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The Association Between Social Support During Pregnancy and the Development of Postpartum Depressive Symptoms

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Master of Public Health

Epidemiology

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By

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B.A., University of Virginia, 2016

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An abstract of
A thesis submitted to the Faculty of the
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Abstract

The Association Between Social Support During Pregnancy and the Development of Postpartum Depressive Symptoms

By Alessandra Kovac

BACKGROUND: Postpartum depression (PPD) is the most common complication of child bearing, with nearly 12% of women in the United States experiencing symptoms, and can create two generations of suffering for mother and her child (8). Although still considered "postpartum", nearly half of PPD episodes actually begin during pregnancy (13). While there is evidence supporting mental and physical health benefits of social support, it is unclear whether social support, specifically during pregnancy, is associated with PPD.

OBJECTIVE: The purpose of this study was to examine the association between low social support during pregnancy and the development of self-reported PPD symptoms.

METHODS: Using state-representative survey data from the 2012-2014 Georgia Pregnancy Risk Assessment Monitoring System (PRAMS), the association between low social support during pregnancy and the development of PPD was examined (n = 2,696). Accounting for the complex survey design, weighted descriptive frequencies were conducted and estimated adjusted odds ratios (aORs) and 95% confidence intervals (95% CI) using weighted multivariable logistic regression were estimated.

RESULTS: In Georgia, about 8% of mothers suffer from PPD symptoms. When adjusting for maternal age, maternal race and ethnicity, maternal education, marital status, abuse before or during pregnancy, and prevalence of stressful life events (SLEs), Georgia mothers with low social support showed no difference in odds of PPD compared to mothers with high social support (aOR = 1.15; 95% CI: 0.72, 1.83).

CONCLUSION: The findings of this secondary analysis did not suggest a significant association between low social support during pregnancy and PPD. Other factors beyond social support, including abuse and SLEs, may help to explain development of PPD. Although inconclusive, these findings have implications for future research on the risk factors associated with PPD.

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CHAPTER I: BACKGROUND

POSTPARTUM DEPRESSION: A PUBLIC HEALTH PROBLEM

Postpartum depression (PPD) is the most common complication of child bearing and poses a unique health problem because of the ability to create two generations of suffering for the mother and her child (1). For a woman to meet the definition of postpartum depression as a diagnosis, she must meet the criteria for a major depressive disorder the onset of which occurred in pregnancy or within 4 weeks of delivery (2).

The estimated two-generational annual economic cost of not treating one mother with maternal depression is $22,647 (3). The cost in lost income and lost productivity of not treating the mother with depression is $7,211 (3). In addition, the costs associated with the child born to a depressed mother add up to over $15,300, due to treating low birthweight babies, pre-term deliveries, loss of future income of the baby, and cost to the justice system (3). Extrapolating the costs to the 570,000 women with PPD who give birth every year in the United States, the annual cost of untreated PPD is the United States is around $13 billion dollars (4). In addition to the financial costs, there are health consequences to both the mother, including functional impairment and decrements in quality of life, and her child, including growth, cognitive, and development problems.

Clinical Definition and Prevalence

The majority of new mothers will experience a mild form of “postpartum blues”, or “baby blues”, after giving birth (1). Characterized by temporary mood swings,

tearfulness, and irritability, this syndrome emerges three to four days after delivery and dissipates within two weeks without consistently affecting the woman's ability to function (1). In contrast, PPD refers to a prolonged and more serious major depressive disorder. According to the American Psychiatric Association's fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5), a major depressive disorder is characterized by at least five of the following symptoms during the same 2-week period, where at least one of the symptoms is either depressed mood or loss of interest or pleasure, and represents a change from previous functioning: depressed mood; loss of interest or pleasure; significant weight loss or weight gain; insomnia or hypersomnia; psychomotor agitation or retardation; decreased energy or fatigue; feeling of worthlessness; diminished ability to think or concentrate, and recurrent thoughts of death or suicidal ideation (2).

As most psychiatric disorders become legitimized in the DSM, it is important to note that major depressive disorder with postpartum onset was not recognized until the publication of DSM-IV in 1994, despite conclusive research on the topic in the 1980s (5). Moreover, the current DSM-5 does not recognize postpartum depression as a unique diagnosis; rather, as noted, women must meet the criteria for a major depressive disorder with peripartum onset, in which the onset occurred in pregnancy or within 4 weeks of delivery (2). Of note, between the fourth and fifth editions of the DSM, the definition has remained the same, but the onset specifier has changed from "postpartum" to "peripartum" to describe the period within 4 weeks of delivery. Despite this, a more flexible temporal criterion for PPD is frequently described in clinical practice, such as

onset of symptoms extended to the first three to six months postpartum, and thus, could be considered a reasonable definition both clinically and epidemiologically (6). Additional symptoms that are more specific to PPD are disinterest in the new infant, obsessional thoughts about violence to the child, and, in some severe cases, infanticide without delusions or hallucinations (7). Assessing depressive symptoms during the postpartum period is further complicated by the fact that pregnancy, childbirth, and breastfeeding sometimes induce several of the symptoms used to identify depression, such as hypersomnia early in pregnancy and insomnia during the postpartum period. Such symptoms count toward a major depressive symptom if they are clearly and fully not attributable to the general medical condition.

The Centers for Disease Control and Prevention (CDC) estimates the 2012 United States prevalence of PPD as 11.5%, ranging from 8.0% in Georgia to 20.1% in Arkansas (8). However other sources have estimated that as many as 19.2% of women have a major depressive episode during the first 3 months after giving birth (9). According to the 2016 National Survey on Drug Use and Health, the twelve-month prevalence of a major depressive disorder in adults in the United States is 6.7% (10). Although the prevalence in adult females (8.5%) is almost double that of males (4.8%), it is notable that women in the pregnancy and the postpartum period are experiencing depressive episodes at higher rates than women in the general population (10).

Despite the long-standing recognition of PPD, it represents a largely undetected form of maternal morbidity. Even though mothers have various interactions with health

professionals during the partum and postpartum periods, they are frequently unwilling to disclose emotional problems, particularly depression (11). One explanation may be the popular myth that equates motherhood with happiness and joy. In addition, depression remains stigmatized, especially in some cultures, and mothers may fear the potential help-seeking consequences, such as being labelled mentally ill or an unfit mother.

Timing and Onset of Symptoms

The obstetrician-gynecologist is confronted with a variety of presentations of mood disorders during pregnancy and postpartum periods. Depression in the postpartum period may represent chronic depressions originating before pregnancy, depression that develop during pregnancy as a new disorder or in the context of relapse, or depression that begins after birth (4). While the DSM defines PPD as the onset of mood symptoms during pregnancy or in the 4 weeks following a live birth, significant variations in the timing of onset and severity of symptoms exist (12). In fact, 50% of "postpartum" major depressive episodes actually begin during pregnancy but are lumped as the same disorder despite noticeable differences (13). Compared with women whose symptoms begin postpartum, women experiencing onset during pregnancy are more likely to experience more severe PPD symptoms, especially poor mood and increased anxiety, which can lead to more obstetric complications and suicidal ideation (12). Therefore, the identification of onset of symptoms becomes a crucial part of assessment with important implications for understanding the cause and prognosis of perinatal and postpartum psychiatric illnesses.

Women who have experienced PPD are at risk of suffering further episodes of depressive illness, either as a recurrence of PPD or as persistent depression (14, 15). In fact, Sydsjö's 2007 longitudinal study showed that women with postpartum depressive symptoms were 5.82 times more likely to display depressive symptoms, even four years later, than women without PPD (16). Consequently, it is important to monitor the mother's mood over time to assess whether the depression will continue.

PPD and Maternal and Child Health Consequences

Untreated PPD is associated with numerous adverse long-term health outcomes for both mother and baby. For the mother, the episode can be the precursor of chronic recurrent depression. Many of the functional consequences of depression derive from individual symptoms, but impairment can range from mild incapacity to complete incapacity in which the depressed individual is unable to attend to basic care needs for herself or her children, is mute or catatonic, or is flooded with suicidal thoughts (2).

For her children, ongoing maternal depression can contribute to emotional, cognitive, and interpersonal problems throughout life. As mothers largely constitute an infant's social environment and experiences with the external world, the mother-infant bond is essential in the first few weeks and months after birth. This bond leads to healthy behavioral, cognitive, social, and interpersonal functioning and is crucial to establish a secure base from which a young infant can begin to explore the outside world (17). Even young infants are highly sensitive to the quality of care they receive, and a mother experiencing PPD symptoms, such as persistently depressed mood, social withdrawal, impaired concentration, hopelessness, guilt, and anxiety, is likely to impact the bonding process.

When this process breaks down, it can lead to insecure attachment between mothers and babies that has lasting effects on the infant's interpersonal relationships and social-emotional functioning and development (18). Current but limited research on PPD and non-PPD mother-infant dyads shows that PPD appears to have salient but selective effects on social interaction and interpersonal relationships (19-21). Compared to interactions with well mothers, depressed mothers were less sensitive, and expressed fewer infant affirmations and more negations (19). Other studies found that children of depressed mothers showed significantly less interest in exploring the environment, less affective sharing, and significantly less sociability to strangers (20, 21).

As depression persists throughout a mother's postpartum life, it is important to consider the long-term effects that maternal depression may have on the infant, including effects on growth and development. The minimal studies in the area of PPD and emotional development suggest an early effect of PPD on an infant's emotional attachment. Infants of mothers with PPD display less positive and more negative facial expressions in response to positive stimuli when compared to infants of mothers without PPD (22, 23). With regard to healthy growth and development, the strongest effects of PPD appear to be on cognitive development such as impaired language, intelligence (IQ), and Piaget's object concept tasks (24-27). These effects are mixed, and it appears that PPD is related to other factors which negatively affect cognitive development, including male sex of the infant, social adversity, and maternal depression (28, 29).

