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Effects of prenatal maternal distress on reproductive outcomes

Kimberly June Nylen
University of Iowa

EFFECTS OF PRENATAL MATERNAL DISTRESS ON REPRODUCTIVE OUTCOMES

by

Kimberly June Nylen

An Abstract

Of a thesis submitted in partial fulfillment of the
requirements for the Doctor of Philosophy degree
in Psychology (Clinical Psychology) in
the Graduate College of
The University of Iowa

July 2009

Thesis Supervisor: Professor Michael W. O'Hara

ABSTRACT

The primary goal of the current study was to examine the association between maternal distress during pregnancy, conceptualized as stress, anxiety, and depression, and infant reproductive outcomes. It was hypothesized that women who report high levels of distress during pregnancy would be more likely to experience adverse reproductive outcomes. An additional goal of the study was to examine the hypothesis that social support and coping style moderate the association between prenatal maternal distress and birth outcomes. This study utilized a prospective, longitudinal design. Pregnant women (N = 257) completed self-report questionnaires and clinical interviews at two time points during pregnancy. Following delivery, birth weight, week of delivery, head circumference, and Apgar score were extracted from medical records. Results suggested that women who were clinically depressed during pregnancy were more likely to experience adverse birth outcomes. In addition, maternal stress, anxiety, and depression were best conceptualized as one general "distress" factor, which did not predict variance in birth outcomes over and above demographic variables. However, when self-report measures were considered individually, they decreased over the course of pregnancy, and were associated with birth outcomes, particularly at time 2. Significant interactions between maternal distress and social support, as well as maternal distress and coping emerged as predictors of birth outcomes. Results suggest that women with high levels of stress, who also have small support networks, are at higher risk of adverse birth outcomes than women with large networks, who were relatively insulated from effects of higher distress. This study points to the need for ongoing assessment of maternal distress and

resources throughout pregnancy, such that women at risk for adverse birth outcomes can be identified and supported as soon as possible.

Abstract Approved: _____
Thesis Supervisor

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Title and Department

_____
Date

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The University of Iowa
Iowa City, Iowa

CERTIFICATE OF APPROVAL

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PH.D. THESIS

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This is to certify that the Ph.D. thesis of

Kimberly June Nylen

has been approved by the Examining Committee
for the thesis requirement for the Doctor of Philosophy
degree in Psychology (Clinical Psychology) at the
July 2009 graduation.

Thesis Committee: _____
Michael W. O'Hara, Thesis Supervisor

_____
Erika Lawrence

_____
Susan Lutgendorf

_____
David Watson

_____
Jerome Yankowitz

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ABSTRACT

The primary goal of the current study was to examine the association between maternal distress during pregnancy, conceptualized as stress, anxiety, and depression, and infant reproductive outcomes. It was hypothesized that women who report high levels of distress during pregnancy would be more likely to experience adverse reproductive outcomes. An additional goal of the study was to examine the hypothesis that social support and coping style moderate the association between prenatal maternal distress and birth outcomes. This study utilized a prospective, longitudinal design. Pregnant women (N = 257) completed self-report questionnaires and clinical interviews at two time points during pregnancy. Following delivery, birth weight, week of delivery, head circumference, and Apgar score were extracted from medical records. Results suggested that women who were clinically depressed during pregnancy were more likely to experience adverse birth outcomes. In addition, maternal stress, anxiety, and depression were best conceptualized as one general "distress" factor, which did not predict variance in birth outcomes over and above demographic variables. However, when self-report measures were considered individually, they decreased over the course of pregnancy, and were associated with birth outcomes, particularly at time 2. Significant interactions between maternal distress and social support, as well as maternal distress and coping emerged as predictors of birth outcomes. Results suggest that women with high levels of stress, who also have small support networks, are at higher risk of adverse birth outcomes than women with large networks, who were relatively insulated from effects of higher distress. This study points to the need for ongoing assessment of maternal distress and

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CHAPTER I

INTRODUCTION

Pregnancy represents a time of significant physical and psychological change for women. Although most women adjust to these changes with little difficulty, many women also experience marked distress during the prenatal period (up to 18%; Gaynes, Gavin, Meltzer-Brody, et al., 2005). A growing body of research suggests that depression and other negative mood states such as stress and anxiety during pregnancy affects not only the woman, but also her developing fetus (Istvan, 1986; Lobel, 1994; Paarlberg, Vingerhoets, Passchier, Dekker, & Van Geijn, 1995). This notion that a woman's emotional or psychological state can influence the in utero environment is not a new one (Sontag & Wallace, 1934). Recent studies have focused on the contributions of stress, anxiety, and depression to reproductive processes and outcomes including fetal growth and behavior, labor and delivery complications, birth weight and gestational age at delivery, maternal postpartum depression, infant temperament, and cognitive development. Given the morbidity and mortality associated with low birth weight and preterm delivery, the vast majority of studies have focused on these outcome variables. Head circumference, which along with birth weight is an index of fetal growth, has also been linked to later developmental outcomes such as infant alertness (Henrichs et al., 2009)

Preterm delivery (defined as delivery less than thirty-seven weeks gestation) and low birth weight (defined as birth weight less than 2500 grams) are significant public health concerns and represent the leading causes of infant morbidity and mortality (Arias, MacDorman, Strobino, & Guyer, 2003; Mathews, Menacker, & MacDorman, 2003). The

health care costs associated with prevention and treatment of these complications exceeds $26.2 billion annually (Behrman & Butler, 2007). Relative to full-term infants, infants born prematurely have significantly more inpatient hospital admissions in first five years of life, which in turn is associated with a much higher cost of health care (Petrou, Hockley, Cook-Mozaffari, Henderson, & Goldacre, 2003). In addition, low birth weight infants and infants born prematurely are at risk for a variety of negative short- and long-term outcomes. For example, low birth weight and prematurity are associated with an increased rate of later neurological disorders (primarily cerebral palsy), cognitive problems including lower scores on intelligence tests, memory and attention problems, and language or motor skills deficits. These children also exhibit a number of behavioral problems such as conduct disorder and ADHD, have poor growth attainment, and suffer a variety of health problems including respiratory infections and ear infections (Hack, Klein, & Glover, 1995).

Despite recent advances in medical technology, preterm delivery and low birth weight continue to increase, reaching 12.0% and 7.8% of births, respectively (Arias et al., 2003). Unfortunately, we still know relatively little about the causes of such reproductive outcomes, and our ability to predict and prevent their occurrence remains poor (Goldenberg, & Rouse, 1998; Johnston, Williams, Hogue, & Mattison, 2001). Several factors including minority racial status, smoking, maternal age, parity, and prenatal infection such as bacterial vaginosis have been consistently associated with adverse birth outcomes, yet these factors do not fully account for the incidence of low birth weight and preterm delivery (Arias et al., 2003; Buescher et al., 1988; Cnattingius, Forman, Berendes, Graubard, & Isotalo, 1993; Cramer, 1987; NCHS, 2000).

Stress during Pregnancy

Broadly defined, prenatal maternal stress has been linked to a variety of reproductive events beginning during pregnancy (e.g. fetal behavior and growth, maternal preeclampsia and/or gestational diabetes) and extending through labor and delivery (e.g. use of analgesia, unplanned cesareans, birth weight, gestational age) and the postpartum (e.g. maternal mental health, infant temperament). With respect to the prenatal period, maternal stress has been shown to adversely affect both the mother and her fetus. In addition, prenatal maternal stress seems to affect the behavior and growth of the developing fetus. During labor and delivery, prenatal maternal stress has been associated with the use of pain medication, which in turn is associated with an increased likelihood of cesarean delivery (Saunders, 2006).

A review of the literature on prenatal maternal stress quickly reveals that many early studies examined the prenatal maternal stress construct using animal models in which researchers were able to experimentally manipulate the stress exposure of pregnant animals (Weinstock, 2001; Welberg & Secki, 2001). In one animal study designed to assess the effects of stress at two different time points during gestation, pregnant rhesus monkeys were subjected to unpredictable psychological stress involving removal from their cages and transport to a dark room with random, loud noise bursts. Although no clear pattern of results emerged with respect to a potential "sensitive period," results indicate that infants of monkeys subjected to stress early in pregnancy weighed less than infants of controls and monkeys stressed later in pregnancy. In addition, infants of monkeys in both stress conditions evidenced poor functioning on neurobehavioral indices

relative to controls, although impairments were somewhat more severe in infants of monkeys stressed early in pregnancy (Schneider, Roughton, Koehler, & Lubach, 1999).

Human Studies

Animal studies do not provide a perfect analogue for determining the effects of prenatal maternal stress on human pregnancy. Although it is not feasible to experimentally expose pregnant women to varying degrees of stress throughout pregnancy, some investigators have utilized naturally occurring stressors (e.g. amniocentesis, natural disasters) as a proxy for stress during pregnancy and have reported mixed results. For example, Bartha, Martinez-Del-Fresno, Romero-Carmona, Hunter, and Comino-Delgado (2003) reported no association between maternal anxiety and fetal behavior at 15 weeks. In contrast, King and LaPlante (2005) reported on a group of women who were pregnant during or became pregnant shortly after a severe ice storm in Quebec, Canada. Infants of women who rated the ice storm and its effects as moderately to highly stressful showed poorer cognitive functioning and less developed play relative to infants of mothers who rated the event as less stressful. Likewise, exposure to an earthquake, another naturally occurring stressor, has been shown to be related to shorter gestation, particularly when women experienced the earthquake early in pregnancy (Glynn, Wadhwa, Dunkel-Schetter, Chicz-DeMet, & Sandman, 2001).

Cognitive challenges (e.g. Stroop Color-Word Test, mental arithmetic) have been used to induce relatively short-lived stress. In one study of women with low-risk pregnancies who participated in the Stroop cognitive challenge, stress resulted in increases in maternal heart rate and skin conductance at 24 and 36 weeks of pregnancy (DiPietro, Costigan, & Gurewitsch; 2003). Fetuses showed increases in heart rate

variability and reduced motor activity at both time points, although the findings for the fetuses were somewhat stronger at 36 weeks. In a similarly designed study, maternal and fetal stress responses to either the Stroop Color-Word Test or a mental arithmetic task were measured, along with state anxiety (Monk, Fifer, Myers, Sloan, Trien, and Hurtado; 2000). Although, few significant physiological responses to stress emerged when data for all subjects were analyzed together, a different pattern of results emerged when women were split into two groups based on scores indicative of high anxiety (n=10) or low anxiety (n=7). Specifically, fetuses of women in the high anxiety group, but not the low anxiety group, showed increased heart rate in response to the stressor. This is in contrast to the results for mothers, which suggest that those women in the high anxiety group actually showed little physiologic reactivity. Finally, Monk, Sloan, Myers, et al. (2004) conducted one of the only studies on the effect of induced stress on fetal heart rate as a function of mothers' psychiatric status. Although the study evidenced relatively weak effects and the sample size was relatively small, it appears that fetuses of mothers who are clinically depressed during pregnancy show greater increases in heart rate in response to a Stroop color-word matching task compared to fetuses of women who had been diagnosed with an anxiety disorder or healthy women who reported relatively low levels of anxiety.

Results of these psychophysiological studies are intriguing and suggest that prenatal maternal stress, when measured concurrently with fetal behavior, has an impact on the developing fetus. The tasks utilized in these studies elicited a stress response in women, and resemble mild cognitive stressors that women likely encounter in the everyday course of pregnancy. We cannot conclude, however, from these studies that

prenatal maternal stress (acute or chronic) is related to more distal reproductive outcomes such as labor and delivery complications, infant birth weight, and gestational age at delivery. However, one small and preliminary study has attempted to examine more distal outcomes of women who were exposed to laboratory induced stressors during pregnancy. McCubbin, Lawson, Cox, Sherman, Norton, and Read (1996) examined maternal blood pressure and heart rate responses to a stressful mental arithmetic task, and found that greater increases in diastolic blood pressure were significantly related to low birth weight and decreased gestational age. The findings from this study begin to suggest a potential biological mechanism for the impact of prenatal stress on neonates, and may suggest that a woman's stress response, not the stressor itself, is implicated in adverse reproductive outcomes.

The great majority of human studies have not employed experimental stress inductions. Rather, these studies typically have obtained women's self-reports of stress, conceptualized in a variety of ways (e.g. life events, hassles, perceived stress, state anxiety), and used these reports to predict an array of mother and infant outcomes. DiPietro, Hilton, Hawkins, Costigan, and Pressman (2002) investigated the effect of affective intensity, pregnancy-related hassles and uplifts, and non pregnancy-specific daily stressors on fetal heart rate and motor activity at various points during pregnancy. Results indicate that women who reported higher levels of affective intensity and more frequent pregnancy-related hassles had more active fetuses; however, there were no consistent findings with respect to fetal heart rate. In addition to fetal behavior, investigators have also been interested in neonatal outcomes such as birth weight and gestational age at delivery.

A number of studies examining the impact of prenatal stress on birth weight, gestational age, and other neonatal health outcomes have relied on retrospective reporting. In these studies, women who gave birth to infants who met criteria for low birth weight (i.e. ≤ 2500 grams) were typically identified via birth records, contacted, and asked to report on their stress levels during pregnancy. In a case-controlled study in which over 2000 postpartum women were asked to recall their perceived stress, life events, and attitudes during their pregnancies, results indicated that women who gave birth to very low or moderately low birth weight babies were more likely than women who gave birth to normal weight babies to endorse high levels of stress during pregnancy, both in terms of specific life events and perceived stress (Sable & Wilkinson, 2000). A more recent population-based study examined birth weight of 1.38 million babies born in Denmark between 1979 and 2002 and found that women who experienced the death or serious illness of a relative during pregnancy, and even 6 months prior to conception, had babies with lower birth weights than women who were not exposed to severe stress (Khashan et al., 2008). Although studies employing this methodology are better positioned to avoid issues related to sample size and power, results are difficult to interpret in light of the high potential for retrospective reporting bias. Moreover, studies of this type tend to define stress broadly. For example, in the study by Sable and Wilkinson (2000), perceived stress was measured using one question, "In general how often did you feel stress during your recent pregnancy?" Women responded on a four point Likert scale ranging from "almost always" to "almost never." This relatively unstandardized measure of stress makes comparison to other studies difficult.

Investigators in the field have realized the shortcomings of these retrospective studies and have begun to employ prospective studies. In one study involving low-income women, the majority of whom were from ethnic minority groups, Lobel, Dunkel-Schetter, and Scrimshaw (1992) found that earlier delivery and prenatal stress predicted lower birth weights. Medical risk and prenatal stress were also significant predictors of earlier delivery. Another study found a dose-response relationship between prenatal stress, as measured by the General Health Questionnaire (GHQ; Goldberg, 1972), and preterm delivery, such that risk for preterm delivery increased from 1% at low levels of stress to 6% for women with high stress scores (Hedegaard, Henriksen, Sabroe, & Secher, 1993). Finally, Dole et al. (2003) found evidence of an association between stressful life events and an increased risk of preterm birth. This finding was particularly important given that it was women's perception of events as having a highly negative impact that was related to increased risk of preterm birth, and not the total number of external stressors. Again, this finding may suggest that it is the subjective experience of stress, and not events themselves that entail risk. In addition, increased risk of preterm birth was also associated with pregnancy-related anxiety; however, the investigators failed to find evidence of an association between either social support or depression and reproductive outcomes. Contrary to results of several recent studies, Barbosa (2000) found no association between life events and preterm delivery in a primarily African-American population; however, women who had lost a mother or sister were more likely to have earlier deliveries. Sheehan (1998), who utilized structural equation modeling to examine the contributions of stress (family and economic) and lack of social support to low birth weight in two large samples of pregnant women, found that these psychosocial

variables were not directly related to birth outcome, but did exert effects on health behavior (i.e. tobacco and alcohol consumption), which in turn influenced low birth weight.

Although the findings are not yet conclusive, the existing literature nonetheless suggests that prenatal stress is associated with increased risk of preterm delivery and low birth weight. Perhaps more interesting is the assertion that "the effects of maternal stress are observed across the entire range of outcome distribution, as opposed to only at one end of the distribution." (Wadhwa, 2005). Although many studies of prenatal stress are conducted to inform the larger goal of preventing clinically-relevant adverse outcomes, it is also important to determine how prenatal stress operates in pregnancies that result in full-term or normal weight infants. When considering our poor ability to predict adverse outcomes, the importance of studying normal pregnancy processes is further highlighted. Moreover, it is likely that some proportion of infants is very close to, but not below, the clinical cutoffs for preterm birth and low birth weight. Thus, studies showing a dose-response relationship between stress and reproductive outcomes measured as continuous variables are particularly informative. In one such study, each unit increase in stress was associated with a 55 gram decrease in birth weight. Moreover, each unit increase in anxiety was associated with a 3-day decrease in gestational age at delivery (Wadhwa, Sandman, Porto, Dunkel-Schetter, & Garite, 1993). Thus, as stress continues to increase, birth weight would presumably continue to decrease, and would be likely to reach the low birth weight cutoff. This is particularly notable in light of epidemiological data showing that as birth weight and gestational age decrease, the risk of infant morbidity and mortality increases (Copper, Goldenberg, Creasy, DuBard, Davis, Entman, Iams, &

Cliver, 1993). Moreover, even studies that have set out to determine whether prenatal stress conforms to a threshold model, in which a certain level of stress is necessary before reproductive outcomes are adversely affected, have not been able to conclusively determine whether these models are appropriate (Whitehead, Hill, Brogan, & Blackmore-Prince, 2002). For this reason, it makes sense to study both stress and reproductive outcomes as continuous variables. Finally, researchers who study demographics involving birth weight, gestational age, and infant mortality have suggested that although the conventional definitions of low birth weight and preterm delivery have been particularly useful, more precise and detailed information regarding the association between gestational age, birth weight, and infant morbidity/mortality may also be useful. Such an approach would require several modifications to the current system, the most fundamental being measurement of gestational age and birth weight as continuous variables (Solis, Pullum, & Frisbie, 2000).

Studies of the effects of prenatal maternal stress are not limited to fetal and immediate neonatal outcomes. Several studies have examined the possibility that prenatal stress exerts further reaching effects on infant development, potentially affecting cognitive development, temperament, and the development of behavioral and/or emotional problems in childhood. For example, Wurmser, Rieger, Domogalla, et al. (2006) reported that prenatal maternal stress, measured by the Life Experiences Survey, was related to increased levels of infant crying and fussing at 3-6 months post partum.

Several studies have utilized the Bayley Scales of Infant Development to examine the contribution of prenatal stress to infant temperament and cognitive development. In general, these studies indicate that infants of prenatally stressed mothers are rated as

having more difficult, restless temperaments (Austin, Hadzi-Pavlovic, Leader, Saint, & Parker, 2005; Davis et al., 2004; Gutteling et al., 2005), have greater difficulty regulating their attention (Huizink, Robles de Medina, Mulder, Visser, & Buitelaar, 2002), show impairments in cognitive and motor development (Huizink, Robles de Medina, Mulder, Visser, & Buitelaar, 2003; King et al. 2005; LaPlante, Barr, Brunet, DuFort, Meaney, Saucier, Zelazo, & King, 2004), and exhibit more externalizing behavior problems (Gutteling et al. 2005; Van den Bergh & Marcoen, 2004). In one notable example of a prospective study designed to determine the impact of stress on later developmental outcomes, Huizink, Robles de Medina, Mulder, Visser, and Buitelaar (2003) found that prenatal daily hassles, pregnancy-specific anxiety, and maternal cortisol values were all significant predictors of lower mental and motor development scores at 8 months of age.

In a study that stands in stark contrast to the existing literature, DiPietro, Novak, Costigan, Atella, and Reusing (2006) recently examined the contributions of both prenatal and postnatal psychological state (e.g. anxiety, depression, and daily, perceived, and pregnancy stress) to child development at age 2 years. Results indicate that higher levels of prenatal stress, depression and anxiety actually seem to contribute to more optimal outcomes for children. Specifically, children of women reporting higher levels of distress showed more advanced motor development on the Bayley Scales of Infant Development. The authors explain these results by suggesting that perhaps a mild to moderate amount of stress and anxiety are necessary for normal development and maturation to occur.

As was the case with studies of neonatal outcomes, assessment of stress in these studies varied considerably with respect to timing and measures utilized. An additional

source of variation involves the timing of infant assessments. Thus, although it seems reasonable to conclude that, generally speaking, maternal stress during pregnancy predicts poor infant outcomes, it remains unclear whether a certain type of stress during a particular time period predicts a specific form of infant outcome. This difficulty in interpretation of results points to a larger problem in the measurement of stress.

Methodological Issues in the Measurement of Stress

Construct Measurement

Across studies, operational definitions of stress have taken several forms, but have often been limited to measures of life events and/or state anxiety. Variable measurement of stress has left the field with unanswered questions regarding the nature of the stress construct and whether particular dimensions of stress are stronger predictors reproductive outcomes than others. Utilizing the stress framework put forward by Lazarus and Folkman (1984), Lobel (1994) suggests that relying on only life events and state anxiety ignores the multiple dimensions of stress including the subjective importance of stressors and the emotional and physiological responses to stress. The ideal for measuring the prenatal maternal stress construct involves a multidimensional approach in which either multiple forms of stress or the stressful stimulus, individual appraisal, and response are incorporated. This approach is becoming increasingly common (e.g. Dominguez, Dunkel-Schetter, Glynn, Hobel, & Sandman, 2008; Glazier et al., 2004; Hilmert et al., 2008; Lobel et al., 2008).

In their 1993 prospective study, Wadhwa, Sandman, Porto, Dunkel-Schetter, and Garite utilized measures of life events, daily hassles, pregnancy-specific anxiety, and perceived stress, among others. Results suggest that pregnancy-specific anxiety was

significantly related to gestational age, independent of medical risk. Likewise, the association between life event stress and birth weight was also significant. Using structural equation modeling, Lobel, Dunkel-Schetter, and Scrimshaw (1992) found that three measures of stress (e.g. perceived stress, state anxiety, and life events) resulted in a two-factor model of stress comprised of 1) anxiety and two measures of perceived stress, and 2) the number life events. In this study, the first factor reflected the latent stress factor and was used in all analyses. Using this conceptualization, the group found main effects for stress on both birth weight and gestational age at delivery. In an attempt to model the various components of stress and their common variance, Roesch, Dunkel-Schetter, Woo, and Hobel (2004) found evidence that pregnancy-related anxiety, but not perceived stress or state anxiety, experienced at multiple time points during pregnancy was strongly associated with reduced gestational age. This research suggests that measures tapping specific aspects of stress may be differentially related to adverse birth outcomes, and may also suggest that the perception of stressful events may be more predictive of outcomes than the events themselves.

Based on the examples and results of studies outlined in the preceding sections, conceptualization of prenatal maternal stress in the present study included measures of life events and their subjective importance, daily hassles, perceived stress, the stress response (e.g. depression, anxiety), and pregnancy-specific stress/anxiety. The rationale for including all of these measures was to provide a strong test of the effects of stress on birth outcomes, contribute to the remaining questions regarding the nature of stress during pregnancy, and aid in determining which aspects of stress and related constructs provide the greatest contribution to low birth weight and preterm delivery after

controlling for predictor variables previously identified in the literature (e.g. age, medical risk, parity, ethnic minority status, etc.).

Timing of Assessments

The point during pregnancy at which stress is measured has also raised important questions regarding the association between stress and reproductive outcomes. For example, results of a study by DaCosta, Larouche, Dritsa, and Brender (1999) provide evidence that levels of stress do not remain constant over the course of pregnancy. Although there were no significant differences between trimesters on a measure of daily hassles, pregnancy-specific anxiety was higher in the first and third trimesters than the second trimester. In addition, women's state anxiety was found to be higher during the third trimester than during the first and second trimesters. Other studies have shown that the impact of stress is decreased over the course of pregnancy, such that women perceive life events as less stressful in late pregnancy than in early pregnancy (Glynn, Dunkel Schetter, Wadhwa, & Sandman, 2004). An important question raised by this and other investigations is whether stress is more detrimental at certain times points in gestation than others.

A number of studies have shown that the experience of stress early in pregnancy is most detrimental to the mother and fetus (Glynn et al., 2001; Schneider et al., 1999). Others indicate that stress during mid to late pregnancy is associated with higher rates of adverse outcomes (Rini, Dunkel-Schetter, Wadhwa, & Sandman, 1999; Wadhwa, Sandman, Porto, Dunkel-Schetter, & Garite, 1993). Hedegaard et al. (1993) reported that high levels of stress in the 16th week of pregnancy were not associated with earlier delivery; however, there was a strong dose-dependent association between stress and

preterm delivery in the 30th week of pregnancy. Likewise, Mancuso, Dunkel-Schetter, Rini, Roesch, and Hobel (2004) found that pregnancy-specific anxiety at 28-30 weeks, but not 18-20 weeks was a significant predictor of gestational age at delivery. Furthermore, recent evidence also suggests that compared to acute life events, chronic stress is a stronger predictor of adverse birth outcomes (Lobel, 1994; Lobel, De Vincent, Kaminer, & Meyer, 2000; Roesch, Dunkel-Schetter, Woo, & Hobel, 2004). To further complicate matters, there is evidence that women may become immunized to the effects of stress via an attenuated HPA axis response by the end of pregnancy (Glynn et al., 2001; Wadhwa, Dunkel-Schetter, Chica-DeMet, Porto, & Sandman, 1996). Kammerer, Adams, von Castelberg, and Glover (2002) reported that a sample of 10 healthy women in their third trimester of pregnancy showed little HPA axis reactivity, measured by salivary cortisol increase, in response to a one-minute cold hand stressor. This is in contrast to a group of non-pregnant controls, who showed a significant response. When the test was repeated at approximately eight weeks postpartum, cortisol responses were variable; some women showed large increases in cortisol and others did not. A recent study by Glynn, Dunkel Schetter, Hobel, and Sandman (2008) sheds some light on the conflicting results seen in research designed to answer questions regarding a potential sensitive period. Their findings suggest that it may not be the level of stress or anxiety at any one time point during pregnancy that predicts later outcomes, but that the pattern of stress across time points that is most predictive. Specifically, women who delivered full-term babies showed declines in stress across pregnancy, while women who gave birth to premature babies experienced increases in stress from the second to third trimester.

Depression and Anxiety during Pregnancy

A somewhat separate, but related line of research has focused on the contribution of prenatal maternal depression and anxiety to adverse birth outcomes. Many early studies of prenatal stress included measures of state anxiety, but failed to assess depression. In contrast, studies that focus on prenatal depression tend to also include measures of anxiety, but not life events or daily hassles. Although a handful of studies have found no effect of prenatal mood and anxiety on reproductive outcomes (Berle et al.2005), several others have found evidence of such an association. For example, depression during pregnancy has been linked to obstetric complications, as well as infant outcomes including low birth weight, preterm delivery, poor cognitive development, and increased levels of fussing and crying (Field, Diego, Dieter, et al. 2004). Moreover, women who are depressed and anxious during pregnancy are at increased risk of developing postpartum depression (O'Hara, Schlechte, Lewis, & Varner, 1991), which itself is associated with a host of negative child outcomes (Goodman & Gotlib, 2002).

