item Center for Epidemiologic Studies Depression scale (CES-D) for depressive symptoms, the 9-item Profile of Mood States (POMS) subscale for anxiety symptoms, the 10-item Perceived Stress Scale (PSS), and the 12-item Maternal Adjustment Maternal Attitudes Scale (MAMA) .

Measures

Postpartum Depressive Symptoms.

The Center for Epidemiologic Studies Depression scale (CES-D) is a 20-item self-report questionnaire that was developed to assess depressive symptoms in the general population. It has since been validated with specific populations (Radloff, 1977). The CES-D assesses frequency of symptoms over the past week, using a 0-3 categorical scale

where zero equals “Rarely or None of the Time (Less than 1Day)”, one means “Some or a Little of the Time (1-2 Days), two is “Occasionally or a Moderate Amount of Time (3-4 Days)”, and 3 equals “Most or All of the Time (5-7 Days)”. Four questions were worded in a positive direction, to break up response sets. For example, question eight states “I felt hopeful about the future”. This measure takes less than 5 minutes to complete, and a score of 16 or greater is indicative of risk for depression.

Factor analysis yielded four factors and kept items with factor loadings greater than .4, depressed affect (blues, depressed, lonely, cry, sad), positive affect (good, hopeful, happy, enjoy), somatic and retarded activity (bothered, appetite, effort, sleep, get going), and interpersonal (unfriendly, dislike). Comparing across three samples, the correlation coefficients for like items were very high (.87 to .99) and very low for differing items (the largest being .13). This indicates that the factor structure holds across groups (Radloff, 1977).

Characteristics of the 121 women studied by Mosack and Shore (1987) included 15-42 year old White, African-American, and Hispanic pregnant and postpartum women. Nineteen women were pregnant, 40 were early postpartum and 39 were late postpartum (6 months to 2 ½ years following delivery). These authors were comparing the effectiveness of the CES-D and the Edinburgh Postnatal Depression scale (EDPS). Data were archival, and only 98 women had completed both depression-screening tools. Cronbach alpha for the CES-D in this group was .87. In their sample, the CES-D was more sensitive, screening 31.6% of participants as at risk for depression (scoring 16 or greater), whereas only 14.3% of participants scored at risk for depression (12 or greater) using the EPDS. Further, the CES-D identified six of the pregnant women as at risk for

depression, and the EPDS did not identify any (Mosack & Shore, 1984). This would indicate that the CES-D is an appropriate measure for use in the pregnant and postpartum population.

Postpartum Anxiety Symptoms

The Profile of Mood States (POMS) is a 65-item scale with six subscales including Tension-Anxiety, Depression-Dejection, Anger-Hostility, Vigor, Fatigue, and Confusion-Bewilderment. The timeframe referenced in the scale is the previous week, including the current day. The questions inquire how an activity or mood state indicated has been experienced, and the response range is 0 (not at all) to 4 (extremely). Scores are sums of responses (Tunis, Golbus, Copeland, Fine, Rosinsky, & Seely, 1990).

In a group of 705 pregnant women in their first trimester of pregnancy seeking genetic counseling for advanced maternal age, the POMS scale was administered and analyzed for psychometric properties (Tunis, et al 1990). Average age of these women was 36.7 years (SD, 2.1, range 33-44 years). Average gestational age was 9.2 weeks (range 6-12 weeks). The women in this sample were predominantly white, well educated, and partnered. The authors performed a factor analysis and found that a seven-factor solution fit this group. The included factors were “Depression”, “Vigor”, “Alert-Friendly, or Sociable”, “Relaxed-Unafraid” (an inverse of the original Tension-Anxiety subscale), “Nonirritable”, “Negative Regard for Self and Others”, and “Distracted”.This current dissertation study used the 9-item “Relaxed-Unafraid” subscale, which includes tense, shaky, on edge, panicky, relaxed, uneasy, restless, nervous and anxious. Higher scores indicate more fear/anxiety.

Perceived Stress.

Prior to the development of the Perceived Stress Scale (PSS), stress was measured on number of assumed stressful events one was managing. This did not address the subjective nature of the perception of events as stressful. The advent of the PSS answered this need (Cohen, Kamarck & Mermelstein, 1983). The original PSS was a 14-item scale that measures situational (non-specific) stress – as the concept of global stress is too highly correlated with number of stressful situations experienced. Validation was done using three samples, two college student groups, and one a group enrolled in a smoking-cessation program for heterogeneity. Questions are stated both positively and negatively, with reverse scoring needed on seven items. The PSS is aimed at a minimum of a junior high school education level, though it was validated in a younger, more highly educated sample with fewer minorities than the general population. Cronbach alpha for reliability for the PSS in the three groups were .84 (college 1), .85 (college 2) and .86 (smoking cessation). Test-retest correlations were done at two days and at six weeks, as short and long interval reliability findings indicate measurement of a state (should be much higher in short intervals than for long intervals). This was found to be the case, where the test-retest correlation was .85 at two days and .55 at six weeks. Concurrent validity was shown via correlations between the PSS and scores of life event stressors, and impact of event ratings.

Validity for the PSS's ability to predict health outcomes was established by comparing outcomes with symptomatology of the individuals. This correlation is predictive, but not causal, therefore whether the symptoms caused the stress, or the stress caused the symptoms is not indicated. The PSS has also been validated as a predictor of

utilization of health services, with significant correlations in the college samples. PSS was also validated as a predictor of social anxiety with moderate, but significant, correlations in the college samples. Lastly, the PSS was validated as predictive of smoking reduction in the smoking cessation group (Cohen et al, 1983). The 10-item version was used in this dissertation study.

Maternal Adjustment and Attitudes.

The Maternal Adjustment Maternal Attitudes (MAMA) questionnaire is a self-administered tool designed to estimate changes in maternal adjustment, spousal relationships, and attitudes toward the baby. This tool was developed using focus groups of pregnant women with researchers in attendance. Six categories of maternal attitudes, self-perception, and behavior were identified (body image, somatic symptoms, the marital relationship, attitudes and feelings about sex, sexual activity, and attitudes to the pregnancy and the baby). The entire 60-item questionnaire requires about 10 minutes to complete (Kumar, Robsen & Smith, 1984). This current dissertation study used the "attitude toward pregnancy and the baby" subscale with 12 items.

The MAMA responses are on a four-point scale, using the words "Never", "Rarely", "Often" and "Very often" to refer to the past month. Questions were randomly reverse-coded to avoid response bias. An item analysis was done and if individual questions correlated with the overall sub-score at greater than .7, they were removed from the questionnaire. Further questions were removed if they received a score of 3-4 from fewer than 10% or more than 90% of participants. The questionnaire was also worded appropriately for postpartum use. Psychometric analysis was conducted with 119 women.

The tests used for reliability of the MAMA questionnaire were test-retest and split half reliability. Test-retest evaluation was challenging because this questionnaire is intended to measure change. To minimize this change as well as decrease the likelihood of recall, the test was administered twice, one week apart. This testing was done in a subsample of 38 women. Split half analysis was done in the entire sample of 119. Test-retest correlations for all sections were .81-.95. Using split half, correlations were .58 (somatic symptoms) to .82 (attitudes to sex). All correlations were statistically significant.

For evaluation of the MAMA questionnaire's criterion-related validity each subscale compared women's responses on presumed representative questions for that subscale. T-tests were run between groups who responded to these questions in differing fashion, and all were found statistically significant. Additionally questionnaire results were compared to interview results as further evidence of criterion-related validity. It continues to be used in the literature as a valid and reliable measure of maternal attitude and adjustment (Wan, Sharp, Howard & Abel, 2011).

Data Analysis

Data were analyzed using SPSS version 18. Categorical demographic variables (work status, education, partner status, race, household income per month and cesarean birth) and NRFS by induction status were tested using Chi-Square analysis. T-tests were performed for continuous demographic variables (age, BMI pre-pregnancy, length of labor, and birthweight). Logistic regression analysis, controlling for length of labor, was performed to test NRFS by induction status and the possibility of length of labor as a mediating variable.

Results

Demographic characteristics of the sample are presented in Table 1. In this sample of 148 women, 85 (57%) indicated that labor was induced or augmented. Methods for induction included artificial rupture of membranes, balloon catheter cervical dilation, prostaglandin insertion behind the cervix, or intravenous pitocin. Reasons for induction are listed in Table 2. There were no significant socio-demographic differences between the induced/augmented and non-induced/augmented groups. However, self-reported length of labor was significantly different ($t=-2.03$, $p = .044$), with the induced group reporting longer labor.

The overall incidence of perceived NRFS was 17.1%. Of the 85 women with induced or augmented labor, 24% (n=20) reported details consistent with NRFS. In contrast, only 10% (n = 6) of the 63 women with spontaneous labor reported details consistent with NRFS. This difference was significant (Chi square = 4.9, $p = .027$). Given the significant difference in length of labor between the induced and non-induced/augmented groups, a logistic regression analysis was then done to control for length of labor (Wald statistic = 2.925 for labor length, and 3.67 for induction/ augmentation, $p=.087$ and $p=.055$ respectively). Results indicate that length of labor had a slight influence on report of NRFS, with longer labors significantly associated with both induction/augmentation status as well as with NRFS report ($t=-2.01$, $p=.037$)

When symptoms of depression (CES-D), anxiety (POMS) and stress (PSS) were examined at one month postpartum, there were no significant differences between women who experienced NRFS in labor and those who did not (Table 3). As also seen in Table 3,

there were also no differences in Maternal Adjustment and Maternal Attitudes Scale (MAMA) scores at one month postpartum.