Screening and Prevention

Given its adverse consequences, it is unfortunate that less than 50% of cases of PPD are detected by healthcare professionals in routine clinical care (30). There are many valuable screening tools for depressive symptoms in pregnant and postpartum women, including self-reported questionnaires, standardized interviews used typically for research purposes, and clinically-assessed instruments. Edinburgh Postnatal Depression Scale (EPDS) is the most widely used instrument as a simple and publicly available screening questionnaire to evaluate depressive symptoms during pregnancy or recently after having a baby (31). The 10-item tool investigates self-reported depressive and anxiety symptoms and scores symptom severity during the past week on a four-point Likert scale (32). Easy enough for a mother to score herself, the ten symptoms are scaled from 0 to 30, with an extra emphasis on suicidal thoughts. A score of 12 or higher likely indicates a major depressive disorder and scores of 10-12 indicate probable cases of minor depression that require additional clinical monitoring (31). Furthermore, if a woman has a total score of 10 or higher on the EPDS or indicates that "the thought of harming myself has occurred to me" either "sometimes" (a score of 2) or "quite often" (a score of 3), a brief clinical interview to review symptoms and establish the diagnosis of depression is warranted (1). Like all screening tools, EPDS cannot be used to obtain a diagnosis and should not replace a clinical assessment and in-depth interview by a trained mental health professional.

While there are numerous tools for screening, research has shown that a two-question instrument may be effective enough to indicate a probable risk for depression. The Primary Care Evaluation of Mental Disorders (PRIME-MD) includes a 27-item screening

questionnaire and follow-up clinical interview for primary care physicians to rapidly diagnose multiple mental disorders commonly found in the general population (33). The questionnaire includes two screening questions for depression on the presence of depressed mood and anhedonia within the last month, known collectively as the Whooley Questions. The original assessment of the Whooley Questions reported that a "yes" answer to either one of these two symptoms was 86% sensitive and 75% specific, compared with a subsequent telephone interview with a clinician to diagnose a major depressive disorder (33). While there is limited information regarding the validity of this instrument in postpartum women, these results should be applicable to mothers, due to the absence of a unique clinical definition for PPD beyond major depressive disorder. While determining the most appropriate instrument to detect PPD is challenging, continued efforts to identify pregnant women who are at-risk of developing PPD with antenatal screening techniques is fundamental such that secondary preventive interventions and treatments may be implemented.

Evidence surrounding the clinical and cost-effectiveness of PPD screening is lacking and further research is required to address this gap (34). Meanwhile, cost-effectiveness data from two systematic efforts to screen for general depression and provide integrated support for treatment suggest that such programs can be implemented efficiently and produce cost-effective outcomes similar to those of other commonly performed preventive services, such as screening for mammography in women older than 50 years (35, 36).

Treatments

The treatments available for PPD are generally the same as those to treat a major depressive disorder and include psychotherapies and pharmacological interventions. In spite of this, postpartum women tend to prefer psychotherapy over antidepressant medication, particularly if they are breastfeeding (37). Fortunately, there are numerous empirically supported psychotherapies for depression and postpartum depression. Treatment modalities include cognitive-behavioral therapy (CBT), interpersonal psychotherapy (IPT), behavioral activation (BA), brief psychodynamic therapy, and internet-based CBT (4). These psychological therapies are relatively short-term and structured and are thereby flexible in how they are delivered. These approaches can be delivered in individual and group formats, in the home, over the internet with and without support, and over the phone (4). They can be delivered by an array of mental health professionals, including psychiatrists, nurse practitioners, social workers, and mental health counselors, as well as non-mental health case managers, nurses, and even peers (4).

Antidepressant medication is the most common treatment for depression in the general population and among postpartum women (4). This medication has the potential to alleviate depressive symptoms and may prevent recurrent episodes of PPD. It requires less intense contact with the patient and is likely less expensive than psychotherapy, but side effects and perceived risk of harm to the infant when breastfeeding are disadvantages many women consider when seeking treatment (4). There has been extensive research on the efficacy of antidepressant medication. While there is conflicting evidence, studies

show that only patients with severe depression benefit from antidepressant medication relative to placebo, and see minimal or nonexistent benefit for mild to moderate severity symptoms (38). With respect to antidepressants to treat PPD specifically, there have been few placebo-controlled trials. Moreover, there is little evidence for the superiority of antidepressant medication over other treatments, particularly psychological interventions, in postpartum depressed women (39). A more recent randomized control trial found that among a subset of participants whose depression began within the first 4 weeks after delivery, there were significant improvements with response to antidepressant medication (40). The heterogeneity of onset of symptoms among women indicates medication may not be effective in all cases.

Treatment for depression has been shown to make health and economic sense. Despite the evidence, only 65% of adults in the United States with a major depressive episode received treatment in 2016 (10) . Resources should be invested in scaling up treatment for depression. According to a 2016 World Health Organization (WHO) study, every $1 invested in depression treatment leads to a return of $5.30 in better health and ability to work (41). Improvements in labor force outcomes and decreased overall healthcare costs represent the instrumental value of improved mental health after effective treatment of depression. Independent of this instrumental value, being alive and healthy provides intrinsic value (41).

Correlates

Based on the literature, indicators that show the strongest prediction of postpartum depression are personal history of mood disorders, mood disorders during pregnancy, experiencing stressful life events, and lack of social support (42). Predictors for which results of PPD are conflicting include sociodemographic factors, such as income and maternal race, unplanned pregnancy, and marital relationship (43). There does not appear to be a relationship between maternal age, level of education, or parity and PPD (43).

SOCIAL SUPPORT

Definition

Social support is a complex, multidimensional concept that involves social interactions between recipients and providers (44). Broadly defined, social support is a voluntary well-intentioned act from one individual, the provider, that is given to another individual, the recipient, and elicits an immediate or delayed positive response in the recipient (45, 46). Using this general definition, there is flexibility in what is and who gives social support, making it difficult to define in detail and measure across interactions. Social support can be given by a family member, husband or partner, friends, and associates. Furthermore, there are different classifications: *emotional*, including expressions of empathy, care, and love; *informational*, where advice and guidance are given during a time of stress; *instrumental,* consisting of practical and tangible help in terms of financial aid or assistance with tasks; and *appraisal*, with information that is useful for and promotes self-evaluation (47, 48). Each of these four attributes is helpful and protective to the recipient of the support.

As opposed to the simplified definitions found in the literature, major theoretical definitions of social support were examined by Hupcey in 1997. These definitions could be placed in five categories: 1) Type of support provided, 2) Recipients' perception of support, 3) Intentions or behaviors of the provider, 4) Reciprocal support, and 5) Social networks (45). Each of these categories get at the complexity and specificity of social support.

Health Benefits

The complexity and broadness of the definition of social support makes review of current and available research difficult to synthesize into one conclusion. However, the consensus of research since the 1970s has shown that social support has direct benefits for health outcomes (48). The "social support theory" suggests that "social relations, or relative lack thereof, constitute a major risk factor for health – rivaling the effects of well-established health risk factors such as cigarettes smoking, blood pressure, blood lipids, obesity, and physical activity" (49). Initially the social support theory related to mental health, but with subsequent research, has expanded to encompass physical health, as well (45, 50). In general, prospective studies consistently show that individuals with greater social support, more specifically individuals who are married, belong to social and religious groups, and participate in relationships with friends and family, live psychologically and physically healthier and longer lives than those with fewer social ties (49, 50).

More recent research has shifted from mortality to morbidity, including important pregnancy outcomes such as fetal, infant, and maternal health (50). The overall evidence from observational studies of the association between social support and pregnancy outcomes, and in particular preterm birth and low birth weight, indicates that social support is associated with improved pregnancy outcomes (51-57). However, conceptualization and measurement of social support vary greatly from study to study. Berkowitz and Kasl's 1983 retrospective case control study found the report of partner support was not significantly different between mothers who had preterm births compared to term birth controls (51). However, when Feldman et al. included tangible and appraisal support from the mother's family as well as partner support, there was a statistically significant positive correlation with birthweight, even after controlling for medical risks (52). Lastly, of note, the 1993 study by Collin et al. included support from health care providers with partner support, but concluded that only the size of social networks was associated with increased birthweight (53). The differences in the independent variable of interest (i.e., how social support is measured) and the outcome (i.e., pregnancy complications) make it hard to draw solid conclusions across studies.

Due to the tremendous variability, less conclusive evidence has resulted from intervention studies. In fact, these trials have produced disappointing results for prevention of preterm and low birth weight outcomes due to differences in eligibility criteria, support interventions, and measure of outcomes. Overall, there appears to be a small, if any, treatment effect of social support interventions for preterm birth and low birth weight outcomes (58-62) . For example, Norbeck et al.'s intervention suggested

home visits and phone calls from "support nurses" decreased low birth weight outcomes (58), while Klerman et al. indicated that augmented prenatal care with smoking cessation and educational group sessions conferred no differences in birth outcomes between the treatment and control groups (59). Despite various differences between trials, Norbeck et al. propose that women with low support, and ultimately their babies, might benefit form enhanced support and targeted prenatal social support intervention programs (58). While it is notable that receiving social support through significant others, friends, and relatives during stressful times like the interval following childbirth can be protective against gestational complications, clearly, there is a need for continued, more focused research on prenatal social support interventions.

Social Support and PPD

When social support is operationalized for research purposes, only a small facet of the definition is employed and is usually only measured in terms of recipients' perception (45). Within the health sphere, research has differentiated between *perceived* support (a person's general perception or belief that people in their social network would provide assistance in times of need) and *received* support (where supportive exchanges can be directly observed or measured). Though not always accurate representations of reality, perceptions are still extremely influential in determining outcomes and notable differences in health outcomes exist, especially as they relate to mental health. Logsdon et al. looked at social support among African-American, low-income pregnant women. Although they found a significant relationship between perceived support and depressive symptoms following delivery, there was no relationship between actual received support

and PPD (63). They concluded that mothers may put a greater emphasis on their perceived social support (63). Differences between perception and actuality may be partly accounted for by the fact that depressed individuals tend to view everything more negatively, including levels of support.