Obstetric Complications

Several studies conducted in recent years have begun to suggest that prenatal symptoms of depression and anxiety are related to a range of obstetric complications including recurrent spontaneous abortion (Sugiura-Ogasawara, Furukawa, Nakano, Aoki, & Kitamura, 2002) and spontaneous preterm labor (Dayan, Creveuil, Herlicoviez, Herbel, Baranger, Savoye, & Thoulin, 2002), which often results in preterm delivery. Moreover, prenatal depression at 32 weeks gestation, but not in early pregnancy, has been associated with an increased risk of neonatal intensive care unit admissions, use of epidural analgesia, and operative deliveries, although the effect of depression on operative

deliveries was nonsignificant when controlling for analgesia administration (Chung, Lau, Yip, Chiu, & Lee, 2001). Both depression and anxiety have been linked to increased risk of preeclampsia and other high-risk conditions (Kurki, Hiilesmaa, Raitasalo, Mattila, & Ylikorkala, 2000). Finally, Teixeira, Fisk, and Glover (1999) found an association between elevated scores on the State Trait Anxiety Inventory (STAI; Spielberger, 1983) and increased uterine artery resistance, which ultimately results in decreased blood flow to the fetus and has been suggested as a potential mediating mechanism in the association between maternal emotional state during pregnancy and neonatal outcome.

Fetal and Neonatal Outcomes

Prenatal symptoms of depression and anxiety have also been linked to decreased fetal growth, birth weight, and gestational age. Results of a study by Orr, James, and Prince (2002) indicate that African-American women with elevated symptoms of depression on the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977) were nearly twice as likely to deliver preterm infants relative to women who did not report elevated CES-D scores (OR = 1.96). It should be noted that this study included only African-American women, a subgroup of the population that relative to Caucasian women is at higher risk for stress and high blood pressure during pregnancy, as well as adverse birth outcomes (Hilmert et al., 2008). This finding was replicated in a large sample (N=791) of ethnically diverse women who were patients at Kaiser Permanente Medical Care Program. In this study, women with CES-D scores greater than 16 were almost twice as likely to deliver preterm babies as women without depressive symptoms. Moreover, it appeared that increased severity of depressive symptoms (e.g. CES-D $\geq$ 22) is associated with additional risk (Li, Liu, & Odouli, 2009).

As previously discussed, there are several sociodemographic variables that have been linked to poor fetal growth and decreased gestational age at delivery. Hoffman and Hatch (2000) measured depressive symptoms at 13, 28, and 36 weeks gestation in a group of 666 women. Results indicated that although there was no association between depressive symptoms and fetal growth or duration of gestation for the overall sample, women who belonged to "low-occupational-status households" showed an association between elevated depressive symptoms and reduced fetal growth at 28 weeks. The finding did not hold at 13 or 36 weeks, and no association was found between depressive symptoms and gestational duration for either group. Likewise, Dole et al. (2003) found that social support and depression were not associated with preterm birth. The recent study by Li, Liu, and Odouli (2009), however, found that effects of depressive symptoms on birth outcomes were particularly pronounced in women with low educational attainment, among other commonly identified risk factors such as previous infertility, obesity, and stressful life events.

Tiffany Field's group has conducted a series of studies demonstrating the scope and magnitude of depression's effects on the fetus and newborn. In a study of 63 pregnant women, elevated depressive symptoms, defined by CES-D scores ≥ 16, were shown to predict neonates' less than optimal scores on the Brazelton Neonatal Behavioral Assessment Scale; however, prenatal depression was not related to infant birth weight, Apgar scores, or obstetric and postnatal complications (Lundy et al., 1999). In a larger study by the same group, Field et al. (2004) reported on a sample of 140 pregnant women, 70 of whom reported elevated symptoms of depression (CES-D scores ≥ 16) and 70 controls (CES-D scores ≤ 12). Relative to the normal subjects, women who were

depressed during pregnancy showed higher levels of anxiety, anger, and cortisol and lower levels of dopamine and serotonin. Depressed subjects were also significantly more likely to deliver low birth weight, premature infants. In addition, the newborns of women who were depressed during pregnancy evidenced several indicators of poor outcome including an alteration in biochemical profiles similar to that of their depressed mothers, less optimal scores on the Brazelton Neonatal Behavioral Assessment Scale, and lower vagal tone. Further analysis indicates that the alterations in maternal biochemistry at least partly account for the effects of depression on birth outcomes. Specifically, path analyses revealed that in addition to the direct effects of maternal depression on birth weight, gestational age at delivery, cortisol, and norepinephrine, depression also indirectly predicted gestational age at delivery through its association with prenatal maternal cortisol. Likewise, depression also had indirect effects on birth weight through its association with prenatal maternal norepinephrine.

Because many of the nonoptimal infant outcomes described in the Field et al. (2004) study could be due to maternal postpartum psychopathology, Diego, Field, and Hernandez-Reif (2005) conducted a follow-up study designed to examine the differences between newborns of mothers who were depressed during pregnancy relative to women who reported depressive symptoms only the in postpartum period. Postpartum maternal and infant assessments were conducted within 2 weeks of delivery in an attempt to minimize the effects of other postpartum events that could potentially influence results (e.g. mother-infant interactions, breastfeeding). Results indicate that infants of mothers with high CES-D scores only during postpartum period, and not during pregnancy, looked similar to infants of nondepressed mothers. In contrast, infants of mothers who

reported elevated depressive symptoms during pregnancy (regardless of postpartum symptomatology) were fussier, tended to cry more, exhibited more stress behaviors, and generally showed less optimal scores on the Brazelton Neonatal Behavioral Assessment Scale relative to infants of mothers who were not depressed at all or depressed only in the postpartum period. Thus, the authors concluded that these findings could be due to "the result of exposure to a dysregulated intrauterine environment." (p. 161).

Similar work has been conducted by Thomas O'Connor and his colleagues, who recently reported the results of a large, longitudinal, prospective study (The Avon Longitudinal Study of Parents and Children) designed to examine the association between maternal mood and anxiety in the pre and postnatal periods and developmental outcomes of the index children (O'Connor, Heron, Glover, & the ALSPAC Study Team, 2002; O'Connor, Heron, Golding, Glover, & the ALSPAC Study Team, 2003). As noted by the authors, a large body of literature has established a link between maternal postpartum depression and negative child outcomes, often explained as an effect of a disrupted mother-infant relationship or nonoptimal parenting (Murray, Cooper, Wilson, Romaniuk, 2003). The vast majority of these studies, however, have failed to examine the possibility of an earlier "programming" effect that could potentially occur during the prenatal period. O'Connor's group examined the independent effects of prenatal and postnatal depression and anxiety on later indices of child behavioral and emotional problems. A series of reports on this study indicate that maternal anxiety during pregnancy predicts child behavioral and emotional problems at 47 and 81 months of age. Moreover, this effect is independent of the effects of postnatal depression, which also accounts for a percentage of the variance in child problems. Interestingly, prenatal

symptoms of depression did not predict child problems (O'Connor, Heron, Glover et al., 2002; O'Connor, Heron, Golding et al., 2003).

These recent studies are particularly important because they included postnatal mood assessments, which have also been linked with child outcomes. By controlling for postnatal mood, the researchers have been able to more definitively establish a link between prenatal mood and child outcomes. Unfortunately, the vast majority of studies of stress, anxiety, and depression rely on self-report to assess these constructs. Very few studies have examined the incidence of diagnosed mood and/or anxiety disorders in relation to reproductive outcomes. However, the results of one small, retrospective pilot study suggest that a prenatal diagnosis of panic disorder is related to higher levels of life stress, and more importantly, infant birth weight (Warren, Racu, Gregg, & Simmens, 2006). Field et al. (2006) conducted a study involving 300 depressed pregnant women which is particularly noteworthy because all women who were enrolled met criteria for a diagnosis of clinical depression and had CES-D scores ≥ 16. Subjects completed a variety of self-report questionnaires and biochemical assessments, and fetal activity and infant assessment were also included. Because all of the women in this study were depressed, the authors chose to impose a median split based on maternal cortisol levels. Results indicate that women in the high cortisol group evidenced higher scores on the CES-D than women in the low cortisol group. In addition, fetuses of mothers with high levels of cortisol were smaller during gestation, experienced a shorter gestation, and weighed less as neonates. In an effort to more closely examine the effects of depression versus cortisol level on gestational age at delivery, the authors conducted a discriminant function analysis, which revealed that preterm delivery was not predicted by CES-D

scores, but was predicted by maternal cortisol levels. Although intriguing, results of this study would be strengthened by inclusion of a group of non-depressed controls who did not evidence elevations on the CES-D. Similarly, Diego, Jones, Field, et al. (2006) found that self-reported symptoms of depression, anxiety, and daily hassles were all significantly negatively related to indices of fetal growth including fetal weight, head circumference, abdominal circumference, and biparietal diameter, which is the standard criterion for estimating gestational age and dating a pregnancy. When these intrauterine fetal growth variables and prenatal cortisol were entered into a prediction model, cortisol was the only remaining significant predictor of fetal weight, suggesting that the association between maternal distress and fetal weight is mediated by maternal prenatal cortisol levels.

Correlates of Prenatal Depression

In considering this literature, it is important to note that depression is associated with a host of factors which may also explain or contribute to nonoptimal reproductive outcomes. Recent studies that examine the correlates of prenatal depression have found significant overlap between depression and a range of sociodemographic and psychosocial variables (Seguin, Potvin, St-Denis, Loiselle, 1995). For example, DaCosta, Larouche, Dritsa, and Brender (2000) conducted a study examining the hypothesis that stress, coping, personal resources, and perceived social support would all be related to the occurrence of depression during pregnancy. Although this study was based solely on self-report data and was based on relatively small sample size, results indicate that women who were depressed during pregnancy, defined as scores ≥ 10 on the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987),

reported a greater number of daily hassles, had higher scores on the STAI, and a higher level of emotion-oriented coping relative to control participants. In a more recent study, Field et al. (2006) reported that women who are clinically depressed during pregnancy were significantly younger than nondepressed women and were less likely to be married, have lower educational attainment, and more likely to fall into a lower socioeconomic range than nondepressed women. In addition, depressed pregnant women also reported higher levels of stress, anxiety, and anger on self-report measures and were less enthusiastic about being pregnant than nondepressed pregnant women. Results of a study by Messer, Dole, Kaufman, and Savitz (2005) indicate that self-reports of unwanted pregnancy predicted elevated depressive symptoms, perceived stress, and less effective coping strategies among pregnant women. Gurung, Dunkel-Schetter, Collins, Rini, and Hobel (2005) were interested in predicting prenatal anxiety. Results of this prospective, longitudinal study indicate that social support, mastery, and a woman's attitudes toward pregnancy were significant predictors of anxiety scores on the STAI. Finally, Rich-Edwards, Kleinman, Abrams, Harlow, McLaughlin, Joffe, and Gillman (2006) reported that younger maternal age, low income, lack of a partner, unwanted pregnancy, and a history of depression all predicted elevated scores on the EPDS. These findings are particularly notable in light of research linking each of these factors to adverse reproductive outcomes.

Several studies examining the role of prenatal depression have suffered from reliance on self-report measures and failure to include measures of highly correlated variables that might also explain the effect on birth outcomes. A related issue concerns the association between depressive symptoms during pregnancy and the post partum. In

fact, the single best predictor of postpartum depressed mood is prenatal depressed mood. This is notable in light of the fact that a substantial number of women (approximately 13%) report elevated symptoms of depression during pregnancy and the postpartum (O'Hara & Swain, 1996). Disturbances in family, work, and social functioning frequently accompany postpartum depression, and typically have deleterious effects on the mother's interpersonal relationships, particularly those with her partner and children (Field, Healy, Goldstein, Guthertz, 1990; Larsen & O'Hara, 2002; O'Hara, Hoffman, Philipps, &Wright, 1992). Thus, prevention efforts are often focused on identifying factors during pregnancy that may place women at increased risk of developing postpartum depression.

In summary, several studies have examined the role of depression in predicting labor and delivery complications, fetal behavior, birth weight and gestational age, infant temperament, and the postpartum health of the mother. In addition, a seemingly separate body of literature has examined the role of prenatal stress/anxiety in predicting these same outcomes. Taken together, results of these studies indicate that maternal symptoms of stress, anxiety, and depression during the prenatal period are related to fetal and neonatal outcomes; however, it remains unclear whether stress, anxiety, and depression are differentially related to birth outcomes. In addition, very few studies have examined the potential moderating roles of social support and coping, both of which have been linked to perinatal maternal stress and birth outcomes.

Potential Moderators: Effect of Social Support and Coping on Adverse Birth Outcomes

Despite the association between stress and detrimental birth outcomes, not all women who experience high levels of stress give birth prematurely or deliver low birth weight infants. Recent studies have begun to identify additional factors that may account for the conflicting findings and results that are difficult to interpret. Historically, there has been some question as to whether main effect or stress-buffering models best represent the true nature of the influence of social support and coping on health outcomes (Cohen & Wills, 1985). In their landmark paper, Cohen and Wills (1985) conclude that there is evidence for both models. Unfortunately, at the time of publication, very few studies had examined this question in the framework of pregnancy. One notable exception was a study by Norbeck and Tilden (1983), which found not only that high life stress predicted increased obstetric complications, but that the interaction of life stress and certain types of social support (i.e. tangible support) also predicted complications.

In the last several years, the state of the literature in this area has not greatly improved. Although there is some evidence for a direct effect of personal resources such as coping, social support, and personality factors on birth outcomes, investigators have continued to target the effects of resources as potential moderating factors that may buffer against the negative effects of stress (Collins et al.1993). In this model, women who experience high stress and have effective means of coping and/or substantial social support will be protected against low birth weight and preterm delivery when compared to women with similar levels of high stress who lack personal resources. Support for this hypothesis comes from recent studies showing positive effects of social support and

coping on birth outcomes (Collins, Dunkel-Schetter, Lobel, & Schrimshaw, 1993; Feldman, Dunkel-Schetter, Sandman, & Wadhwa, 2000; Lobel, DeVincent, Kaminer, & Meyer, 2000; Lobel, Yali, Zhu, DeVincent, & Meyer, 2002; Rini et al., 1999). What is less clear, however, is whether the effects are particularly strong for women experiencing high levels of stress, a question which is complicated further by the potential for inverse associations between stress and personal resources.

Social support (or lack thereof) during pregnancy has been linked to a variety of reproductive outcomes, including the onset of depression during pregnancy and the post partum. In one test of the stress-buffering hypothesis, the interaction between life events and social support was significant. Specifically, for women with few life events, social support was unrelated to birth weight; however, social support predicted higher birth weight for women with many life events (Collins, Dunkel-Schetter, Lobel, & Schrimshaw, 1993). Rini, Dunkel-Schetter, Wadhwa, and Sandman (1999) also investigated the effect of personal resources, specifically self-esteem, optimism, and perceived control, on the association between stress and birth outcomes; however, the interaction between stress and personal resources was not significant, suggesting that the stress-buffering hypothesis was not supported. Rather, it appeared that all women, regardless of stress level benefited from stronger resources. Given the myriad variables found to be associated with birth outcomes, varied forms of measuring them, and inconclusive evidence regarding protective effects of social support and coping, research in this field should consider both stress and variables that may protect against the impact of stress.

In many studies of social support, particularly those conducted during pregnancy, the construct is defined broadly or measures only the frequency of various types of support, as opposed to measuring network and partner support as separate aspects of the social support construct. Moreover, the vast majority of studies have not measured the extent to which women are satisfied with the level of received support. In the broader literature on partner support, there is evidence that perception of support adequacy, which reflects a match between preference for and receipt of support behaviors, is more predictive of outcomes such as marital satisfaction than is the actual amount of received support (Lawrence et al. 2008). Studies conducted during pregnancy have revealed similar results, such that women who rated their partners as being more effective in provision of support demonstrated lower overall levels of anxiety during pregnancy and decreases in anxiety from mid to late pregnancy (Rini, Dunkel Schetter, Hobel, Glynn, & Sandman, 2006). Thus, one possible explanation for the lack of significant interaction effects in previous stress-buffering studies may lie in the measurement of social support. Alternatively, the findings of Rini, Dunkel Schetter, Hobel, Glynn, and Sandman (2006) suggest that it may be the case that women who indicate that they are satisfied with their level of received support also tend to report lower levels of stress in general, thus making it difficult to identify a group of women who experience high stress *and* high levels of satisfaction with social support.

Indications that chronic stress exerts a greater effect on birth outcomes than acute stress have led researchers to wonder if chronic stress actually reflects a more trait-like or dispositional quality of particular women. For example, in a study examining prenatal maternal stress and dispositional optimism in a group of 129 high-risk pregnant women,

structural equation modeling revealed that optimism but not stress predicted infant birth weight. Specifically, women who were less optimistic experienced higher levels of stress and gave birth to infants who weighed less than more optimistic women (Lobel, DeVincent, Kaminer, & Meyer, 2000). Follow-up studies by the same group suggest that optimism may actually decrease emotional distress through its association with coping and appraisals of stressful events (Lobel, Yali, Zhu, DeVincent, & Meyer, 2002).

Given the association between optimism and coping, it may be informative to identify specific appraisal styles or coping strategies employed by optimistic versus pessimistic women, particularly during pregnancy. A relatively recent study examined the coping strategies employed during pregnancy and the post partum among groups of women who reported high versus low levels of depressive symptomatology (de Tychey, et al. 2005). Using the Brief COPE (Carver, 1997) as a measure of coping style, results suggested that women with higher levels of depressive symptomatology were more likely to utilize strategies commonly categorized as "maladaptive" (i.e. distancing, denial, blame, and substance use) to cope with stress. Nondepressed women were more likely to utilize "adaptive" strategies such as acceptance and humor.

Conclusion and Hypotheses

In summary, the current state of the literature suggests that prenatal maternal stress, measured in a variety of ways across the literature, is associated with a host of adverse reproductive outcomes including labor and delivery complications, reductions in birth weight, decreases in gestation, postpartum depression, and difficult infant temperament. These findings persist even after controlling for sociodemographic and medical variables with demonstrated effects on birth outcomes such as ethnic minority,

income, substance use, and preexisting medical conditions. Despite converging evidence from animal studies, analogue stress studies, retrospective studies, and prospective cross-sectional and longitudinal studies, many questions remain to be answered regarding the impact of prenatal maternal distress on birth outcomes.

One of the most pressing unresolved issues in the literature involves the nature of the stress construct, what precisely is being measured across studies, and which aspects of the construct are important in predicting birth outcomes. Even less is known about the possible mechanisms that account for the effect of prenatal maternal distress on birth outcomes. Similarly, investigators have been interested in mechanisms by which the negative impact of prenatal maternal distress may be moderated. In this regard, maternal psychosocial resources such as social support from partners and networks, along with the ability to utilize adaptive coping strategies have been targeted as potential moderators, yet few studies have addressed this issue.

The primary purpose of this study was to examine the association between prenatal maternal stress and neonatal outcomes. Given that the measurement of prenatal maternal stress has been inconsistent across studies, the first aim of the present study was to integrate measurement of stressful life events and hassles, the subjective impact of events and perceived stress, and symptoms of anxiety and depression. Because some studies have suggested that specific forms of stress may be more important than general stress, the goal was to potentially integrate findings from the vast array of studies and to test whether these components of stress reflect a unitary construct, or whether each component is predictive of birth outcomes independent of the others. It was expected that these commonly used measures of prenatal stress (e.g. stressful events and hassles,

anxiety, and depression) would represent separate, but related, constructs, each of which would account for variance in infant outcomes. This hypothesized measurement model was tested using factor analysis.

Moreover, regardless of the ultimate structure of prenatal maternal stress, it was predicted that higher levels of prenatal maternal stressful events, anxiety, and depression would be associated with more negative birth outcomes such as lower birth weight, fewer weeks gestation, smaller head circumference, shorter length, and lower Apgar scores. Hierarchical regression analyses were employed to test the paths between prenatal maternal stress and birth outcomes.

A great deal of attention has been paid to the impact of prenatal maternal stress on birth outcomes, with a relative dearth of data to address which factors may decrease the risk of adverse birth outcomes or increase the likelihood of optimal birth outcomes. Moreover, studies that include such factors have not uniformly concluded whether a main effects or moderation model is most appropriate. Thus, maternal psychosocial resources including social support and coping were included in the present study as a means of examining both main effects and stress-buffering (moderation) models. Specifically, it was predicted that women with more adaptive coping styles (e.g., more frequent use of humor and acceptance) would experience lower levels of distress and more positive birth outcomes. It was also predicted that women who were more satisfied with their partner's support and who had larger support networks would experience lower levels of distress and more positive outcomes. Finally, it was expected that social support satisfaction and/or adequacy and adaptive coping style would moderate the association between prenatal stress and reproductive outcomes. The paths between prenatal maternal coping,

social support, and birth outcomes were also tested using hierarchical regression analyses, as were the interactions between stress and maternal resources.

In conducting the present study, it was expected that study findings could have important implications for how the field conceptualizes the construct of prenatal maternal stress. Specifically, should it be the case that stress, anxiety, and depression represent separate constructs, each of which is directly related to birth outcomes, it would suggest that it is not adequate to simply assess stressful events, anxiety, or depression, but that all must be considered if we are to fully understand effects of prenatal maternal psychological functioning on birth outcomes. Moreover, an additional goal of including maternal resources variables was to identify factors that will shift the focus of the field away from a relatively narrow conceptualization of the impact of prenatal distress on birth outcomes to a more integrative view that accounts for contextual factors that may also impact women and their babies.

With respect to broader implications, it was hoped that providers could utilize these results to identify women at high risk for preterm delivery or delivering low birth weight infants. Moreover, there was potential for identifying possible mechanisms of intervention, such as increasing mothers' social support or improving coping strategies to deal with prenatal distress. Ultimately, early intervention may lessen the impact of prenatal distress on immediate and delayed physical health outcomes for mothers and their infants, with the potential for significantly reducing associated health care expenses. Moreover, at a conceptual level, support for the outlined hypotheses may help to answer questions regarding the nature of stress and coping, particularly in a portion of the

population where these constructs influence not only the well-being of adult women, but also their infants.

Summary of Hypothesized Model

Hypotheses

1. It was expected that stress, anxiety, and depression would represent separate, but related constructs. Changes in prenatal maternal stress, anxiety, depression, social support, and coping across time were also explored across two assessments.
2. Higher levels of prenatal maternal stress (i.e. stress, anxiety and depression) were hypothesized to predict adverse reproductive health outcomes.
3. Higher levels of maternal psychosocial resources (i.e. adaptive coping, social support) were hypothesized to predict more optimal reproductive health outcomes (Main Effect model).
4. Maternal psychosocial resources (i.e. coping, social support) were hypothesized to moderate the relationship between prenatal maternal stress and reproductive health outcomes (Buffering model).

CHAPTER II

METHOD

Participants

The participants in this study were 257 pregnant women, recruited via media advertisements distributed throughout Eastern Iowa, in-person recruiting in the Department of Obstetrics and Gynecology at the University of Iowa Hospitals and Clinics, letters distributed to patients of obstetrics and gynecology practices in Eastern Iowa, and the clinic associated with the Johnson County Department of Public Health (see Appendix A). In the initial phase of the study, women were eligible to participate if they were 14 years or older, English speaking, and 20 weeks gestation or less in their singleton pregnancy. Mid-way through the study, the protocol was altered to accommodate an additional arm of the study. This change allowed any woman who was pregnant on June 10, 2008 to enroll in the study, resulting in a group of women who completed time 1 questionnaires at *any* point during pregnancy, not just women who were 20 weeks gestation or less. In addition, all women who were 28 weeks gestation or less were asked to complete two assessments. A summary of study procedures and timing of assessments is shown in Figure B1.

Across recruiting sites, 349 women agreed to participate. Of the women who enrolled in the study, 41 were unable to be reached via phone and did not return any study materials. An additional 41 women were dropped from the study because they did not return a consent form (n=3), had a miscarriage (n=4), discovered a multiple gestation (n=5), or withdrew from the study for various reasons (n=29). Of the 267 women who completed some aspect of the study, 92 were enrolled during the first trimester (0-13

weeks gestation), 118 were enrolled during the second trimester (14-27 weeks), and 55 were enrolled during the third trimester (28-40 weeks). Trimester of enrollment was unknown for 2 of the 267 women. Of these 267 women, a number of them did not provide sufficient data or had not delivered by the time of data analysis and are therefore not included in subsequent analyses. The final sample size for the present study was 257 at time 1 (See Figure B2).

Procedure

A portion of the women in this study were enrolled through personal contact with research assistants or via media advertisements instructing potential participants to contact researchers via phone or email for further information. If a woman was deemed eligible to participate, she was asked to provide contact information, weeks gestation, and probable delivery location. If the woman was enrolled via in-person recruiting, she completed a consent form at the time of enrollment. A packet containing initial questionnaires was given to the woman to complete at a more convenient time. Women who learned of the study through media releases and expressed interest in participating were contacted via phone to further explain details of participation. Contact information, weeks gestation, and probable delivery location were collected over the phone; consent forms and initial questionnaires were mailed to the participants, along with a postage paid return envelope. A number of women were also recruited in the context of prenatal care. These women were provided with a description of the study and contact information forms to be completed if they were interested in participating. Contact information forms were then faxed or mailed to the Iowa Depression and Clinical Research Center by the practice collecting the information. For all methods of recruiting, consent to participate

in this study entailed permission to audiotape interviews and permission to access the medical records of subjects and their infants to collect information regarding identified outcome variables (i.e. obstetric events and complications, infant outcomes).

For the entire group of women enrolled in the study, questionnaire and diagnostic interview data were collected shortly after enrollment. A subset of these women who were 28 weeks gestation or less at the time of enrollment provided questionnaire and interview data at an additional time point, roughly between 30-32 weeks. Women who consented to participate were provided with packets containing questionnaires assessing sociodemographic variables (i.e. age, education, marital status, income), maternal distress (i.e. stress, anxiety, depression), resources (i.e. social support, coping), and substance use at two points during pregnancy. At each assessment point, women participated in structured telephone interviews to establish the presence of mood and anxiety disorders. Prior to the change in protocol, participants were compensated twenty dollars at each time point for completing both the questionnaire packets and telephone interviews. Thus, if all portions of the study were completed, a participant received a total of forty dollars. Following the change in protocol, participants received $20 for completing the first set of questionnaires, $20 for completing the first interview, and $25 for completing the second set of questionnaires and interview when applicable. Information regarding obstetric complications, birth weight, week of delivery, and other infant variables were collected from medical records of women and their infants following delivery. Maternal and infant outcomes were extracted and coded by a senior obstetrician gynecologist.

Women's responses to items assessing suicidal ideation (both interview and questionnaire measures) were closely monitored. Studies examining endorsement of self-

harm items on self-report questionnaires suggest that the vast majority of women never or hardly ever think about harming themselves during pregnancy (Lindahl, Pearson, & Colpe, 2005). This finding held true for our sample as well; only one woman endorsed a "3" or "Yes, quite often," on Edinburgh Postnatal Depression Scale (Cox, Holden, & Sagovsky, 1987) item 10, which reads "The thought of harming myself has occurred to me." This woman did not endorse suicidal ideation or a desire to self-harm on any other measure, and when contacted via phone was not in imminent danger. The subject requested referrals and was given a referral for psychological treatment.