Discussion

Medical intervention has been seen in previous literature to be a contributing factor to the experience of trauma in childbirth. The implications of this are twofold. First, understanding that mothers in labor are aware of the occurrence of NRFS would assist healthcare providers to minimize the risk of experiencing traumatic childbirth. This can be done by fully educating women about the risks of medical interventions, such as induction or augmentation, and empowering them in the decision-making process, therefore decreasing the likelihood of postpartum depression or PTSD symptoms. Secondly, knowing that induction/augmentation increases risk in delivery, and potentially allostatic load on the infant through the labor, birth, and early postpartum minutes (due to added nursing interventions during the transitional period), should inform care providers to avoid induction or augmentation except when medically necessary.

With regard to other maternal and labor characteristics, the induced/augmented and non-induced/augmented groups differed only by length of labor, which was a partial mediator for the relationship between induction/augmentation and NRFS. In this sample, induction/augmentation resulted in significantly longer self-reported labor duration ($p=.044$), with a mean length of labor of 18.8 hours compared to 14.5 hours in non-induced/augmented labors. Current research is conflicting regarding the effect of induction on duration of labor. Labor augmentation for a woman already experiencing contractions is shown to shorten labor duration (Rogers, Gilson, Miller, Izquierdo, Curet & Qualls, 1997), most likely due to the woman's cervix being ready to dilate.

Conversely, inductions occurring before the woman's cervix is ready (cervical length >3 cm) can increase labor duration (Yang, Roh & Kim, 2004). Analgesia type and timing can also have an effect on labor duration (Wong, McCarthy, Sullivan, Scavone, Gerber & Yaghmour, 2009). Finally, for some participants in this sample, the length of labor may have been the indicator for augmentation of labor.

These findings are from a secondary data analysis of a larger study of new mothers' sleep patterns and therefore telephone interview data pertaining to the labor experience were not elaborate. Specifically, whether labors were induced or augmented was not clear, but were indicated only as "induced" with open ended questions indicating the possibility of augmentation rather than induction. This study did not explore the mother's feelings around her birth experience, so it is unknown whether or not the birth could be labeled "traumatic." Further, all data were obtained by maternal report during the early postpartum period, a reporting bias that may limit validity of the findings. Finally, the induction/augmentation rate in this sample (57%) was higher than the national rate (22.5%), although again, this may be underreported in national data. It is unclear what role this high induction/augmentation rate may have played in these findings. Specifically, if induction/augmentation is normative behavior for care providers in this population of women, it is likely that the experiences shared by other mothers around them prepared them for this outcome. Being prepared for the outcome would likely be protective against increased stress when considered within the allostatic load theoretical framework.

Findings in this dissertation study support protection against mental stressors and symptoms of depression and anxiety as well as perceived stress.

Further analysis was done on this group of women to evaluate the potential maternal outcomes may result from induced versus non-induced labors, and from mothers' experiences of non-reassuring fetal heart tones. In this sample of women, there was no increase in symptoms of depression, anxiety, or stress at one month postpartum. However, 55% of women in this sample had a CES-D score of 16 or higher, indicating risk for clinical depression. Depressive symptoms may be more prevalent in the postpartum period for all women, and confounded by postpartum healing and postsurgical recovery. However, depressive symptoms may be more pronounced in this sample compared to the general population of postpartum women due to factors such as socioeconomic status, lack of social support, or pre-existing history of depressive symptoms.

Table 1. Sample Demographic Characteristics (n = 148)

		Not Induced (n = 63)	Induced (n = 85)	p value
Work Status (prenatal)	Full Time	1 (1%)	4 (3%)	p =.57
	Part Time	8 (5%)	11 (7.5%)	
	Not Employed	54 (37%)	69 (47%)	
Education	≤High School	21 (14%)	32 (22%)	p =.78
	Some College	37 (25%)	45 (30%)	
	Some Grad School	5 (3%)	8 (5%)	
Partner Status	Unpartnered	10 (7%)	16 (11%)	p =.40
	Partnered	53 (36%)	69 (47%)	
Race	Asian	24 (16%)	18 (12%)	p =.15
	African American	8 (5%)	12 (8%)	
	Caucasian	13 (9%)	21 (14%)	
	Other **	18 (12%)	34 (23%)	
Household Income	<$1,000	23 (16%)	28 (19%)	p =.67
(per month)	$1,000-$1,999	20 (14%)	23 (16%)	
	$2,000-$2,999	11 (8%)	13 (9%)	
	>$3,000	6 (4%)	14 (10%)	
	don't know	2	5	
Age	Mean ± SD	26±6.9	26±6.3	p =.74
BMI pre-pregnancy	Mean ± SD	23±4.3	24±5.6	p =.12
Length of labor (hrs)	Mean ± SD	14±12.1	18±12.7	p =.04*
Birthweight (kg)	Mean ± SD	3.34±.44	3.31±.56	p =.83
Cesarean birth	Number (% of induced/non-induced births)	18 (29%)	27 (32%)	p =.41

*statistically significant

**including Native American, Pacific Islander, Latina and multi-racial

Table 2. Reasons for induction or augmentation by maternal report (n=85)

Reason for Induction/Augmentation	**Frequency (%)**
Augmentation for lack of progress	24 (28)
Augmentation for maternal fever	1 (1)
Induction for Post-dates (after 40 weeks)	14 (16)
Induction for Rupture of membranes before onset of labor	17 (20)
Induction for Elevated blood pressure, with or without pre-eclampsia	14 (16)
Induction for Low amniotic fluid	4 (5)
Induction for Maternal seizure	1 (1)
Induction for Breech	1 (1)
Induction for Gestational diabetes	1 (1)
Induction for Lack of fetal growth	1 (1)
Induction for Maternal fever	1 (1)
Induction for meconium in amniotic fluid	1 (1)
Other (reason not given)	5 (6)

Table 3a. Maternal mood scores at one month postpartum (mean ± SD) by NRFS status

NRFS	CES-D	POMS	PSS	MAMA
Yes (n=24)	12.4±8.4	7.8±5.4	15.6±6.4	1.85±.32
No (n=107)	13.3±7.7	6.7±5.4	15.7±6.0	1.84±.36
p-value	p=.61	p=.39	p=.99	p=.92

Table 3b. Maternal mood scores at one month postpartum (mean ± SD) by induction status

Induced	CES-D	POMS	PSS	MAMA
Yes (n=77)	12.5±8.0	7.3±5.8	15.4±6.4	1.86±.37
No (n=59)	13.9±7.6	6.4±4.6	16.0±5.5	1.81±.33
p-value	p=.30	p=.32	p=.60	p=.36

Chapter 4

Mode of Delivery: Maternal and Neonatal Adaptation at One-Month

Background

Mode of delivery, differentiated as either spontaneous vaginal birth, instrument vaginal delivery, cesarean (emergency or planned cesarean) has the potential to have lasting repercussions for both the mother and the infant. Physically, an operative delivery (abdominal or vaginal) results in longer healing time and possibly a longer length of stay in the hospital for the mother. Increased postpartum surgical pain may result in difficulties with breastfeeding and bonding with her infant. For the neonate, normal extrauterine adaptation involves respiratory, circulatory, thermoregulatory and metabolic changes. In an otherwise healthy pregnancy, the addition of labor interventions can increase the risk of a difficult transition to extrauterine life for the newborn (Aziz, Chadwick, Baker & Andrews, 2008, Rajani, Chitkara & Halamek, 2009). Cesarean deliveries continue to rise, and are now approximately 33% of all deliveries in the United States (Hamilton, Martin & Ventura, 2010). This rise does not appear to be related to an increase in pregnancy risk factors (Declercq, Menacker, & Macdorman, 2006).

Cesarean delivery can result in decreased fluid clearance from the newborn's lungs and increased risk of transient respiratory problems. Hypothermia is a risk in a cold operating room. Cesarean delivery results in separation of the mother from her infant, which can delay or inhibit the onset of breastfeeding. Without early colostrum, glucose stores are depleted. Signs of stress exhibited by the newborn can include poor muscle tone, low heart rate, and poor spontaneous respiration or increased work of breathing (Anderson, 1989; Mercer & Graves, 2007). Positive pressure ventilation, used to promote fluid clearance from the lungs, can lead to air in the abdomen or increase the risk of pneumothorax (Frazier & Werthammer, 2007). Maternal risk after cesarean delivery

includes an increase potential for infection and prolonged hospital stay (Villar, Carroli, Zavaleta, Donner, Wojdyla, Faundes et al, 2007).

Vacuum extraction can result in cephalohematoma, or subgaleal bleeds. Subgaleal bleeds can result in severe hemorrhage, shock and even death. Subgaleal bleeds have been reported to occur at a rate of 26-45 per 1000, or 2.6-4.5% of, extractions (Boo, Foong, Mahdy, Yong & Jaafar, 2005). Some reports indicate subgaleal bleeds in up to 21% of vacuum extractions, and of those, 10% resulted in hypovolemic shock (Yeomans, 2010; Boo, et al, 2005). Vacuum delivery can also result in shoulder dystocia (and subsequently clavicular fracture). Forceps carry the risk of facial nerve palsy (approximately 1% of all forceps deliveries), bruising, and intracranial bleeding (Yeomans, 2010). Physical risks to the mother are perineal trauma and bleeding.

The purpose of this study was to describe how mode of delivery can influence maternal psychological health and neonatal adaptation during the first month of life. Mode of delivery for this study was categorized as normal spontaneous vaginal delivery (NSVD), instrument vaginal, scheduled cesarean and cesarean in labor.