O'Hara, Rehm, and Campbell studied perceived social support and found that, compared to well mothers, depressed women reported that their spouse was deficient in providing instrumental and emotional support after delivery, but they did not report their spouse was any less supportive during the pregnancy (64). While much of the literature has focused on the husband or partner as the means of social support, other research has broadened to include other forms. In fact, Cutrona noted that several dimensions of perceived social support during pregnancy were predictive of PPD symptoms and the strongest predictor actually concerned the availability of companionship and feeling of belonging to a group of similar others, rather than the quality of the relationship with the husband (65).

Social support can be conceptualized and measured in terms of structural aspects and/or the functional aspects of social support (50). The structural approach looks into the existence of various social relationships by using marital status or social ties as a measure of social integration (50). On the other hand, the functional approach focuses on the emotional and instrumental support obtained from the relationship (50). Lack of social support is a relatively potent risk factor for mental health disorders, but research is

needed to further examine these structural and functional aspects of social support as it relates to PPD, particularly during pregnancy and expanding beyond the spouse.

Screening

Similar to screening for depression, clinicians and researchers have developed multiple self-administered screening tools to subjectively assess social support. The Medical Outcomes Study (MOS) Social Support Scale has diagnostic value, especially for research purposes. Originally designed for patients in the MOS, a two-year survey that was developed for patients with chronic conditions in 1991, the MOS Social Support Scale has been utilized outside of the intended study (66). Containing 19 functional support items, the questionnaire attempts to measure five dimensions of social support based on available, if needed: emotional support, informational support, tangible support, positive social interaction, and affectionate support (66). Responses range from 1 to 5 and are summed to create a score; recent research has employed a cut-off score of 48 or above as a criterion for satisfactory social support (67).

Related to aspects of social support relevant to maternal health, the Postpartum Social Support Questionnaire (PSSQ) has been developed and validated as a scale to assess social support after pregnancy and childbirth and is useful in PPD research (68). The PSSQ is a 50-item questionnaire designed to measure instrumental and emotional support received by new mothers from their spouse/partner, family, and friends (68). The scale was constructed to yield four subscale scores including partner support (15 items), parent support (11 items), parent-in-law support (9 items), and extended-family and friends support (13 items), as well as two items assessing general support (68). Remarkably, a

study has shown that the modified PSSQ administered during pregnancy assessing maternal expectations of the level of postpartum social support yielded similar loading patterns to those observed in the postpartum administration of the original PSSQ (69).

Treatment of Inadequate Social Support and PPD

Research of social support over the last forty years has shown the positive health outcomes of adequate social support, but related research showing that health outcomes can be modified by manipulating social support is lacking (45). While inadequate social support is difficult to "treat," as in a physician prescribing medication, a lack of social support can be addressed in other ways, especially in the context of PPD. For instance, the framework of Interpersonal Psychotherapy (IPT) lends itself well as a "treatment" for low social support in depressed mothers. As the basic tenet of IPT, patients have social problems, called problem areas, that may take the form of interpersonal conflict (with spouse, family or friends), problems in role transition (e.g., becoming a mother, leaving the workforce), or in managing loss (such as death of a loved one) (4). IPT begins with an assessment of the interpersonal circumstances of a patient's depression and ultimately focuses on one problem for treatment, such as the lack of social support from a women's family and friends. The general goals of IPT are to help the woman identify the specific sources of conflict with her partner, identify her goals for the relationship, and make a plan of action to clearly communicate with her partner outside of therapy (4). While also providing the type of social support a new mother may need, the IPT therapist would address the lack of support from others by exploring strategies to increase social support, such as learning to directly ask for it from her partner or family members or by seeking it out among other new and experienced mothers as her social network. IPT is relevant for

the treatment of PPD when lack of adequate social support could be an underlying cause, but more research is needed to test how these interventions and treatment of low social support can change onset or presence of PPD outcomes.

CURRENT PROBLEM AND STUDY RELEVANCE

Healthy People provides science-based ten-year "ambitious, yet achievable" objectives for improving the health of all Americans (70). Under the collaboration of the United States Department of Health and Human Services and other federal agencies, public stakeholders, and the advisory committee, *Healthy People 2020* emphasizes 1,200 specific objectives organized into 42 topic areas where action much be taken if the United States is to achieve better health by the year 2020 (70, 71). Around 1,000 of these objectives are considered "measurable," with baseline data and established targets, or have already achieved high levels of success but are being tracked without a target for informational purposes (70). The remaining 200 objectives do not have established baseline data and are considered "developmental" until data sources are identified and measurable targets can be created (70). Included as "developmental", a new Maternal, Infant and Child Health objective (MICH-34) aims to decrease the proportion of women delivering a live birth who experience postpartum depressive symptoms (72). Classifying this objective as "developmental", Healthy People has identified a critical research and data collection need on postpartum depression among women in the United States in order to improve the population's health.

While many physiological and psychosocial causes of PPD have been explored, few studies have examined the relationship between social support, specifically during pregnancy, and experiencing symptoms of PPD. Since around half of PPD cases start before child birth, the need for research on risk factors during pregnancy is essential. The obstetrician-gynecologist is the only primary care provider for many women in the United States and, therefore, she has a great responsibility to address the mental health of patients, along with their physical health, before, during, and after pregnancy. By the time a woman delivers, the obstetrical team should already have a good idea of her vulnerability to depression from her medical records, conversations throughout the pregnancy, and formal screening of depressive symptoms during pregnancy and after delivery. If a mother is particularly vulnerable, the physician should follow-up with a more detailed assessment of symptoms and impairment in functioning before initiating treatment or making a referral to a variety of mental health professionals.

The effects of PPD on the mother and her children make it an important condition to diagnose, treat, and prevent. If PPD is to be prevented, increased research on risk factors, protective factors, and effective treatments is essential. The conclusions derived from this analysis will help to better understand the role social support plays as a risk factor for PPD. Implementing prenatal screening using known risk factors for PPD can help to identify women who are likely to develop depression in the postnatal period. In addition to ongoing surveillance and screening of particularly high risks, subsequent interventions with resources and support may alleviate months of depressive suffering for a new mother and decrease the potentially harmful impacts to her baby.

CHAPTER II: METHODOLOGY

RESEARCH DESIGN

This secondary data analysis utilized publicly available data from the Georgia Pregnancy Risk Assessment Monitoring System (PRAMS) to assess the association between social support during pregnancy and the development of PPD, specifically with mothers who delivered a live birth in the state of Georgia during the 2012 to 2014 sampling years. This exploratory research uses questions and data that are related to postpartum depressive symptoms (main outcome variable), social support (main exposure outcome), and selected sociodemographic, maternal, and pregnancy-related covariates that potentially moderate, mediate, or confound this relationship.

HISTORY OF PREGNANCY RISK ASSESSMENT MONITORING SYSTEM

PRAMS is an ongoing, population-based surveillance system that collects state-specific data on recent live births in the United States (73). The surveillance system was established in 1987 as part of the CDC's initiative to reduce infant morbidity, mortality, and low birthweight by collecting information on maternal behaviors before, during, and immediately after pregnancy (73). As a supplement to vital records, PRAMS also generates data for planning and assessing perinatal health programs (74). The original PRAMS questionnaire was developed in 1987 and data collection was initiated in the Fall of 1988 (74). Since that pilot Phase 1, from fall 1988 to summer 1990 in 5 states and the District of Columbia, methodology has become more streamlined and funding has been awarded to expand PRAMS (74). The project has undergone substantial growth to fifty-one sites, including forty-seven states, New York City, Puerto Rico, the District of

Columbia, and the Great Plains Tribal Chairmen's Health Board (GPTCHB) (75). It represents approximately 83% of all live births in the United States (75).

OVERVIEW OF PRAMS COMPLEX SAMPLING

PRAMS employs a complex sampling method that is designed to oversample certain populations, such as racial and ethnic minorities and low birth weight infants, and to ensure a representative sample of all women who had a live birth in the site area. With the stratified sampling method, states may choose up to two stratification variables from the following list: birthweight, maternal race and ethnicity, maternal education, maternal age, geographic area, and Medicaid status (74). To limit annual samples to a manageable size, each stratification variable can have from two to four levels, but the total number of strata cannot exceed six (74). From eligible birth certificates, PRAMS selects a stratified random sample of women who had a live birth within the preceding 2-6 months to participate in each site (74). Each site samples around 100 to 300 women per month, totaling 1,300-3,400 women per year (74). Responses are collected and weighted to be representative of all women who had a live birth in that site. Stratification and oversampling allows researchers to make inferences about specific subpopulations as well as make comparisons among several subpopulations.

Exclusions to the sampling process "are made because of particular concerns or operational difficulties" and a more detailed process is detailed in the *PRAMS Model Surveillance Protocol* (74). The main exclusions include: out-of-state births to residents; in-state births to nonresidents; missing information on mother's last name and essential

contact information; and birth certificates processed more than six months after birth (74). Other exclusion criteria for multiple gestations, adopted infants, and surrogate births are more nuanced.

Particular to the Georgia PRAMS site, the Georgia Department of Public Health selects a stratified random sample of 100 to 200 mothers every month from Georgia birth certificate registries (76). Georgia's stratification and oversampling by certain attributes has changed throughout the years, based on the state's needs and population. Of interest to this analysis is the 2012 – 2014 stratification and oversampling. In 2012, the attributes of interest were: Teen mothers (19 years old or younger at the time their new baby was born) vs adult mothers (20 years old or older at the time their new baby was born) and low birthweight (infants who weighed less than 2,500 grams at birth) vs normal birthweight (infants who weighed 2,500 grams or more at birth) (76). In 2013 and 2014, the attributes of interest were counties identified as infant mortality clusters in 2012, which included Bibb County, Chatham County, Fulton County, Lowndes County, Muscogee County, and Richmond County vs all other Georgia counties (76).

DATA COLLECTION AND INSTRUMENT

A strength of the PRAMS surveillance system is the standardized collection methodology among participating sites. This methodology is detailed in the *PRAMS Model Surveillance Protocol (74)*. This standardization allows for comparisons across sites and the use of data for single- or multi-state analysis.