Measures

Structured Clinical Interview for DSM-IV Diagnoses (SCID-IV; First, Spitzer, Gibbon, & Williams, 1997). A modified version of the SCID-IV, commonly used in research settings, was used to determine whether participants met criteria for DSM-IV (American Psychiatric Association, 2000) mood and anxiety disorders including major depression, dysthymia, bipolar disorder, generalized anxiety disorder, panic disorder with or without agoraphobia, obsessive-compulsive disorder, and posttraumatic stress disorder. Participants were also screened for substance use and eating disorders. The SCID-IV takes approximately 45-90 minutes to complete and was conducted by the author and four additional research team members at the master's or doctoral level. At the time of the interviews, women were also reminded to return their questionnaire packets if they had not already done so.

Hamilton Rating Scale for Depression (HRSD; Hamilton, 1960). In conjunction with the SCID and self-report measures of depressive symptoms, the 17-item version of the HRSD served as an additional indicator of depression severity and was integrated into

the clinical interview. The HRSD is a clinician-rated measure of severity of depressive symptoms experienced by participants over the last week. Notably, although the version of the HRSD that was utilized in this study reflects standard HRSD items, many symptoms of depression, particularly the physiological symptoms, overlap with those of pregnancy. For this reason, slightly modified thresholds for scoring specific items were used. Changes to the scoring criteria are outlined in the appendix. Scores on the 17-item version can range from 0-54, where scores of 0-6 indicate normal symptoms, scores between 7 and 17 are typically thought to reflect mild levels of depression, 18- 24 indicate moderate depression, and scores over 24 indicate severe depression.

Sociodemographic information. Participants provided information about themselves on several sociodemographic variables previously found to be associated with low birth weight and preterm delivery (e.g. age, relationship status, ethnicity, household income, parity, and education). Information regarding employment status and number and outcome of previous pregnancies was also collected. Current medications, psychiatric history and current mental health treatment was briefly assessed in the context of the self-report demographic form or the introduction to the clinical interview. Women were also asked whether their pregnancies were planned.

Peripartum Events Scale (PES; O'Hara, Varner & Johnson, 1986). The PES served as the primary measure of infant outcomes for the present study. The PES is an instrument designed to assess stressful events and complications occurring during pregnancy, labor, and delivery. The PES contains eleven subscales including demographic, past obstetric history, medical risk factors, obstetric risk factors, indication for admission to labor and delivery, progress in labor, method of delivery, duration of

labor, fetal monitoring, delivery complications, and infant outcome. The PES has been shown to be a reliable, valid measure of stressful events occurring in the perinatal period. Interrater agreement between two obstetricians was found to be .92 (O'Hara et al., 1986). In previous studies, the PES has also been shown to correlate significantly with women's self-reports of stress during labor and delivery, as well as women's scores on the BDI in the second trimester of pregnancy and at three, six, and nine weeks postpartum (O'Hara et al., 1986).

Key items extracted from medical charts included sex of the baby, birth weight, birth length, head circumference, and gestational age at delivery. As suggested by Collins et al. (1993), Apgar scores also served as a dependent measure of birth outcomes, as they are thought to be somewhat independent of birth weight. Apgar scores are used to evaluate the baby's condition at one and five minutes after birth. Infants are rated on five factors: activity and muscle tone, pulse, grimace response, appearance or skin coloration, and respiration. Each factor is scored on a scale of 0 to 2, with possible scores ranging from 0-10 for the overall scale. Based on the example of Lobel et al. (2000), birth weight (grams), length (centimeters), head circumference (centimeters), gestational age (weeks), and Apgar scores were used as continuous variables in analyses.

Medical History Questionnaire. Obstetric *history* and medical risk represent two of the best known predictors of birth outcomes; thus, women completed a questionnaire designed to assess ongoing medical conditions that might place a woman at high risk for adverse reproductive outcomes. Medical conditions assessed include kidney disease, epilepsy, diabetes, hypertension, anemia, HIV or infectious disease, Rh negative status, cardiac disease, asthma, sexually transmitted infections, clotting disorder, thyroid

disorder, vaginal infection, cervical infection, and urinary tract infection. In addition, the measure assessed history of adverse events and outcomes experienced during previous pregnancies. Such risk variables include history of preterm labor or delivery, previous stillbirth, miscarriage, or elective termination. In addition, previous infertility, preeclampsia, multiple gestations, incompetent cervix, placental problems, vaginal bleeding, fetal growth retardation, severe nausea or vomiting, premature rupture of membranes, labor induction, and caesarean sections were also assessed. Women who experienced medical risk factors for adverse reproductive outcomes were not excluded from the study, but medical risk was controlled in regression analyses. As has been done in previous research, the number of risk factors experienced by women was summed to create risk indices based on obstetric history and medical conditions for each woman (Lobel et al., 1992; Mancuso et al., 2004; Roesch et al., 2004).

Substance Use. Smoking and other substance use have consistently been identified as predictors of low birth weight and gestational age at birth (Cnattingius et al., 1993; McCormick, Brooks-Gunn, Shorter, Holmes, Wallace, & Heagarty, 1990). Accordingly, information regarding tobacco use, as well as use of other substances including alcohol and illicit drugs were collected at each time point using a survey developed by a member of our research team (Larsen, 2004). Screening questions pertaining to possible substance use disorders were also asked as part of the telephone interview.

Stress Measures

Prenatal Life Experiences Questionnaire. (PLEQ; Larsen, 2004) The PLEQ is a measure adapted for use in pregnant women that is designed to assess whether a number

of life events occurred, and if so, how positive or negative an impact the events had. The PLEQ was previously developed by Larsen (2004) based on survey of existing life events questionnaires. Items on the instrument were derived from the Life Experiences Survey (LES; Sarason, Johnson, & Siegel, 1978), Life Events Inventory (LEI; Cochrane & Robertson, 1973), Life Event Scales for Obstetrics Practice (Barnett, Hanna, & Parker, 1983), and Life Events Questionnaire (LEQ; Norbeck, 1984). Items included on this measure assess a variety of life events including career changes, changes in living arrangements, financial troubles, graduation from college, physical and/or sexual abuse, loss of a loved one, difficulties in interpersonal relationships, and problems specific to pregnancy, among others.

Using a checklist containing 50 life events (plus space for events not covered on the questionnaire), participants were asked to indicate which, if any of the events occurred "since you became pregnant," in the case of the first assessment point, and "since your last assessment" in the case of the second assessment point. In addition, participants are asked to rate how much of a positive or negative impact each event had on their lives. Ratings are made on a Likert-type scale with the following response options: 1 = highly negative impact, 2 = negative impact, 3 = no impact, 4 = positive impact, 5 = highly positive impact. Items endorsed as negative are tallied to reflect a negative events score (e.g. number of negative/stressful life events). The number of events perceived as having a positive impact can also be calculated in the same manner, but were not utilized for the purposes of this study. In addition to summing the number of negative events experienced at each time point, a weighted sum was also calculated,

corresponding to the subjective impact of negative events. Events rated as "negative" or "highly negative" were also assigned scores of 1 or 2 and summed across events.

With respect to psychometrics of the PLEQ and life events measures more generally, internal consistency estimates are not particularly relevant. There is little reason to expect that items on a checklist of events should be highly correlated with other items on the measure. In other words, many events occur independently of others and reflect a "set of heterogeneous items grouped together because it is assumed that they have a common effect rather than arising from a common source (Fergusson & Horwood, 1986, p.54)." Across studies, life events measures have typically shown concurrent associations with measures of mood and anxiety, and in studies of stress during pregnancy these measures have predicted birth outcomes (Dole et al., 2003). Although this study represents one of few studies utilizing the PLEQ, there is little consistency in the literature with respect to which life events scale is used in studies of prenatal stress. Moreover, most life events inventories are not used in their original form; they are typically modified to answer study questions. For example, a recent study utilized a modified version of the Life Experiences Survey (Sarason et al., 1978), which was shown to predict birth outcomes (Dole et al., 2003). Thus, life events measures appear to exhibit a high degree of external validity.

Hassles and Uplifts Scale –Revised. (DeLongis, Folkman, & Lazarus, 1988). The original Hassles and Uplifts scales were comprised of 118 and 136 items, respectively (Kanner, Coyne, Schaefer, & Lazarus, 1981). The original instructions for these scales asked participants to indicate which of the listed hassles and uplifts they had experienced in the last month, which was then followed by a rating of the severity (in the case of

hassles) or frequency (in the case of uplifts). The Revised Hassles and Uplifts Scale is a 53-item instrument that measures the extent to which common daily events (e.g. housework, car maintenance) are considered by participants to be either a hassle or uplift during the day, measured over four consecutive days. Items are to be rated on a 4-point Likert scale where 0 = none or not applicable, 1 = somewhat, 2 = quite a bit, and 3 = a great deal.

For the purposes of this study, the hassles scale served as an indicator of daily stressors, and provided a measure of stress chronicity across assessment points. Because women were only asked to complete the questionnaire on one day, which may not fully capture the extent to which items have been hassles or uplifts, the instructions were modified to reflect a response time frame of two weeks (see appendix). This time frame was chosen in an effort to attempt to characterize the extent to which items have generally been hassles or uplifts and to minimize recall difficulty for participants.

Scores on hassles were calculated in two ways: First, subjects received a total score, reflecting the total number of hassles experienced over the last two weeks. In other words, it is simply a count of the number of items endorsed. Second, subjects received an "intensity" score, which reflects the average rating, on a 0-3 scale, of endorsed hassles.

Reliability of this instrument has been assessed by examining the stability of hassles from day to day and month to month, both of which have shown high correlations. In our sample, we examined both internal consistency and test-retest reliability. With respect to the hassles scale, alpha at time 1 was 0.93, and alpha at time 2

was 0.92. Correlations between time 1 and time 2 were .54 and .65 for frequency of hassles and intensity of hassles, respectively.

Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). The PSS is a 14-item global instrument that measures the degree to which participants experienced life as stressful over the last month. Cohen, Karmack, and Mermelstein (1983) noted that the items were designed to assess the extent to which participants view life as unpredictable, uncontrollable, and overloading. Participants were asked to respond to each question on a five point Likert scale where 0 = never, 1 = almost never, 2 = sometimes, 3 = fairly often, and 4 = very often. Several items are reverse-scored, and a total score is calculated by summing across all 14 items. Higher scores reflect a greater frequency/degree of perceived stress. Internal consistency values were high for this sample; $\alpha = 0.85$ at time 1 and $\alpha = 0.88$ at time 2.

Depression Measures

Beck Depression Inventory Second Edition (BDI-II; Beck, Steer, Brown, 1996). The BDI-II is a 21-item inventory that served as a measure of depressive symptoms during pregnancy. Items were rated on a four-point scale (0-3), with higher scores reflecting more severe depressive symptoms. Specifically, scores of 0-13 indicate minimal depression, scores of 14-19 suggest mild depression, scores of 20-28 indicate moderate depression and 29-63 indicates severe depression (Beck et al., 1996).

Participants were asked to rate each item based on how they have been feeling for the "past two weeks, including today." The BDI has been shown to have good psychometric properties and is used extensively in depression research with pregnant and postpartum women, including that conducted in our laboratory (O'Hara, Schlechte,

Lewis, & Varner, 1991; O'Hara, Schlechte, Lewis, & Wright, 1990). Total scores were calculated by summing responses across all items. Internal consistency values were high in this sample, both at time 1 (α= 0.85) and time 2 (α= 0.86).

Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987). The EPDS is a 10-item self-report measure of depressive symptoms that has been well-validated in samples of pregnant and postpartum women. Participants are asked to rate how they have been feeling "in the past 7 days." The EPDS is scored by reverse scoring several of the items and summing across participant responses, and higher scores reflect greater level of depression symptoms. The measure is quick and easy to complete and has desirable psychometric properties. Cox, Holden, and Sagovsky (1987) reported that when using a cutoff of 12/13, sensitivity of the EPDS was 86% and the specificity was 78%. The split-half reliability and internal consistency values were .88 and .87, respectively. In the present study, alpha was 0.83 at both time 1 and time 2.

Inventory of Depression and Anxiety Symptoms (IDAS; Watson, O'Hara, Simms, et al., 2007). The IDAS is a 64-item self-report measure of mood and anxiety symptoms comprised of 2 broad scales including General Depression and Dysphoria, as well as 10 scales that are specific to symptoms of mood and anxiety disorders including Suicidality, Lassitude, Insomnia, Appetite Loss, Appetite Gain, Ill Temper, Well-Being, Panic, Social Anxiety, and Traumatic Intrusions. Participants are asked to rate each item on a 5-point Likert scale corresponding to "how often they felt or experienced things this way during the past two weeks, including today." Possible responses range from 1 = not at all, to 5 = extremely. Scores on the IDAS scales are created by reverse scoring where indicated and

summing responses to items comprising each scale. Higher scores reflect higher levels of distress on each scale, with the obvious exception of the Well-Being scale.

The psychometric properties of the IDAS are excellent, with internal consistency values of individual scales ranging from 0.86 to 0.92 in a sample of community adults. Similar results were reported in samples of college student, patient, and postpartum populations. The IDAS has also shown good test-retest reliability, as well as convergent and discriminant validity (Watson et al., 2007). In our sample, internal consistency values were largely similar to those previously reported. The majority of scales had internal consistency values of 0.70 or higher (range 0.69 to 0.96) at time 1; however, time 2 internal consistency values were somewhat lower. For example, alphas were 0.43, 0.66, and 0.67 for suicidality, panic, and traumatic intrusions, respectively. The remainder of scales at time 2 had high internal consistency values (range 0.76 to 0.95).

Anxiety Measures

Beck Anxiety Inventory (BAI; Beck, & Steer, 1993). The BAI is a 21-item inventory that assesses presence and severity of somatic and psychological symptoms of anxiety over "the past week, including today." Items are rated on a 4-point scale where 0 = not at all, 1 = mildly, 2 = moderately, and 3 = severely. Total scores were calculated by summing responses across all items, with a range from 0-63. On this measure, scores of 0 - 7 are considered minimal anxiety, scores of 8 - 15 reflect mild anxiety, scores of 16 - 25 indicate moderate anxiety, and scores of 26 - 63 reflect severe anxiety (Beck & Steer, 1993). It has been shown to have high internal consistency and test-retest reliability (Beck, Epstein, Brown, & Steer, 1988). Internal consistency values for the overall sample

at time 1 was 0.84, and for the subset of women who completed questionnaires and interviews at time 2 was 0.82.

Pregnancy-related anxiety. Based on the work of Rini et al. (1999) and Wadhwa et al. (1993), women were asked to complete a set of 10 questions indicating their concerns related to pregnancy, labor, and delivery during the last month. Examples of items included on this measure are "I am concerned about developing medical problems during my pregnancy" and "I am concerned about losing the baby." Item ratings are made on a 4-point Likert scale corresponding to the following values: 1= never/not at all, 2 = generally/sometimes/a little, 3 = a fair amount, 4 = a lot/very much. Items one, "I am confident of having a normal childbirth" and two "I think my labor and delivery will go normally" are reverse scored. A total score was created by summing responses to all ten items. Higher scores reflect higher levels of pregnancy-related anxiety. Internal consistency for this sample was high at both time points (α= 0.87 for time 1, α= 0.83 for time 2).

Maternal Resources Measures

Brief COPE (Carver, 1997). The Brief COPE is a 28-item measure comprised of several scales designed to assess participants' means of coping with stressful life circumstances. Participants are asked to indicate to what extent the items reflect their *usual* responses to stressful events. As originally designed, the Brief COPE yields fourteen scales, each comprised of two items. The fourteen scales include self-distraction, active coping, denial, substance use, use of emotional support, use of instrumental support, behavioral disengagement, venting, positive reframing, planning, humor, acceptance, religion, and self-blame. Carver, Scheier, and Weintraub (1989) indicate that active coping, planning, and use of instrumental support scales generally fall under the broader category of problem-focused coping, whereas the use of emotional

support, positive reframing (formerly positive reinterpretation and growth), acceptance, denial, humor, and religion scales largely represent forms of emotion-focused coping. Finally, the venting, behavioral disengagement, substance use, self-blame, and self-distraction (formerly mental disengagement) scales all generally represent maladaptive or less useful coping strategies.

Response to items on the Brief COPE scale are rated on a four-point Likert scale where 1 = I usually don't do this at all, 2 = I usually do this a little bit, 3 = I usually do this a medium amount, and 4 = I usually do this a lot. Scores for each scale are calculated by summing item responses for items on each scale. Higher scores reflect more frequent use of the identified coping strategy. Internal consistency values for the Brief COPE scales range from .50 to .90 depending on the scale; however, it is notable that each scale only contains two items, which is a less than desirable psychometric feature of the instrument. Internal consistency values for our sample at time 1 were similar, ranging from 0.28 (Self-Distraction) to 0.91 (Religion). The majority of the scales were in the 0.70 to 0.85 range. Internal consistency values were comparable at time 2, again ranging from 0.32 to 0.93.

Social Support Questionnaire Short Form (SSQSR; Sarason, Sarason, Shearin, & Pierce, 1987). The SSQSR is a six-item measure assessing participants' social support network and the extent to which they are satisfied with the level of support received. For each item participants are asked to list the initials and their relationship to the subject, for example "J.D. (Brother)," on the first part of each item, and rate the degree of satisfaction with the overall level of each type of support on the second half of each item.

Satisfaction items are rated on 6-point Likert scales where 1 = very dissatisfied and 6 = very satisfied.

Scores reflecting the number of individuals in the network, as well as satisfaction with support, are derived by summing across items and dividing by the number of items. Specifically, for number of individuals in the support network, the number of people/initials listed for each item is summed across items and divided by six to yield the a value of network size. Higher values reflect larger support networks. Similarly, responses to satisfaction with social support are summed across items and divided by six to yield the average satisfaction with level of support. Higher scores reflect greater satisfaction.

Internal reliability for this version of the Social Support Questionnaire is quite high, ranging from .90 to .93 on both the Number and Satisfaction scales. In our sample, similar values were obtained for the Number scale at time 1 (α= 0.89) and time 2 (α= 0.88), as well as the Satisfaction scale at time 1 (α= 0.93) and time 2 (α= 0.93).

Support in Intimate Relationships Rating Scale (SIRRS; Barry, Bunde, Lawrence, & Brock, 2009; Dehle, Larsen, & Landers, 2001). The SIRRS was used as an indicator of perceptions of social support from the mother's partner or spouse. Women who were not currently in a relationship were instructed to go on to the next questionnaire. The original version of the SIRRS was a 48-item instrument that assesses frequency and preference for support within a close relationship, which may be of particular relevance to samples of pregnant women, as opposed to general network support, which has shown weaker relationships to outcomes of interest in such samples. The SIRRS was shown to have excellent internal consistency (α = .97); however, the original SIRRS was not

subjected to a structural analysis, which is notable given the ongoing debate regarding the existence and predictive validity of distinct types of social support.

More recently, Barry, Bunde, Lawrence, and Brock (2009) created a modified version of the SIRRS, which asks participants to rate the number of times their partner/spouse has engaged in specific support behaviors in the last month (support frequency), as well as whether they preferred their partner to do each behavior more, less, or about the same amount (support adequacy). Although this format does not differ dramatically from Dehle's version (Dehle, Larsen, & Landers, 2001), it is somewhat easier to rate and allows for aggregation of partners' behaviors over time, as opposed to rating them on a daily basis over several days.

Although Dehle et al. (2001) originally proposed an untested five factor structure consisting of information support, emotional support, esteem support, tangible support, and network support for the SIRRS, Barry et al. (2009) did not find support for this model. In contrast, results of exploratory and confirmatory factor analyses indicate that a four factor solution consisting of physical comfort, tangible support, informational/insight support, and esteem/emotional support is the best fit for the data. Based on these analyses, several items were omitted from the final measure; however, we have chosen to retain forty-two items (6 items corresponding to network support and items omitted from the Barry et al. (2009) paper were omitted) for the purposes of replication of the above described solution.

For the purposes of our study, we examined total scores for both frequency and adequacy of support, as well as the scores on scales identified by Barry et al. (2009). Frequency items are scored on a Likert-type scale corresponding to the following values:

0 = Never, 1 = Rarely, 2 = Sometimes, 3 = Often, and 4 = Almost Always. Frequency scores were computed by summing across the 42 utilized items, with a possible range from 0 to 168. For adequacy items, women were asked to indicate whether they preferred more, less, or the same amount of each type of partner support. Responses to adequacy items were coded dichotomously such that 0 = woman perceived the support to be inadequate (e.g. they wanted more *or* less of the support), or 1 = adequate (e.g. they wanted the same amount of support). The possible range for support adequacy was 0-42, with higher values reflecting higher perceived adequacy across items. Alphas were high on all scales at time 1 and time 2, with all values above 0.80. At time 1, the range for frequency scales was 0.89 to 0.97, and the range for adequacy scales was 0.80 to 0.96. At time 2, the range for frequency scales was 0.87 to 0.96, and the range for adequacy scales was 0.80 to 0.95.

Statistical procedures

Preliminary analyses (e.g. bivariate correlations) were examined to determine whether demographic characteristics (e.g. marital status, ethnicity, household income, parity, and education), medical risk (e.g. preexisting medical conditions, history of pregnancy complications), and substance use (e.g. alcohol and tobacco) were significantly associated with prenatal maternal stress and/or reproductive outcomes. Variables with significant associations were controlled in subsequent prediction analyses.

To test our hypothesis that stress, anxiety, and depression represent separate, but related constructs, a series of exploratory factor analyses (EFA) were conducted at time 1 utilizing a) the sample of pregnant women who completed time 1 self-report measures of maternal distress (N=257), and b) the subset of pregnant women for whom assessments

were completed at both time 1 and time 2 (N=173). Exploratory factor analyses (EFA) were conducted using SPSS software (SPSS Inc., 2008). Principal factor analysis was used to determine the best fitting structural model for the data and was chosen as the method of choice because it tends to replicate better in confirmatory factor analysis (CFA). The coefficient of congruence was calculated using the Coefficient of Congruence program (Watkins, 2002) to determine the congruence of factors extracted from the overall and subset samples. Confirmatory factor analyses (CFA) were conducted using M-Plus software (Muthen and Muthen, 2004) with time 2 data utilizing the subset of pregnant women who completed both assessments (N=174).

Factor scores from those factors identified from time 1 and time 2 data were utilized in hierarchical regression models that were used to test hypotheses 2, 3, and 4. Steps included in the hierarchical regression equations were:1) demographic and obstetric risk variables associated with birth outcome, 2) diagnosis of clinical disorder, 3) factor scores of maternal distress, 5) maternal scores on the IDAS Panic scale, 5) maternal resources, and 6) centered interaction terms distress x resources. Separate regression equations were run at each time point for each infant outcome variable.

CHAPTER III

RESULTS

Participant Characteristics

Women were recruited from July 2007 through January 2009. The point in pregnancy when women completed study materials varied as a function of enrollment date. On average, women completed time 1 materials at 20.13 weeks gestation (SD=8.99 weeks), with a range from 5 to 41 weeks. A subset of women completed materials at both time 1 and time 2. These women completed time 1 materials, on average, at 16.86 weeks (SD = 6.03). Weeks gestation at which women completed time 2 materials was calculated based on due date and date women completed materials. The available data for time 2 suggest that women completed time 2 materials, on average, at 31.10 weeks gestation (SD=2.58 weeks), with a range from 25 to 38 weeks gestation. Although the goal of this study was to assess women between 30-32 weeks of pregnancy at time 2, error in estimation and challenges of reaching women in this three-week window influenced the range of weeks at which women were assessed. Nonetheless, on average, women completed the second assessment in roughly the middle of the assessment window, and the standard deviation suggests little spread in completion time relative to time 1.

Participant characteristics are presented in Table A1. The majority of women enrolled in the study were well educated, with 79.5% completing at least some college. Participants ranged in age from 18 to 45 years (M = 29.53 years, SD = 5.03 years). Over one-third of the sample (34.6%) reported total household incomes above $70,000. Nearly three-quarters of the participants worked outside the home (71.2%), and 81.3% of the

sample was married. Over half of the sample was primiparous (i.e. women having their first live birth), and over half had planned the pregnancy. The vast majority of participants were Caucasian.

With respect to maternal health during pregnancy, women were asked to report on any current medical conditions, use of tobacco or alcohol during the current pregnancy, and history of pregnancy complications. The most commonly reported medical conditions during the current pregnancy included anemia (6.2%), Rh negative status (10.9%), asthma (11.7%), and urinary tract infections (7.0%). The number of medical conditions a woman experienced ranged from 0 to 4 out of a possible 15 medical conditions.

Although 70 women (27.2%) endorsed a lifetime history of smoking, only 41 were smoking in the month before pregnancy (16.0%), and fewer yet endorsed smoking in the past trimester (8.9 %) or drinking alcohol during pregnancy (10.1 %). Of those women who endorsed smoking during pregnancy, the mean number of cigarettes smoked per day was 5.85 (SD = 4.78), with a range from 1-20. Of those women who endorsed drinking alcohol, the mean number of drinks per occasion was 1.16 (SD = .50), with a range from 1-3.

With respect to history of pregnancy complications in previous pregnancies, the most common pregnancy complications experienced included vaginal bleeding (7.8%), preterm labor (7.0%), severe nausea or dehydration (9.3%), cesarean section (11.7%), and induction of labor (17.5%). The number of previous complications ranged from 0 to 6 out of 13 total possible complications. In addition to these complications, 42 women (16.3%) indicated that they had experienced a miscarriage in their lifetime.

Completers vs. Noncompleters

Of the 257 women who provided either interview or questionnaire data at time 1, birth outcomes data were available for 236 women. Of these women, 163 were from women who completed some portion of both time 1 and time 2 assessments. Every effort was made to collect all outcome variables of interest from all women and infants; however, due to differences in record keeping across hospitals, not all information, such as head circumference, was available for all infants. Of the 349 women originally enrolled in the study, a number of women who were pregnant at the time of enrollment did not participate in assessments; however, medical records were still collected (n = 21). Although the group sizes were not equivalent, no differences were detected on outcome variables between women who returned materials and women who did not. Because women who enrolled in the study but dropped prior to assessment did not complete the sociodemographic questionnaire, comparisons based on maternal factors are not possible.