Theoretical Basis

Labor is a natural and necessary stress that alters vital functions for transition to extrauterine life. Boldt and colleagues discovered that normal labor and delivery resulted in elevated infant cord blood levels of adrenomedullin, a potent pulmonary vasodilator, when compared to cesarean deliveries without labor. This supports the physiologic role that normal labor stress plays in neonatal adaptation (Boldt, Luukkainen, Fyhrquiest, Pohjavuori, & Andersson, 1998). However, additional birth trauma may have lasting repercussions (Lupien, McEwen, Gunnar & Heim, 2009). A review by Anand and Scalzo

(2000) describes such lasting repercussions as altered responses to pain, behavioral and emotional problems in childhood, major psychoses, anxiety/depression, and suicide in adolescence and adulthood.

According to the theory of allostatic load, strain on the body is "produced by repeated ups and downs of physiologic response, as well as by the elevated activity of physiologic systems under challenge" (McEwen & Stellar, 1993, page 2094). This strain can place the mother-infant dyad at risk for poor health outcomes. The importance of minimizing stress during the birthing process is also addressed in this theoretical discourse. Physical stress during childbirth is placed on both the mother and the infant and can be understood as a source of allostatic load. Evaluating the outcomes for both mother and infant in the early postpartum period may provide insight into the implications of the accumulation of stress from labor and delivery.

Literature Review

Mothers and postpartum depression (PPD).

Traumatic birth has been found to be a risk factor for PPD, and Post Traumatic Stress Disorder (PTSD) (Jack, 2005; Beck, 2004; Ayers, 2007). In a review of existing literature, Soet, Brack and Dilorio (2003) found that approximately 20-30% of women report having traumatic birth experiences. Their findings indicated 34% of 112 women show some symptoms of PTSD after delivery. Contributing factors to experiencing trauma in birth included feelings of powerlessness, lack of social support, unexpected pain in labor, and medical interventions. Cesarean delivery and operative vaginal delivery may be unexpected interventions, and may result in a sense of powerlessness as well as

unexpected pain. While literature exists on the risk of PPD following traumatic birth, little exists on maternal and neonatal adaptation following operative delivery.

Cesarean delivery alone does not appear to be an independent risk factor for PPD, however, it does result in increased dissatisfaction with birth experience, especially when birth by cesarean was unplanned. Two meta-analyses reported on physical and psychological outcomes after cesarean birth (Carter, Frampton & Mulder, 2006; DiMatteo, Morton, Lepper, Damush, Carney, Pearson, et al, 1996). Inclusion and exclusion criteria for articles chosen were well described for both studies. Carter and colleagues found that while many articles had mixed findings, those that were more methodologically rigorous did not find a significant relationship between cesarean birth and PPD. The greatest limitation to this meta-analysis is that cesarean delivery was not differentiated into planned or unplanned, therefore not indicating whether the cesarean was potentially traumatic. DiMatteo and colleagues evaluated subsets of psychological outcomes as they pertained to the immediate postpartum period in the hospital, early postpartum period at home, the late postpartum period up to one year. After cesarean delivery, mothers had significantly: 1) longer time to first mother-infant interaction, 2) less interaction time on day one, 3) less positive feelings toward the infant, 4) lower rates of breastfeeding, 5) more dissatisfied with the birth experience, 5) less mother-infant interaction (persisting to five months postpartum), and 6) more fatigue (persisting up to four years after delivery). This meta-analysis, however, had many outcomes, and some outcomes were included in as few as two studies. Of those listed above, the most powerful findings include maternal feelings toward infant (five studies), initiation of breastfeeding (ten studies), and maternal dissatisfaction with birth (ten studies).

In a prospective descriptive study, Rowe-Murray and Fisher (2001) studied 203 primiparous women in four hospitals in metropolitan Australia. They found that mode of delivery is associated with compromised first mother-infant interaction, and that a negative first interaction increased scores on the Edinburgh Postnatal Depression Scale and the Profile of Mood States in the early postpartum period as well as eight months later. The instrument vaginal delivery group did not demonstrate this association. The authors speculated that this might be because of the lack of differentiation in the amount of instrument assistance received (for example high versus outlet forceps, or repeated vacuum attempts versus a single smooth ventouse extraction). Strengths of this study included a large sample size, controlling for additional potential explanatory variables (including maternal, fetal and neonatal health concerns, length of labor, number of obstetric procedures experienced, maternal age, partner support). Limitations included lack of psychological screening of women prior to delivery, attrition by the eight month follow up (164 out of 203 women completed questionnaires at eight months), lack of psychometric evaluation of the scales used, and the introduction of an otherwise un-validated scale, the First Contact Index.

In the Term Breech Trial, 798 women planning a vaginal birth and 798 women planning a cesarean birth were randomized and assessed at three months postpartum with emotional and physical health measures (Hannah, Hannah, Hodnett, Chalmers, Kung, Willan et al, 2002). The Edinburgh Postnatal Depression Scale (EPDS) was used, with a cut off of 12 to indicate depression. There was no significant difference in the dichotomized depression variable between planned cesarean delivery and planned vaginal delivery groups. Actual mode of delivery was not differentiated. With regard to

breastfeeding, there was no difference between planned cesarean and planned vaginal births (again, with no differentiation for actual mode of delivery) at three months postpartum, however fewer women in the planned cesarean delivery group breastfed their infants within the first few hours of life.

Maternal adaptation.

A woman's adaptation to her role as mother can affect her ability to care for her infant, which in turn may impact both her own behavior and the behaviors of her infant. Further, if a mother struggles in adapting, she risks not meeting the physical needs (specifically, nutrition and hygiene) or emotional needs of her baby.

Researchers at Yale evaluated maternal adaptation by studying brain responses via magnetic resonance imaging (MRI) of mothers, differentiated by cesarean or vaginal delivery, to their own infant's cry (Swain, Tasgin, Mayes, Feldman, Constable & Leckman, 2008). A sample of 12 mothers (all right-handed), six with vaginal births, six with uncomplicated maternal-choice cesarean births (with no other significantly different demographic characteristics), was recruited for this study. Each completed The Yale Inventory of Parental Thoughts and Actions (a previously validated measure of parental worries) and the Beck Depression Inventory. MRI scans were all conducted between 2-4 weeks postpartum. During the scans, recordings of their baby's cry were played back interspersed with control noises. The baby's cry was captured during mild discomfort such as a diaper change, but not while in pain or hungry, and then standardized by the research team for duration and extraneous noise. Mothers with a cesarean birth had fewer brain responses to their own baby's cry than women with a vaginal birth. The two measures of worry and mood correlated with these findings and therefore estimated

overall maternal role attainment, which was more pronounced in mothers experiencing vaginal birth. Although there were significant findings, a major limitation was its small sample of only 12 women and inability to generalize to the larger population. Strengths included multi-modal data collection using well-validated tools and physiologic measures.

In a longitudinal study of 374 Swiss women, Lemola and colleagues (2007) evaluated the traumatic impact of delivery on maternal and infant psychological health five months after childbirth (Lemola, Stadlmayr, & Grob, 2007). Validated measures included The Salmon's Item List-German Language Version, EPDS, and the Impact of Event Scale-Revised. There was no medical record review for obstetric outcomes. Mode of delivery was not associated with psychological adjustment when assessed at five months post-birth. However, mothers with scores indicating trauma in their childbirth experience were more likely to be depressed and less well-adjusted five months after delivery. Positive social support was protective of this effect.

Mode of delivery and lactation.

Due to changing attitudes about breastfeeding, both in society and in the hospital, studies evaluated in this review of the literature pertaining to breastfeeding and mode of delivery are limited to publications since 1999. However, one study published in 1969, which evaluated the physiologic basics of newborn sucking, and one study pertaining to the physiology of lactogenesis, are included.

The first study utilized combined data from two studies and divided 210 infants by delivery risk factors into a "suspect" group compared to a "normal" delivery group (Dubignon, Campbell, Curtis, & Partington, 1969). Risk factors in the "suspect" group

included antepartum hemorrhage, <37 weeks gestation, >43 weeks gestation, >2 hours second-stage labor, mid forceps delivery, breech delivery, posterior presentation, precipitate delivery, cesarean birth, “birth injury” (not otherwise specified), birth weight less than 2,500 grams, one minute Apgar score <7, “abnormal signs” in the baby (not otherwise specified), and initial treatment in the intensive care unit. All babies were evaluated before their first feeding in the laboratory for non-nutritive sucking on a special nipple that registered pressure exerted and sucking time (time spent sucking during the last 90 seconds of a two minute trial). After this baseline was established, 94 babies were given an additional two minutes sucking during which .5 milliliters of 5% dextrose water was delivered every tenth suck. Length of labor was related to sucking time, as well as feeding. The shortest labor groups had less sucking time. Babies born spontaneously, or with low forceps, had less sucking time than other groups. Maternal anesthetic use resulted in shorter sucking times. Heavier babies had a significantly greater intake than lighter babies, as did more gestationally mature babies. Within the “suspect” group of babies, lower Apgar scores resulted in greater intake. Babies born to primiparous mothers took in significantly less than other newborns. All perinatal factors except mode of delivery were significant for feeding behaviors when formula feeding. Sucking behaviors were significantly related to labor duration, type of delivery and anesthesia. Non-nutritive sucking was not significantly influenced by labor risk factors. Major limitation to this study was the pre-feeding intervention. Artificial nipples are currently being discouraged in breastfeeding newborns, as the physiology of sucking on an artificial nipple is different from suckling on mother’s breast. Therefore, it is possible that the use of an artificial

nipple may not reflect breastfeeding-sucking physiology, and may affect subsequent breastfeeding in some infants.