PRAMS employs a multi-modal approach to reach respondents and collect data. Initially, a survey is mailed and multiple follow-ups are attempted by mail (74). If there is no response to the repeated mailings, a survey by telephone is attempted and administered (74). Beginning two to four months after delivery, an explanatory pre-letter introducing the survey is sent to the sampled mothers, explaining the questionnaire basics, describing the procedures for completing and returning the questionnaire, and providing staff contact information (74). A few days later, the initial PRAMS packet is mailed. This packet includes the initial letter, questionnaire booklet with self-addressed and pre-paid return envelope, brochure providing additional information on PRAMS, 3-year calendar as a memory aid, and participation incentive (74). Participation incentives, sent to all sampled mothers, and rewards, sent to all survey respondents, include: coupons for certified birth certificates, entry into a raffle for a cash award, postage stamps, bibs, a dollar bill, and/or magnetic picture frames (74). Within 7 to 10 days of the initial packet, a thank you and reminder letter is sent, and subsequently a second mail questionnaire package, and in most states a third, is mailed to those who have not yet responded (74).

Lastly, PRAMS staff telephones the nonresponsive mothers within two weeks of the last mailed questionnaire (74). As a last attempt, a variety of sources are used to obtain valid contact numbers and up to 15 calls are staggered over different times of the day and days of the week to reach the mother and complete the survey (74). In total, the data collection process, from the mailing of the pre-letter to the close of the telephone follow-ups, lasts approximately 60 to 95 days, and is carried out for each of the 12 samples per year (74).

PRAMS questionnaires include two types of questions: core and standard. Core questions are asked by all participating sites and include questions about contraception use, prenatal care, maternal alcohol and tobacco consumption, physical abuse before and during pregnancy, attitudes about the most recent pregnancy, and mother's knowledge of pregnancy-related health issues, such as adverse effects of tobacco and alcohol, benefits of folic acid, and risks of HIV (77). The remaining questions on the survey are chosen from a pretested list of standard questions developed by the CDC and can be revised, added, or dropped for any given survey version (77). Furthermore, the PRAMS questionnaire has both English and Spanish versions with identical content (77).

Georgia's phase 7 PRAMS questionnaires consist of 84 questions, including the required core questions and expanded standard questions regarding prenatal care visits, breastfeeding practices, HIV testing and influenza vaccination during pregnancy, infant safe sleep practices postpartum depression, and social support (78).

DATA RETRIEVAL

Georgia PRAMS data was requested through the Georgia Department of Public Health and was downloaded in SAS format. The dataset included birth certificate variables, questionnaire variables, analytic variables, operational variables, and weighting variables that account for the PRAMS survey design and statistical weighting of the data. SAS software was used to modify the PRAMS dataset and specialized SAS procedures were

used to control for the complex survey design (i.e. SURVEYLOGISTIC, SURVEYFREQ).

DATA SELECTION

The text below serves as a guide for the selected variables of interest, informed by associations in the literature. Variables were created either from the Georgia birth certificate record or the Phase 7 PRAMS survey responses.

Postpartum Depressive Symptoms

PPD is the outcome of interest, but due to the generality of the PRAMS survey, questions on any health topic, especially maternal mental health, are limited. Maternal mental health is restricted to two questions on frequency of PPD symptoms and one question regarding seeking help for depression after pregnancy. Moreover, PRAMS does not directly ask about a clinical diagnosis of PPD by a healthcare professional. Self-reported PPD symptoms are ascertained through responses to the following questions included on all PRAMS questionnaires: 1) "Since *your new baby was born*, how often have you felt down, depressed, or hopeless?" 2) "Since *your new baby was born*, how often have you had little interest or pleasure in doing things?" The CDC has classified postpartum depression as a response of "always" or "often" to either or both of the questions (79). While these two questions represent the two cornerstone symptoms of depression, depressed mood and anhedonia, at least four other symptoms would need to be identified by a clinician to verify a diagnosis of depression. Nevertheless, the questions are phrased in the same manner as the two questions from the PRIME-MD survey that have been

validated to diagnosis depression with relatively strong sensitivity and specificity. Using a more clinical and epidemiological definition of PPD, since it includes classification of symptoms up to six months after birth, a response of "always" or "often" to the frequency of at least one major depressive symptom was used to determine women suffering from PPD based on CDC's definition.

Social Support

PRAMS measures both the structural and functional aspects of social support as the main exposure of interest. The structural aspect, a measure of social ties and social integration, is assessed based on the martial status, captured on the birth certificate, and the relationship with the baby's father, from the PRAMS questionnaire. This analysis concentrates on the functional aspect, focusing on the tangible assistance from the mother's personal relationships. Assessing social supports is not included as part of the core questions on PRAMS surveys. Therefore, sites have a choice whether to include it based on the needs of their area and, if included, there is not standardization across all surveys. During Phase 7 surveys, seven sites asked about social support during pregnancy and four sites asked about social support after the baby's birth (80). In addition to the differences in timing, phrasing of the question differed between surveys. Five sites assessed social support during pregnancy through the question: "Since *you delivered your new baby*, would you have the kinds of help listed below if you needed them? a) Someone to loan me $50 b) Someone to help me if I were sick and needed to be in bed c) Someone to talk with about my problems d) Someone to take care of my baby e) Someone to help me if I were tired and feeling frustrated with my new baby" (80).

Survey respondents would check all types of support they anticipate receiving if needed and the CDC classified "adequate" social support as reporting three or more types of support (79). Other research using this question from other PRAMS surveys has grouped the social supports as low (0-1 supports), medium (2-3 supports), and high (4+ supports) (81).

Georgia and two other sites include a more nuanced question to investigate who is providing social support during pregnancy: "During your *most recent* pregnancy, who would have helped you if a problem had come up? For example, who would have helped you if you needed to borrow $50 or if you got sick and had to be in bed for several weeks? a) My husband or partner b) My mother, father, or in-laws c) Other family members or relative d) A friend e) Religious community e) Someone else". Popular answers categorized as other were the boyfriend's family, coworkers, neighbors, and a nanny.

As CDC does not have an indicator of adequate social support based on Georgia's question, four different categorizations of social support were explored. First, based on previous literature, support was grouped as low (0-1 supports), medium (2-3 supports) and high (4+ supports). Second, based on the data's tertiles, support was grouped as low (0-2 supports), medium (3 supports), and high (4+ supports). Third, support was dichotomized as none (0 supports) vs some (1+ supports). Lastly, to follow CDC's classification, support was dichotomized as low (0-2 supports) vs high (3+ supports).

Potential Confounding Variables

Based on the review of current literature, covariates considered for inclusion in the model included maternal age, maternal race and ethnicity, household income, maternal education, marital status, previous diagnosis of depression, abuse before or during pregnancy, presence of stressful life events, gestational age, pregnancy intention, cigarette smoking during pregnancy, and alcohol use during pregnancy. Variables were retrieved from the following sources: PPD, social support, income, previous diagnosis of depression, abuse before during pregnancy, pregnancy intention, and stressful life events were obtained from the PRAMS survey. Maternal age, race/ethnicity, maternal education, and marital status were obtained from the birth certificate.

Socio-demographic Characteristics. For this analysis, maternal age was categorized as less than 20 years of age, 20-34 years of age, and 35 years of age or older. Maternal race and ethnicity were combined as one race/ethnicity variable and categorized as non-Hispanic, White; non-Hispanic, Black; Hispanic; and non-Hispanic, Other. Other races included American Indian, Chinese, Japanese, Filipino, other Asian, other race, and mixed race. Total annual household income was categorized as $0-$15,000, $15,001-$26,000, $26,001-$52,000, $52,001+, and missing. Maternal education was categorized as less than high school, high school graduate, some college, and four or more years of college. Marital status was categorized as married or other.

Maternal Characteristics. Medical history of depression was categorized as “no” or “yes” based on the question, “Before you got pregnant with your new baby, did a doctor, nurse,

or other health care worker tell you that you had depression?" Abuse before and during pregnancy was categorized as "no" or "yes" based on both a physical and emotional component. Physical abuse was assessed through the questions, "During the *12 months before you got pregnant with your new baby*, did your husband or partner push, hit, slap, kick, choke, or physically hurt you in any other way" and "During *your most recent pregnancy*, did you husband or partner push, hit, slap, kick, choke, or physically hurt you in any other way". Emotional abuse was assessed through the questions, "During the 12 months before you got pregnancy, did your husband or partner threaten you, limit your activities against your will, or make you feel unsafe in any other way?" and "During your most recent pregnancy, did your husband or partner threaten you, limit your activities against your will, or make you feel unsafe in any other way?" An affirmative response to any of these 4 questions was considered abuse.

Pregnancy-related Characteristics. Gestational age at birth was categorized as less than 28 weeks, 28-33 weeks, 34-36 weeks, and 37 weeks or greater. Pregnancy intention was based on the question "Thinking back to *just before* you got pregnant with your *new* baby, how did you feel about getting pregnant?" with response choice of wanted to be pregnant later, wanted to be pregnant sooner, wanted to be pregnant then, didn't want to be pregnant then or at any time in the future, or was not sure. To be consistent with the previous literature, pregnant intention was classified as intended (wanted to be pregnant then or sooner), mistimed (wanted to be pregnant later), unintended (not then nor in the future), and unsure (82-85). Cigarette smoking during pregnancy was based on the question, "In the *last 3 months* of your pregnancy, how many cigarettes did you smoke on

an average day?". Responses were categorized as no, if the respondent answered she did not smoke any time in the past 2 years or specified she did not smoke in the last 3 months of her pregnancy, or yes, if she indicated she had smoked any amount of a cigarette while pregnant. Alcohol use during pregnancy was based on the question, "During the *last 3 months* of your pregnancy, how many alcoholic drinks did you have in an average week?" Responses were categorized as no, if the respondent answered she did not drink alcohol any time in the past 2 years or specified she did not drink alcohol in the last 3 months of her pregnancy, or yes, if she indicated she drank any amount of alcohol while pregnant. Presence of stressful life events (SLEs), or stressors, included family illness, separation or divorce, recent move, homelessness, partner lost job, mother lost job, reduced work for the mother or partner, military deployment or extended work travel, arguments with partner, partner does not want pregnancy, trouble paying bills, mother or partner in jail, drug problems with someone close to the mother, or death of someone close to the mother. Cumulated stress during pregnancy was totaled based the number SLEs indicated within 12 months before the new baby was born and categorized as 0 stressors, 1-2 stressors, 3-5 stressors, and 6 or more stressors.