A small number of women completed questionnaires but not interviews, or vice versa. Despite numerous reminder calls and emails, 11 women completed time questionnaires 1 but not the interview, and 9 women completed the time 1 interview but not questionnaires. Similarly, 174 completed the time 2 questionnaires, while only 160 completed the time 2 interview. In addition, a number of women participated in the Time 1 assessment, and were eligible for the second assessment based on weeks of pregnancy at enrollment, but did not participate at Time 2. Specifically, 13 women who completed both the time 1 questionnaires and interview did not complete the time 2 questionnaires or interview. In addition, a number of women completed the time 1 questionnaires, but not the time 2 questionnaires (n = 25), and a number of women who completed the time 1

interview did not complete the time 2 interview (n = 41). Examination of independent samples t-tests reveals significant differences on key outcome variables for women who were eligible for and completed both time 1 and time 2 assessments compared to women who did not. Specifically, women who did not complete both assessments were more likely than women who did not complete both assessments to have babies who weighed less t (235) = 2.35, $p < .05$, were shorter t (221) = 2.72, $p < .01$, had smaller head circumferences t (205) = 2.18, $p < .05$, and were born earlier t (233) = 4.04, $p < .01$. There were no differences with respect to Apgar score. This finding is not particularly surprising that women who deliver earlier simply had less time during pregnancy to complete the second assessment. In addition, babies who are born earlier are generally smaller, and therefore would have lower birth weights, shorter length, and smaller head circumference. Women who completed time 1, but not time 2 assessments did not differ from women who completed both assessments on marital status, ethnicity, HRSD scores, number of medical conditions, history of obstetric complications, age, number of previous psychiatric diagnoses or alcohol or tobacco use. Women who completed time 1 questionnaires but not time 2 were significantly less educated t (247) = 2.01, $p < .05$ and had significantly lower household incomes t (240) = 1.94, $p < .05$ than women who completed both sets of questionnaires.

Because the procedure was changed midway through the study, analyses were also conducted to determine whether women who enrolled in the study prior to the changed differed from women who enrolled following the change. Results of independent samples t-tests indicate that there were no differences with respect to key outcome variables between groups, nor were there any differences with respect to

maternal age, marital status, ethnicity, number of medical conditions, history of obstetric complications, or alcohol or tobacco use. Women enrolled following the change, however, had significantly higher HRSD scores t (245) = -2.89, $p < .01$, lower levels of education, t (247) = 3.24, $p < .01$, and more historical psychiatric diagnoses t (244) = -2.64, $p < .01$ than women enrolled prior to the change. Again, this finding is not particularly surprising given that the revised recruiting strategy was geared toward women who had been impacted by a significant natural disaster, which itself generally impacted women who resided in lower income areas of the affected cities.

Descriptive Statistics – Interview Data

Of the 257 women that made up the final sample, 247 women had complete interview data available. Of these women, 17 (6.6%) met full criteria for a current episode of major depression at the time 1 interview. Sixty-nine women (26.8%) met full criteria for a past episode of major depression. For participants who completed the time 1 interview, none met criteria for alcohol abuse, alcohol dependence, anorexia nervosa, bulimia nervosa or mania (past or during pregnancy). One woman (0.4%) met criteria for dysthymic disorder, 1 (0.4%) met for current substance abuse, 2 (0.8%) for panic disorder, 3 (1.2%) for social phobia, 6 (2.3%) for obsessive compulsive disorder, 2 (0.8%) for posttraumatic stress disorder, and 11 (4.3%) for generalized anxiety disorder. With respect to HRSD scores, the present sample evidenced relatively low scores at time 1 ($M = 6.25$, $SD = 5.46$), reflecting minimal levels of depressive symptoms.

In total, 160 women completed the time 2 interview. Of these women, all but one also completed the time 1 interview. Of women who completed the time 2 interview only 6 (3.8%) met full criteria for a current episode of major depression. As was the case at

time 1, HRSD scores were similarly low at time 2 (M = 6.29, SD = 4.72). Again, none of the participants met criteria for alcohol abuse or alcohol dependence. In addition, none of the women met criteria for current substance abuse, social phobia, obsessive compulsive-disorder, bulimia nervosa, or mania since the time of the first interview. Rates of dysthymic disorder, panic disorder, posttraumatic stress disorder, generalized anxiety disorder, and anorexia nervosa were all very low. As noted above, not all of the women who participated in the time 1 interview completed a time 2 interview, either due to attrition or study design. Although the prevalence of past MDE was assessed at the time 2 interview, subjects were first asked if they had experienced an episode since the last assessment, and if not, were asked to report on lifetime episodes to be sure any episodes not cited by subjects in the first interview were captured. This led to some lack of clarity regarding the timing of episodes and made estimating of the prevalence of "past mde" at time 2 difficult. Complete descriptive statistics for interview data are presented in Table A2.

Descriptive Statistics – Self-Report Data

As was the case with the interview, and as referenced in preceding sections, not all women who completed questionnaires at time 1 completed questionnaires at time 2, either due to attrition or study design. However, all women who completed questionnaires at time 2 also completed them at time 1.

Maternal Distress

Tables A3 and A4 contain means and standard deviations for self-report maternal distress data (e.g. depression, anxiety, stress) at times 1 and 2. In addition, means and standard deviations at time 1 for the subset of women who completed two assessments

are also included for the sake of comparison across time. In general, women in our sample reported relatively low levels of maternal distress, reflected in normal or minimal levels of depression and anxiety and relatively low numbers of negative life events and/or hassles.

Maternal Resources

Table A5 contains means and standard deviations for measures of coping and social support at time 1 for both the overall sample and subset of the larger sample. Means and standard deviations for time 2 data are presented for the group of women who completed that assessment. With respect to network support, women in this sample reported having an average of 4 people they could count on for help or support across several different areas on the SSQ. In addition, women were, on average, fairly satisfied with the level of received support. Again, although not all scales from the Brief COPE and SIRRS were utilized of interest for the main study hypotheses, they were also deemed to be of interest for exploratory analyses and are presented along with relevant data.

For the subjects who completed both time 1 and time 2 assessments, mean scores at each time point were compared using paired-samples t-tests (Tables A3-A5). Results of these analyses suggest that, in general, women's mood and anxiety symptoms had decreased at the time of the second assessment, relative to the first. For example, time 2 scores on the BDI-II, EPDS, and several of the IDAS scales were significantly lower than scores at time 1, indicating that symptoms of depression tended to improve over the course of pregnancy. Anxiety (as measured by the BAI) and insomnia (as measured by the IDAS), were significantly higher at time 1 than at time 2. In addition, well-being

scores (as measured by the IDAS) at time 2 were significantly higher than scores at time 1. There were no significant differences between time 1 and time 2 on measures of coping or social support. Test-retest correlations were in the moderate to high range for most study measures, with the exception of hassles, life events, and some of the COPE scales.

Infant Outcomes

Descriptive statistics for infant birth outcomes are presented in Table A6. Infants born to women in our sample were generally very healthy based on standard birth weight and gestational duration criteria; 10 (4.2%) women gave birth to low birth weight infants (i.e. ≤ 2500 grams) and 23 (9.8%) women experienced preterm delivery (i.e. prior to 37 weeks gestation).

Structural Analyses

Bivariate Correlations

Given that previous studies of prenatal stress have not uniformly assessed depression and anxiety, it was important to determine whether depression and/or anxiety predict variance in birth outcomes, independent of the effects of stress, as it has traditionally been measured in the form of life events. Thus, intercorrelations of these measures at both assessment points were examined. The correlations between measures range from quite high (.81) to near zero (.04); however, the majority of correlations among these measures fall in the moderate range. Based on the pattern of correlations shown in Table A7, it appears that there are not three easily discernible factors of stress, anxiety, and depression. If that were the case, within-measure correlations should exceed the between-measure correlations, which is only the case for the measure of depressive

symptomatology. In fact, within measure correlations for anxiety and stress scales are in many cases weaker than their associations with depression scales.

Exploratory Factor Analysis

As a means of determining the underlying factor structure of measures that purportedly reflect depression, anxiety, and stress, questionnaire and interview data from time 1 were subjected to a series of principal axis factoring analyses. As suggested by Clark and Watson (1995), a marker was defined as an item that loaded .30 or greater on a factor and had its highest loading on that factor. Scales purported to measure depressive symptoms include the HRSD, BDI, EPDS, and IDAS General Depression scale. Scales purported to measure anxiety included the BAI, IDAS Social Anxiety, Panic, and Traumatic Intrusions scales, and pregnancy related anxiety. Scales thought to reflect stress included the PSS, Hassles and Uplifts, and PLEQ.

Diagnoses of MDE were not included in the factor analyses for both logistic and theoretical reasons. First, diagnosis of MDE was coded as a dichotomous variable, which in this sample violates assumptions of normality and linear associations among indicators. Use of dichotomous variables may suggest the use of principal components analysis or weighted least squares mean and variance adjusted estimation with tetrachoric correlations; however, given the hypotheses, these methods were not employed. Second, it was expected that a maternal diagnosis of MDE may be more detrimental to fetuses than high depressive symptomatology or stress by itself; thus, the question of whether MDE diagnosis predicted unique variance in birth outcomes was examined.

Examination of the structural data indicated that three factors had eigenvalues greater than 1.0; thus, solutions of one, two, and three factors were considered, with the

final structural model determined based on criteria of interpretability, strength of loadings, and relative lack of cross loadings. Based on results of the structural analyses, a one-factor solution appeared to best fit the data. Just over 50% of the variance was accounted for by factor one, whereas only 9.11%of the variance was accounted for by factor two, and 8.45% was accounted for by factor 3. Factor one appeared to be a general factor containing items representative of maternal distress; all scales loaded relatively highly on this factor with the exception of the IDAS Panic scale, which split across factors 1 and 2, the Frequency of Hassles scale, which split across factors 1 and 3, and Pregnancy-Related Anxiety, which evidenced weak loadings on factors 1 and 3 (Table A8). Rotation did not substantially improve interpretation of the model-data fit. Similarly, the two-factor model also appeared to reflect one large maternal distress factor that included relatively high loadings of each scale and a second factor for which the IDAS Panic scale loaded highly (Table A9). Given the relatively few number of markers on factors 2 and 3 of the corresponding models, as well as the ease of interpretability and strength of factor loadings, the one factor model was deemed to be the best fitting model for the maternal stress data in the overall sample of pregnant women at time 1. Contrary to expectations, it appeared that this factor represented a general “distress” factor comprised of stress, anxiety, and depression. Unrotated factor loadings for the one factor model are presented in Table A10. As previously discussed, three scales (IDAS Panic, Pregnancy-Related Anxiety, and Frequency of Hassles) loaded highly enough to be considered markers of the factor; however, relative to the other indicators had weak loadings on the factor.

Exploratory factor analyses were also conducted with the subset of women who completed both assessment and similar results were obtained. Results from these data are also presented in Table A10. As a test of congruence between these two sets of factor loadings, the Coefficient of Congruence was computed and was found to be .99, which is considered to be very high (Sakamoto, Kijima, Tomoda, Kambara, 1998).

In an effort to determine whether the one-factor model would replicate in the time 2 data, intercorrelations between measures were examined at time 2 (Table A11). The pattern of correlations observed at time 2 was similar to that observed at time 1, with the majority of values falling in the moderate range. Again, it was difficult to discern three separate factors of anxiety, stress, and depression at time 2. Although comparison of bivariate correlations provides some evidence for the similarity of factor structure across time points, more rigorous statistical methods are warranted.

Confirmatory factor analyses indicated that the one-factor structure was a marginal fit for the time 2 data, $\chi^2 = 114.38$, $p < .00$ (CFI = .94, SRMR = .08, RMSEA = .05). In an effort to achieve a better model-data fit, the IDAS panic scale was removed from the model. Results from this analysis suggest that the revised model was an excellent fit for the time 2 data, $\chi^2 = 43.36$, $p > .05$ (CFI = 1.00, SRMR = .03, RMSEA = .00). Based on these results, the time 1 factor structure was re-estimated without the IDAS panic scale (Table A12). Factor scores were derived using regression based approaches of each software package and utilized in subsequent analyses. Scales not included in the structural analysis were utilized in exploratory analyses outlined below. For time 1 analyses, factor scores from the overall sample, rather than the subsample,

were used to maximize use of available data. The correlation between factor scores at time 1 and time 2 was $r = .81$.

Association between Demographic Variables and Birth Outcomes

A number of maternal socioeconomic, medical, and behavioral variables have previously been identified as risk factors for adverse birth outcomes. These variables include maternal age, parity, education, income, planning status of the pregnancy, and ethnicity, chronic and preexisting medical conditions and history of previous obstetric complications, and maternal behaviors including smoking and alcohol consumption (Arias et al., 2003; Buescher et al., 1988; Cnattingius et al., 1993; Cramer, 1987; NCHS, 2000). In the present study (Table A13), a greater number of medical risk factors, ethnic minority status, and cigarette smoking were associated with lower birth weight. Similarly, greater number of medical risk factors, greater number of previous pregnancy complications, and cigarette smoking were all significantly associated with fewer weeks gestation. Cigarette smoking and minority ethnicity were also associated with smaller head circumference and lower Apgar scores, respectively. As expected, birth weight and weeks gestation were significantly positively correlated. Although planning and parity were not highly related to birth outcomes in the present study, they were nonetheless included in subsequent analyses based on examples in the literature. All of the variables included as control variables were also chosen based on their potential associations with prenatal maternal stress. That is, these previously identified risk factors may exert their effects indirectly via increased stress on the mother or in response to increased stress (e.g.

tobacco use) and therefore should be controlled in subsequent analyses. Base rates of alcohol consumption were very low, and were not included in subsequent analyses.

Although the vast majority of the subjects in this sample were Caucasian, previous studies of low birth weight and preterm delivery have consistently demonstrated an association between ethnic minority status and birth outcome (Arias et al., 2003; Cramer, 1987; Institute of Medicine, 2006). Independent samples t-tests reveal a significant difference between minority and non-minority women with respect to birth weight and head circumference. Specifically, women belonging to minority racial groups had babies with lower birth weight t (226) = 2.45, $p < .05$, and smaller head circumference t (198) = 2.64, $p < .01$

Associations among Maternal Distress, Maternal Resources, and Birth Outcomes

The associations among maternal distress (i.e. factor scores), maternal resources (social support and coping), and birth outcomes were first examined using bivariate correlations, presented in Table A14. Examination of the time 1 data indicates that maternal distress was significantly correlated with social support and coping in the expected direction for all scales but the Brief Cope Humor scale. Women who endorsed greater maternal distress also reported significantly less satisfaction with network support, decreased adequacy of partner support, lower frequency of partner support behaviors, fewer individuals in their support networks, and less frequent use of acceptance as a coping strategy. Maternal distress was significantly negatively correlated with head circumference; however, no other associations between negative, resources, and birth outcomes emerged at time 1. Because none of the hypothesized study variables

were associated with birth length, it was dropped as a dependent measure from subsequent analyses.

The associations among maternal distress (i.e. factor scores), maternal resources (social support and coping), and birth outcomes at time 2 are presented in table A15. Similar to the pattern of correlations observed at time 1, maternal distress was significantly correlated with network size, satisfaction with and adequacy of social support in the expected direction; however, maternal distress was not correlated with coping or frequency of support behaviors. Relative to time 1, more significant associations emerged between maternal distress, resources, and birth outcomes at time 2. Specifically, increased frequency of humor was associated with lower gestational age and higher perceived satisfaction with network support was significantly associated with greater gestational age. In addition, increased adequacy of social support was associated with lower birth weight. Finally, higher scores on maternal distress were associated with lower Apgar scores, whereas higher perceived satisfaction with network support was associated with higher Apgar scores. As was the case at time 1, because none of the hypothesized study variables were associated with birth length, it was dropped as a dependent measure from subsequent analyses.

In order to examine the association between psychiatric diagnosis and birth outcomes, a series of independent-samples t-tests were conducted (Tables A16-A20). Analyses reveal a significant difference between depressed and non-depressed women with respect to birth weight, head circumference, and gestational age at delivery. Specifically, women who were depressed at time 1 had babies who weighed less at birth than babies of nondepressed mothers, t (227) = 2.29, $p < .05$, had smaller head

circumferences, t (199) = 2.66, $p < .01$, and were born earlier, t (226) = 2.45, $p < .05$, than babies of nondepressed women. Interestingly, a history of depression assessed at time 1, regardless of current depressive status, was also related to birth outcomes, such that women with a history of depression had babies who were shorter in length than babies of women who did not have a history of depression, t (215) = 2.31, $p < .05$. There was a marginally significant effect for the impact of past depression on birth weight, t (227) = 1.76, $p < .10$. These effects were not replicated at time 2; women who reported being depressed at time 2 evidenced no differences in birth outcomes relative to nondepressed subjects.

In addition to a depression, differences between clinically anxious and non-anxious women were also examined. Somewhat surprisingly, results of independent samples t-tests indicate that women with a diagnosis of Generalized Anxiety Disorder at time 1 were significantly more likely to have *heavier* babies than women without generalized anxiety disorder, t (227) = -2.10, $p < .05$. Again, this effect did not hold at time 2.

Do Maternal Distress and Maternal Resources Predict Birth Outcomes?

Hierarchical regression analyses were utilized to determine how demographic variables, clinical diagnosis, prenatal maternal distress, resources, and their interactions related to birth outcomes at time 1 and 2. Using birth outcomes as the criterion variables across analyses, demographic and medical risk variables previously associated with birth outcomes (tobacco use, obstetric history, medical risk, ethnicity, parity, and planned pregnancy) were entered at the first step of the equation. Given the association between

MDE and birth outcomes, diagnosis of MDE was entered in the second step, followed by factor scores reflecting maternal distress on the third step. Because the IDAS Panic scale was ultimately removed from the factor analysis, it was entered separately at the fourth step. At the fifth step, maternal resources (COPE Humor and Acceptance scales, size of network and satisfaction with support from the SSQ, and total scale frequency and adequacy of support scales from the SIRRS) were entered into the equation. At the sixth and final step, variables reflecting the interaction between maternal distress and resources were entered. All variables were centered prior entering the regression equations and prior to computing interaction terms. Centering was done by subtracting the variable's mean from each case's value on that variable. Given the multiple models being tested, the significance level for overall regression equations was set at $\alpha = .01$; alpha for individual blocks and predictors within each model was set at .05.

Results of the hierarchical regression analyses at time 1 indicate that, as expected, a number of sociodemographic variables account for variance in birth outcomes; however, clinical diagnosis of MDE, maternal distress, panic, and resources at time 1 generally did not account for a significant portion of the variance in birth outcomes over and above sociodemographic variables. This finding held true for birth outcomes including gestational age at delivery, birth weight, and Apgar score (Tables A21-A23); however, clinical diagnosis of MDE accounted for a significant portion of variance in head circumference (Table A24). Results of time 2 hierarchical regression analyses are presented in Tables A25-A28. With few exceptions, the overall regression equations were not significant at time 2. Clinical diagnosis of MDE, maternal distress, and panic at time 2 did not account for a significant portion of the variance in birth outcomes.

Moreover, maternal resources did not predict a significant amount of variance in birth weight, head circumference, or Apgar score; however, maternal resources did predict a marginally significant amount of variance in birth outcomes in gestational age at delivery (F change (15, 119) = 1.67; p = .07). With respect to individual predictors, both use of humor as a coping strategy and network size accounted for a significant portion of the variance in gestational age at delivery. Although a larger network size predicted greater weeks gestation at delivery; lower scores on use of humor (i.e. less frequent use) also predicted greater weeks gestation at delivery, which runs counter to the expected result.

Because researchers have argued that gestational age is confounded with birth weight, head circumference, and Apgar score, separate regression equations that included gestational age as a covariate were estimated. Results were largely unchanged, with the exception of time 2 variables predicting birth weight. In this model, both use of humor and satisfaction with network support accounted for a significant portion of the variance in birth weight, over and above gestational age and parity (Table A29).

Do Maternal Resources Moderate the Association between Prenatal Distress and Birth Outcomes?

Despite null findings for maternal distress and maternal resources at time 1, the potential for a significant interaction between predictors remained. Considered as a block, interactions between maternal distress and maternal resources did not account for a significant portion of the variance in birth outcomes over and above demographic variables; however, two interesting findings emerged (Tables A21-A24). The interaction between maternal distress network size, as well as the interaction between maternal distress and satisfaction with network support were significant predictors of birth weight

(Figures B3 & B4). Specifically, for women with "high" satisfaction with network support, as maternal distress increased, birth weight decreased. For women with "low" satisfaction with network support, as maternal distress increased, birth weight also increased. For women with mid-level satisfaction with network support, there was little change in birth weight as a function of maternal distress. With respect to the maternal distress x network size interaction, women with "large" network sizes experienced an increase in birth weight as maternal distress increased; however, women with "small" network size experienced a decrease in birth weight as maternal distress increased. Again, women with "medium" sized networks evidenced little change in birth weight as a function of maternal distress. Although not significant at the $p < .05$ level, one interaction term was significant at the $p < .10$ level (maternal distress x network size for head circumference).

Few significant results emerged with respect to interactions at time 2. Again when considered as a block, interactions between maternal distress and maternal resources did not account for a significant portion of the variance in birth outcomes, over and above variables entering the equation earlier (Tables A25-A28); however, with respect to birth weight, the change in R^2 change did approach significance when birth weight was the outcome variable. Specifically, the interaction between maternal distress and acceptance as well as the interaction between maternal distress and adequacy of partner support were significant predictors of birth weight (Figures B5 and B6). Women with frequent use of acceptance as a coping strategy experienced an increase in infant birth weight as maternal distress increased. Women with infrequent use of acceptance as a coping strategy experienced a decrease in infant birth weight as maternal distress

increased. Finally, women with average frequency of use of acceptance evidenced little change in birth weight as a function of maternal distress. When considering the interaction between maternal distress and adequacy of partner support, a finding contrary to expectations emerged. First, women who indicated high adequacy of partner support evidenced *decreases* in infant birth weight as maternal distress increased. In addition, women who indicated low adequacy of partner support evidenced *increases* in infant birth weight as maternal distress increased.

Supplemental Analyses

Do Maternal Distress and Maternal Resources Predict Birth Outcomes?

Because a number of equations representing the overall model were not significant, but individual predictors were, it was hypothesized that the nonsignificant predictors created "noise" in the model, thereby reducing the significance of the overall model. To test this hypothesis, the models were simplified such that only three steps were included in hierarchical regression analyses: 1) demographic and obstetric risk variables associated with birth outcome, 2) main effects including factor scores of maternal distress and maternal resources, and 3) centered interaction terms distress x resources. In addition, separate regressions were run for each of the maternal resources measures (e.g. Brief COPE, SSQ, and SIRRS). Results of these analyses at time 1 indicated that despite overall significant F statistics for each equation, maternal distress and resources did not predict birth outcomes. Results at time 2 indicated that with the exception of the Brief COPE no longer predicting gestational age, all other findings held, and no additional significant predictors emerged.

To investigate the impact of maternal distress and resources on clinically significant adverse birth outcomes, logistic regressions were conducted utilizing preterm delivery (i.e. less than 37 weeks) and low birth weight (less than 2500 grams) as dependent variables. In these models, maternal diagnosis of MDE, distress scores, and panic scores were included in the same block to reduce the number of steps in the equation. Because of the small sample size at time 2, logistic regressions were not conducted with time 2 data, and SPSS would not compute solutions. With respect to low birth weight, results of hierarchical regressions at time 1 were confirmed; neither maternal distress nor maternal resources emerged as significant predictors of low birth weight (Table A30). With respect to preterm delivery, again, maternal distress did not emerge as a significant predictor of outcome; however, the SIRRS Adequacy scale was a significant predictor of preterm delivery, despite lack of significance of the overall model (Table A31).

Finally, because few women experienced adverse birth outcomes in this sample, a composite variable reflecting presence of *any* adverse birth outcome was created. Specifically, women who gave birth to infants who weighed less than 2500 grams or were delivered prior to 37 weeks or had 5-minute apgar scores less than 7 were classified as having had adverse outcomes. This composite variable was used as a dependent variable in a logistic regression, and again, a similar pattern of results emerged. At both time 1 and time 2, none of the blocks consisting of maternal distress or resources were significant; however, SIRRS Adequacy and social support network size emerged as significant predictors of outcome at times 1 and 2, respectively (Table A32 and A33).

Do Maternal Resources Moderate the Association between Prenatal Distress and Birth Outcomes?

With respect to the reduced model outlined above, results of hierarchical regression analyses at time 1 and time 2 indicated that the overall F statistics became significant, and significant interactions remained such (and evidenced the same pattern of results). Similarly, when considering results of logistic regression analyses at time 1 (Tables A30-A31), both the overall models and blocks containing interaction terms were significant. Moreover, the interaction of maternal distress x network size was a significant predictor of both low birth weight and preterm delivery; however, the interaction between maternal distress and satisfaction with network support was no longer significant. Results of the logistic regression based on a composite outcome variable also produced similar findings; again the interaction between network size and maternal distress was significant at time 1, and the interaction of maternal distress and partner support adequacy as well as the interaction of maternal distress and acceptance approached significance at time 2 (Tables A32 and A33).

Scale-Level Associations between Maternal Distress, Maternal Resources, and Birth Outcomes

As previously discussed, the general factor reflecting maternal distress and measures of maternal resources did not predict variance in birth outcomes at times 1 or 2. To account for the possibility that additional scales beyond those included in structural analyses may be related to birth outcomes, intercorrelations between individual scales and birth outcomes were explored at time 1 (Tables A34-A37) and time 2 (Tables A38-A41).

In general few significant associations emerged. At time 1, the IDAS Insomnia, Suicidality, and Appetite Gain scales were significantly negatively associated with Apgar score, indicating that higher scores on the IDAS scales were associated with lower Apgar scores. In addition, the Brief COPE Disengagement and Self-Blame scales were significantly negatively associated with head circumference and Apgar score, respectively. With respect to social support, a number of SIRRS scales were significantly positively associated with birth weight including Physical Support Adequacy, Tangible Support Adequacy, and Informational Support Adequacy. It is notable that none of the SIRRS Frequency scales were associated with birth weight, nor was the overall Adequacy scale. Finally, additional significant associations between maternal distress and birth outcomes emerged for the BDI, HRSD, and intensity of Hassles. More specifically, higher scores on the BDI were associated with smaller head circumferences, greater intensity of hassles was associated with lower birth weight and smaller head circumference, and higher scores on the HRSD were associated with lower Apgar scores.

At time 2, a different pattern of findings emerged. Specifically, seven IDAS scales were significantly negatively associated with Apgar score (Table A38), and seven Brief COPE scales were significantly negatively associated with gestational age, head circumference, and Apgar scores. Interestingly, the majority of significant associations were between less adaptive forms of coping and birth outcomes, in the expected direction. Specifically, lower frequency scores on maladaptive forms of coping were associated with more positive birth outcomes (Table A39). With respect to measures of social support, no consistent pattern of findings emerged. Some of the scales were significantly positively associated with birth outcomes, while others were significantly

negatively associated with birth outcomes (Table A40). Finally, the BDI, BAI, intensity of hassles, PSS, and EPDS were all significantly negatively associated with at least one birth outcome (Table A41).

CHAPTER IV

DISCUSSION

An increasingly large literature has examined the nature of women's emotional experiences during pregnancy in hopes of shedding light on potential contributions to adverse infant reproductive outcomes. Although questions remain regarding the types of experiences that are most detrimental to the mother and fetus, the timing of these experiences, and potential protective factors, the consensus of the field is clear; maternal distress during pregnancy has a negative impact on the mother and the developing child. This finding has been replicated across a wide range of methodologies and samples. Moreover, there is evidence that maternal distress exerts both immediate and distal effects. The present study was conducted in an effort to replicate existing studies and to address unanswered questions in the field, particularly those related to potential factors that may buffer against the negative impact of maternal distress during pregnancy.