The second early study explored cesarean delivery as a risk factor for delayed onset of lactation. Specifically, in this prospective longitudinal study 192 women were recruited in Connecticut from 1996-1997 to evaluate risk factors for delayed onset of lactation (Chapman, Perez-Escamilla, 1999). Delayed onset of lactation was defined as "milk coming in" greater than 72 hours after birth and was assessed by maternal report. Exclusive formula-feeding prior to onset of lactation, infant less than 8 lb at birth, unscheduled cesarean birth, prolonged stage 2 labor, maternal obesity, and white or Hispanic ethnicity were risk factors for delayed onset of lactation. Women in the study were nulli- and multi-parous, mostly Caucasian, moderately well educated, and the majority had anesthesia in delivery. While not all intended to breastfeed, over 75% were breastfeeding on day two. Medical complications in the pregnancy were equally distributed between those women who had delayed onset of lactation and those who experienced early onset. Authors intentionally included a higher proportion of women who were nulliparous and who underwent cesarean delivery in their sample. The authors attributed delayed onset of lactation to emergency cesarean delivery and prolonged second stage of labor. They did not address pre-delivery feeding plans.

Cakmak and Kuguoglu (2007) studied breastfeeding success in cesarean (n=118) versus vaginal (n=82) births in Istanbul, Turkey. They used the well-validated LATCH breastfeeding assessment tool (LATCH stands for Latch, Audible swallowing, Type of nipple, Comfort, and Help) to assess the first three breastfeeding sessions post birth. Cronbach alpha values for internal consistency were moderate (.48-.65, decreasing for

each subsequent feed). Inter-rater reliability was not reported. Both cesarean delivery and vaginal delivery groups were similar in sociodemographic characteristics, parity, breastfeeding experience, and sex of the infant. Women who had cesarean deliveries held their babies, and began breastfeeding significantly later than women with vaginal births. Of those who fed their babies in the first hour, 69.4% had vaginal births, and 30.6% had cesarean births. Authors mentioned that the rate of cesareans under general anesthesia was increasing, however failed to indicate what portion of the cesarean deliveries were done with general versus epidural or spinal anesthesia. These results were not followed up for breastfeeding duration.

In a study of 280 women in Davis, California, cesarean delivery was also found to be an obstacle to early breastfeeding success, along with nulliparity, duration of labor, labor medications, and formula use (Dewey, Nommsen-Rivers, Heinig, & Cohen, 2003). Outcomes of interest were "Suboptimal Infant Breastfeeding Behavior" (SIBB), delayed onset of milk production, and excess infant weight loss on day three (as defined as weight loss of 10% or more since birth). Specifically, investigators found that cesarean delivery was a significant risk factor for SIBB during the first 24 hours of life, and for delayed onset of lactation. SIBB was defined as a score of 10 or less on the Infant Breast Feeding Assessment Tool (IBFAT). A significant interaction was found for parity and mode of delivery, with infants born vaginally to multiparous mothers being at the lowest risk. Infants born by cesarean to primiparous mothers were at some risk for SIBB (1.68 times more risk; 95% confidence interval, CI, 1.06-2.24, p=.047), infants born vaginally to primiparous mothers were at 1.72 times the risk of SIBB (95% CI, 1.28-2.09, p=.001),

and infants born by cesarean to multiparous mothers were at 2.46 times the risk of SIBB (95% CI, 1.31-2.74, p=.02).

Newborn sleep.

Newborn sleep, unlike newborn feeding, is less likely to be influenced by societal trends and hospital practices. However, some sleep behaviors are reinforced or interrupted by routine hospital procedures that include light/dark cues, rooming-in practices, pediatrician assessment times, and nursery "weigh-in" times. Regardless, these practices are less likely to have changed dramatically in the last ten to fifteen years, and therefore older articles reviewed here. In fact, research was largely done on birth mode and sleep in the late 1980s to mid-1990s.

Newborn sleep was assessed in one study involving infants of diabetic mothers (Sadeh, Dark & Vohr, 1996). Researchers also questioned the role of mode of delivery as it pertained to infant sleep. Using actigraphy to record infant sleep patterns in a sample of 102 infants born to mothers with gestational diabetes and 118 control infants (77% vaginal and 23% cesarean), researchers found that cesarean born infants spend significantly more time in active sleep than those born vaginally. This sample was largely Caucasian, and all were born at the Women and Infants Hospital in Providence, Rhode Island. The large sampling of infants of diabetic mothers may limit generalizability of findings, as the incidence of gestational diabetes is only 2-3% in the general population.

Freudigman and Thoman (1998) evaluated 51 full-term infants throughout their hospital stay for sleep/wake states and mode of delivery. Twenty-six infants were born vaginally, 12 by emergency cesarean, and 13 by elective cesarean. Twelve of the 13

elective cesarean births were done due to previous cesarean delivery, and one was due to suspected macrosomia. This allowed for three-group comparisons for the first two days, and for two-group comparison (emergency and elective cesarean deliveries) for the later days. All infants were healthy, although 12 of the original 63 recruited infants were excluded because they spent less than 30% of the first day of life in their crib. Emergency cesareans were all done due to labor that "failed to progress." Groups were similar on demographic variables with the exception of exclusive breastfeeding, where 61.5% of vaginally born infants were exclusively breastfeeding, and 33.3% emergency cesarean born infants were exclusively breastfeeding. Authors evaluated feeding method for its effect on infant sleep, and found no difference. Baby sleep data were gathered using a well-validated tool involving a mattress pad that recorded infant respirations and body movement whenever the infant is in the crib. Babies were placed in their cribs upon transfer to the newborn nursery, at anywhere from 30 to 120 minutes of age, at which time data collection began. Recorders ran for 24 hours, however, only in-crib times yielded measures. This provides a potential for error, in that it assumes all infants sleep optimally in the crib, whereas many infants fall sleep being held or fed, may be disrupted upon transfer, or may simply sleep more soundly while in contact with the mother. Despite the small sample, results indicate that babies born by cesarean demonstrated significantly less active sleep, more sleep-wake transitions, and more waking. Further, infants born by cesarean were also significantly lacking in diurnal rhythms, demonstrating "day-night confusion." The authors discuss the possibility of hormonal cues as well as general anesthesia and medications in birth that can be likely culprits for differences in sleep for babies born vaginally compared to cesarean.

Mode of delivery, catecholamine surge at birth, and neurobehavioral adaptation one, two and five days after birth were compared in 15 Swedish infants born by uncomplicated scheduled cesarean and 15 born by uncomplicated vaginal delivery (Otamiri, Berg, Ledin, Leijon & Lagercrantz, 1991). All infants were healthy with no signs of difficulty with fetal-to-neonatal transition. Cord clamping occurred immediately upon delivery before the infant was raised above the level of the mother's abdomen and arterial umbilical blood was drawn. Blood handling procedures were standardized. There were no significant differences between the two groups on demographic characteristics. Umbilical plasma levels of noradrenaline were significantly higher in the babies born vaginally, though there was no significant difference in adrenaline. The authors indicate that this finding demonstrates the role of the sympathoadrenal system in birth and neonatal adaptation.

Otamiri and colleagues (1991) also assessed neurologic status using a well-validated neurologic tool created by Prechtl. There was a significant neurologic difference, specifically lower excitability scores, on day one for cesarean born babies. By day five, no significant differences in neurologic scores remained. These findings reflect poorer neurologic adaptation in infants born by elective cesarean compared to normal spontaneous vaginal birth. The researchers also combined groups to evaluate catecholamine levels and neurologic adaptation, and those infants (regardless of birth mode) with lower noradrenaline levels had significantly poorer neurologic adaptation, reinforcing the role of catecholamines in neonatal adaptation. Potential limitations included small sample size, non-standardization of maternal anesthesia/analgesia, and no reporting of inter-rater reliability for neurologic examinations.

Newborn Temperament.

Newborn temperament has been studied in relation to postpartum maternal factors, but infrequently with regard to mode of delivery. The following two studies evaluated infant temperament as it relates to the birth experience.

In a randomized clinical trial, women were assigned to Leboyer technique deliveries or "gentle but conventional" deliveries (Nelson, Enkin, Saigal, Bennett, Milner & Sackett, 1980). The outcomes of interest included infant irritability and responsiveness in neonatal period, maternal experience and perception of her labor and delivery, and maternal perception of her infant. Prior to randomization, in the 3rd trimester, the mothers completed an investigator-developed questionnaire about health status and attitudes toward pregnancy and childbirth. At 36 weeks mothers were stratified by parity and social class and then randomized to the Leboyer technique or "gentle" control. Birth conditions were well controlled. For Leboyer deliveries, the room was kept at 27˚C, and dimly lit with one gooseneck lamp. Deliveries occurred in the same bed that mothers labored in, with a sterile sheet placed under the mother's buttocks. The baby was placed skin-to-skin on mom's abdomen and massaged by the mother immediately after delivery. The umbilical cord was cut when it stopped pulsing, and the father bathed the newborn in warm water. Sound levels were kept at a minimum throughout. Conventional deliveries took place in a delivery room kept at 24˚C, lit by overhead fluorescent lights, with full sterile drapes placed, the cord was cut within 60 seconds of delivery, and the baby was wrapped in a blanket and returned to the mother. No bath was given, and no limitation was placed on sound levels. Bulb suctioning was done as necessary and weighing and silver nitrate eye drops were deferred until after the first hour in both groups. All

obstetricians scrubbed and gowned in the same manner. All infants were handled gently and infant/parent interaction was facilitated. If forceps or cesarean delivery occurred or if the baby could not remain with the mother, the protocol was not completed. Although 20 infants per group were needed to detect the expected large effect size (asserted by Leboyer), there were not always 20 per group for all observations and there were no statistically significant group differences for any outcome, including infant temperament. The effect size for this study was .65, a moderately large effect that would have required 39 infants per group to detect (Cohen, 1988).