STATISTICAL ANALYSIS

SAS 9.4 was used to account for the complex survey weights and to conduct all statistical analyses.

Exploratory Analyses

Social Support Categorizations. An exploratory analysis of categorization of social supports was performed. Initially, continuous count of social supports was plotted against the log odds of PPD. After combining 0 and 1 supports and 4 and 5 supports to avoid small counts, social support was re-plotted against the log odds of PPD. Additionally, in order to compare the effects of different categorizations, linear risk models for each categorical social support were estimated and fit.

Survey Year. PRAMS has a minimum overall response rate threshold policy in order to release meaningful data. For years 2006 and earlier, CDC set the threshold at 70%. From 2007-2011, the response rate threshold for data release was lowered to 65%. During 2012-2014, which includes the years of interest to this analysis, CDC has furthered reduced the response threshold to 60%. Of note, the target response rate has been since been reduced to 55%. PRAMS data from 2014 did not reach the recommended 60% threshold, but data were still released for the potential to be useful. Since 2012 and 2013 years did reach the recommended response rate, chi-square test was performed to assess if significant differences existed between social support, PPD, and all covariates, comparing mothers who completed the 2012 and 2013 surveys to mothers completing the 2014 survey.

Descriptives

Descriptive statistics included examining unweighted and weighted frequency distributions of all variables and assessing for missing data using standard SAS software

and the specialized procedures for the complex survey design (e.g. PROC SURVEYFREQ). All variables were either dichotomous or categorical variables with 2-5 categories. Survey frequencies, weighted percentages, and 95% confidence intervals (95% CI) were calculated for the exposure and correlates of interest, stratified by the outcome.

Diagnostics

Primary Variables. After review of the current literature, a total of 13 potential correlates were of interest in this analysis, excluding the exposure and outcome. Before proceeding with the analysis, the following variables were considered essential for the analysis and inclusion in the final model based on previous literature reviews: maternal age, maternal race/ethnicity, marital status, and education.

Preliminary Effect Measure Modification Assessment. To consider effect measure modification, odds ratio (OR) estimates were calculated for social support and PPD, stratified by each covariate separately. If the stratified effect estimates differed considerably among covariate levels, the variable was considered for potential effect measure modification. A joint statistical significance test for the interaction terms was conducted for each stratified relationship and a p-value < 0.20 indicated significant interaction at this preliminary stage.

Bivariate Analysis. Univariable logistic regression models for weighted data were evaluated for the relationships between the correlates and PPD, as well as the correlates

and social support. Rao-Scott chi-square tests for weighted data were performed and unadjusted ORs and 95% CI for each relationship were calculated. Variables were considered for inclusion in the model if a moderate to strong association with the exposure and outcome was indicated by a Rao-Scott chi-square test p-value<0.30 for both bivariate associations.

Collinearity. Multicollinearity was evaluated through backwards elimination among the full model of independent variables including the exposure, correlates, and preliminary interaction terms. A SAS macro for the SURVEYLOGISTIC procedure was performed to account for the complex survey design. Collinearity was assessed by monitoring the condition index and variance decomposition proportion (VDP) values; a model with a condition index greater than 30 with at least two VDP values greater than 0.5 signified a potentially collinear relationship among variables in the model. In such an instance, a single correlate or interaction term was dropped from the model and the SURVEYLOGISTIC collinearity procedure would be repeated until an acceptable model with a condition index of less than 30 was reached.

Significance Testing of Interaction Terms. A Wald test of all preliminary effect measure modification terms was performed to assess the overall significance of the interactions terms. Although the model did not produce a significant Wald test statistic, the model underwent stepwise backwards elimination through significance testing to ensure interaction terms were not significant. Interaction terms were considered for exclusion if the associated p-value was greater than 0.05, starting with the removal of the least

significant (e.g. largest p value). The model was further reduced until all interaction terms were removed.

Confounding Assessment. A reduced model of the exposure and 10 correlates underwent confounding assessment. Excluding the 4 variables identified in the *a priori* statement as primary correlates of interest, 6 correlates were eligible for removal. Variable selection utilized a combination of stepwise backward elimination and specified change-in-estimate criterion. Excluding the variables identified in the *a priori* statement, the variable with the largest p-value was dropped from the model and a further reduced model was run. Variables were retained if their removal from the result model results in a change of $\geq 10\%$ in the OR effect estimate.

Multivariate Logistic Regression. A weighted multivariate logistic regression was performed on the final reduced model to assess the relationship between social support and PPD, adjusting for covariates of interest. As recommended for PRAMS data, procedures that accommodate the study design and complex survey methods (e.g. PROC SURVEYLOGISTIC) were used to analyze this data. Adjusted ORs and 95% CIs were reported.

IRB CLEARANCE

Analysis performed in the completion of this analysis involved secondary analysis of publicly-available and de-identified data. As a result, the analysis was exempt from approval by the Institutional Review Board (IRB) at Emory University.

CHAPTER III: RESULTS

STUDY POPULATION

A total number of 3,122 women responded to the Georgia PRAMS survey between 2012-2014 years and were weighted to represent 316,906 Georgia mothers. 426 participants (14.0 %) were excluded from the analysis if data were missing for the outcome variable (PPD), any of the main exposure components (the 6 social support questions), or any of the potential 13 correlates. After exclusions, 2,696 respondents had complete information and were included in the analysis, representing 267,614 mothers in the state of Georgia.

EXPLORATORY ANALYSES

Social Support Categorizations. Categorizations of social support were explored by plotting social support counts against the log odds of PPD, as well as estimating and fitting linear risk models for each categorizations. The four different categorizations are summarized in Table 1 (see below). Of note, no respondents indicated 6 types of support.

Table 1. Comparison of social support categorizations used in this study

Number of social supports	Categorizations used in this study			
	Literature	**Tertiles**	**Dichotomization 1**	**Dichotomization 2**
0	Low	Low	None	Low
1	Low	Low	Some	Low
2	Medium	Low	Some	Low
3	Medium	Medium	Some	High
4	High	High	Some	High
5	High	High	Some	High
6[a]	High	High	Some	High

[a] Zero respondents indicated 6 social supports on the PRAMS survey

Initially, continuous counts of social supports were plotted against the log odds of PPD. From 0 to 4 supports, the plot had a nearly linear negative association between count of social supports and log odds of PPD, supporting that the higher number of supports reported decreased the odds of PPD. However there was a slight increase in log odds at 5 supports. This unanticipated increase may be partly explained by the small number of respondents (7.1%) who marked 5 supports. Moreover, only 0.6% of respondents marked 0 supports. After combining 0 and 1 supports and 4 and 5 supports and re-plotting the relationship, the plot showed a completely negative association between social support and log odds of PPD. In this manner, a linear association was visualized for 0-2 supports and a separate nearly linear association was visualized for 3-5 supports. These results endorsed a dichotomization of social support into 0-2 supports vs 3-6 supports.

Secondly, linear risk models for each categorical social support were estimated and fit. The plots of PPD risk and categorization based on the literature cut points (0-1, 2-3, 4+ supports) appeared similar to the plot with categorization based on the data's tertiles (0-2, 3, 4+ supports). However, the literature cut points produced wider confidence intervals. Comparing the two dichotomizations, the none vs some cut points (0, 1+) was not well fitting for the data and produced large confidence intervals, while the low vs high cut points (0-2, 3+) fit well, had narrowest confidence intervals of all plots, and followed the same shape as the three-level categorizations. Ultimately dichotomization of social support during pregnancy into low (0-2 supports) versus high (more than 3 supports) was chosen based on the results of the log odds of PPD and linear risk plots.

Survey Year. In this sample, 1578 mothers (58.5%) responded to the 2012 and 2013 surveys and 1118 (41.5%) responded to the 2014 survey. Chi-square tests were performed to assess significant differences in social support, PPD, and all covariates comparing mothers who completed the 2012 and 2013 surveys, which met CDC's 60% response rate threshold, to mothers completing the 2014 survey, which did not meet the designated 60% response rate. Results indicated there may be differences in covariate characteristics between the populations by survey year. To control for these differences, survey year was included as a covariate in the analysis at this step. PPD symptomology did not significantly differ between survey year groups (9.6% for 2012 and 2013 respondents and 9.9% for 2014 respondents, p-value = 0.88). However, social support significantly differed between survey years as respondents of the 2012 and 2013 surveys more likely reported receiving low social support compared to 2014 respondents. In this

study, 54.1% of 2012 and 2013 respondents reported low social support, while 39.4% of 2014 respondents reported low social support (*p*-value <0.0001).

CHARACTERISTICS ASSOCIATED WITH PPD

Of the study population, 263 (9.8%) indicated they suffered from PPD symptoms. Table 2 shows the characteristics of the study population by PPD status. Total household income, previous diagnosis of depression, abuse before or during pregnancy, number of stressors in the past year, pregnancy intention, cigarettes use during pregnancy, and alcohol use during pregnancy were found to be significantly associated with PPD symptoms. Maternal age, maternal race/ethnicity, maternal education, marital status, gestational age, and survey year were not found to be significantly associated with PPD.

Household Income. The distribution of total annual household income among respondents without PPD was significantly different than those with PPD (*p*-value <0.0001). Only 13.5% of mothers without PPD made less than $15,000 in annual household income, compared to over a third (35.2%) of mothers with PPD. Additionally, 28.2% of mothers without PPD reported an income of more $52,000 per year, while only 16.3% of mothers with PPD reported the same. Notably, mothers without PPD (28.7%) had a significantly higher proportion of missing income responses than mothers with PPD (15.5%).

Previous Diagnosis of Depression. A significantly higher proportion (12.8%) of mothers with PPD reported a previous diagnosis of depression compared to the small proportion (4.1%) without PPD (*p*-value = 0.0002).

Abuse Before or During Pregnancy. A higher proportion (11.8%) of mothers suffering from PPD reported suffering any partner abuse before or during pregnancy compared to the small proportion (2.5%) without PPD (*p*-value <0.0001).