The first aim of the present study was to examine the nature of maternal stress, anxiety, and depression (i.e. maternal distress) during pregnancy, and to establish a link between maternal distress during pregnancy and adverse infant birth outcomes. With respect to the nature of maternal distress during pregnancy, results of this study indicate that the sample was generally psychologically healthy. Rates of MDE during pregnancy fell within the range reported in a recent review (Gaynes et al., 2005); albeit on the low end of the range. In addition, mean scores on measures of maternal distress during pregnancy were similar to those reported in previous studies of pregnant and/or postpartum women. For example, scores on the IDAS at both time points were very much in line with results from Watson et al. (2007), in which the IDAS General

Depression mean in a postpartum sample was 38.92 (SD = 12.40). Means and standard deviations similar to those reported by Watson et al. (2007) were obtained for the majority of the other IDAS scales. Mean scores on the BDI and BAI across time in our sample were also similar to or slightly lower than those reported by Watson et al. (2007) in a postpartum sample (BDI = 10.03, SD = 7.41; BAI = 7.21, SD =7.99). Similar scores have also been obtained by previous studies collecting BDI responses from women attending prenatal care appointments at UIHC (O'Hara, Neunaber, & Zekoski, 1984). On average, women experienced few negative life events during pregnancy, which is in line with results obtained in a previous study utilizing the PLEQ (M = 1.91 across three trimesters, SD = 2.56, range = 0-12) (Larsen, 2004). In addition, scores on the PSS were similar to those previously reported by Cohen et al. (1983), in which means for college samples and combined samples were 23.18 (SD = 7.31) and 23.67 (SD = 7.79), respectively.

With respect to the nature of maternal social support and coping (i.e. maternal resources), women in the present study evidenced lower scores on partner support amount and adequacy at both time points relative to a newlywed sample (Lawrence et al., 2008). This result is not surprising given the previously reported phenomenon of declines in marital satisfaction across the transition to parenthood, and even prior to birth for wives (Lawrence, Nylen, & Cobb, 2007). On average, women identified just over 4 people they could count on for various types of network support, which is similar to results obtained from an undergraduate sample on the original version of the SSQ (Sarason, Levine, Basham, & Sarason, 1983). Finally, scores on the Brief COPE at both time points were comparable to or slightly more adaptive than (i.e. higher means on

adaptive coping scales, lower means on maladaptive coping scales) a group of non depressed women (de Tychey et al., 2005). These data suggest that, in some ways, the present sample is fairly representative of pregnant samples in Iowa, which tend to be Caucasian, married, and members of the middle class. For example, state of Iowa median household income in 2007 was $47,324 (U.S. Census Bureau, 2009). As shown in Table A1, women from our sample in Eastern Iowa, and particularly those in the Iowa City area, tend to be somewhat more educated and have higher incomes than average women in the state. In the current study, rates of preterm delivery and low birth weight were 9.8% and 4.2%, respectively. These figures are somewhat lower, but generally representative of babies born in Iowa, where reported rates of low birth weight were 6.4% in 2007 (Iowa Department of Public Health, Center for Health Statistics, 2007). Women and infants in the current study, however, may not be representative of populations comprised of more adolescents, ethnic minorities, and lower socioeconomic class women, who tend to exhibit higher rates of negative affect during pregnancy and adverse birth outcomes, as demonstrated in the current study and others (Arias et al., 2003; Cramer, 1987). Moreover, researchers have found more robust results with respect to the association between prenatal distress and birth outcomes in these groups of women (Dominguez et al., 2008; Hilmert et al., 2008; Lobel et al., 1992).

Associations between Measures of Maternal Distress

Across studies of prenatal maternal distress, researchers have relied on a number of instruments to measure the construct(s) of interest. The present study aimed to incorporate the most commonly used measures to determine what precisely is being measured in the literature. It has previously been suggested that stressful events, stress

appraisal, depression, and anxiety are separate and equally important components of stress that should all be assessed (Lobel, 1994); however, the associations between these constructs has not been adequately examined in a perinatal population. Based on the existing literature, it was expected that stress, anxiety, and depression would represent three separate, but related components of stress; however, this hypothesis was not supported. Instead, results of correlational and structural analyses in the present study indicate that these constructs more likely reflect a higher-order, more general "distress" or "negative affect" factor, even when taking into account frequency of life events and daily hassles. Moreover, after removing the IDAS Panic scale from time 2 analyses, the presence of a large, general distress factor was strongly confirmed. Our results are similar to those of one study which reported that hassles, depressive and anxiety symptoms were highly correlated and reflected one general factor (Diego et al., 2006).

Results of this study can be broadly compared to previous studies of maternal distress during pregnancy. Although many researchers have examined anxiety and life events within the same study and found that anxiety and life events load on separate factors (Lobel et al., 1992), few studies have measured stressful events, depressive symptoms, and anxiety together. Thus, it is unclear how adding a measure of depression would impact results of structural analyses in such studies. However, examination of the broader literature suggests that regardless of which measure is utilized (i.e. life events, anxiety, depression), results overwhelmingly point to an effect of prenatal maternal distress on birth outcomes. Of course, it is also possible that results from the present study would differ in a more diverse population, or one that experiences more events and/or hassles. Also of interest in the present study is the IDAS Panic scale. It can

largely be thought of as a measure of physiological reactivity, and although correlated with the general distress factor, appeared to make up its own factor, which may suggest that the physiological response to stress may hold important clues to the impact of maternal psychological distress on birth outcomes.

Pattern of Maternal Distress and Resources across Time

An additional aim of the present study was to examine the pattern of maternal distress across time points during pregnancy. Previous studies have found mixed results regarding the stability of stress, anxiety, and depression during pregnancy. For example, Glynn et al. (2004) reported that women perceive life events as less stressful in late pregnancy relative to early pregnancy. In contrast, DaCosta et al. (1999) reported no significant differences between trimesters on a measure of daily hassles; however, pregnancy-specific anxiety and state anxiety were higher in the third trimester than in the first trimester. Results of the present study largely indicate that symptoms of maternal distress decrease across pregnancy, with few exceptions. Although women in this sample experienced somewhat higher symptoms of anxiety on the BAI, additional measures of anxiety, including pregnancy-related anxiety, decreased across time. Women also reported more difficulty sleeping, which is not uncommon during late pregnancy, when it becomes more difficult to sleep comfortably due to the increasing size of the fetus. Despite these slight increases on insomnia and one measure of anxiety, women also experienced improvements in their sense of well-being at the second assessment relative to the first. Moreover, although the paired-sample t-test was not significant for frequency of hassles, the general trend appeared to suggest that women experienced more hassles at

the second assessment, but rated the intensity of hassles as significantly lower than at the first assessment. Thus, it may simply be the case that regardless of changing frequency of hassles or life events, women's perceptions of stress decline across pregnancy. Studies utilizing the cold stressor test have found that women become less physiologically reactive to such stressors with advancing gestation (Kammerer et al., 2002); thus, it may be the case that women also become less psychologically reactive to mild stressors as well, particularly in a sample of psychologically healthy women. Alternatively, as suggested by Glynn et al. (2008), it may be that the pattern of stress across pregnancy is more important than stress at any one time point. Thus, women who do not show decreasing sensitivity to stress across pregnancy may be at higher risk for adverse outcomes.

Not surprisingly, there were no significant differences in coping or social support across time. It may also be particularly interesting to identify women who do experience a change in coping or social support during pregnancy to determine the impact, if any, on the well-being of the woman and fetus.

Impact of Maternal Distress and Maternal Resources on Birth Outcomes

Results of the present study suggest that when considered as a general factor, maternal distress demonstrated few associations with birth outcomes, thus indicating that hypothesis 2 was largely not supported. For those associations that did emerge, associations were modest at best, and did not account for additional variance in birth outcomes over and above demographic variables. Results were clearer for diagnosis of MDE at time 1, which indicate important differences in birth weight, gestational age, and

head circumference between depressed and nondepressed women. In addition, diagnosis of MDE at time 1 predicted a significant amount of variance in head circumference, over and above demographic and medical risk variables. Oddly, these findings did not hold for diagnoses at time 2; however, this may have been due to the decreased sample size and prevalence of depression at time 2. The pattern of associations between maternal resources and birth outcomes was also inconsistent across time, with some evidence of maternal resources at time 2 predicting variance in gestational age.

When considering the results of supplemental analyses, several additional findings emerged, at both time points. In general, there were fewer associations between measures of maternal distress and birth outcomes than between maternal resources and birth outcomes, at both time points. Interestingly, of the time 1 scales that demonstrated significant associations with birth outcomes (i.e. IDAS insomnia, suicidality, appetite gain, social anxiety, BDI, HRSD, and intensity of hassles), only three of them were included in the structural analysis described above. Moreover, despite a smaller sample size, a number of significant associations emerged at time 2. Scales on the IDAS showed more robust associations with Apgar scores, in the expected direction, and additional associations between maternal distress and birth outcomes also emerged (Table A41). It is puzzling that many of the scales purported to measure stress, anxiety, and depression loaded highly on one general factor at each time point, which was not associated with birth outcome; however, when considered separately, several of the measures *were* related to birth outcome, particularly at time 2. It is equally puzzling that MDE at time 1 emerged as a predictor of birth outcome, but fewer time 1 self-report measures showed associations with birth outcome than time 2 self-report measures. One potential

explanation is found in a recent study by Lobel, Cannella, Graham, et al. (2008), which found that pregnancy-specific stress was a better predictor of birth outcome than state anxiety, perceived stress, life events, and a latent factor representing stress in general.

With respect to maternal resources, few significant predictors of birth outcomes emerged in the regression equations, again, suggesting that hypothesis 3 was not supported. When considering supplemental analyses, several of the scales from the Brief COPE were significantly negatively associated with birth outcomes, indicating that less adaptive coping (i.e. higher frequency of self-distraction, denial, disengagement, and venting) is associated with less optimal birth outcomes including smaller head circumference and lower Apgar scores. Oddly, three scales that might be considered adaptive coping were also significantly negatively associated with birth outcome. Higher frequency of accessing emotional support and instrumental support, as well as positive reframing were associated with younger gestational age at and lower Apgar scores. These results are counterintuitive, and might possibly be explained by the generally poor psychometric characteristics of the Brief COPE, rather than the construct of coping itself. Additional studies using more psychometrically sound measures of coping, perhaps measures with fewer scales or scales that contain more than two items apiece, are called for. One possibility may be that reliance on maladaptive coping strategies is more detrimental to birth outcomes than adaptive coping styles are protective, at least in a sample of psychologically healthy women. Thus, although the hypothesized adaptive coping strategies (i.e. humor, acceptance) did not demonstrate significant bivariate correlations between birth outcomes at time 1 or time 2, nor were they predictive of

outcomes in regression equations, the possibility remains that coping style is a potentially important construct to assess in studies of maternal distress during pregnancy.

A similar pattern of results emerged with respect to supplemental analysis of social support, such that fewer findings emerged from time 1 data; however, the findings that emerged from time 2 data were difficult to interpret. For example, at time 1, greater perceived adequacy of partner support was significantly associated with higher birth weight; however, the finding did not hold at time 2, and in fact, higher frequency of partner supportive behaviors was significantly associated with lower birth weight. Interestingly, greater perceived adequacy of partner support, greater support network size, and greater satisfaction with network support at time 2 were all significantly associated with more optimal birth outcomes.

There are a number of potential explanations for the lack of significant findings with respect to maternal social support. The present study characterized support as adequate or inadequate, as opposed to further determining in which direction support was inadequate. For example, overprovision versus underprovision of support may have vastly different implications for birth outcomes. Such findings have been borne out in the marital literature, with overprovision of support being more strongly associated with decreased marital satisfaction over time than underprovision (Brock & Lawrence, 2009). Further research during pregnancy is warranted. In addition, simply assessing preference for support does not take into account the frequency and skill with which women access support from partners or their larger support networks. This effect may also vary as a function of trimester, although results are too preliminary to conclude with certainty that

distress and resources later in pregnancy are more highly predictive of birth outcomes than distress and resources early in pregnancy.

Interaction of Maternal Distress and Maternal Resources on Birth Outcomes

There was mixed evidence for support of hypothesis 4. Although no main effect was identified between maternal distress and birth outcomes, bivariate correlations point to an association, suggesting that power may have been an issue in the regression analysis. Moreover, the absence of a main effect does not diminish the theoretical or statistical importance of the interaction term. Although the R^2 change for Step 6 was not significant (Table A22), the overall equation remained significant at Step 6, and two interaction terms emerged as significant predictors of birth weight.

One of the main findings to emerge with respect to the interactions is that women with mid-sized support networks and women who fall in the middle range of satisfaction with network support show little variation in infant birth weight as a function of level of distress. Women on the high and low ends of the spectrum, however, do show changes in infant birth weight as a function of level of distress. As expected, women with "small" network size had babies with decreased birth weight as maternal distress increased; they did not appear to be protected against the impact of maternal distress. Interestingly, women with "large" network sizes had babies with increased birth weight as maternal distress increased. Thus, not only were these women protected from the impact of prenatal distress, it appeared that they (and their babies) actually benefited from the combination of high distress and a "large" support network. One possible explanation for these results is that psychologically healthy women with "small" support networks

generally do well in conditions of low distress; however, as distress increases, they do not have the support to draw on to help manage high levels of distress. In contrast, women with "large" support networks may have a number of people from whom to receive support, perhaps increasing the likelihood of being able to effectively manage distress. These results were replicated in both reduced model equations and logistic regressions accounting for clinical outcomes. Moreover, the results are reminiscent of those reported by Collins, Dunkel-Schetter, Lobel and Scrimshaw (1993), who found that social support was unrelated to birth weight for women with few life events; however, when women experienced many life events, social support predicted higher birth weight for women with many life events. A related study that did not assess birth outcomes found that life stress and depressive symptoms were more highly associated for women with low levels of social support than women with high levels of social support (Glazier, Elgar, Goel, & Holzapfel, 2004). Finally, an early study by Norbeck and Tilden (1983) found that the interaction of life stress and tangible social support predicted obstetric complications and outcomes. It is unclear why women with the smallest network sizes had babies with the highest starting birth weights in Figure 3; however, it should be noted that the y-axis ranges from 7 pounds at the low end to 8 pounds at the high end.

The pattern of results for the network size moderator was not upheld for satisfaction with network support. Women who reported "high" satisfaction with network support, showed decreased in infant birth weight as maternal distress increased. In contrast, women who reported "low" satisfaction with network support showed increased infant birth weight as maternal distress increased. One possible explanation for these counterintuitive results may be that in conditions of high maternal distress,

satisfaction with network support made little difference with respect to infant birth weight; there was generally little variance in birth weights across groups (Figure 4). In conditions of low maternal distress, however, satisfaction with network support did appear to influence birth weight, such that women with higher satisfaction had babies with heavier birth weights. In conditions of high maternal distress, it appeared that women who were highly satisfied with their support were not protected against the effects of distress. In addition, and quite contrary to what was expected, women in the low satisfaction condition possibly took it upon themselves to mobilize their own personal resources, resulting in heavier birth weight babies than women who were more satisfied with their network support. Alternatively, it may simply be the case that it is difficult to identify women who are both highly distress and satisfied with their social support.

At time 2, additional interactions were revealed. First, women with frequent use of acceptance experienced an increase in birth weight as maternal distress increased; however, women with low frequency of use of acceptance experienced a decrease in birth weight as maternal distress increased. Women with mid-range frequency of use of acceptance evidenced little change in birth weight as a function of maternal distress. In addition, women with "high" adequacy of partner support, as maternal distress increased, birth weight decreased. For women with "low" adequacy of partner support, as maternal distress increased, birth weight also increased. For women with mid-level adequacy of partner support, there was little change in birth weight as a function of maternal distress. Again, these findings are interesting particularly given that they are so counterintuitive. One explanation may relate to the measurement of adequacy. The current study only

measured adequate vs. inadequate support; overprovision versus underprovision of support may make a difference and have vastly different impact on birth outcomes. It is also curious that the moderation effects did not replicate across time points. This may be due to a number of factors including sample size, range of weeks of gestation at times 1 and 2, measurement of the construct, or differences in the impact of social support across pregnancy. Further investigation is warranted.

A particularly interesting addition to future studies may be to include personality or attachment style measures in conjunction with measures of willingness and ability to access support in times of stress. More careful measurement of coping style may also shed light on these questions. On the one hand, perhaps inclusion of additional scales such as positive reframing or planning may have been important; however, although admittedly only exploratory in nature, the data do not suggest strong associations with birth outcomes, and in the case of positive reframing, bivariate correlations were the opposite of what was expected. Alternatively, perhaps the distinction between problem-focused and emotion-focused coping is more relevant to pregnant women (Terry, Mayocchi, & Hynes, 1996). In addition, some researchers have suggested that because individuals who are depressed may be less likely to employ adaptive coping strategies than their nondepressed counterparts, stress buffering models may not hold. Instead, it may be that certain individuals, either in times of stress or depression, may be more likely to employ maladaptive coping strategies, thus exacerbating the effects of stress (Pakenham, 1999; Terry et al., 1996). Further, it seems likely that individuals who are stressed and depressed may be less likely than nondistressed individuals to rely on social support and rate their social support as satisfying or adequate.

Limitations

Although results of this study provide some evidence of the impact of both maternal distress and resources on birth outcomes, methodological limitations may have limited results and conclusions. First, although the sample size at time 1 was relatively large, rates of low birth weight and preterm delivery are generally low in the population, and were potentially even lower in our sample, which limits variance to be predicted. Given this fact, larger sample sizes may have been required to identify robust effects at each time point. Moreover, despite recruiting from a number of communities in Iowa, a wider net must likely be cast to establish a study sample that is truly representative of pregnant women in Iowa. Second, a number of birth records were unavailable due to late deliveries, hospital delays, or subjects' failure to sign release of information forms, which may also have reduced variance in birth outcomes. Third, the present sample was generally psychologically healthy, demonstrating low levels of anxiety, depression, and few life events during pregnancy. Moreover, women who are at greater risk for perinatal depression have been shown less likely to participate in health care and intervention research (Murray, Woolgar, Murray, & Cooper, 2003). Thus, relationships between measures of maternal distress and other study variables may have been limited by range restriction issues. Fourth, demographic characteristics of the sample likely also contributed to the present findings. Although representative of samples in Iowa, the vast majority of women who participated in this study were not members of groups at highest risk for adverse birth outcomes. Thus, it may be the case that the associations between maternal distress, resources, and birth outcomes varies as function of demographic characteristics, as has been reported by previous researchers (Hilmert et al., 2008). In

addition, it may be the case that women who are more likely to experience adverse reproductive events are also less likely to participate in research. Fifth, although this study employed a longitudinal design, not all women participated at both assessments due to a change in study design. The question of chronicity of distress as opposed to cross-sectional measurement at two time points, was not addressed by the present study. Moreover, there was evidence that women recruited prior to and following the change in protocol differed with respect to education and distress. Future studies could consider preferentially seeking women who are members of high risk groups, so that key variables (i.e. income, ethnicity, adolescence) can be examined for such moderator effects. Alternatively, it might be particularly interesting to enroll women from both high and low risk groups to determine whether different models of prenatal maternal stress are operating in different groups. Sixth, although the present study included diagnostic assessment of psychiatric diagnosis, stressful events occurring during pregnancy were not assessed via interview. More careful assessment of the precise timing of life events and maternal response to such events may yield important findings with respect to the timing of stress and/or distress and the impact on birth outcomes. Seventh, despite collecting information regarding the history of depression, the assessment of pre-pregnancy functioning was not comprehensive, and may help answer questions about the timing of stressful events as they relate to the development of depression. Moreover, some studies have identified histories of abuse or trauma to be predictive of birth outcomes, and future studies should incorporate assessment of these experiences. Eighth, although it is likely that not many women experienced psychiatric disorder or engaged in substance use during pregnancy, it may also be the case that women underreported these phenomena,

given the social stigma associated with them. Ninth, several regression equations were examined, and few significant results emerged. Although a correction was made to account for these multiple analyses, and although reduced models were significant and produced similar results, it should be noted that findings may at least partially be due to Type I error. Finally, as is the case with any human study of prenatal distress, the present study was not experimental in nature, and therefore, associations between distress, resources, and outcomes should not be interpreted as causal in nature.

Strengths

Although the nature of the sample potentially limited the number of significant results obtained, the study provides important data pertaining to a group of women who are often overlooked in studies of maternal distress. The present study also represents a significant methodological advance in the measurement of maternal distress during pregnancy, and makes several important contributions to the literature. First, few, if any, studies have simultaneously measured stress, anxiety, and depression across pregnancy, and fewer yet have included measures of all three constructs in conjunction with clinical interviews. In addition to reducing method bias, the multiple forms of assessment provide a more complete picture of psychological functioning during pregnancy in a group of healthy pregnant women, a population that is often overlooked. Moreover, the assessment of both self-report symptomatology and clinical diagnosis allowed for more careful examination of what types of distress lead to negative birth outcomes. Second, few investigators have incorporated measures of social support and coping style into studies of prenatal distress, which has limited the conclusions the field can make regarding potential psychosocial factors that may have a *positive* impact on birth

outcomes. Results of this study suggest that constructs related to resources should be taken into account when examining the impact of maternal distress on birth outcomes. Third, the present study assessed not only network support, but also partner support and perceived adequacy of support, which appears to be as important, or perhaps even more important, than quantitative measures of support in predicting outcomes. Fourth, the present study employed prospective assessment at two time points during pregnancy, which minimized retrospective reporting bias and allowed for comparison across time. Fifth, as noted by the developer of the PLEQ, the measure did not reference prenatal events, and therefore health outcomes were not confounded by prenatal health events (Larson, 2004). Finally, preexisting medical conditions and obstetric history were assessed and accounted for in all prediction models, which has not uniformly been done across studies.

Conclusions, Implications and Future Directions

The focus of this study was to examine stress, coping, and social support in the context of infant outcomes. Within the field of prenatal maternal stress research, there has been much debate regarding whether general or specific forms of stress or distress are more harmful to the mother and fetus. Many studies of prenatal maternal stress have included measures of life events and anxiety, without considering the closely related construct of depression. Moreover, even fewer studies have modeled the associations between these measures to determine whether the constructs, and therefore the effects on birth outcomes, are interchangeable, or whether they truly represent separate constructs. The results of the present study suggest that, in fact, stress, anxiety (including pregnancy-related anxiety), and depression appear to have more in common than not.

Results of the current study suggest that hypotheses 1, 2, and 3 were largely not supported; however, a number of important results emerged. First, major depression at time 1, as well as a history of major depression, was clearly associated with more negative birth outcomes. When self-report measures were considered individually, they were also found to be associated with birth outcome, particularly at time 2. More importantly, it appears that there are interactions between maternal distress and social support (both network size and satisfaction with support), that significantly impact reproductive outcomes, suggesting support for hypothesis 4. Thus, this study raises additional questions regarding the nature of prenatal maternal stress, which aspects of stress contribute to adverse birth outcomes, and what factors may protect against adverse outcomes.

Although it would be somewhat reassuring to conclude that maternal mood states and stressful events during pregnancy do not uniformly influence reproductive outcomes, the methodological limitations cited above, coupled with the preponderance of evidence suggesting otherwise, caution making such a conclusion from the present results. Given the significant bivariate correlations between birth outcomes and several individual scales not included in the measurement model, this question must be examined more closely.

In addition to examining questions regarding the nature of maternal prenatal stress, an additional aim of the present study was to examine whether it is important to shift the field from a relatively narrow view of prenatal maternal distress to a broader view that incorporates contextual or environmental factors that may be at work. In addition to questions regarding the nature of distress, timing of distress, and differences in impact of birth outcomes across varied populations of women, perhaps additional

questions should be examined more closely. For example, what factors such as a woman's interpersonal relationships, coping strategies, self-efficacy, etc. may also contribute to the experience of pregnancy and distress? To what extent do care providers play a role? Further, across the literature examining early mother-child relationships, much work has focused on examining the contributions of both mother and child to disruptions in relationships. Although the fetus cannot be directly observed in the way that an infant is, perhaps questions relating to how women experience pregnancy, and to what extent is pregnancy itself viewed as a stressful event or not are also important. Finally, research on prenatal maternal distress carries with it some danger that women will interpret adverse outcomes as being their responsibility to prevent. Thus, incorporating a broader view is not only empirically justified, but also decreases the potential of reverting back to a time in which mothers were often to blame.

One of the long-standing questions in the field of developmental psychology is to what extent the negative impact of maternal distress is best captured by a sensitive period or programming model versus a chronicity model (Diego et al., 2005; O'Connor et al., 2003). Future studies should take into account not only multiple time points during pregnancy, as was done in the present study, but also the degree and rate of change on key variables between time points. Thus, an ideal measurement strategy may be to assess women once per month during pregnancy and utilize hierarchical linear modeling in conjunction with pre-pregnancy functioning assessments to identify predictors of rates of change. Similarly, rates of change over time could then serve as predictors of key outcome variables such as birth weight, gestational age, and other reproductive outcomes.

The present study did not collect biological measures of maternal distress; however, the existing literature strongly suggests a biological mechanism for the impact of maternal distress on birth outcomes (Diego et al., 2006; Field et al., 2006). Candidate measures would likely include the hormonal response to stress, as well as markers of physiological reactivity such as heart rate, vagal tone, blood pressure, or skin conductance response. Further exploration of underlying biology may also include glucocorticoid and cytokine responses to stress, both acute and chronic, which may have vastly different effects on human physiology (Behrman & Butler, 2007). Again, such measures may not demonstrate the same associations with birth outcomes in different groups of women. For example, a recent study found that blood pressure was positively associated with a composite measure of stress (comprised of chronic socioenvironmental stress, PSS, pregnancy-related anxiety, and State-Trait Anxiety Inventory) in African American, but not non-Hispanic white women (Hilmert et al., 2008). In addition, although stress and blood pressure did not predict variance in birth weight, a significant interaction between stress and blood pressure did emerge. Specifically, women with high blood pressure and high stress had babies with the lowest birth weights, and African American women were more likely than white women to fall into this subgroup. These results, though focused on race and biological measures of the stress response, are similar to those obtained in the present study, which indicate that women with high stress and "small" social network size had babies with the lowest birth weights. If we are to fully understand the impact and mechanism of prenatal distress on birth outcomes, further work must be done to integrate assessment of psychophysiological and biological

components of the stress response into pregnancy studies that address the entire psychosocial context of women's lives.

A related question concerns the long-term impact of maternal distress during pregnancy, particularly when distress shows up in the form of a major depressive episode. Hence, there is a dire need for well-designed longitudinal outcome studies that examine not only the physical health of the child, but also the mental health of the mother, child, and family unit.

In sum, the current study employed a rigorous methodology and multiple assessments during pregnancy in a somewhat specific group of healthy, pregnant, adult women. It contributes to the growing literature additional pieces of the prenatal maternal distress puzzle, which increasingly suggests that prenatal distress is but one of many factors that interact in complex ways, ultimately leading to adverse reproductive outcomes.