In a follow up study, another group of researchers in Quebec looked at infant temperament in relation to gentle birth techniques and other perinatal risk factors (Maziade, Boudreault, Cote, & Thivierge, 1986). They had a convenience sample of 49 infants in the gentle birth group and 263 in the non-gentle birth group. They rated infants as either "easy" or "difficult" using the Infant Temperament Questionnaire, and compared them on birth techniques, sex, rooming-in or not, and mode of delivery. Like the previous study (Nelson et al 1980), no significant differences were found between temperamentally easy infants and difficult infants at four or eight months.

Study Questions

The specific questions for this study were: 1) Did women who experienced different modes of birth differ in postpartum adaptation, anxiety, stress or depression? 2) Does mode of birth by maternal report predict infant temperament, infant sleep patterns, or breastfeeding at one month of age?

Study Designs and Methods

Sample and Setting

Data were obtained as part of a larger postpartum sleep study of women recruited from clinics serving low-income women in San Francisco, California. Included in the study were first-time expectant mothers who were at least 18 years of age and who could read and write English. Women were excluded if they had a sleep or mood disorder, or worked night shifts. Women were contacted by telephone after delivery, at which time information about their labor was obtained. At 1-month postpartum women completed the questionnaires that included a brief investigator-developed infant temperament scale. At this time mothers were also given a diary to complete for infant sleep.

Measures

Measures

Postpartum Depressive Symptoms.

The Center for Epidemiologic Studies Depression scale (CES-D) is a 20-item self-report questionnaire that was developed to assess depressive symptoms in the general population. It has since been validated with specific populations (Radloff, 1977). The CES-D assesses frequency of symptoms over the past week, using a 0-3 categorical scale where zero equals “Rarely or None of the Time (Less than 1 Day)”, one means “Some or a Little of the Time (1-2 Days), two is “Occasionally or a Moderate Amount of Time (3-4 Days)”, and 3 equals “Most or All of the Time (5-7 Days)”. Four questions were worded in a positive direction, to break up response sets. For example, question eight states “I felt hopeful about the future”. This measure takes less than 5 minutes to complete, and a score of 16 or greater is indicative of risk for depression.

Factor analysis yielded four factors and kept items with factor loadings greater than .4, depressed affect (blues, depressed, lonely, cry, sad), positive affect (good, hopeful, happy, enjoy), somatic and retarded activity (bothered, appetite, effort, sleep, get going), and interpersonal (unfriendly, dislike). Comparing across three samples, the correlation coefficients for like items were very high (.87 to .99) and very low for differing items (the largest being .13). This indicates that the factor structure holds across groups (Radloff, 1977).

Characteristics of the 121 women studied by Mosack and Shore (1987) included 15-42 year old White, African-American, and Hispanic pregnant and postpartum women. Nineteen women were pregnant, 40 were early postpartum and 39 were late postpartum (6 months to 2 ½ years following delivery). These authors were comparing the effectiveness of the CES-D and the Edinburgh Postnatal Depression scale (EDPS). Data were archival, and only 98 women had completed both depression-screening tools. Cronbach alpha for the CES-D in this group was .87. In their sample, the CES-D was more sensitive, screening 31.6% of participants as at risk for depression (scoring 16 or greater), whereas only 14.3% of participants scored at risk for depression (12 or greater) using the EPDS. Further, the CES-D identified six of the pregnant women as at risk for depression, and the EPDS did not identify any (Mosack & Shore, 1984). This would indicate that the CES-D is an appropriate measure for use in the pregnant and postpartum population.

Postpartum Anxiety Symptoms

The Profile of Mood States (POMS) is a 65-item scale with six subscales including Tension-Anxiety, Depression-Dejection, Anger-Hostility, Vigor, Fatigue, and

Confusion-Bewilderment. The timeframe referenced in the scale is the previous week, including the current day. The questions inquire how an activity or mood state indicated has been experienced, and the response range is 0 (not at all) to 4 (extremely). Scores are sums of responses (Tunis, Golbus, Copeland, Fine, Rosinsky, & Seely, 1990).

In a group of 705 pregnant women in their first trimester of pregnancy seeking genetic counseling for advanced maternal age, the POMS scale was administered and analyzed for psychometric properties (Tunis, et al 1990). Average age of these women was 36.7 years (SD, 2.1, range 33-44 years). Average gestational age was 9.2 weeks (range 6-12 weeks). The women in this sample were predominantly white, well educated, and partnered. The authors performed a factor analysis and found that a seven-factor solution fit this group. The included factors were "Depression", "Vigor", "Alert-Friendly, or Sociable", "Relaxed-Unafraid" (an inverse of the original Tension-Anxiety subscale), "Nonirritable", "Negative Regard for Self and Others", and "Distracted".This current dissertation study used the 9-item "Relaxed-Unafraid" subscale, which includes tense, shaky, on edge, panicky, relaxed, uneasy, restless, nervous and anxious. Higher scores indicate more fear/anxiety.

Perceived Stress.

Prior to the development of the Perceived Stress Scale (PSS), stress was measured on number of assumed stressful events one was managing. This did not address the subjective nature of the perception of events as stressful. The advent of the PSS answered this need (Cohen, Kamarck & Mermelstein, 1983). The original PSS was a 14-item scale that measures situational (non-specific) stress – as the concept of global stress is too highly correlated with number of stressful situations experienced. Validation was done

using three samples, two college student groups, and one a group enrolled in a smoking-cessation program for heterogeneity. Questions are stated both positively and negatively, with reverse scoring needed on seven items. The PSS is aimed at a minimum of a junior high school education level, though it was validated in a younger, more highly educated sample with fewer minorities than the general population. Cronbach alpha for reliability for the PSS in the three groups were .84 (college 1), .85 (college 2) and .86 (smoking cessation). Test-retest correlations were done at two days and at six weeks, as short and long interval reliability findings indicate measurement of a state (should be much higher in short intervals than for long intervals). This was found to be the case, where the test-retest correlation was .85 at two days and .55 at six weeks. Concurrent validity was shown via correlations between the PSS and scores of life event stressors, and impact of event ratings.

Validity for the PSS's ability to predict health outcomes was established by comparing outcomes with symptomatology of the individuals. This correlation is predictive, but not causal, therefore whether the symptoms caused the stress, or the stress caused the symptoms is not indicated. The PSS has also been validated as a predictor of utilization of health services, with significant correlations in the college samples. PSS was also validated as a predictor of social anxiety with moderate, but significant, correlations in the college samples. Lastly, the PSS was validated as predictive of smoking reduction in the smoking cessation group (Cohen et al, 1983). The 10-item version was used in this dissertation study.

Maternal Adjustment and Attitudes.

The Maternal Adjustment Maternal Attitudes (MAMA) questionnaire is a self-administered tool designed to estimate changes in maternal adjustment, spousal relationships, and attitudes toward the baby. This tool was developed using focus groups of pregnant women with researchers in attendance. Six categories of maternal attitudes, self-perception, and behavior were identified (body image, somatic symptoms, the marital relationship, attitudes and feelings about sex, sexual activity, and attitudes to the pregnancy and the baby). The entire 60-item questionnaire requires about 10 minutes to complete (Kumar, Robsen & Smith, 1984). This current dissertation study used the "attitude toward pregnancy and the baby" subscale with 12 items.

The MAMA responses are on a four-point scale, using the words "Never", "Rarely", "Often" and "Very often" to refer to the past month. Questions were randomly reverse-coded to avoid response bias. An item analysis was done and if individual questions correlated with the overall sub-score at greater than .7, they were removed from the questionnaire. Further questions were removed if they received a score of 3-4 from fewer than 10% or more than 90% of participants. The questionnaire was also worded appropriately for postpartum use. Psychometric analysis was conducted with 119 women.

The tests used for reliability of the MAMA questionnaire were test-retest and split half reliability. Test-retest evaluation was challenging because this questionnaire is intended to measure change. To minimize this change as well as decrease the likelihood of recall, the test was administered twice, one week apart. This testing was done in a subsample of 38 women. Split half analysis was done in the entire sample of 119. Test-retest correlations for all sections were .81-.95. Using split half, correlations were .58

(somatic symptoms) to .82 (attitudes to sex). All correlations were statistically significant.

For evaluation of the MAMA questionnaire's criterion-related validity each subscale compared women's responses on presumed representative questions for that subscale. T-tests were run between groups who responded to these questions in differing fashion, and all were found statistically significant. Additionally questionnaire results were compared to interview results as further evidence of criterion-related validity. It continues to be used in the literature as a valid and reliable measure of maternal attitude and adjustment (Wan, Sharp, Howard & Abel, 2011).

Sleep and breastfeeding.

Mothers were given diaries to record infant sleep and feeding times as well as type of feeding. Recordings were made for three consecutive 24-hour periods, with periods of 15-minute blocks to be shaded in to indicate infant sleep and feeding type. Feeding type was then categorically coded as exclusively breastfeeding, formula and breastfeeding, or exclusively formula feeding at one month of age in the mother's diary.

Data Analysis

Data were analyzed using SPSS version 18. Chi-square and analyses of variance (ANOVA) statistics were performed to evaluate mode of delivery and sociodemographic characteristics. ANOVA statistics were performed to evaluate symptoms of depression, anxiety, perceived stress, maternal attitude toward baby, and infant temperament across the four modes of delivery. Chi-Square statistics were calculated for the dichotomous variable of "still breastfeeding". ANOVA statistics were performed to compare infant

sleep patterns across four modes of delivery, while t-tests were conducted to compare infant sleep between all vaginal births and all cesarean births.