Stressful Life Events. The distribution of number of stressful life events significantly differed between mothers suffering from PPD and those who were not (*p*-value <0.0001). Among mothers who did not report PPD symptoms, a majority (52.7%) reported no SLEs during the past year, followed by 29.8% who reported 1-2, 14.4% who reported 3-5, and 3.1% who reported 6 or more. Contrastingly, only 26.0% of mothers with PPD reported no SLEs, while 28.3% reported 1-2, 34.2% reported 3-5, and 11.5% reported 6 or more.

Cigarette Smoking During Pregnancy. Mothers without PPD primarily reported never smoking cigarettes or not within the last 3 months of pregnancy (96.3%), compared to 88.2% of mothers with PPD who reported never smoking cigarettes or not within the last 3 months of pregnancy (*p*-value = 0.0004).

Alcohol Use During Pregnancy. Almost all (95.9%) mothers without PPD primarily reported never drinking alcohol or not within the last 3 months of pregnancy, compared

to 87.3% of mothers with PPD who reported never drinking alcohol or not within the last 3 months of pregnancy (*p*-value = 0.0007).

CHARACTERISTICS ASSOCIATED WITH LOW SOCIAL SUPPORT

Of the study population, 1,294 (48.0%) reported low social support. Table 3 shows the characteristics of the study population stratified by social support level. Maternal age, maternal race/ethnicity, total household income, maternal education, marital status, abuse before or during pregnancy, number of stressors, and pregnancy intention were found to be significantly associated with PPD symptoms. Previous diagnosis of depression, cigarette use during pregnancy, and alcohol use during pregnancy were not found to be significantly associated with PPD.

Maternal Age. The distribution of maternal age differed significantly among respondents who had low social support and those who had high social support (*p*-value = 0.009). Mothers with low social support tended to be younger compared those with high social support. Among mothers with low social support, 10.0% were less than 20 years old, while only 5.2% of mothers with high social support were less than 20 years old.

Maternal Race/ Ethnicity. Among mothers with high social support, the majority (56.7%) were non-Hispanic white, followed by 27.3% non-Hispanic Black, 11.4% Hispanic, and 4.6% non-Hispanic other. Contrastingly, 43.6% mothers with low social support identified as non-Hispanic white, 37.21% as non-Hispanic Black, 12.9% as Hispanic, and 6.3% as other. These differences in proportions were significant (*p*-value = 0.0002).

Maternal Income. The distribution of total annual household income among respondents with low social support was significantly different than among those with high social support (*p*-value <0.0001). Mothers who reported low social support tended to be poorer than those with high social support. Only 10.7% of mothers with high social support made less than $15,000 in annual household income, compared to over 19.8% of mothers with low social support. Additionally, more than a third (34.8%) of mothers with high social support reported an income of more $52,000 per year, while only 20.3% of mothers with low social support reported the same. Notably, mothers with low social support (30.5%) had a significantly higher proportion of missing income responses than mothers with high social support (24.9%).

Maternal Education. Mothers with low social support tended to be less educated compared to their high social support counterparts (*p*-value <0.0001). More than a third of mothers with high social support (36.1%) were college graduates, compared to 23.0% of mothers with low social support.

Marital Status. Most mothers with high social support were married (65.3%), while only 47.8% of mothers with low social support were (*p*-value <0.0001).

Abuse Before or During Pregnancy. A greater proportion of mothers with low social support (5.0%) reported suffering any partner abuse before or during pregnancy compared to 1.5% of mothers with high social support (*p*-value = 0.003).

Stressful Life Events. Mothers with low social support were more likely to report a greater number of stressors during the past year compared to mothers with high social support (p-value < 0.0001). The majority of mothers with high social support (54.3%) reported no SLEs, followed by 31.3% who reported 1-2, 12.3% who reported 3-5, and 2.1% who reported 6 or more. Contrastingly, only 46.9% of mothers with low social support reported no SLEs, while 27.9% reported 1-2, 19.7% reported 3-5, and 5.4% reported 6 or more.

Pregnancy Intention. Most (57.4%) mothers with high social support reported the most recent pregnancy as intended, 22.4% reported it as mistimed, 3.5% reported it as unintended, and 16.8% were unsure. Contrastingly, only 46.8% of mothers with low social support reported an intended pregnancy, 25.5% reported a mistimed pregnancy, 7.3% reported an unintended pregnancy, and 20.5% were unsure. These differences were significant (p-value = 0.001).

MULTIVARIATE LOGISTIC REGRESSION ANALYSIS

A weighted multivariate logistic regression analysis was employed to study the relationship between social support during pregnancy and postpartum depressive symptomology. The full model incorporates all sociodemographic, maternal, and pregnancy-related characteristics of interest from the previous literature, as well as survey year to control for potential differences in sampled characteristics between 2012-2013 and 2014. Additionally, based on the preliminary assessment, correlates were chosen as

potential effect measure modifiers if there was evidence that the estimated effect between low social support and PPD differed between levels of the variable, indicated by a jointly significant interaction term at a *p*-value < 0.20. The results of the interaction assessment can be found in Table 4 of Appendix II. The variables included as potential effect measure modifiers were maternal education, marital status, abuse before or during pregnancy, and cigarette use during pregnancy. Therefore, the full model included the exposure, 13 correlates, and 4 interaction terms:

Model 1 (Full):

$$OR_{PPD} = \beta_{\text{social support}} + \beta_{\text{maternal age}} + \beta_{\text{maternal race/ethnicity}} + \beta_{\text{income}} + \beta_{\text{maternal education}} + \beta_{\text{marital status}} + \beta_{\text{previous depression diagnosis}} + \beta_{\text{abuse before/ during pregnancy}} + \beta_{\text{SLEs}} + \beta_{\text{gestational age}} + \beta_{\text{pregnancy intention}} + \beta_{\text{cigarette use during pregnancy}} + \beta_{\text{alcohol use during pregnancy}} + \beta_{\text{survey year}} + \beta_{\text{social support * maternal education}} + \beta_{\text{social support * marital status}} + \beta_{\text{social support * abuse before/ during pregnancy}} + \beta_{\text{social support * cigarette use during pregnancy}}$$

Initial bivariate association assessment eliminated three variables that were not associated moderately to strongly with both PPD and social support, denoted by a *p*-value < 0.30. Results can be found in Table 5 of Appendix II. The eliminated variables included gestational age, cigarette use during pregnancy, and alcohol use during pregnancy. Since cigarette use was not found to be associated with social support, the subsequent interaction term with social support was also excluded. At this stage, the reduced model contained the exposure, 10 correlates of interest, and 3 interaction terms.

Model 2:

$$OR_{PPD} = \beta_{social\ support} + \beta_{maternal\ age} + \beta_{maternal\ race/ethnicity} + \beta_{income} + \beta_{maternal\ education} + \beta_{marital\ status} + \beta_{previous\ depression\ diagnosis} + \beta_{abuse\ before/\ during\ pregnancy} + \beta_{SLEs} + \beta_{pregnancy\ intention} + \beta_{survey\ year} + \beta_{social\ support\ *\ maternal\ education} + \beta_{social\ support\ *\ marital\ status} + \beta_{social\ support\ *\ abuse\ before/\ during\ pregnancy}$$

Multicollinearity was evaluated for Model 2. Multicollinearity assessment included removing collinear interaction terms and correlates that produced condition index values greater than 30 with at least 2 VDPs greater than 0.50. Without the interaction terms, Model 2 did not flag collinearity. However, Model 2 with the interaction terms indicated collinearity among the interaction terms and their components. Since the interaction terms were only collinear with the components, significance testing of the terms was performed to ensure effect measure modification was not present. The initial joint significance test of all three interaction terms resulted in an insignificant Wald test, indicating the interaction terms were not statistically significant and could be removed. Additionally, backwards elimination removed all three interaction terms as nonsignificant. Removing the three interaction terms, produced the following as Model 3:

Model 3:

$$OR_{PPD} = \beta_{social\ support} + \beta_{maternal\ age} + \beta_{maternal\ race/ethnicity} + \beta_{income} + \beta_{maternal\ education} + \beta_{marital\ status} + \beta_{previous\ depression\ diagnosis} + \beta_{abuse\ before/\ during\ pregnancy} + \beta_{SLEs} + \beta_{pregnancy\ intention} + \beta_{survey\ year}$$

Excluding the four correlates in the *a priori* statement as correlates of interest, the following six variables were eligible for removal from the model: annual household

income, previous diagnosis of depression, abuse before or during pregnancy, number of SLEs, pregnancy intention, and survey year. Confounding assessment involved a combination of stepwise backwards elimination and 10% change-in-estimate criteria. Stepwise backwards elimination identified the least significant correlate for removal. Based on the change-in-estimate criterion, correlates that, when removed, did not change the effect estimate between social support and PPD by 10% or more were removed. Based on these methods, four correlates were removed: survey year, pregnancy intention, income, and previous diagnosis of depression.

The reduced model examined the association between low social support during pregnancy and PPD among Georgia mothers who delivered a live birth in the years 2012-2014, adjusting for six correlates of interest: maternal age, maternal race/ethnicity, maternal education, marital status, abuse before or during pregnancy, and number of SLEs.

Model 4 (Fully reduced with *a priori* variables):

$$OR_{PPD} = \beta_{\text{social support}} + \beta_{\text{maternal age}} + \beta_{\text{maternal race/ethnicity}} + \beta_{\text{maternal education}} + \beta_{\text{marital status}} + \beta_{\text{abuse before/ during pregnancy}} + \beta_{\text{SLEs}}$$

Results of the analysis using the reduced model with the *a priori* variables (Model 4) can be found in Table 6. When adjusting for all other variables in the reduced model, the odds of PPD for mothers who had inadequate social support did not statistically differ from

those of mothers with adequate social support (OR = 1.15; 95% CI: 0.72, 1.83). Abuse before or during pregnancy was found to be significantly correlated with odds of PPD (OR = 2.87; 95% CI: 1.14, 7.21). Additionally, the number of stressors in the past year was significantly associated with odds of PPD in a dose-response fashion, with mothers suffering from 1-2 SLEs (OR = 2.01; 95% CI: 1.14, 3.54), from 3-5 SLEs (OR = 4.75, 95% CI: 2.67, 8.46), and from 6 or more SLEs (OR = 6.46, 95% CI: 2.82, 14.78) at increased odds of PPD, compared to mothers who suffered no SLEs.