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APPENDIX A

TABLES

Table A1. Participant Characteristics (N =257)

Participant Characteristics	**M (SD)**
Age	29.53 (5.03)
Week Pregnancy (Time 1)	20.13 (8.99)
Participant Characteristics	**%**
Married	81.3%
Caucasian	91.4%
Working	71.2%
Primiparous	55.6%
Planned pregnancy	59.5%
Not receiving mental health treatment	91.8%
At least some college	79.5%
Did not finish high school	0.4%
GED	1.2%
High School Diploma	4.4%
Technical/AA Degree	12.0%
Some College	16.5%
Bachelor's Degree	38.2%
Master's Degree	19.3%
Doctoral Degree	8.0%
Annual income ≥ $70,000	36.8%
$60,000 - $70,000	16.1%
$50,000 - $60,000	7.9%
$40,000 - $50,000	9.9%
$30,000 - $40,000	8.3%
$20,000 - $30,000	7.0%
$10,000 - $20,000	7.4%
< $10,000	6.6%

Table A2. Prevalence of Clinical Diagnosis at Times 1 and 2

	Time 1 Overall (N=247) %	**n**	**Time 1 Subset (N=159) %**	**n**	**Time 2 (N=159) %**	**n**
MDE - Current	6.6	17	5.7	9	3.8	6
MDE - Past	26.8	69	28.3	45	--	--
Dysthymia	0.4	1	0.6	1	0.6	1
Alcohol Abuse	0	0	0	0	0	0
Alcohol Dependence	0	0	0	0	0	0
Substance Abuse	0.4	1	0.6	1	0	0
Panic Disorder	0.8	2	1.3	2	0.6	1
Social Phobia	1.2	3	0.6	1	0	0
OCD	2.3	6	3.8	6	0	0
PTSD	0.8	2	1.3	2	1.9	3
GAD	4.3	11	6.3	10	2.5	4
Anorexia Nervosa	0	0	0	0	0	0
Bulimia Nervosa	0	0	0	0	0	0
Current Manic Episode	0	0	0	0	0	0
Past Manic Episode	0	0	0	0	0	0

MDE = Major Depressive Episode; OCD = Obsessive-Compulsive Disorder; PTSD = Posttraumatic Stress Disorder; GAD= Generalized Anxiety Disorder

Table A3. Means, Standard Deviations, and Stability of Maternal Distress across Time

	Time 1 Overall (N=257)		**Time 1 Subset (N=174)**		**Time 2 Subset (N=174)**		**Test-Retest Correlation**
	M	SD	M	SD	M	SD	*r*
HRSD (0-54)	6.25	5.46	6.40	5.50	6.29	4.72	.69**
BDI-II (0-63)	9.18	6.13	9.28	6.28	8.68*	5.64	.79**
EPDS (0-30)	6.35	4.68	6.31	4.68	5.67*	4.42	.69**
PSS (0-56)	21.40	7.58	21.55	7.67	20.83	7.89	.64**
BAI (0-63)	6.91	6.08	6.82	5.70	6.88*	5.58	.59**
Preg. Anxiety (0-40)	1.97	0.58	1.98	0.55	1.87*	0.48	.68**
IDAS Gen Dep (20-100)	38.14	10.32	38.28	10.26	36.76*	9.51	.73**
IDAS Dysphoria (10-50)	16.84	6.17	16.95	6.21	16.13*	5.68	.70**
IDAS Lassitude (6-30)	13.24	3.87	13.59	3.83	12.39*	3.77	.57**
IDAS Insomnia (6-30)	12.33	5.18	11.59	5.07	13.29*	4.96	.52**
IDAS Suicidality (6-30)	6.26	1.10	6.30	1.27	6.19	0.80	.78**
IDAS App Loss (3-30)	4.78	2.72	4.92	2.87	3.98*	1.91	.28**
IDAS App Gain (3-30)	6.13	2.57	6.32	2.58	5.72*	2.47	.42**
IDAS Ill Temper (5-25)	8.03	3.31	8.10	3.30	7.50*	2.99	.61**
IDAS Well-being (8-40)	24.04	6.42	23.67	6.17	24.44*	6.07	.69**
IDAS Soc Anx (5-25)	6.63	2.63	6.73	2.62	6.29*	2.10	.69**
IDAS Panic (8-40)	9.67	2.44	9.71	2.36	9.52	2.28	.43**
IDAS Traum (4-20)	5.31	2.24	5.34	2.32	4.91*	1.68	.61**

Note. Possible ranges of each instrument or scale are shown in parentheses. BDI-II = Beck Depression Inventory –II; EPDS = Edinburgh Postnatal Depression Scale; PSS = Perceived Stress Scale; BAI = Beck Anxiety Inventory; IDAS = Inventory of Depression and Anxiety Symptoms. * = significant difference between time 1 and time 2 (N=174) at the $p<.05$ level. ** = Correlation significant at the $p < .001$ level.

Table A4. Means, Standard Deviations, and Stability of Stressful Events across Time

	Time 1 Overall (N=257)		**Time 1 Subset (N=174)**		**Time 2 Subset (N=174)**		**Test-Retest Correlation**
	M	SD	M	SD	M	SD	*r*
Frequency of Hassles (0-53)	20.07	10.28	20.90	10.23	21.59	9.91	.55**
Intensity of Hassles (0-3)	1.48	0.40	1.47	0.39	1.42*	0.35	.65**
Number of Negative Life Events (0-50)	0.98	1.71	0.88	1.63	0.71	1.13	.34**
Impact of Negative Life Events (0-100)	1.60	2.65	1.47	2.58	1.21	1.95	.32**

Note. Possible ranges of each instrument or scale are shown in parentheses. * = significant difference between time 1 and time 2 (N=173) at the $p<.05$ level. ** = Correlation significant at the $p < .001$ level. PLEQ = Prenatal Life Events Questionnaires

Table A5. Means, Standard Deviations, and Stability of Maternal Resources across Time

	Time 1 Overall (N=257)		Time 1 Subset (N=174)		Time 2 Subset (N=174)		Test-Retest Correlation
	M	SD	M	SD	M	SD	*r*
COPE							
Self-Distraction (0-8)	4.89	1.33	4.92	1.31	4.78	1.30	.32**
Active Coping (0-8)	6.05	1.36	6.11	1.32	6.05	1.30	.45**
Denial (0-8)	2.35	0.82	2.23	0.65	2.23	0.68	.54**
Substance Use (0-8)	2.13	0.59	2.15	0.66	2.10	0.46	.26**
Emotional Supp (0-8)	5.78	1.66	5.80	1.67	5.93	1.50	.57**
Instrument Supp (0-8)	5.55	1.65	5.59	1.62	5.68	1.57	.64**
Disengagement (0-8)	2.54	0.91	2.50	0.83	2.45	0.74	.41**
Venting (0-8)	4.72	1.46	4.72	1.46	4.80	1.47	.58**
Positive Reframe (0-8)	5.18	1.51	5.16	1.53	5.24	1.48	.55**
Planning (0-8)	5.81	1.44	5.90	1.43	5.88	1.27	.59**
Humor (0-8)	4.13	1.62	4.10	1.66	4.11	1.58	.65**
Acceptance (0-8)	5.52	1.31	5.59	1.24	5.57	1.18	.44**
Religion (0-8)	4.37	2.17	4.46	2.16	4.42	2.09	.85**
Self-Blame (0-8)	3.88	1.51	3.95	1.55	3.78	1.48	.62**
SSQ							
Number (0-9)	4.37	1.85	4.44	1.77	4.10	1.73	.74**
Satisfaction (1-6)	5.34	0.89	5.33	0.91	5.35	0.75	.65**
SIRRS							
Physical Freq (0-16)	11.41	4.19	11.33	4.12	10.88	4.02	.69**
Physical Adeq (0-4)	2.38	1.70	2.29	1.72	2.15	1.79	.59**
Tangible Freq (0-20)	11.18	5.12	10.94	4.91	10.59	4.81	.69**
Tangible Adeq (0-4)	3.10	1.98	3.01	1.97	2.86	1.99	.63**
Info Freq (0-32)	15.79	6.57	15.32	6.22	14.95	6.00	.73**
Info Adeq (0-8)	5.45	2.43	5.39	2.38	5.66	2.38	.61**
Emotional Freq (0-32)	19.45	7.45	19.09	6.92	18.68	6.60	.72**
Emotional Adeq (0-8)	5.33	2.74	5.36	2.66	5.41	2.66	.61**
Total Freq (0-168)	95.86	34.64	93.98	32.73	91.98	29.9	.82**
Total Adeq (0-42)	27.06	12.05	26.64	11.21	27.09	11.7	.75**

Note: Possible ranges of each instrument or scale are shown in parentheses. There were no significant differences between time 1 and time 2 on measures of coping or social support. ** = Correlation significant at the $p < .001$ level.

Table A6. Descriptive Statistics – Infant Characteristics

	Time 1 Overall (N=236)		**Time 1 Subset (N=163)**	
	M	SD	M	SD
Birth Weight (g)	3420.11	561.20	3417.02	487.94
Birth Length (cm)	51.17	3.53	51.20	3.46
Head circumference (cm)	34.44	2.29	34.55	2.27
Gestational Age (weeks)	39.04	1.94	39.18	1.70
5-minute Apgar (0-10)	8.82	0.61	8.83	0.44

Note. g = grams; cm = centimeters.

Table A7. Time 1 Intercorrelations among Measures Included in Structural Analyses

	1	2	3	4	5	6	7	8	9	10	11	12
1. BDI-II	--											
2. IDAS Gen. Dep	.83**	--										
3. EPDS	.75**	.81**	--									
4. PSS	.68**	.73**	.75**	--								
5. BAI	.55**	.60**	.60**	.52**	--							
6. IDAS Social Anx.	.56**	.59**	.52**	.49**	.50**	--						
7. IDAS Traumatic	.49**	.55**	.55**	.44**	.51**	.55**	--					
8. IDAS Panic	.31**	.43**	.32**	.27**	.60**	.43**	.48**	--				
9. Preg. Anxiety	.39**	.38**	.42**	.37**	.31**	.30**	.33**	.18**	--			
10. # Life Events	.42**	.38**	.48**	.40**	.35**	.38**	.39**	.17**	.12	--		
11. # Hassles	.31**	.33**	.24**	.21**	.18**	.24**	.18**	.13*	.28**	.04	--	
12. HRSD	.61**	.67**	.61**	.52**	.53**	.52**	.47**	.31**	.26**	.38**	.26**	--

** p <.001, * p <.05. BDI = Beck Depression Inventory; IDAS = Inventory of Depression and Anxiety Symptoms; EPDS = Edinburgh Postnatal Depression Scale; PSS = Perceived Stress Scale; BAI = Beck Anxiety Inventory; HRSD = Hamilton Rating Scale for Depression

Table A8. Three-Factor Solution for Time 1 Maternal Distress Measures

	Factor 1 Overall Sample	**Factor 2 Overall Sample**	**Factor 3 Overall Sample**
Scale			
BDI-II	.85	-.22	.07
HRSD	.71	-.05	-.03
IDAS General Depression	.90	-.12	.08
EPDS	.87	-.21	-.09
PSS	.76	-.22	-.07
BAI	.73	.28	-.06
IDAS Social Anx.	.69	.12	-.02
IDAS Traumatic	.67	.19	-.04
IDAS Panic	.53	.69	.06
Preg. Anxiety	.45	-.07	.25
Hassles - F	.33	-.08	.39
Life Events - #	.52	-.07	-.31

Note: Values included in the table represent unrotated factor loadings. BDI = Beck Depression Inventory; HRSD = Hamilton Rating Scale for Depression; IDAS = Inventory of Depression and Anxiety Symptoms; EPDS = Edinburgh Postnatal Depression Scale; PSS = Perceived Stress Scale; BAI = Beck Anxiety Inventory

Table A9. Two-Factor Solution for Time 1
Maternal Distress Measures

	Factor 1 Overall Sample	**Factor 2 Overall Sample**
Scale		
BDI-II	.85	-.22
HRSD	.71	-.05
IDAS General Depression	.90	-.12
EPDS	.87	-.21
PSS	.76	-.22
BAI	.73	.28
IDAS Social Anx.	.69	.12
IDAS Traumatic	.67	.19
IDAS Panic	.53	.69
Preg. Anxiety	.45	-.07
Hassles - F	.33	-.08
Life Events - #	.52	-.07

Note: Values included in the table represent unrotated factor loadings. BDI = Beck Depression Inventory; HRSD = Hamilton Rating Scale for Depression; IDAS = Inventory of Depression and Anxiety Symptoms; EPDS = Edinburgh Postnatal Depression Scale; PSS = Perceived Stress Scale; BAI = Beck Anxiety Inventory

Table A10. One-Factor Solution for Time 1 Maternal Distress Measures

	Factor 1 Overall Sample (N=257)	**Factor 1 Subsample (N=174)**	**Congruence Coefficient**
Scale			+.9981
BDI-II	.85	.89	
HRSD	.71	.73	
IDAS General Depression	.90	.91	
EPDS	.87	.88	
PSS	.76	.75	
BAI	.73	.68	
IDAS Social Anx.	.69	.70	
IDAS Traumatic	.67	.66	
IDAS Panic	.53	.37	
Preg. Anxiety	.45	.44	
Hassles - F	.33	.38	
Life Events - #	.52	.47	

Note: Values included in the table represent unrotated factor loadings. BDI = Beck Depression Inventory; HRSD = Hamilton Rating Scale for Depression; IDAS = Inventory of Depression and Anxiety Symptoms; EPDS = Edinburgh Postnatal Depression Scale; PSS = Perceived Stress Scale; BAI = Beck Anxiety Inventory

Table A11. Time 2 Intercorrelations among Measures Included in Structural Analyses

	1	2	3	4	5	6	7	8	9	10	11	12
1. BDI-II	--											
2. IDAS Gen. Dep	.79**	--										
3. EPDS	.75**	.79**	--									
4. PSS	.71**	.73**	.74**	--								
5. BAI	.57**	.57**	.52**	.55**	--							
6. IDAS Social Anx.	.39**	.41**	.43**	.33**	.28**	--						
7. IDAS Traumatic	.41**	.47**	.46**	.35**	.39**	.29**	--					
8. IDAS Panic	.36**	.38**	.34**	.30**	.63**	.29**	.44**	--				
9. Preg. Anxiety	.49**	.45**	.52**	.51**	.38**	.24**	.28**	.25**	--			
10. # Life Events	.26**	.31**	.29**	.34**	.22**	.11	.21**	.19**	.12	--		
11. # Hassles	.37**	.39**	.39**	.37**	.29**	.23**	.12	.24**	.32**	.16*	--	
12. HRSD	.61**	.60**	.60**	.57**	.53**	.26**	.43**	.33**	.31**	.28**	.30**	--

** p <.001, * p <.05. BDI = Beck Depression Inventory; IDAS = Inventory of Depression and Anxiety Symptoms; EPDS = Edinburgh Postnatal Depression Scale; PSS = Perceived Stress Scale; BAI = Beck Anxiety Inventory; HRSD = Hamilton Rating Scale for Depression

Table A12. Revised One-Factor Solution for Time 1 Maternal Distress Measures

	Factor 1 Overall Sample (N=257)	**Factor 1 Subsample (N=174)**	**Congruence Coefficient**
Scale			+.9991
BDI-II	.86	.90	
HRSD	.72	.73	
IDAS General Depression	.91	.91	
EPDS	.88	.89	
PSS	.78	.76	
BAI	.69	.66	
IDAS Social Anx.	.68	.69	
IDAS Traumatic	.65	.65	
Pregnancy Anxiety	.45	.44	
# Hassles	.32	.38	
Life Events #	.52	.47	

BDI = Beck Depression Inventory; HRSD = Hamilton Rating Scale for Depression; IDAS = Inventory of Depression and Anxiety Symptoms; EPDS = Edinburgh Postnatal Depression Scale; PSS = Perceived Stress Scale; BAI = Beck Anxiety Inventory

Table A13. Associations between Demographic Variables and Birth Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Gender	--															
2. Planned?	-.09	--														
3. Med Risk	-.06	-.12	--													
4. OB History	-.02	-.03	.15*	--												
5. Psych History	-.05	-.19**	.16*	.08	--											
6. Age	.05	.04	-.08	.18**	-.06	--										
7. Ethnic	.02	.08	-.20**	-.03	-.13*	.06	--									
8. Education	.09	.31**	-.19**	-.05	-.09	.41**	.05	--								
9. Income	.01	.35**	-.18**	-.10	-.31**	.41**	.24*	.49**	--							
10. Tobacco	-.03	-.25**	.17**	.00	.35**	-.17**	-.12	-.25**	-.32**	--						
11. Alcohol	.13	-.03	.02	.04	.08	.11	.08	.01	.09	.16*	--					
12. GA	.08	.07	-.17*	-.15*	-.07	.-.08	.11	.07	-.05	-.15*	.01	--				
13. Weight	-.09	.10	-.15*	.03	-.07	.00	.20**	.03	-.07	-.20**	-.02	.62**	--			
14. Length	-.17*	.08	-.14*	-.10	.03	-.02	.11	.01	.05	-.09	-.05	.50**	.65**	--		
15. Head	-.11	.15*	-.08	.02	-.10	.05	.01	.01	.10	-.15*	-.04	.46**	.61**	.46**	--	
16. Apgar	.08	.04	-.02	.03	.01	-.05	.15*	-.02	.02	-.09	.00	.20**	.23**	.20**	.20**	--

** = p <.01, * = p <.05. OB = Obstetric; GA = gestational age; Head = head circumference

Table A14. Association between Maternal Distress, Maternal Resources, and Birth Outcomes (Time 1)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. MD Time 1	--														
2. Panic Time 1	.45**	--													
3. Humor	.03	.04	--												
4. Acceptance	-.17**	-.05	-.04	--											
5. SSQ Number	-.32**	-.13*	.13*	.09	--										
6. SSQ Satisfaction	-.43**	-.15*	-.00	.05	.38**	--									
7. SIRRS Frequency	-.18**	-.005	.13*	.13*	.23**	.38**	--								
8. SIRRS Adequacy	-.35**	-.002	.10	.07	.33**	.41**	.69**	--							
9. GA	-.08	-.02	-.07	-.05	.05	-.02	-.03	.03	--						
10. Birth Weight	-.14*	-.10	-.04	-.05	.01	-.02	-.02	.13	.62**	--					
11. Birth Length	-.12	-.07	.00	-.04	.03	.05	.00	.13	.50**	.65**	--				
12. HC	-.15*	-.06	-.03	-.04	.07	.10	-.07	.06	.46**	.61**	.46**	--			
13. Apgar	-.13	-.01	-.11	-.06	-.01	.05	-.01	.05	.20**	.23**	.20**	.20**	--		
14. MDE - 1	.48**	.19**	.01	-.04	-.07	-.13	.01	.01	-.16*	-.15*	-.09	-.19**	-.10	--	
15. GAD - 1	.27**	.03	.00	.05	-.02	-.22**	.04	.00	.05	.14*	.00	.10	.07	.10	--

** = p <.01, * = p <.05. MD = Maternal Distress SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Rating Scale; GA = gestational age; HC = head circumference; MDE = Major Depressive Episode; GAD = Generalized Anxiety Disorder

Table A15. Association between Maternal Distress, Maternal Resources, and Birth Outcomes (Time 2)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. MD Time 2	--														
2. Panic Time 2	.44**	--													
3. COPE Humor	.08	.20**	--												
4. COPE Acceptance	.05	.07	.01	--											
5. SSQ Number	-.19*	-.07	.19*	.13	--										
6. SSQ Satisfaction	-.43**	-.18*	.04	.10	.32**	--									
7. SIRRS Frequency	-.09	-.02	.13	.02	.03	.26**	--								
8. SIRRS Adequacy	-.31**	-.06	-.04	.07	.04	.34*	.57**	--							
9. GA	-.12	-.10	-.20*	-.02	.19*	-.04	-.12	-.03	--						
10. Birth Weight	-.05	-.05	-.04	.06	.06	.04	-.23*	-.02	.62**	--					
11. Birth Length	-.11	.04	-.10	.05	.08	.09	-.09	.13	.50**	.65**	--				
12. HC	-.15	-.11	-.08	.02	.15	.09	-.09	.05	.46**	.61**	.46**	--			
13. Apgar	-.18*	.02	.08	.05	.06	.16*	.00	.14	.20**	.23**	.20**	.20**	--		
14. MDE	.38**	.28**	-.05	-.02	.04	-.32**	-.19*	-.24**	.05	.03	-.01	-.05	-.02	--	
15. GAD	.29**	.25**	.13	-.05	-.05	-.23**	-.09	-.17*	.05	-.00	-.08	-.08	.05	.39**	--

** = p <.01, * = p <.05. MD = Maternal Distress SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Rating Scale; GA = gestational age; HC = head circumference; MDE = Major Depressive Episode; GAD = Generalized Anxiety Disorder

Table A16. Independent Samples T-tests for Psychiatric Diagnoses – Birth Weight

	M	SD	t (df)
History of MDE			1.76 (227)
Yes	3324.12	573.62	
No	3464.81	535.23	
MDE – Time 1			2.29 (227)*
Yes	3114.22	1024.54	
No	3446.65	496.13	
GAD – Time 1			-2.10 (227)*
Yes	3776.90	666.62	
No	3408.80	539.20	
MDE – Time 2			-.40 (151)
Yes	3529.80	445.11	
No	3450.60	432.95	
GAD – Time 2			.02 (151)
Yes	3449.00	565.10	
No	3453.27	431.47	

** = p <.01, * = p <.05. MDE = Major Depressive Episode; GAD = Generalized Anxiety Disorder

Table A17. Independent Samples T-tests for Psychiatric Diagnoses – Birth Length

	M	SD	t (df)
History of MDE			2.31 (215)*
Yes	50.32	2.37	
No	51.53	3.81	
MDE – Time 1			1.25 (215)
Yes	50.06	5.00	
No	51.27	3.38	
GAD – Time 1			-.06 (215)
Yes	51.25	2.71	
No	51.19	3.55	
MDE – Time 2			.09 (147)
Yes	51.20	1.35	
No	51.34	3.39	
GAD – Time 2			.96 (147)
Yes	49.50	2.18	
No	51.38	3.36	

** = p <.01, * = p <.05. MDE = Major Depressive Episode; GAD = Generalized Anxiety Disorder

Table A18. Independent Samples T-tests for Psychiatric Diagnoses – Head Circumference

	M	SD	t (df)
History of MDE			1.56 (199)
Yes	34.08	1.65	
No	34.64	2.46	
MDE – Time 1			2.66 (199)**
Yes	32.89	3.47	
No	34.60	2.14	
GAD – Time 1			-1.44 (199)
Yes	35.56	2.05	
No	34.44	2.28	
MDE – Time 2			.55 (135)
Yes	34.05	.90	
No	34.68	2.28	
GAD – Time 2			.89 (135)
Yes	33.25	.35	
No	34.68	2.26	

** = p <.01, * = p <.05. MDE = Major Depressive Episode; GAD = Generalized Anxiety Disorder

Table A19. Independent Samples T-tests for Psychiatric Diagnoses – Gestational Age

	M	SD	t (df)
History of MDE			1.29 (226)
Yes	38.79	1.82	
No	39.15	2.15	
MDE – Time 1			2.45 (226)*
Yes	37.89	3.83	
No	39.13	1.70	
GAD – Time 1			-.76 (226)
Yes	39.50	1.18	
No	39.03	1.95	
MDE – Time 2			-.55 (151)
Yes	39.59	1.44	
No	39.20	1.57	
GAD – Time 2			-.62 (151)
Yes	39.76	1.97	
No	39.20	1.56	

** = p <.01, * = p <.05. MDE = Major Depressive Episode; GAD = Generalized Anxiety Disorder

Table A20. Independent Samples T-tests for Psychiatric Diagnoses – Apgar Score

	M	SD	t (df)
History of MDE			.24 (227)
Yes	8.83	.42	
No	8.85	.49	
MDE – Time 1			1.51 (227)
Yes	8.67	.62	
No	8.86	.46	
GAD – Time 1			-1.08 (227)
Yes	9.00	.00	
No	8.84	.48	
MDE – Time 2			.29 (151)
Yes	8.80	.45	
No	8.86	.44	
GAD – Time 2			-.58 (151)
Yes	9.00	.00	
No	8.86	.44	

** = p <.01, * = p <.05. MDE = Major Depressive Episode; GAD = Generalized Anxiety Disorder

Table A21. Hierarchical Regression Analysis for Time 1 Variables Predicting Gestational Age

Predictor	B	SE B	β	Block Δ R^2	F (df)
Step 1 - Demographics				.079**	2.91** (6, 204)
Tobacco Use	1.31	.52	-.17*		
OB History	-.25	.13	-.14*		
Medical Risk	-.27	.18	-.11		
Ethnicity	-.19	.60	-.02		
Planned Pregnancy	.17	.28	.04		
Parity	-.05	.28	-.01		
Step 2 – Time 1 MDE	-.88	.53	-.11	.012	2.91** (7, 203)
Step 3 - Maternal Distress	.11	.17	.05	.004	2.60** (8, 202)
Step 4 - Panic	.03	.06	.04	.001	2.33* (9, 201)
Step 5 - Resources				.011	1.54 (15, 195)
COPE Humor	-.06	.08	-.05		
COPE Acceptance	-.13	.10	-.09		
SSQ Number	.04	.08	.04		
SSQ Satisfaction	-.10	.21	-.04		
SIRRS Frequency	-.001	.01	-.01		
SIRRS Adequacy	.01	.02	.03		
Step 6 – Interaction				.031	1.43 (21, 189)
MD x Humor	-.14	.09	-.12		
MD x Acceptance	.10	.11	.07		
MD x SSQ Number	.08	.10	.08		
MD x Satisfaction	.07	.19	.04		
MD x SIRRS Frequency	.01	.01	.21		
MD x SIRRS Adequacy	-.02	.02	-.11		

* = p <.05; ** = p < .01. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A22. Hierarchical Regression for Time 1 Variables Predicting Birth Weight

Predictor	B	SE B	β	Block Δ R^2	F (df)
Step 1 - Demographics				.11**	4.32** (6, 205)
Tobacco Use	-396.6	139.94	-.19**		
OB History	-10.05	35.40	-.02		
Medical Risk	-48.32	48.76	-.07		
Ethnicity	-137.59	165.85	-.06		
Planned Pregnancy	90.93	77.07	.08		
Parity	223.57	77.98	.21**		
Step 2 – Time 1 MDE	-268.44	146.60	-.12	.014	4.23** (7, 204)
Step 3 - Maternal Distress	-29.37	45.11	-.05	.002	3.74** (8, 203)
Step 4 - Panic	.59	16.60	.003	.000	3.31** (9, 202)
Step 5 - Resources				.024	2.36**(15, 196)
COPE Humor	-7.68	22.66	-.02		
COPE Acceptance	-33.49	28.52	-.08		
SSQ Number	-25.63	21.66	-.09		
SSQ Satisfaction	29.84	57.63	.04		
SIRRS Frequency	-.86	1.67	-.05		
SIRRS Adequacy	6.63	4.94	.14		
Step 6 - Interaction				.031	2.04** (21, 190)
MD x Humor	-29.23	25.27	-.09		
MD x Acceptance	7.90	30.11	.02		
MD x SSQ Number	61.18	27.31	.22*		
MD x Satisfaction	-103.10	51.51	-.20*		
MD x SIRRS Frequency	.13	1.92	.01		
MD x SIRRS Adequacy	1.03	6.49	.02		