Results

Demographic characteristics of the sample are presented in Table 1, and were not significantly different between the four delivery mode groups, with the exception of pre-pregnancy body mass index (BMI) in mothers with scheduled cesarean deliveries. This is consistent with current research that shows increase in BMI associated with increased risk of cesarean deliveries of all types (Lynch, Sexton, Hession & Morrison, 2008; Crane, Wojtowycz, Dye, Aubry & Artal, 1997). The reasons for cesarean birth, as reported by the mothers in the sample, are listed by frequency in Table 2.

As indicated in Table 3, there were no significant differences in maternal adjustment, depressive symptoms, anxiety, or perceived stress at one month postpartum by mode of delivery. This finding remained when mode of delivery was dichotomized as either vaginal or cesarean. There were also no significant differences in maternal perception of infant temperament or type of infant feeding by mode of delivery group.

Infant sleep patterns, however, significantly differed by mode of delivery group. When delivery was differentiated into four modes (Table 4a), ANOVA indicated an overall significant effect (F [df, 3,131]=3.54, p=.017) for daytime sleep, but post-hoc analyses did not support any difference between the four groups. With four modes of delivery, the overall effect was not significant for 24-hour sleep. Due to the small sample size in the scheduled cesarean group (n=5), both types of cesarean births were grouped together (n=41) and findings remained significant for daytime sleep (F [df 2,131]= 4.617, p=.012) and total sleep over 24 hours (F [df 2,132]=3.18, p=.045). Compared to the

NSVD infants, the infants born by cesarean slept significantly more (0.9 hours on average) during the day, and slept one hour more over the 24 hours.

Total night-time sleep and number of sleep cycles were not significantly different by night (9 PM to 9 AM) when cesarean and vaginal births were compared (see Table 4b). However, over the three days of recording, average 24-hour sleep time ($t= 2.5$, $p=.017$) and average daytime sleep differed significantly between cesarean and vaginal deliveries ($t = 3.03$, $p=.003$). Babies who were born vaginally slept about one hour less over the 24-hour period than cesarean-born babies, and this difference was primarily a result of less sleep recorded in the mother's diary during the day.

Discussion

Maternal symptoms of depression, anxiety, and perceived stress.

Despite literature indicating cesarean delivery as a risk factor for postpartum depression, this study did not find a relationship between mode of delivery and frequency of depressive symptoms at one month postpartum. Rowe–Murray and Fisher (2001) found mode of delivery to be a risk factor for PPD, with impaired mother–infant interactions acting as a mediator for PPD. Mode of delivery was also unrelated to perceived stress and anxiety in this sample, whether evaluated by each of the four different modes or by two groups of vaginal or cesarean births.

It should be noted, however, that 41 women (30%) in this sample had a CES-D score of 16 or higher at one month postpartum. This percentage is larger than general prevalence estimates in the literature of approximately 13% and may reflect the common "baby blues" seen during the first month postpartum and indicate a risk for postpartum depression (Lancaster, Gold, Flynn, Yoo, Marcus & Davis, 2010; Leigh & Milgrom,

2008). Risk factors identified included low socioeconomic status, low social support, low self-esteem, history of abuse, and history of depression (Lancaster et al, 2010; Leigh & Milgrom, 2008).

Maternal adaptation.

Swain and colleagues (2008) found that mothers who had a cesarean birth also had compromised physiologic responses to their infants. This could indicate poor maternal adaptation. However, no studies were found using the subscale of the MAMA that was used in this current dissertation study to evaluate adaptation based on mode of delivery. Maternal adaptation did not differ based on mode of delivery when differentiated by the four modes, or by the two modes of vaginal and cesarean births. This could be due to small sample sizes, though the effect size was only .04 (SD units) and not clinically meaningful.

Breastfeeding.

The studies included in the review of literature here regarding mode of delivery and breastfeeding primarily focus on the success of lactation by the mother, and no research was found regarding continuation of breastfeeding based upon mode of delivery after the time of the hospital stay. However in the study by Dewey and colleagues (2003), cesarean delivery was a culprit in suboptimal infant breastfeeding behavior and newborn weight loss up to two weeks later during home visits. In this study, 133 out of 137 women (97%) intended to breastfeed. By approximately one month of age, 65 women (47%) were still breastfeeding exclusively, 46 (34%) were combining breastmilk and formula, and 25 (18%) were exclusively formula feeding. There was no significant difference in method of feeding by mode of delivery group. This sample, however, was

highly motivated to breastfeed, which may impact interpretation of these findings. Information regarding timing of, or success with initiating breastfeeding after delivery was unavailable. The effect size for breastfeeding by mode of delivery was very small (.17 SD units).

Infant temperament.

The majority of literature pertaining to infant temperament evaluates the relationship between maternal and infant psychological adaptation. Little literature explores infant temperament as it pertains to mode of delivery. "Gentle" birthing techniques did not to make a significant contribution to infant temperament (Nelson et al, 1980; Maziade et al 1986) and the current findings in this dissertation study support these prior studies.

Infant sleep.

Infant sleep assessed by maternal diary reports at approximately one month of age differed significantly between infants born vaginally and infants born by cesarean delivery. Daytime sleep, and therefore 24-hour sleep, was significantly different between cesarean and vaginally born infants. The effect size for 24-hour sleep was .469 SD units (95% CI = .097, .841). This finding is consistent with the findings of Feudigman and Thoman (1998) that may indicate that cesarean born infants lack diurnal rhythms, although they found no overall effect on sleep type in the immediate postpartum period based upon mode of delivery in their small sample of only 51 infants. Additionally, Otamiri and colleagues (1991) found significantly lower noradrenalin levels, as well as less neurological "excitability" in cesarean born infants, although these effects disappeared by approximately day 5 of life. This lack of catecholamine response and lack

of excitability at birth may carry through infant's sleep over time. Infants born vaginally may be more alert as early as one month postpartum during the daytime, which could indicate early sleep organization. Additionally, cesarean born infants may have an elevated allostatic load, and require additional daytime sleep for recovery. Conversely, as sleep norms have not been widely studied in this age group, it is possible that both brain and physical growth are more rapid during sleep time, and therefore those infants sleeping longer are maturing more quickly. Finally, the clinical importance of one hour more sleep time is not known, and infants who sleep more may have fewer feedings, and early follow up for adequate feeding and growth may be needed for cesarean born infants.

Major limitation to these findings is the use of only maternal-report sleep diaries. Nighttime sleep may have been inaccurately reported due to attempts to recollect sleep times the following morning. Sleep totals were estimated into 15-minute blocks during the day, which may have under- or over-reported sleep times in any given block. Lastly, there is an inherent risk to validity in using only self-report diaries.

A prospective study evaluating sleep using diaries as well as actigraphy, both immediately after delivery and at one month of age, would be of value to understand the potential impact of mode of delivery on infant sleep. Additionally, having larger and more similar group sizes may help to differentiate any effect from either scheduled cesarean births or instrument deliveries.

Table 1. Demographic Characteristics of the Sample (n = 137)

		Spontaneous vaginal (n=82)	Instrument vaginal (n = 13)	Scheduled cesarean (n=6)	Cesarean in labor (n=37)	p value
Work status	Employed	21 (15%)	2 (1%)	0 (0%)	7 (5%)	p =.56
	Mat. Leave	14 (10%)	2 (1%)	2 (1%)	3 (2%)	
	Not Employed	38 (28%)	8 (6%)	3 (2%)	19 (14%)	
	Student	8 (6%)	1 (<1%)	0 (0%)	8 (6%)	
	Other	1 (<1%)	0 (0%)	0 (0%)	0 (0%)	
Education	≤High School	34 (25%)	4 (3%)	3 (2%)	10 (7%)	p =.11
	Some College	38 (28%)	7 (5%)	2 (1%)	27 (20%)	
	Some Grad School	10 (7%)	2 (1%)	1 (<1%)	0 (0%)	
Partner status	Unpartnered	12 (9%)	2 (1%)	2 (1%)	7 (5%)	p =.50
	Partnered	70 (51%)	11 (8%)	3 (2%)	30 (22%)	
Race	Asian	20 (14%)	7 (5%)	1 (<1%)	11 (8%)	p =.20
	African American	9 (6.5%)	2 (1%)	2 (1%)	5 (4.5%)	
	Caucasian	24 (17.5%)	1 (<1%)	0 (0%)	6 (4%)	
	*Other	29 (21%)	3 (2%)	2 (1%)	15 (11%)	
Household income	<1,000	23 (17%)	4 (3%)	2 (1%)	12 (9%)	p =.95
($ per month)	1,000-1,999	24 (17.5%)	4 (3%)	2 (1%)	11 (8%)	
	2,000-2,999	11 (8%)	2 (1%)	1 (<1%)	7 (5%)	
	>3,000	14 (10%)	1 (<1%)	0 (0%)	4 (3%)	
	don't know	2 (1%)	1 (<1%)	0 (0%)	3 (2%)	

Maternal age	Mean ± SD	26±6.2	30±7.6	30.6±8.6	27±6.0	p =.08
BMI pre-pregnancy	Mean±SD	24±4.7	23±2.7	33±7.5	25±5.5	p =.001
Birth-weight (kg)	Mean±SD	3.3±.46	3.20±.58	3.42±.56	3.55±.59	p =.50

*statistically significant
*including Native American, Pacific Islander, Latina and multi-racial

Table 2. Reasons for cesarean delivery (n=40)

Reason for cesarean delivery	**Frequency (%)**
Failure to progress	11 (28)
Non-reassuring fetal status	12 (30)
Breech	6 (15)
Cephalopelvic disproportion	5 (13)
Elevated blood pressure	2 (5)
Maternal request	1 (2.5)
Transverse	1 (2.5)
Maternal bleeding	1 (2.5)
HIV+	1 (2.5)

Table 3. Maternal and infant outcomes by mode of delivery.