Inclusion of the 4 sociodemographic variables maternal age, maternal race/ethnicity, maternal education, and marital status is standard in analyses of the association between social support and PPD. Despite this, the results of this analysis indicated that all *a priori* variables may not necessary or significant for inclusion in the final model from an epidemiological standpoint.

CHAPTER IV: DISCUSSION

The purpose of this correlation study investigated whether inadequate social support during pregnancy is associated with the development of self-reported PPD symptoms among Georgia mothers who delivered a live birth.

Overall Prevalence of PPD and Low Social Support

Based on this analysis using 2012-2014 Georgia PRAMS survey data, a weighted estimated 7.8% (95% CI: 6.2 – 9.3) of Georgia mothers experienced PPD symptoms. This aligned with the PRAMS 2012 estimate of 8.0% for Georgia and was lower than the PRAMS 2012 national average of 11.5% (8).

As the most common complication of child bearing, this study aimed to investigate PPD and the effect inadequate social support during pregnancy may play in its development. The results indicate that almost half of Georgia mothers do not receive adequate social support during pregnancy (weighted % = 49.3%; 95% CI: 46.3 – 52.3). With evidence supporting a link between low social support and health consequences, this study also aimed to investigate the negative consequences of low social support during a crucial period in a mother's life.

Association between Inadequate Social Support and PPD

The association between inadequate social support and PPD was evaluated adjusting for the *a priori* variables (maternal age, maternal race/ethnicity, maternal education, and marital status) and other correlates (abuse before or during pregnancy and number of

SLEs) in the reduced model. With these variables controlled, the exposure of interest, low (2 or less indicated types) social support during pregnancy, was not associated with a significant difference in the odds of PPD compared to mothers with high (3 or more indicated types) social support (OR= 1.15; 95% CI: 0.72, 1.83),

While not statistically significant at the 95% significance level, the OR effect estimate from this study was greater than 1, suggesting that there may be a small effect of social support on PPD that could be detected with a larger sample size. Further research with a larger sample is needed to investigate the potential effects of social support and the development of PPD symptoms.

Abuse before or during pregnancy (OR = 2.87; 95% CI: 1.14, 7.21) and the number of stressful life events in the past year (1-2 stressors: OR = 2.01; 95% CI: 1.14, 3.55; 3-5 stressors: OR = 4.75; 95% CI: 2.67, 8.46; 6+ stressors: 2.82, 14.77) were found be significantly associated with PPD. These correlates may have a stronger association with PPD than social support does and should be explored in continued analyses as the primary exposures of interest.

The results of this study did not find as strong and significant relationship between social support and PPD as previous studies. As described previously, social support is a complicated concept which is not easily defined nor measured. Moreover, the lack of a standardized definition of adequate social support, even between the different participating PRAMS sites, may help to explain the weaker association than expected.

Based on available literature and the results of the initial exploratory analysis of social support categorizations, dichotomization of social support into low (0-2 supports) versus high (3-6 supports) was elected. This analysis of the relationship between social support and PPD should also be performed with other categorizations, including using multi-level categorizations to explore a potential dose-response effect. The measure of social support is also potentially biased, due to the fact that it is retrospectively reported after the birth of the child and possible development of PPD, which could affect the mother's perception of the social support she received during pregnancy.

Additionally, 2014 PRAMS survey data did not meet the 60% response rate standard threshold set by the CDC. While survey year was not found to be significantly associated with report of PPD, it was found to be statistically significantly associated with social support. The odds of inadequate social support among 2014 survey respondents was significantly lower than the odds of inadequate social support among 2012 and 2013 respondents (OR = 0.60; 95% CI: 0.46, 0.77). Although not associated with the outcome, survey year was retained in the model for further assessment to ensure there was not multi-level confounding. Ultimately, survey year was the first correlate dropped in confounding assessment as it did not confound the relationship between inadequate social support and PPD.

STRENGTHS AND LIMITATIONS

The primary strength of this analysis was the large sample size for a survey over a three-year period and the state-representative nature of the PRAMS complex sampling

methodology. As a stratified random sample, PRAMS ensures a representative sample due to the oversampling of minority groups. To maintain a study population during the analyses that was representative of all Georgia mothers who had a live birth, all survey frequencies and the logistic regression model were analyzed incorporating the stratum-specific weights. These features of the PRAMS data and subsequent analysis lend strength to the conclusions made in this study as well as their generalizability to Georgia mothers outside of the study.

Several limitations in this study design also warrant discussion when interpreting the results:

1. The cross-sectional nature of this study only allows for exploratory research. Therefore, the results are correlational and can only provide descriptive and inferential information that cannot speak to causality in the study effect estimates. These effect estimates indicate correlations that should be further researched with a prospective design.
2. As with any study using self-reported measures, information bias poses a threat. With the PRAMS surveillance system, there may be missing or inaccurate data on the questionnaire and/or the birth certificate. The inaccuracy may be due to: a) recall bias as mothers are asked about their behaviors and experiences as far back as one and a half years prior b) social desirability bias as responses may be influenced by the aforementioned stigma of PPD or negative perception of certain actions during pregnancy, and c) mode bias, as women who complete the telephone interview may answer differently than they would have if they

complete a self-administered questionnaire by mail or the web. Moreover, the practice of using a "cut off" score to identify PPD and collecting information on social support via methods that are not easily measured or validated can lead to misclassification of the outcome and exposure within the data.

3. Responses to the survey dictate the generalizability of the results to all women in Georgia who had a live birth. The lack of generalizability arises from selection bias; the women who choose to participate in the PRAMS survey may be different from all women who had a live birth. The selection bias may be due to a) noncoverage bias when certain groups are underrepresented in a study sample for that reporting year, or b) nonresponse bias when subgroups of the sample do not response to the survey or are less likely to response than other groups. Many of these differences are identified and corrected during the weighting process using all women in the state's population. If response rates are 65% or higher, the weights are useful and meaningful, but as response rates drop below 65%, the potential for bias increases. Uncorrected differences result in estimates that are inaccurate for the population of underrepresented subgroups.

The findings may also be limited by missing data. Of the original 3,122 observations, 426 were excluded due to missing data on PPD symptoms, social support measures, or any of the correlates. Since a large number of mothers were missing values for total annual household income (n = 814), a separate income category for "missing" was created to not exclude another almost 30% of the sample size. Income is reported on both the birth certificate and the PRAMS questionnaire, but values for this analysis were extracted from

the PRAMS questionnaire only. It is possible that more income values were recorded on the birth certificate. Those with missing data for PPD were significantly more likely to be younger, poorer, less educated and unmarried. As the data appear to have been excluded differentially based on these factors, the weighting of the sample could have been affected, making the finding less reliable.

IMPLICATIONS AND FUTURE DIRECTIONS

Although weak and nonsignificant, the association between inadequate social support and PPD could have implications for public health programmers and clinicians. These results indicate potentially increased odds of PPD for mothers with low social support during pregnancy. Therefore, clinicians who see pregnant women and mothers should be aware of the risk factors of PPD since they are usually the primary source of health care for this population. Since PPD is the most common complication in child bearing, these clinicians should be versed in the screening questionnaires, diagnostic tools, and depression assessments in order to identify, target, and, treat pregnant women and new mothers with increased risk for depressive symptoms postpartum.

From an epidemiological perspective, this study provided rationale that previously controlled sociodemographic factors, such as maternal age, maternal race/ethnicity, maternal education, and marital status, may not be important correlates for inclusion in analysis. This is an important finding which should be taken into consideration in future studies

Few studies have been conducted on the association between low social support and PPD using nationally representative surveys. While this analysis contributes valuable information to the discourse on the development of PPD, further studies on social support are required to confirm or add to the findings. This analysis used data from the State of Georgia, which has the lowest prevalence of PPD in the nation. While valuable, further studies should investigate states with a higher prevalence of PPD, such as Arkansas, with the 2012 highest national average of PPD at 20.1%. Additionally, performing a multi-state analysis takes advantage of PRAMS survey standardization and results can, therefore, be further generalized to a larger population; this analysis can only be generalized to Georgia mothers who had a live birth.

CONCLUSIONS

In summary, Georgia PRAMS data provided nonsignificant results regarding the association between low social support and development of PPD symptomology. However, abuse before or during pregnancy and presence of stressors in the mother's life may help to explain the outcome of PPD. Despite the results and limitations, this study has generated information that may help with future studies that aim to measure social support and with estimates of effect size for the association between social support and PPD.