* = $p < .05$; ** = $p < .01$. a = marginally significant at $p < .10$. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A23. Hierarchical Regression Analysis of Time 1 Variables Predicting Apgar Score

Predictor	B	SE B	β	Block Δ R^2	F (df)
Step 1 - Demographics				.07*	2.58 (6, 205)
Tobacco Use	-.15	.13	-.09		
OB History	-.01	.03	-.01		
Medical Risk	.01	.04	.02		
Ethnicity	-.38	.15	-.18*		
Planned Pregnancy	.02	.07	.17		
Parity	.16	.07	.17*		
Step 2 – Time 1 MDE	-.05	.13	-.03	.001	2.22 (7, 204)
Step 3 - Maternal Distress	-.03	.04	-.05	.002	1.99 (8, 203)
Step 4 - Panic	.01	.02	.08	.004	1.87 (9, 202)
Step 5 - Resources				.015	1.33 (15, 196)
COPE Humor	.001	.02	.01		
COPE Acceptance	-.01	.03	-.02		
SSQ Number	-.02	.02	-.09		
SSQ Satisfaction	.04	.05	.06		
SIRRS Frequency	-.002	.002	-.11		
SIRRS Adequacy	.01	.004	.12		
Step 6 - Interaction				.016	1.10 (21, 190)
MD x Humor	.01	.02	.02		
MD x Acceptance	.003	.03	.01		
MD x SSQ Number	.03	.03	.14		
MD x Satisfaction	-.02	.05	-.03		
MD x SIRRS Frequency	-.001	.002	-.04		
MD x SIRRS Adequacy	.002	.01	.03		

* = p <.05; ** = p < .01. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A24. Hierarchical Regression Analysis of Time 1 Variables Predicting Head Circumference

Predictor	B	SE B	β	Block Δ R^2	F (df)
Step 1 - Demographics				.076*	2.46* (6, 180)
Tobacco Use	-1.15	.66	-.13		
OB History	-.01	.18	-.01		
Medical Risk	-.003	.23	-.001		
Ethnicity	-1.11	.73	-.11		
Planned Pregnancy	.61	.37	.12		
Parity	.62	.37	.13		
Step 2 – Time 1 MDE	-1.4	.67	-.16*	.023*	2.81** (7, 179)
Step 3 - Maternal Distress	.01	.22	.004	.000	2.44* (8, 178)
Step 4 - Panic	.02	.07	.02	.000	2.17* (9, 177)
Step 5 - Resources				.017	1.49 (15, 171)
COPE Humor	.001	.11	.001		
COPE Acceptance	-.14	.13	-.08		
SSQ Number	.02	.10	.02		
SSQ Satisfaction	.20	.27	.07		
SIRRS Frequency	-.01	.01	-.07		
SIRRS Adequacy	-.01	.02	-.03		
Step 6 - Interaction				.024	1.28 (21, 165)
MD x Humor	-.09	.12	-.07		
MD x Acceptance	.004	.15	.003		
MD x SSQ Number	.24	.13	.20[a]		
MD x Satisfaction	-.24	.24	-.12		
MD x SIRRS Frequency	.01	.01	.11		
MD x SIRRS Adequacy	-.01	.03	-.03		

* = p <.05; ** = p < .01. a = marginally significant at p < .10. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A25. Hierarchical Regression Analysis of Time 2 Variables Predicting Gestational Age

Predictor	B	SE B	β	Block Δ R^2	F (df)
Step 1 - Demographics				.085[a]	1.99 (6, 128)
Tobacco Use	-.90	.66	-.12		
OB History	-.14	.14	-.09		
Medical Risk	-.23	.18	-.11		
Ethnicity	-.38	.68	-.05		
Planned Pregnancy	-.16	.30	-.05		
Parity	-.56	.30	-.17		
Step 2 – Time 2 MDE	.38	.96	.04	.001	1.72 (7, 127)
Step 3 - Maternal Distress	-.001	.02	-.01	.000	1.49 (8, 126)
Step 4 - Panic	.02	.07	.03	.001	1.32 (9, 125)
Step 5 - Resources				.087[a]	1.67 (15, 119)
COPE Humor	-.21	.09	-.22*		
COPE Acceptance	-.01	.11	-.01		
SSQ Number	.30	.09	.32**		
SSQ Satisfaction	-.18	.27	-.07		
SIRRS Frequency	.002	.01	.03		
SIRRS Adequacy	-.01	.02	-.04		
Step 6 - Interaction				.049	1.54 (21, 113)
MD x Humor	-.01	.01	-.08		
MD x Acceptance	.02	.01	.18		
MD x SSQ Number	-.01	.01	-.06		
MD x Satisfaction	-.02	.04	-.05		
MD x SIRRS Frequency	.001	.001	.20		
MD x SIRRS Adequacy	-.004	.002	-.22		

* = $p < .05$; ** = $p < .01$. a = marginally significant at $p < .10$. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A26. Hierarchical Regression Analysis of Time 2 Variables Predicting Birth Weight

Predictor	B	SE B	β	Block Δ R^2	F (df)
Step 1 - Demographics				.082 [a]	1.90 (6, 128)
Tobacco Use	-372.29	169.59	-.19*		
OB History	-32.95	36.30	-.09		
Medical Risk	-8.11	46.68	-.02		
Ethnicity	-234.38	174.49	-.12		
Planned Pregnancy	-31.47	76.75	-.04		
Parity	120.56	77.68	.15		
Step 2 – Time 2 MDE	53.45	246.07	.02	.000	1.62 (7, 127)
Step 3 - Maternal Distress	2.18	5.06	.04	.001	1.43 (8, 126)
Step 4 - Panic	-3.95	17.01	-.02	.000	1.27 (9, 125)
Step 5 - Resources				.061	1.34 (15, 119)
COPE Humor	13.81	24.33	.06		
COPE Acceptance	27.14	28.81	.08		
SSQ Number	13.37	23.40	.06		
SSQ Satisfaction	121.18	69.90	.18 [a]		
SIRRS Frequency	-2.31	1.60	-.16		
SIRRS Adequacy	-.61	4.33	-.02		
Step 6 - Interaction				.083 [a]	1.59 (21, 113)
MD x Humor	-.15	3.33	-.01		
MD x Acceptance	8.13	3.68	.24*		
MD x SSQ Number	-.92	3.61	-.03		
MD x Satisfaction	-9.17	9.16	-.11		
MD x SIRRS Frequency	.34	.23	.26		
MD x SIRRS Adequacy	-1.15	.59	-.27*		

* = $p < .05$; ** = $p < .01$. a = marginally significant at $p < .10$. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A27. Hierarchical Regression Analysis of Time 2 Variables Predicting Apgar Score

Predictor	B	SE B	β	Block Δ R^2	F (df)
Step 1 - Demographics				.049	1.10 (6, 128)
Tobacco Use	-.33	.18	-.16		
OB History	-.01	.04	-.03		
Medical Risk	-.04	.05	-.07		
Ethnicity	-.12	.18	-.06		
Planned Pregnancy	.04	.08	.04		
Parity	.05	.08	.06		
Step 2 – Time 1 MDE	.26	.25	.09	.008	1.09 (7, 127)
Step 3 - Maternal Distress	-.01	.01	-.17	.023	1.37 (8, 126)
Step 4 - Panic	.02	.02	.11	.010	1.38 (9, 125)
Step 5 - Resources				.049	1.28 (15, 119)
COPE Humor	.02	.03	.08		
COPE Acceptance	.02	.03	.05		
SSQ Number	.000	.02	.000		
SSQ Satisfaction	.15	.07	.22*		
SIRRS Frequency	.000	.002	.01		
SIRRS Adequacy	.000	.004	-.01		
Step 6 - Interaction				.038	1.16 (21, 113)
MD x Humor	.01	.003	.19		
MD x Acceptance	-.001	.004	-.04		
MD x SSQ Number	.001	.004	.02		
MD x Satisfaction	.003	.01	.03		
MD x SIRRS Frequency	.000	.000	-.20		
MD x SIRRS Adequacy	.001	.001	.21		

* = p <.05; ** = p < .01. a = marginally significant at p < .10. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A28. Hierarchical Regression Analysis of Time 2 Variables Predicting Head Circumference

Predictor	B	SE B	β	Block Δ R^2	F (df)
Step 1 - Demographics				.050	1.002 (6, 114)
Tobacco Use	-1.26	.96	-.12		
OB History	.07	.23	.03		
Medical Risk	-.12	.28	-.04		
Ethnicity	-1.20	.99	-.12		
Planned Pregnancy	.50	.46	.10		
Parity	.18	.48	.04		
Step 2 – Time 1 MDE	-.04	1.39	-.002	.000	.85 (7, 113)
Step 3 - Maternal Distress	-.01	.03	-.02	.000	.74 (8, 112)
Step 4 - Panic	-.04	.10	-.04	.001	.67 (9, 111)
Step 5 - Resources				.031	.63 (15, 105)
COPE Humor	-.02	.15	-.02		
COPE Acceptance	-.05	.18	-.03		
SSQ Number	.24	.14	.18		
SSQ Satisfaction	.01	.44	.002		
SIRRS Frequency	-.01	.01	-.07		
SIRRS Adequacy	.01	.03	.06		
Step 6 - Interaction				.053	.74 (21, 99)
MD x Humor	.02	.02	.13		
MD x Acceptance	.04	.02	.20		
MD x SSQ Number	-.02	.02	-.15		
MD x Satisfaction	-.03	.06	-.07		
MD x SIRRS Frequency	.002	.001	.22		
MD x SIRRS Adequacy	-.001	.004	-.05		

* = p <.05; ** = p < .01. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A29. Hierarchical Regression of Time 2 Variables Predicting Birth Weight, Revised

Predictor	B	SE B	β	Block Δ R^2	F (df)
Step 1 - Demographics				.300**	7.77** (7, 127)
Tobacco Use	-260.68	149.71	-.13		
OB History	-15.96	31.85	-.04		
Medical Risk	21.04	41.18	.04		
Ethnicity	-186.82	153.13	-.10		
Planned Pregnancy	-11.18	67.35	-.01		
Parity	189.73	68.97	.23**		
Gestational Age	124.45	19.78	.49**		
Step 2 – Time 1 MDE	5.68	215.87	.002	.000	6.75** (8, 126)
Step 3 - Maternal Distress	2.36	4.43	.05	.002	6.00** (9, 125)
Step 4 - Panic	-6.18	14.90	-.04	.001	5.38** (10, 124)
Step 5 - Resources				.075*	4.46** (16, 118)
COPE Humor	42.27	21.28	.17*		
COPE Acceptance	29.07	24.69	.09		
SSQ Number	-26.58	20.93	-.11		
SSQ Satisfaction	144.94	60.01	.21*		
SIRRS Frequency	-2.55	1.38	-.18[a]		
SIRRS Adequacy	.08	3.71	.002		
Step 6 - Interaction				.036	3.59** (22, 112)
MD x Humor	.94	2.92	.03		
MD x Acceptance	5.14	3.26	.15		
MD x SSQ Number	-.09	3.16	-.003		
MD x Satisfaction	-6.97	8.03	-.08		
MD x SIRRS Frequency	.22	.20	.16		
MD x SIRRS Adequacy	-.70	.52	-.16		

* = p <.05; ** = p < .01. a = marginally significant p < .10. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A30. Logistic Regression of Time 1 Variables Predicting Low Birth Weight

Predictor	B	Wald χ^2	OR	Block χ^2	Model χ^2
Step 1 - Demographics				11.86[a]	11.86[a]
Tobacco Use	1.87	4.07*	6.48		
OB History	.11	.09	1.11		
Medical Risk	.78	3.91*	2.19		
Ethnicity	-.84	.29	.43		
Planned	-.13	.02	.88		
Parity	-.57	.36	.57		
Step 2 – Distress				4.11	15.98 [a]
MDE	1.50	1.48	4.48		
Distress	.16	.07	1.18		
Panic	-.29	1.63	.75		
Step 3 - Resources				3.02	18.99
COPE Humor	.01	.001	1.01		
COPE Accept	.16	.16	1.17		
SSQ Number	.28	1.05	1.32		
SSQ Satisfaction	.67	.45	1.94		
SIRRS Freq	.01	.07	1.01		
SIRRS Adequacy	-.01	.01	1.00		
Step 4 - Interactions				13.02*	32.01*
MD x Humor	.36	.95	1.44		
MD x Accept	-.13	.07	.88		
MD x SSQ #	-1.43	5.41*	.24		
MD x Satisfact	-.10	.01	.91		
MD x SIRRS Freq	-.07	2.54	.94		
MD x SIRRS Ade	.21	2.42	1.23		

* = p <.05; ** = p < .01. a = marginally significant p < .10. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A31. Logistic Regression of Time 1 Variables Predicting Preterm Delivery

Predictor	B	Wald χ^2	OR	Block χ^2	Model χ^2
Step 1 - Demographics				9.15	9.15
Tobacco Use	1.17	2.59	3.21		
OB History	.14	.39	1.15		
Medical Risk	.51	3.32	1.66		
Ethnicity	.03	.001	1.03		
Planned	-.13	.06	.88		
Parity	-.20	.13	.82		
Step 2 – Distress				.85	10.00
MDE	.58	.35	1.79		
Distress	-.29	.56	.75		
Panic	-.01	.01	.99		
Step 3 - Resources				9.23	19.23
COPE Humor	.27	2.71	1.31		
COPE Accept	.03	.02	1.03		
SSQ Number	-.25	2.11	.78		
SSQ Satisfaction	.78	2.01	2.18		
SIRRS Freq	.02	1.65	1.02		
SIRRS Adequacy	-.08	4.04*	.93		
Step 4 - Interactions				18.03**	37.25*
MD x Humor	.36	2.76	1.43		
MD x Accept	-.39	1.67	.68		
MD x SSQ #	-.61	5.56*	.54		
MD x Satisfact	-.06	.01	.94		
MD x SIRRS Freq	-.03	2.77	.97		
MD x SIRRS Ade	.05	.65	1.05		

* = $p < .05$; ** = $p < .01$. a = marginally significant $p < .10$. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A32. Logistic Regression of Time 1 Variables Predicting Adverse Outcome Composite

Predictor	B	Wald χ^2	OR	Block χ^2	Model χ^2
Step 1 - Demographics				8.53	8.53
Tobacco Use	1.03	2.08	2.79		
OB History	.06	.07	1.06		
Medical Risk	.57	4.26	1.77		
Ethnicity	.05	.002	1.05		
Planned	.003	.000	1.00		
Parity	-.01	.000	.99		
Step 2 – Distress				.38	8.91
MDE	.33	.11	1.39		
Distress	-.06	.03	.94		
Panic	-.05	.18	.95		
Step 3 - Resources				9.21	18.12
COPE Humor	.21	1.85	1.24		
COPE Accept	-.01	.004	.99		
SSQ Number	-.28	2.68	.76		
SSQ Satisfaction	.88	2.61	2.41		
SIRRS Freq	.01	1.13	1.01		
SIRRS Adequacy	-.07	3.77*	.93		
Step 4 - Interactions				18.59**	36.70*
MD x Humor	.25	1.72	1.28		
MD x Accept	-.44	.26	.65		
MD x SSQ #	-.62	6.31**	.54		
MD x Satisfact	.000	.000	1.00		
MD x SIRRS Freq	-.03	2.75	.97		
MD x SIRRS Ade	.05	.81	1.05		

* = p <.05; ** = p < .01. a = marginally significant p < .10. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A33. Logistic Regression of Time 2 Variables Predicting Adverse Outcome Composite

Predictor	B	Wald χ^2	OR	Block χ^2	Model χ^2
Step 1 - Demographics				4.37	4.37
Tobacco Use	.90	.50	2.45		
OB History	.06	.03	1.06		
Medical Risk	.51	1.55	1.66		
Ethnicity	.50	.15	1.64		
Planned	.72	.67	2.06		
Parity	.83	1.15	2.37		
Step 2 – Distress				1.37	5.73
MDE	-18.87	.000	.000		
Distress	.04	.53	1.04		
Panic	-.13	.52	.88		
Step 3 - Resources				16.72**	22.45
COPE Humor	.31	1.07	1.36		
COPE Accept	-.05	.02	.95		
SSQ Number	-1.61	7.28**	.20		
SSQ Satisfaction	-.28	.12	.76		
SIRRS Freq	.01	.21	1.00		
SIRRS Adequacy	-.001	.001	1.00		
Step 4 - Interactions				12.07 [a]	34.52*
MD x Humor	.05	.51	1.06		
MD x Accept	-.18	2.80 [a]	.84		
MD x SSQ #	.02	.03	1.02		
MD x Satisfact	.16	.70	1.17		
MD x SIRRS Freq	-.003	.19	1.00		
MD x SIRRS Ade	.03	3.19 [a]	1.03		

* = p <.05; ** = p < .01. a = marginally significant p < .10. OB = Obstetric; MDE = Major Depressive Episode; SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Scale; MD = Maternal Distress

Table A34. Intercorrelations between Time 1 IDAS Scales and Birth Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. General Dep	--															
2. Dysphoria	.94**	--														
3. Lass	.60**	.52**	--													
4. Insom	.67**	.56**	.27**	--												
5. Suicidal	.46**	.48**	.15*	.23**	--											
6. App Loss	.45**	.27**	.35**	.19**	.06	--										
7. App Gain	.10	.15*	.22**	.12	.04	-.17**	--									
8. Ill Temper	.60**	.62**	.34**	.42**	.33**	.15*	.16*	--								
9. Well Being	-.60**	-.55**	-.25**	-.29**	-.30**	-.16**	.02	-.41**	--							
10. Social Anx	.59**	.63**	.40**	.31**	.44**	.28**	.14*	.37**	-.29**	--						
11. Panic	.43**	.44**	.32**	.35**	.20**	.18**	.15*	.35**	-.18**	.43**	--					
12. Trauma	.55**	.61**	.26**	.37**	.56**	.12	.11	.45**	-.31**	.55**	.48**	--				
13. GA	-.07	-.02	-.13	-.09	-.06	-.02	-.02	-.10	.08	-.03	-.02	.01	--			
14. BW	-.07	-.06	-.09	-.06	-.08	-.04	-.06	-.13*	.04	-.13*	-.10	-.05	.62**	--		
15. HC	-.11	-.11	-.12	-.09	-.12	-.04	-.07	-.02	.09	-.15*	-.06	-.11	.46**	.61**	--	
16. Apgar	-.07	-.06	-.04	-.13*	-.15*	.04	-.17*	-.06	.01	-.10	-.01	-.09	.20**	.23**	.20**	--

* = p <.05; ** = p < .01. GA = gestational age; BW = birth weight; HC = head circumference

Table A35. Intercorrelations between Time 1 COPE Scales and Birth Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Distraction	--																	
2. Active	-.01	--																
3. Denial	.03	-.28**	--															
4. Substance	.07	-.07	.20**	--														
5. Emotional	.09	.26**	-.01	.02	--													
6. Instrumental	.11	.22**	.04	.03	.77**	--												
7. Disengage	.07	-.30**	.38**	.13*	-.13*	-.08	--											
8. Venting	.22**	.21**	.03	.16*	.29**	.35**	.12	--										
9. Reframing	-.09	.34**	-.05	-.01	.14*	.10	-.14*	-.06	--									
10. Planning	.04	.72**	-.24**	.03	.27**	.27**	-.32*	.24**	.37**	--								
11. Humor	.10	.07	.10	-.05	.09	.12	.08	.19**	.17**	.04	--							
12. Acceptance	.18**	.44**	-.15*	.09	.11	.13*	-.08	.23**	.15*	.40**	-.04	--						
13. Religion	.01	.22**	-.06	-.11	.19**	.22**	-.09	.04	.39**	.25**	.02	.10	--					
14. Self-Blame	.03	-.26**	.31**	.12	.06	.16*	.31**	.19**	-.16*	-.07	-.01	-.04	-.03	--				
15. GA	-.03	..04	-.09	.08	-.07	-.06	-.11	.00	-.05	.04	-.07	-.05	-.03	-.01	--			
16. BW	-.05	.05	-.01	.11	.03	-.04	-.12	.00	-.03	.02	-.04	-.05	-.05	-.07	.62**	--		
17. HC	-.08	.11	-.12	.09	.08	.08	-.17*	.02	-.04	.04	-.03	-.04	.08	-.04	.46**	.61**	--	
18. Apgar	-.04	.10	-.11	-.07	-.02	.05	-.06	-.12	-.03	.04	-.11	-.06	-.05	-.14*	.20**	.23**	.20**	--

* = p <.05; ** = p < .01. GA = gestational age; BW = Birth Weight; HC = head circumference

Table A36. Intercorrelations between Time 1 Social Support and Birth Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. SSQ #	--															
2. SSQ Satis	.38**	--														
3. SIRRS Freq	.23**	.38**	--													
4. SIRRS Adeq	.33**	.41**	.69**	--												
5. SIRRS Phys F	.22**	.36**	.77**	.56**	--											
6. SIRRS Phys A	.26**	.28**	.50**	.66**	.68**	--										
7. SIRRS Tang F	.10	.29**	.85**	.58**	.61**	.37**	--									
8. SIRRS Tang A	.19**	.28**	.58**	.78**	.44**	.43**	.63**	--								
9. SIRRS Info F	.12	.29**	.83**	.46**	.54**	.29**	.60**	.43**	--							
10. SIRRS Info A	.18**	.32**	.49**	.81**	.31**	.37**	.41**	.53**	.42**	--						
11. SIRRS Emo F	.25**	.32**	.87**	.64**	.59**	.43**	.66**	.46**	.63**	.43**	--					
12. SIRRS Emo A	.30**	.32**	.53**	.84**	.37**	.46**	.39**	.52**	.29**	.62**	.61**	--				
13. GA	.05	-.02	-.03	.03	.08	.06	-.06	.05	-.04	.02	-.06	.07	--			
14. BW	.01	.03	-.02	.13	.09	.14*	-.02	.15*	-.04	.15*	-.05	.09	.62**	--		
15. HC	.07	.10	-.07	.06	-.02	.05	-.11	.02	-.03	.03	-.05	.05	.46**	.61**	--	
16. Apgar	-.01	.05	-.01	.05	-.05	.02	-.01	-.05	-.08	.06	-.03	.13*	.20**	.23**	.20**	--

* = p <.05; ** = p < .01. SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Rating Scale; GA = gestational age; BW = birth weight; HC = head circumference

Table A37. Intercorrelations between Time 1 Maternal Distress Measures and Birth Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. BDI	--														
2. BAI	.55**	--													
3. Hassle Freq	.31**	.18**	--												
4. Hassle Severity	.48**	.30**	.91**	--											
5. Hassle Intensity	.50**	.33**	..22**	.54**	--										
6. Pregnancy Anx	.39**	.31**	.28**	.38**	.35**	--									
7. PSS	.68**	.52**	.21**	.39**	.47**	.37**	--								
8. EPDS	.75**	.60**	.24**	.40**	.48**	.42**	.75**	--							
9. # Neg Events	.42**	.35**	.04	.16*	.32**	.12	.40**	.48**	--						
10. Neg Impact	.38**	.31**	.04	.14*	.30**	.10	.37**	.45**	.98**	--					
11. HRSD	.61**	.53**	.37**	.37**	.37**	.26**	.52**	.61**	.38**	.36**	--				
12. GA	-.08	-.04	.05	.02	-.05	-.01	-.04	-.09	-.02	-.01	-.08	--			
13. BW	-.09	-.09	-.04	-.10	-.18**	-.12	-.11	-.12	-.08	-.07	-.10	.62**	--		
14. HC	-.17*	-.11	-.06	-.13	-.18*	-.06	-.06	-.06	-.06	-.06	-.12	.46**	.61**	--	
15. Apgar	-.06	-.05	-.10	-.12	-.09	-.06	-.07	-.06	-.003	.01	-.14*	.20**	.23**	.20**	--

* = p <.05; ** = p < .01. BDI = Beck Depression Inventory; BAI = Beck Anxiety Inventory; PSS = Perceived Stress Scale; EPDS = Edinburgh Postnatal Depression Scale; HRSD = Hamilton Rating Scale for Depression. GA = gestational age; BW = birth weight; HC = head circumference

Table A38. Intercorrelations between Time 2 IDAS Scales and Birth Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. General Dep	--															
2. Dysphoria	.94**	--														
3. Lass	.75**	.66**	--													
4. Insom	.61**	.46**	.48**	--												
5. Suicidal	.40**	.40**	.39**	.21**	--											
6. App Loss	.33**	.20**	.14	.11	.13	--										
7. App Gain	.42**	.43**	.37**	.31**	.33**	-.02	--									
8. Ill Temper	.70**	.71**	.60**	.43**	.46**	.08	.39**	--								
9. Well Being	-.61**	-.56**	-.35**	-.19*	-.19*	-.14	-.11	-.36**	--							
10. Social Anx	.41**	.45**	.35**	.13	.43**	.02	.35**	.35**	-.28**	--						
11. Panic	.38**	.37**	.36**	.25**	.25**	.14	.26**	.30**	-.16*	.29**	--					
12. Trauma	.47**	.48**	.38**	.36**	.54**	.08	.27**	.47**	-.21**	.29**	.44**	--				
13. GA	-.16*	-.10	-.15	-.23**	.01	.01	-.11	-.07	.10	-.002	-.09	-.10	--			
14. BW	-.03	-.01	-.02	-.09	.03	.06	-.14	-.03	-.03	.04	-.05	-.08	.62**	--		
15. HC	-.13	-.13	-.11	-.09	-.11	-.01	-.20*	-.09	.01	-.10	-.11	-.16	.46**	.61**	--	
16. Apgar	-.19*	-.19*	-.16*	-.20**	-.18*	.03	-.09	-27**	.16*	-.08	.02	-.11	.20**	.23**	.20**	--

* = p <.05; ** = p < .01. GA = gestational age; BW = birth weight; HC = head circumference

Table A39. Intercorrelations between Time 2 COPE Scales and Birth Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Self-Distraction	--																	
2. Active Coping	.10	--																
3. Denial	-.03	-.21**	--															
4. Substance Use	.09	.10	-.08	--														
5. Emotional	.20**	.23**	-.15	.04	--													
6. Instrumental	.21**	.15	-.11	.11	.75**	--												
7. Disengagement	.02	-.20**	.28**	.08	-.10	-.07	--											
8. Venting	.17*	.15	.12	.14	.23**	.18*	.20**	--										
9. Reframing	-.002	.28**	-.09	-.16*	.18*	.14	-.23**	-.13	--									
10. Planning	.01	.59**	-.07	.002	.20**	.14	-.21**	.14	.30**	--								
11. Humor	.12	.04	.02	.06	.17*	.21**	-.003	.08	.15*	.06	--							
12. Acceptance	.12	.25**	-.03	.01	.19*	.06	-.02	.28**	.20**	.38**	.01	--						
13. Religion	.003	.10	-.04	-.14	.21**	.16*	-.13	-.02	.28**	.18*	-.09	.12	--					
14. Self-Blame	.14	-.11	.30**	.02	.06	.13	.33**	.27**	-.24**	-.10	.06	.11	.01	--				
15. GA	-.03	-.09	-.09	-.05	-.17*	-.15*	.01	-.15	-.13	-.08	-.20*	-.02	-.04	.05	--			
16. BW	-.05	-.09	.03	-.09	-.15	-.11	-.06	-.07	-.09	-.04	-.04	.06	-.09	.06	.62**	--		
17. HC	-.20*	-.05	-.05	-.08	.07	.07	-.11	-.02	-.17*	.02	-.08	.02	.11	.07	.46**	.61**	--	
18. Apgar	.10	.12	-.20*	-.03	-.03	.09	-.17*	-.19*	.08	.04	.08	.05	.05	-.18*	.20**	.23**	.20**	--