		Spont. vaginal (n = 81)	Inst. vaginal (n = 13)	Scheduled cesarean (n=5)	Cesarean with labor (n=37)	Statistic and p value
Maternal Outcomes						
MAMA	Mean±SD	1.83±.33	2.02±.48	1.62±.18	1.84±.35	F=1.9, p=.14
CES-D	Mean±SD	13.49±7.5	14.5±10.7	9.6±5.4	12.24±7.9	F=.67, p=.57
POMS	Mean±SD	7.14±5.6	7.38±5.5	3.5±4.5	6.6±4.6	F=.67, p=.57
PSS	Mean±SD	15.5±6	16.8±8	13.2±5.9	15.9±6	F=.45, p=.72
Infant Outcomes						
Tempera-ment	Mean±SD	3.43±1.35	3.49+1.51	3.58±1.61	3.06±1.19	F=.80, p=.50
Breast-feeding	%	29	6	2	12	X^2=8.7, p=.19

Table 4a. Infant Sleep Patterns at One Month of Age, Averaged Over Three 24-hour Periods for Four Mode of Delivery Groups (M ± SD).

	Spontaneous Vaginal (n = 80)	Instrument Vaginal (n = 12)	Scheduled Cesarean (n=5)	Cesarean with Labor (n=36)	Statistics
# of Sleep Episodes					
Day	3.60±1.08	3.94±.88	3.2±.56	3.9±1.63	F(3,131)=.97 p=.41
Night	3.60±1.11	4.0±.99	3.0±.78	3.9±1.15	F(3,133)=1.4 p=.23
Total Sleep (hours)					
Day	5.96±1.5	6.1±1.6	7.6±1.5	6.75±1.5	F(3,131)=3.5 p=.017*
Night	8.2±1.17	8.0±1.23	8.1±.71	8.4±1.22	F(3,133)=.61 p=.61
24-hour	13.62±2.17	13.67±2.58	15.08±1.78	14.61±2.3	F(3,132)=2.2 p=.09

Note: M = mean, SD =standard deviation; Day = 9 AM–9 PM; Night = 9 PM–9 AM
* statistically significant

Table 4b. Infant Sleep at One Month of Age, Averaged Over Three 24-hour Periods by Vaginal and Cesarean Mode of Delivery (M ± SD).

	Vaginal (n=92)	Cesarean (n=41)	Statistics
# of Sleep Episodes			
Day	3.60±1.05	3.82 ±1.55	t(133)=-.77, p=.44
Night	3.66±1.20	3.77 ±1.14	t(135)=-.52, p=.60
Total Sleep (hours)			
Day	5.98 ±1.55	6.85 ±1.53	t(133)=-3.03, p=.003*
Night	8.16 ±1.19	8.38 ±1.17	t(135)=-.98, p=.33
24-hour	13.63 ±2.22	14.67 ±2.21	t(134)=-2.5, p=.013*

Note: M = mean, SD =standard deviation; Day = 9 AM–9 PM; Night = 9 PM–9 AM
* statistically significant

Chapter Five

Discussion

Interpretation of Findings

Chapter 2 addressed antenatal factors that could potentially influence mode of birth, including sociodemographic variables, depressive symptom scores on the Center for Epidemiological Studies –Depression (CES-D) scale, anxiety symptoms as scored on the Profile of Mood States (POMS) subscale, perceived stress scores on Cohen's Perceived Stress Scale (PSS) and maternal adjustment scores on the Maternal Adaptation and Maternal Adjustment (MAMA) scale. In Chapter 3, maternal perception of non-reassuring fetal status (NRFS) in labor was evaluated for women who experienced labor induction or augmentation compared to women who experienced spontaneous labor. Chapter 4 addressed maternal and infant outcomes at approximately one month postpartum by mode of delivery. Findings are addressed here by variable, with results discussed as they spanned the three chapters.

Depressive Symptoms

Maternal symptoms of depression did not differ by mode of delivery at any time point. However 34% of women demonstrated symptoms of depression, with scores greater than 16 on the CES-D, and 30% of the sample scored 16 or higher at the one-month point, likely reflecting the postpartum "blues" experienced by many women during the first postpartum month. This dissertation sample had primarily low-income women, which is a known risk factor for depression, especially during pregnancy (Leigh & Milgrom, 2008). Therefore, depressive symptoms were more prevalent than reported for the general population, perhaps due to an already high allostatic load.

Anxiety Symptoms

Anxiety scores did not differ significantly between any groups at any time point. The theory of allostatic load indicates that when one's load is increased not only is there an increased risk to overall health, but that one might make choices that negatively impact their health (McEwen & Seeman, 1999). Most literature regarding prenatal anxiety addressed the outcome of elective cesarean delivery, a mode of delivery that indicates primarily elective choice by the women in consultation with her health care provider. This mode, however, adds risk to the delivery, increases postpartum recovery time, and carries risk into future pregnancy health (Sherman et al, 1993; Rossen et al, 2006; Gielchinskya et al, 2002; Gilliam et al, 2002; Mahoka et al, 2004; Jerbi et al, 2006; Terner et al, 2006; Grossetti et al, 2007). In this current dissertation sample, only six women had scheduled a cesarean delivery (data available for only five at one month postpartum). It is likely that the sample size was not adequate to find an effect for anxiety based on mode of delivery. A larger group of women opting for a scheduled cesarean birth, and perhaps multiple measures of anxiety (the State/Trait Anxiety Index) would help better understand their anxiety experience. A measure of fear of birth would also be beneficial to increase our understanding of potential associations between anxiety and scheduled cesarean delivery.

Little literature is available regarding anxiety in the postpartum period. One article was found addressing anxiety at about one month postpartum after emergency cesarean delivery. Compared to low-risk vaginal birth, no significant difference in anxiety or depression scores were found for the emergency cesarean group (Padawer, Faga, Janoff-Bulman & Strickland, 1996). However, these findings are from research

conducted in 1984, a time in which the climate of birth was very different from today, specifically the increased rate of cesarean delivery and the medical organization's anti-VBAC (vaginal birth after cesarean) stance. Therefore research regarding postpartum anxiety based on delivery mode is currently lacking. Findings from this dissertation research suggest that there is no difference in prenatal or postpartum anxiety at one month based on mode of delivery within the limitations of measures and groups sizes.

Perceived Stress

Prenatal stress is minimally addressed in the literature as it pertains to mode of delivery. In one study, women who scheduled a cesarean delivery were eliminated from the sample (Saunders, Lobel, Veloso & Meyer, 2006). In considering fear of childbirth as a possible covariate of stress, this may be pertinent, however it may also result in a loss of critical information about prenatal stress and birth mode. Their findings indicated that analgesia in labor may be a significant mediator of emergency cesarean delivery. The increased allostatic load due to stress experienced prenatally may be mitigated by the choice to not experience labor pain. However, as previously stated, the choice made based on that increased stress might result in poorer health outcomes in the form of cesarean delivery. Postpartum stress is only evaluated in the literature as part of a posttraumatic stress symptomatology. In this sample, no significant effects for perceived stress were found at any time point. There was no measure of posttraumatic stress symptoms in this study, however. With such a small group of women who had a scheduled cesarean delivery, this study was underpowered to detect a significant effect for that group. When eliminating the six scheduled cesarean deliveries from this sample,

the results were still not significant. Therefore, no follow up analyses were done for the potential mediating effect of analgesia in labor.

Maternal adjustment

As stated in chapter two, prenatal adjustment (MAMA score) was significantly related to cesarean delivery when compared to vaginal delivery, as well as when compared across the four mode of delivery types. However, when instrument vaginal deliveries were separated from NSVD and compared to all cesarean deliveries, this was no longer significant. This is likely due to lack of statistical power when instrument deliveries (n=14) are differentiated. No literature was located addressing prenatal adjustment and mode of delivery. As lower scores reflect a more positive attitude, it is possible that women who have a more positive attitude toward the concept of motherhood during their pregnancy may be more eager to accept labor interventions, including pitocin, artificial rupture of membranes, and ultimately a cesarean delivery. With an increase in interventions, mothers might experience an increased need for labor analgesia, which is related to slowing of labor progression (Klein, 2006), and again a choice of cesarean delivery might be made. Mode of delivery did not affect postpartum maternal attitude toward baby. A more positive attitude toward the pregnancy/baby was associated with an increase in allostatic load due to cesarean birth with more surgical intervention types of stressors.

Non-Reassuring Fetal Status

NRFS by maternal report was significantly associated with labor induction/augmentation (Chi Square=4.9, p=.027). Even after controlling for length of labor, the association remained (p = .055). Maternal understanding of NRFS in labor was

considered as a potential surrogate marker for traumatic experience in childbirth. Despite this, women who experienced NRFS in labor (n= 26) were not significantly different from those who did not report NRFS on postpartum depressive symptoms, anxiety, stress or attitude toward baby. Therefore, the experience of NRFS in labor may be an inadequate marker for a traumatic experience in childbirth. The experience of trauma is subjective, however, and is based on each woman's existing allostatic load, history, and her current circumstances. Additionally, differences exist between women related to how much they feel in control of their labor experience or want to be in control, and how hospital staff address their concerns at the time, which could then influence a woman's fears in the moment. Finally, while women may have felt traumatized at the time of their birth experience, the continuing experience of trauma will differ based on postpartum experiences and social support. The measures used for this study may not capture posttraumatic stress symptoms, as noted previously, and may have been missed at the one-month postpartum assessment.

Infant temperament

Infant temperament did not differ significantly by mode of delivery. Most of the literature regarding infant temperament pertains to its relationship to maternal factors, specifically appraisal of parenting problem-solving self-confidence (Pridham, Change & Chiu, 1994) and parenting stress and mother-infant interactions (Mantymaa, Puura, Luoma, Salmelin, & Tamminen, 2006). Gentle birth techniques have been studied in relation to infant temperament, however, findings were not significant (Nelson et al, 1980; Maziade et al, 1986). Infant temperament is also likely to be affected by innate

factors, prenatal allostatic load, and postpartum stressors that were not accounted for in this secondary analysis dissertation study.

Breastfeeding

While the literature to date indicates that mode of delivery has an effect on initiation of breastfeeding there was no literature on duration of breastfeeding in the first weeks to months of life based on mode of delivery (Chapman, Perez-Escamilla, 1999; Cakmak & Kuguoglu, 2007; Dewey, Nommsen-Rivers, Heinig, & Cohen, 2003). There was no significant difference between mode of delivery and continuation of breastfeeding at one month in this sample. Increased allostatic load on both the mother and the infant due to stressors of parenting and physical adaptation during the first month of life are likely contributors. Additionally, no information was available regarding success of breastfeeding after delivery, and therefore information regarding initiation compared to continuation of breastfeeding was also unavailable.

Infant sleep patterns

Mothers reported infant sleep in sleep diaries for three days and nights. Infant sleep patterns were evaluated based on number of sleep periods during the night and during the day, and the total amount of sleep during the night (9PM-9AM), during the day (9AM-9PM) and over the full 24 hours. While no significant differences were found in the number of sleep periods by mode of delivery, significant differences were found in the total day, and therefore 24 hour, sleep time. Missing data were common on the first day due to variations in diary start times. Sleep times were averaged over the days and nights when a minimum of two days/nights was available. These averages were then compared by delivery type using ANOVA. Cesarean and vaginal deliveries differed

significantly for average day sleep time (t=-3.03, p=.003) and average 24-hour sleep time (t=-2.5, p=.017). Babies who were born vaginally slept 0.9 hours less on average during the day, and 1.05 hour less on average over the 24-hour period, than cesarean babies. Further differentiation of mode of delivery also yielded significance for average total daytime sleep (F=3.18, p=.045) when comparing "non-stressful" deliveries (scheduled cesareans and NSVDs) to cesarean deliveries in labor - with assisted vaginal deliveries not being significantly different from either group - though not for average total 24 hour sleep.

Finally, when both cesarean groups were combined (n = 41) and compared to the NSVD group (n= 81) and assisted vaginal deliveries (n=13), cesarean born infants were again significantly different from the NSVD group for daytime sleep (F=4.617, p=.012) and for total 24-hour sleep (F=3.57, p=.031). These findings are consistent with previous literature indicating that infants born vaginally are more likely to develop diurnal rhythms sooner than cesarean infants (Freudigman & Thoman, 1998). Increased allostatic load based on the added stressors to the infant from a cesarean birth might require increased sleep for recovery and adaptation to extrauterine life.

Limitations

The primary limitations to this study included that it was a secondary data analysis, with unequal group sizes and small group sizes for scheduled cesarean deliveries and assisted vaginal deliveries. Measures may not have captured the concepts of interest, and data collected by maternal report and sleep diaries in newly postpartum women may have increased threat to validity and reliability. In particular, further information pertaining to labor and delivery in the immediate postpartum period would

have allowed for more thorough data analyses. Intentional sampling to increase the number of participants who had scheduled cesarean sections would have improved statistical power. However it would be clearly unethical to intentionally subject women to assisted vaginal deliveries, therefore only an increase in overall sample size would improve the number of women with this mode of delivery. The use of the MAMA questionnaire to capture maternal adjustment may not have adequately assessed mother's adaptation to her new role, specifically the sole use of the subscale of the MAMA used to estimate the mother's perception of her adaptation to the pregnancy and baby. The relevance and validity of these questionnaires, many developed in the 1980's, may be in question today, however, they continue to be widely used and continue to be validated in different populations (Maloni, 2005; Mosack & Shore, 2006; Reis, Hino & Rodriguez-Anez, 2010). However, the MAMA questionnaire, though still used in research, has not been validated recently. Additionally, adding the State-Trait Anxiety Index as a measure may improve the understanding of maternal anxiety, both prenatally and postpartum. Lastly, verification of labor and delivery circumstances by medical record review, and of infant sleep patterns by actigraphy, would strengthen these findings.

Strengths

Strengths of this study include prospective design and data collection, well-validated and reliable tools, good overall sample size, and relatively heterogeneous sample (though similar in being low income and all having their first birth). Additionally this study is the first to look at prenatal attitude toward baby and effects on mode of delivery, which may stimulate further interest in this aspect of maternal emotional risk factors for cesarean birth, especially in the current climate of increasing operative

deliveries. In Chapter 3, potential risk factors for traumatic experience in birth were identified, and the incidence of NRFS was quantified as it was perceived by the mother. Few studies have addressed this outcome. Lastly, newborn sleep related to mode of delivery, while addressed in the immediate newborn period, has not been followed over time to understand the potential repercussions of the infant's birth experience.

Implications for nursing practice

Within the framework of allostatic load, nurses need to be part of a care team with mothers helping them understand the potential outcomes of decisions being made that can increase risk during labor and delivery. Knowing that women anticipating the birth of their child eagerly might opt for interventions in birth that could result in cesarean delivery, nurses should counsel women regarding risk factors for cesarean birth. Additionally, knowing that when induction needs to occur, or is chosen, nurses should prepare women for potential NRFS. To minimize allostatic load on the infant during delivery, additional risk factors for NRFS should be considered by the care team and minimized where possible. Finally, knowing that infants may sleep longer during the day, which may indicate recovery time from added stressors of a cesarean birth, nurses may need to counsel mothers to follow through with early pediatrician assessments to guarantee adequate feeding and growth.

Some of the implications of these findings for nursing practice can be framed within feminism, which "in general aims to understand and fight against inequalities between the sexes, with respect to political rights, economic understanding, and social status" (Godfrey-Smith, 2003, p. 137). Childbirth is inherently a situation where women are put in a vulnerable position, and are often treated as less than equal by their care

providers when making decisions about their care. While women are given choices regarding their care, informed consent regarding labor interventions and outcome risks (such as NRFS) may be incomplete. As a result, many women may still turn to their obstetricians to make choices for them. Nurses in obstetrics and labor and delivery are typically women, caring for women. They are critical in helping women become informed about all procedures related to pregnancy and childbirth. Nurses in the prenatal setting are in the unique position to be able to educate and empower women regarding risk factors and potential outcomes of different modes of childbirth. Nursing knowledge and care can make pregnant women stronger and safer by decreasing risk for operative birth. Nurses can also encourage women to find a care provider who will help them achieve the birth they want. Being an active partner in their own care would reduce the risks of postpartum depression (PPD) and PTSD.

Implications for nursing research

This descriptive research study was intended to prospectively explore prenatal variables that may influence mode of delivery, as well as explore maternal and neonatal outcomes at approximately one-month postpartum based on mode of delivery. Modes of delivery have varying physical and emotional risk to both mother and infant. Group sizes in this study were inadequate for the purpose of fully evaluating these risk factors and outcomes. Therefore, further study should include larger groups, and multiple measures. Prenatal maternal adjustment as a potential risk factor for cesarean delivery should be explored further, again with larger sample sizes, and using the full prenatal MAMA scale. Additionally, further study should address potential mediating variables that contribute to the relationship between a positive attitude and cesarean delivery.

Prenatal mood measures used in this study may not have reflected the construct of "fear of birth" which has been shown to increase elective cesarean deliveries (Saisto et al, 2001; Nerum et al, 2006). Further research is needed to examine prenatal mood measures, assess fear of birth, and explore fear of birth as a potential modifying variable for the relationship to mode of delivery. Postpartum mood and mode of delivery should be re-explored using a sample that was not already at high risk for depression. Factors that contribute to the experience of birth as stressful should also be explored further.

Induction was shown to be a risk factor for maternal perception of NRFS. However, that NRFS experience did not increase risk of postpartum symptoms of depression, anxiety, or stress. Therefore, being able to assess a stressful birth experience, and understanding not only the physiologic factors of labor that contribute to this experience, but also the psychological factors, including history, the obstetric team's involvement, obtaining of truly informed consent, and the woman's active participation in the experience would be valuable future research.

Evaluation of breastfeeding should begin immediately after delivery, and be followed longitudinally to better understand how mode of delivery affects breastfeeding. More research on how mode of delivery affects newborn feeding and sleeping patterns is needed. Evaluating sleep patterns longitudinally, beginning immediately after delivery, would be valuable to understanding how mode of delivery affects development of infant circadian rhythms. It would be important, however, to use more objective measures of infant sleep, with actigraphy for example, to get more accurate data about infant sleep times, particularly at night.

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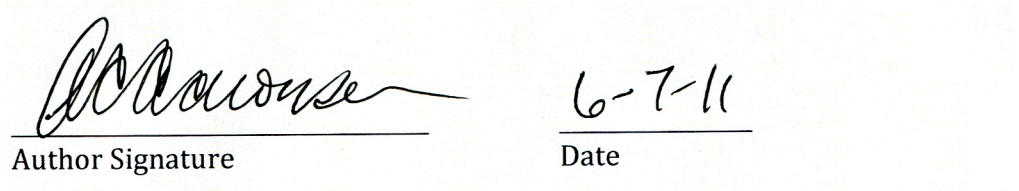

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