* = p <.05; ** = p < .01. GA = gestational age; BW = birth weight; HC = head circumference

Table A40. Intercorrelations between Time 2 Social Support and Birth Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. SSQ Number	--															
2. SSQ Satis	.32**	--														
3. SIRRS Tot Freq	.03	.26**	--													
4. SIRRS Tot Ad	.04	.34**	.57**	--												
5. SIRRS Phys F	.11	.22**	.65**	.42**	--											
6. SIRRS Phys A	.03	.13	.35**	.56**	.66**	--										
7. SIRRS Tang F	.03	.23**	.82**	.42**	.40**	.15	--									
8. SIRRS Tang A	.10	.33**	.45**	.75**	.24**	.26**	.53**	--								
9. SIRRS Info F	-.05	.20**	.81**	.35**	.41**	19*	.61**	.27**	--							
10. SIRRS Info A	.01	.33**	.39**	.80**	.20**	.28**	.26**	.51**	.31**	--						
11. SIRRS Emo F	.03	.20**	.89**	.56**	.51**	.30**	.64**	.39**	.66**	.39**	--					
12. SIRRS Emo A	.03	.27**	.42**	.87**	.27**	.41**	.25**	.54**	.21**	.67**	.52**	--				
13. GA	.19*	-.04	-.12	-.03	.11	.04	-.20*	-.10	-.12	-.05	-.10	.03	--			
14. BW	.06	.04	-.23**	-.02	-.06	-.03	-.25**	.01	-20*	-.004	-.19*	-.05	.62**	--		
15. HC	.15	.09	-.09	-.09	.13	.15	-.22**	.001	-.05	-.02	-.03	.11	.46**	.61**	--	
16. Apgar	.06	.16*	.004	.14	.03	.16*	-.09	-.02	-.04	.19*	.09	.16	.20**	.23**	.20**	--

* = p <.05; ** = p < .01. SSQ = Social Support Questionnaire; SIRRS = Support in Intimate Relationships Rating Scale; GA = gestational age; BW = birth weight; HC = head circumference

Table A41. Intercorrelations between Time 2 Maternal Distress Measures and Birth Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. BDI	--														
2. BAI	.57**	--													
3. Hassle Freq	.37**	.29**	--												
4. Hassle Sev	.52**	.39**	.91**	--											
5. Hassle Int	.51**	.38**	.30**	.62**	--										
6. Preg. Anx	.49**	.38**	.32**	.42**	.39**	--									
7. PSS	.71**	.55**	.37**	.52**	.52**	.51**	--								
8. EPDS	.75**	.52**	.39**	.51**	.45**	.52**	.74**	--							
9. # Neg Events	.26**	.22**	.16*	.23**	.27**	.12**	.34**	.29**	--						
10. Neg Impact	.18*	.18*	.13	.18*	.22**	.04	.28**	.23**	.97**	--					
11. HRSD	.61**	.53**	.30**	.42**	.44**	.31**	.57**	.60**	.28**	.23**	--				
12. GA	-.09	-.11	.03	-.04	-.15	-.06	-.08	-.06	-.01	.004	-.17*	--			
13. BW	-.03	-.04	.02	-.06	-.17*	-.08	-.10	-.01	-.05	-.03	-.07	.62**	--		
14. HC	-.17*	-.03	.10	.02	-.14	-.07	-.17*	-.10	-.12	-.10	-.03	.46**	.61**	--	
15. Apgar	-.15	-.17*	-.05	-.12	-.22**	-.12	-.16*	-.17*	.02	.05	-.08	.20**	.23**	.20**	--

* = p <.05; ** = p < .01. BDI = Beck Depression Inventory; BAI = Beck Anxiety Inventory; PSS = Perceived Stress Scale; EPDS = Edinburgh Postnatal Depression Scale; HRSD = Hamilton Rating Scale for Depression. GA = gestational age; BW = birth weight; HC = head circumference

APPENDIX B

FIGURES

Figure B1. Summary of Study Procedures

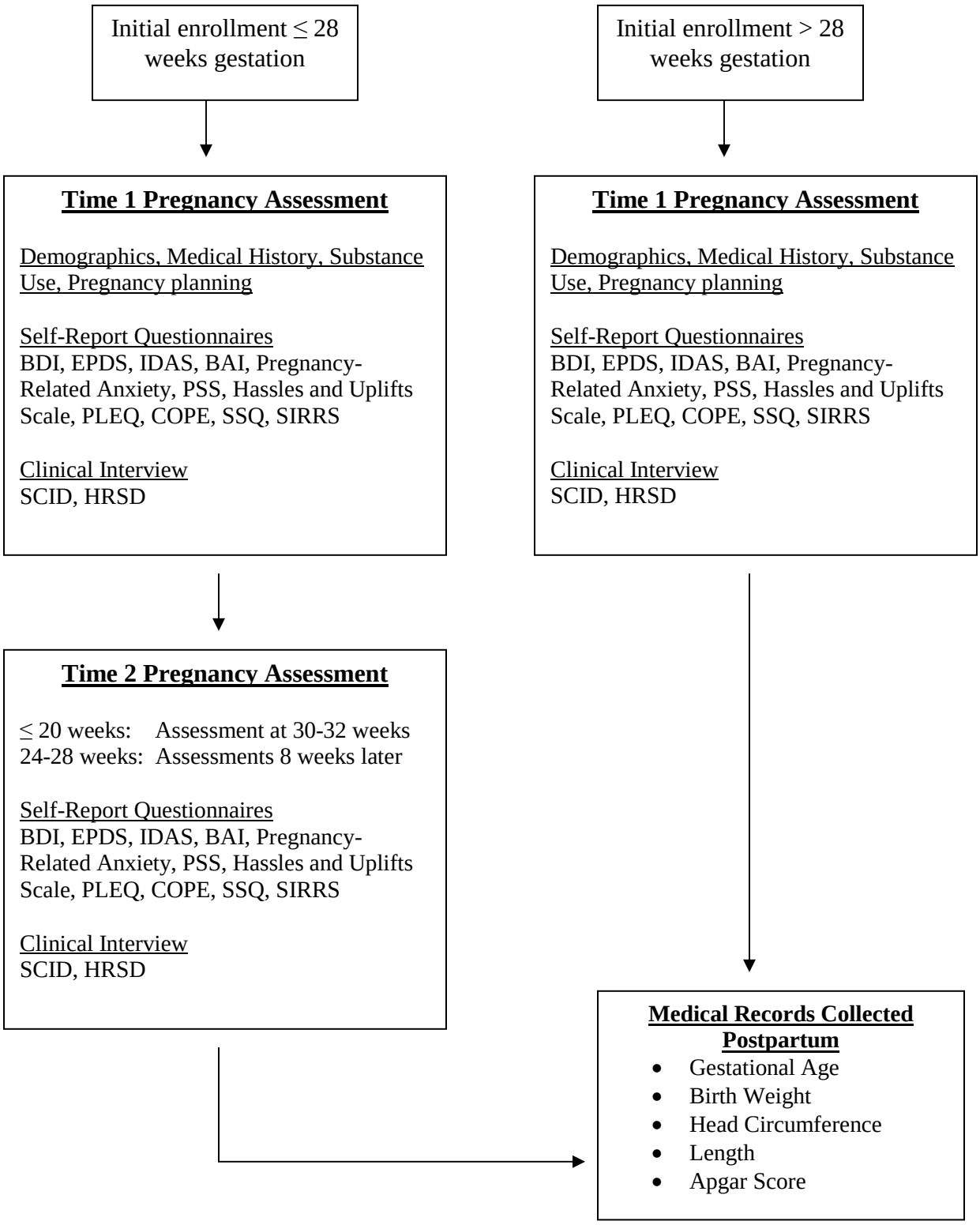


Figure B2. Summary of Participation for Enrolled Women

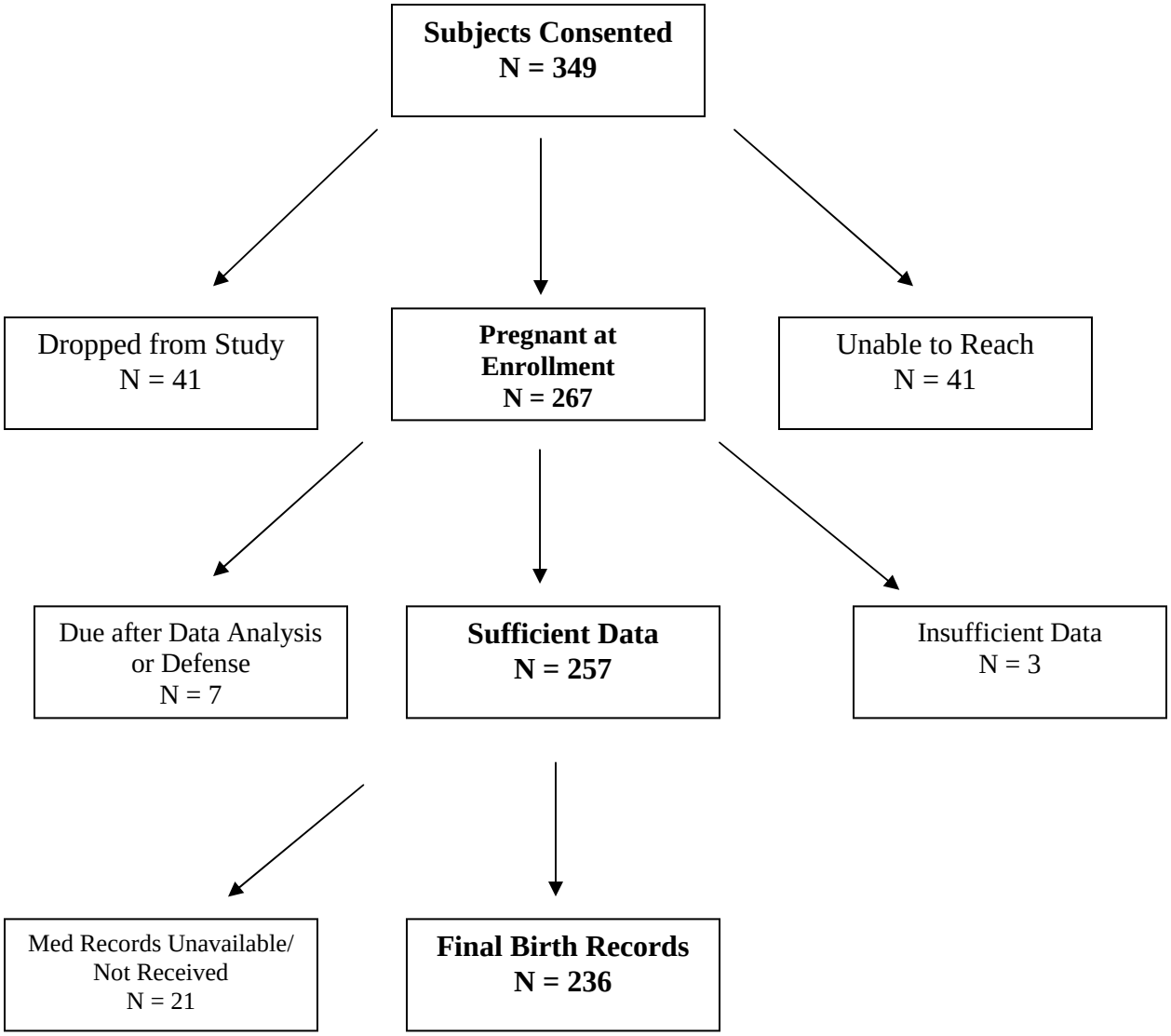


Figure B3. Interaction between Maternal Distress and Network Size (Time 1) on Birth Weight

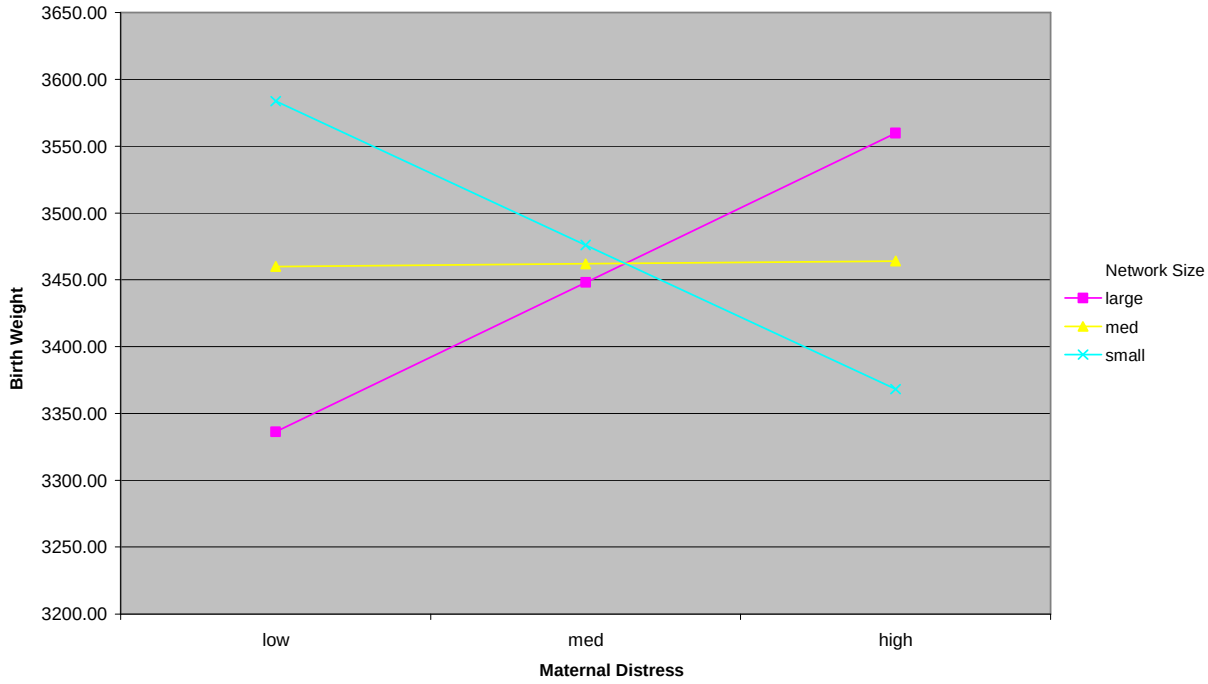


Figure B4. Interaction between Maternal Distress and Support Satisfaction (Time 1) on Birth Weight

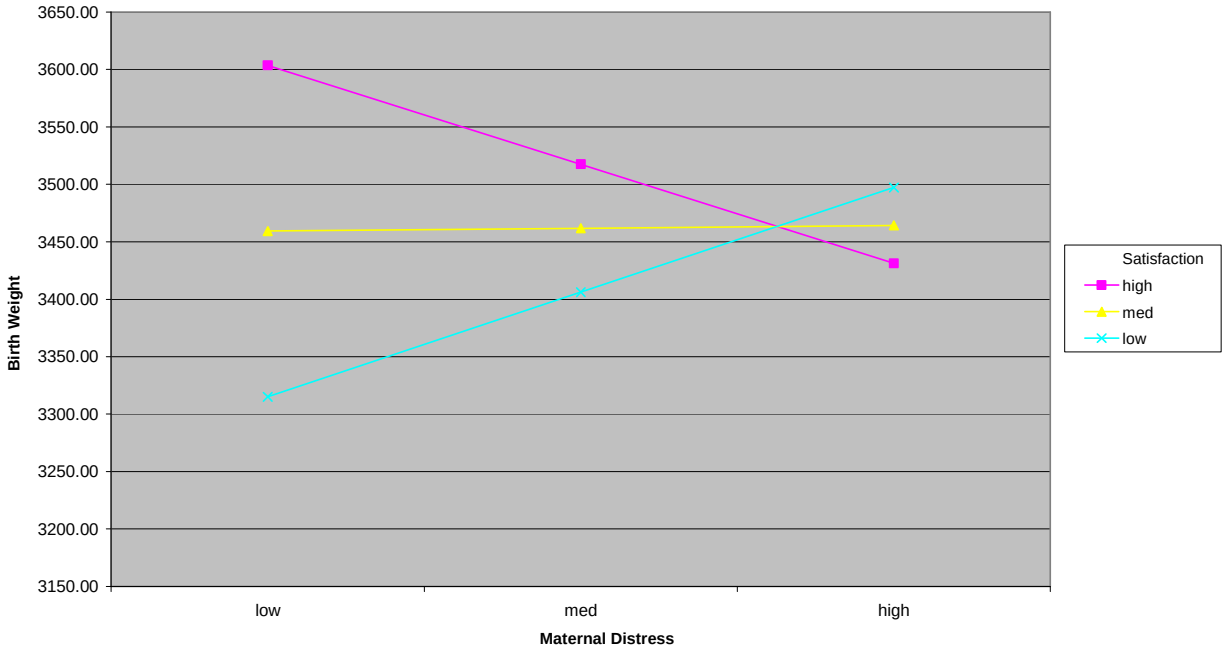


Figure B5. Interaction between Maternal Distress and Acceptance (Time 2) on Birth Weight

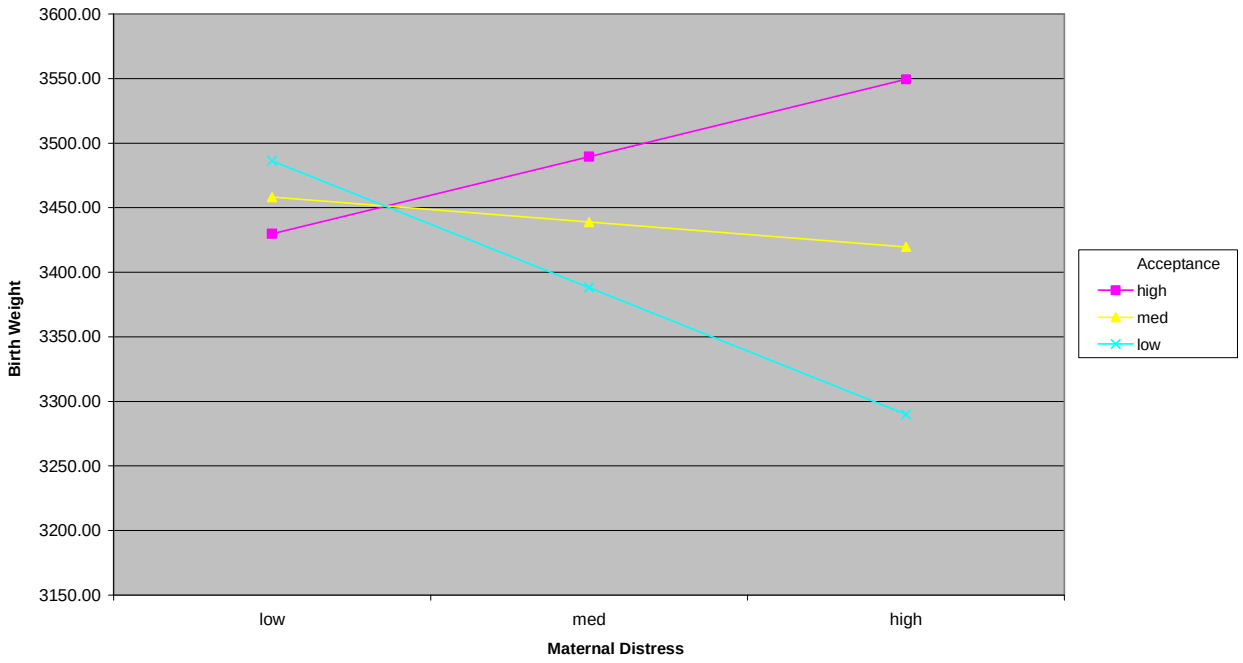
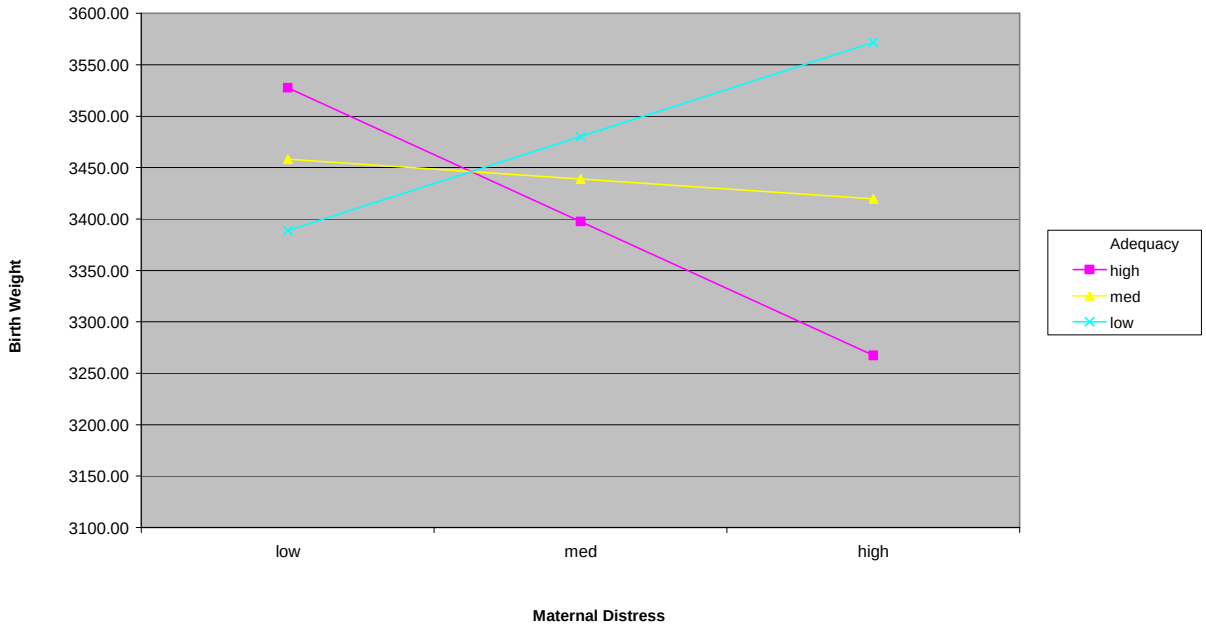


Figure B6. Interaction between Maternal Distress and Support Adequacy (Time 2) on Birth Weight



APPENDIX C

MEDIA ADVERTISEMENTS

Newspaper Advertisement #1

Are you Pregnant (or recently delivered) and Living in Linn, Johnson, or Blackhawk County?

Pregnant women and women who delivered after June 10, 2008 aged 18 and above are invited to participate in a study by the Iowa Depression and Clinical Research Center at the University of Iowa. This study is investigating the impact of recent flooding on pregnancy (among affected and non-affected women). Participants will complete questionnaires and phone interviews (and provide saliva) during pregnancy (or after delivery). Compensation will be provided. For more information, please call 319-335-0307 or toll free at 1-866-UIWOMEN (1-866-849-6636) or email IDCRC@uiowa.edu and mention "Flood Study."

Newspaper Advertisement #2

FLOOD STUDY
Pregnant and Postpartum Women Invited to Participate

Pregnant women and women in Johnson, Linn and Black Hawk counties who delivered after June 10, 2008 aged 18 and above are invited to participate in a study by the Iowa Depression and Clinical Research Center at the University of Iowa. This study is investigating the impact of recent flooding on pregnancy (among affected and non-affected women). Participants will complete questionnaires and phone interviews (and provide saliva) during pregnancy (or after delivery). For more information, please call 319-335-0307 or toll free at 1-866-UIWOMEN (1-866-849-6636) or email IDCRC@uiowa.edu and mention "Flood Study."

Compensation will be provided.

Johnson County & OB/GYN Associates Letter

FLOOD 2008 RESEARCH STUDY

To our Pregnant Patients and Patients who delivered after June 10, 2008:

University of Iowa researchers are conducting a study to examine how the Floods of 2008 have impacted mothers and their babies by comparing the experiences of those who were and were not affected by the flooding. The study will investigate the women's emotional and stressful life experiences and how those experiences might influence the mothers and her infant's health.

Women who are currently pregnant and women who delivered babies in Johnson, Linn and Black Hawk counties after June 10, 2008, are invited to participate in the study by the Iowa Depression and Clinical Research Center. Participants must be 18 or older to take part in the study and will be compensated.

Participants will complete questionnaires and phone interviews and provide saliva samples. Women who complete all portions of the study will receive $60 - $85 compensation for their efforts. You will not have any costs for being in this research study.

The surveys ask about emotional experiences, social relationships, ways of coping with stress, pregnancy concerns, demographic information and the impact of flooding. Phone interviews will involve questions about mood and feelings, appetite and eating habits, sleep habits, physical symptoms, and recent life events that have affected participants' health. Saliva samples will be collected on two consecutive days to measure cortisol, an important stress hormone.

There are no known risks from being in this study, and you will not benefit personally. However we hope that others may benefit in the future from what we learn as a result of this study.

The researchers will obtain your permission in getting access to your medical records following delivery. They will evaluate pregnancy, labor and delivery outcomes, as well as outcomes related to your baby. All information obtained from your medical records and used in the study will remain confidential.

Researchers aim to include 400 women in the study and to assess the development of their infants after birth. Involvement is voluntary, and participants can decide to stop taking part at any point. Johnson County Public Health is not involved in the study except to hand out this information. Participation in the study is completely your decision. If you decide not to be in this study, or if you stop participating at any time, you won't be penalized or lose any benefits for which you otherwise qualify.

If you have any questions about the research study itself, please contact Michael O'Hara, Ph.D. at 1-866-849-6636. If you experience a research-related injury, please contact: Michael O'Hara, Ph.D. at 1-866-849-6636**.** If you have questions about the rights of research subjects, please contact the Human Subjects Office, 300 College of Medicine Administration Building, The University of Iowa, Iowa City, IA 52242, (319) 335-6564, or e-mail irb@uiowa.edu. To offer input about your experiences as a research subject or to speak to someone other than the research staff, call the Human Subjects Office at the number above.

If you are interested in having someone from the University of Iowa research group contact you to provide additional information to any questions you may have, or to enroll you in the study, please provide the following information which we will forward to them.

Name _____ Due Date _____

Phone # _____(H) _____(W) _____(C)

E-Mail Address: _____

I would prefer to be contacted at (circle): Home #, Work #, Cell #, E-mail address.

Please give the above information to a clinic staff member. Thank you for your time.