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APPENDIX II: TABLES

Table 1. Comparison of social support categorizations used in this study

Number of social supports	Categorizations used in this study			
	Literature	**Tertiles**	**Dichotomization 1**	**Dichotomization 2**
0	Low	Low	None	Low
1	Low	Low	Some	Low
2	Medium	Low	Some	Low
3	Medium	Medium	Some	High
4	High	High	Some	High
5	High	High	Some	High
6[a]	High	High	Some	High

[a] Zero respondents indicated 6 social supports on the PRAMS survey

Table 2. Number and weighted percentages of respondent characteristics stratified by postpartum depressive symptoms, Georgia PRAMS 2012-2014

Characteristic	Total (n=2,696)		No PPD (n= 2,433)		PPD (n= 263)		
	Number of respondents[a]	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	Rao-Scott Chi-Square P value*
Postpartum Depressive Symptoms							--
No	2433	92.2 (90.7 - 93.8)	--	--	--	--	
Yes	263	7.8 (6.2 - 9.3)	--	--	--	--	
Categorized Social Support[b]							0.04
Low	1294	49.3 (46.3 - 52.3)	1144	48.4 (45.3 - 51.5)	150	59.6 (49.7 - 69.4)	
High	1402	50.7 (47.7 - 53.7)	1289	51.6 (48.5 - 54.7)	113	40.4 (30.6 - 50.3)	
Maternal Age							0.76
< 20 years	356	7.6 (6.2 - 8.9)	308	7.4 (6.0 - 8.8)	48	9.3 (6.4 - 12.1)	
20-34 years	2010	78.2 (75.8 - 80.6)	1816	78.3 (75.8 - 80.8)	194	77.5 (69.7 - 85.3)	
≥ 35 years	330	14.2 (12.1 - 16.3)	309	14.3 (12.1 - 16.5)	21	13.2 (5.7 - 20.8)	
Maternal Race/Ethnicity							0.49
White, non-Hispanic	1216	50.2 (47.2 - 53.2)	1104	50.7 (47.6 - 53.9)	112	44.1 (33.8 - 54.4)	
Black, non-Hispanic	1084	32.3 (29.4 - 34.9)	977	31.9 (29.0 - 34.7)	107	36.1 (26.1 - 46.0)	
Hispanic	256	12.2 (10.2 - 14.1)	226	11.9 (9.9 - 13.9)	30	15.5 (7.8 - 23.1)	
Other, non-Hispanic[c]	140	5.4 (4.1 - 6.7)	126	5.5 (4.1 - 6.9)	14	4.3 (0.6 - 8.1)	
Total Household Income							<0.0001
$0 to $15,000	480	15.2 (13.0 - 17.3)	383	13.5 (11.4 - 15.7)	97	35.2 (25.8 - 44.6)	
$15,001 to $26,000	381	14.4 (12.2 - 16.5)	344	14.6 (12.4 - 16.9)	37	11.5 (4.9 - 18.1)	
$26,001 to $52,000	360	15.1 (12.9 - 17.4)	324	14.6 (12.3 - 16.9)	36	21.5 (12.3 - 30.7)	
$52,001 +	661	27.6 (25.0 - 30.2)	621	28.6 (25.8 - 31.4)	40	16.3 (8.9 - 23.7)	
Missing	814	27.8 (25.0 - 30.3)	761	28.7 (25.9 - 31.64	53	15.5 (9.0 - 22.1)	

Characteristic (Continued)	Total (n=2,696)		No PPD (n= 2,433)		PPD (n= 263)		Rao-Scott Chi-Square P value*
	Number of respondents[a]	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	
Maternal Education							0.06
< High school	415	14.1 (12.1 - 16.2)	358	13.7 (11.6 - 15.9)	57	19.1 (11.2 - 26.9)	
High school graduate	824	30.1 (27.3 - 32.9)	740	29.4 (26.5 - 32.3)	84	38.5 (28.3 - 48.7)	
Some college	734	26.1 (23.5 - 28.8)	661	26.6 (23.8 - 29.5)	73	19.9 (12.1 - 27.7)	
College graduate	723	29.6 (27.0 - 32.3)	674	30.2 (27.4 - 33.1)	49	22.5 (13.9 - 31.2)	
Marital Status							0.10
Married	1418	56.7 (53.7 - 59.7)	1292	57.4 (54.3 - 60.5)	126	48.4 (38.1- 58.7)	
Other	1278	43.3 (40.3 - 46.3)	1141	42.6 (39.5 - 45.7)	137	51.6 (41.3 - 61.9)	
Previous Diagnosis of Depression							0.0002
No	2554	95.2 (93.8 - 96.5)	2332	95.9 (94.5 - 97.2)	222	87.2 (80.6 - 93.7)	
Yes	142	4.8 (3.5 - 6.2)	101	4.1 (2.8 - 5.5)	41	12.8 (6.3 - 19.4)	
Abuse Before or During Pregnancy							<0.0001
No	2604	96.8 (95.7 - 97.9)	2367	97.5 (96.5 - 98.5)	237	88.2 (81.1 - 95.3)	
Yes	92	3.2 (2.1 - 4.3)	66	2.5 (1.5 - 3.5)	26	11.8 (4.7 - 18.9)	
Number of Stressors[d]							<0.0001
0	1331	50.6 (47.6 - 53.6)	1256	52.7 (49.6 - 55.8)	75	26.0 (17.7 - 34.3)	
1-2	831	29.7 (26.9 - 32.4)	758	29.8 (26.9 - 32.6)	73	28.3 (18.9 - 37.6)	
3-5	431	16.0 (13.7 - 18.2)	352	14.4 (12.2 - 16.7)	79	34.2 (24.6 - 43.9)	
6+	103	3.7 (2.6 - 4.8)	67	3.1 (2.0 - 4.2)	36	11.5 (5.9 - 17.2)	
Gestational Age							0.62
≤ 27 weeks	44	0.7 (0.3 - 1.1)	41	0.7 (0.2 - 1.1)	3	1.2 (0.0 - 3.2)	
28 - 33 weeks	126	2.3 (1.4 - 3.1)	108	2.2 (1.3 - 3.1)	18	3.2 (0.5 - 5.9)	
34 - 36 weeks	281	7.4 (5.9 - 8.8)	257	7.5 (6.0 - 9.1)	24	5.2 (1.1 - 9.3)	
≥ 37 weeks	2245	89.7 (87.9 - 91.4)	2027	89.6 (87.8 - 91.4)	218	90.4 (85.2 - 95.6)	

Characteristic (Continued)	Total (n=2,696)		No PPD (n= 2,433)		PPD (n= 263)		
	Number of respondents[a]	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	Rao-Scott Chi-Square P value*
Pregnancy Intention							0.01
Intended	1335	52.1 (49.1 - 55.1)	1236	53.4 (50.3 - 56.5)	99	36.8 (27.0 - 46.6)	
Mistimed	704	23.9 (21.3 - 26.4)	625	23.2 (20.5 - 25.8)	79	32.3 (22.6 - 42.1)	
Unintended	159	5.4 (4.0 - 6.7)	130	5.1 (3.7 - 6.4)	29	9.2 (3.9 - 14.5)	
Unsure	498	18.6 (16.2 - 21.0)	442	18.4 (15.9 - 20.9)	56	21.7 (13.0 - 30.4)	
Cigarette Smoking During Pregnancy[e]							0.0004
No	2546	95.7 (94.4 - 96.9)	2325	96.3 (95.1 - 97.5)	221	88.2 (81.4 - 95.0)	
Yes	150	4.3 (3.1 - 5.6)	108	3.7 (2.5 - 4.9)	42	11.8 (5.0 - 18.6)	
Alcohol Use During Pregnancy[e]							0.0007
No	2568	95.2 (94.0 - 96.4)	2330	95.9 (94.7 - 97.0)	238	87.3 (79.8 - 94.9)	
Yes	128	4.8 (3.6 - 6.0)	103	4.1 (3.0 - 5.3)	25	12.7 (5.1 - 20.2)	
Survey Year							0.88
2012/2013	1578	60.0 (58.5 - 61.4)	1426	60.0 (58.5 - 61.5)	152	59.2 (53.3 - 65.1)	
2014	1118	40.0 (38.7 - 41.5)	1007	40.0 (38.5 - 41.5)	111	40.8 (34.9 - 46.7)	

PRAMS Pregnancy Risk Assessment Monitoring System *PPD* postpartum depression *CI* confidence interval

[a] Unweighted

[b] Social support is categorized as low (0-2 supports) vs high (3+ supports)

[c] Other includes American Indian, Chinese, Japanese, Filipino, other Asian, other race, and mixed race

[d] Stressors include family illness; separation or divorce; recent move; homelessness; partner lost job; mother lost job; reduced work for the mother or partner; military deployment or extended work travel; arguments with partner; partner does not pregnancy; trouble paying bills; mother or partner in jail; drug problems with someone close to the mother; or death of someone close to the mother.

[e] "During Pregnancy" is defined as during the last 3 months of pregnancy

* Statistical significance is defined at p-value < 0.05 (Rao – Scott Chi Square test)

Table 3. Number and weighted percentages of respondent characteristics stratified by categorized social support, Georgia PRAMS 2012-2014

Characteristic	Total (n=2,696)		Low Social Support (n= 1,294)		High Social Support (n= 1,402)		
	Number of respondents[a]	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	Rao-Scott Chi-Square P value*
Categorized Social Support[b]							--
Low	1294	49.3 (46.3 - 52.3)	--	--	--	--	
High	1402	50.7 (47.7 - 53.7)	--	--	--	--	
Postpartum Depressive Symptoms							0.04
No	2433	92.2 (90.7 - 93.8)	1144	90.6 (88.3 - 92.9)	1289	93.8 (91.8 - 95.8)	
Yes	263	7.8 (6.2 - 9.3)	150	9.4 (7.1 - 11.7)	113	6.2 (4.2 - 8.2)	
Maternal Age							0.009
< 20 years	356	7.6 (6.2 - 8.9)	234	10.0 (7.9 - 12.0)	122	5.2 (3.5 - 7.0)	
20-34 years	2010	78.2 (75.8 - 80.6)	894	75.6 (72.1 - 79.0)	1116	80.8 (77.5 - 84.1)	
≥ 35 years	330	14.2 (12.1 - 16.3)	166	14.5 (11.5 - 17.4)	164	14.0 (11.0 - 16.9)	
Maternal Race/Ethnicity							0.0002
White, non-Hispanic	1216	50.2 (47.2 - 53.2)	508	43.6 (39.4 - 47.9)	708	56.7 (52.5 - 60.8)	
Black, non-Hispanic	1084	32.3 (29.4 - 34.9)	590	37.2 (33.1 - 41.3)	494	27.3 (23.7 - 31.0)	
Hispanic	256	12.2 (10.2 - 14.1)	125	12.9 (10.0 - 15.8)	131	11.4 (8.8 - 14.1)	
Other, non-Hispanic[c]	140	5.4 (4.1 - 6.7)	71	6.3 (4.2 - 8.4)	69	4.6 (2.9 - 6.2)	
Total Household Income							<0.0001
$0 to $15,000	480	15.2 (13.0 - 17.3)	277	19.8 (16.4 - 23.2)	203	10.7 (8.2 - 13.2)	
$15,001 to $26,000	381	14.4 (12.2 - 16.5)	187	14.3 (11.4 - 17.3)	194	14.4 (11.3 - 17.6)	
$26,001 to $52,000	360	15.1 (12.9 - 17.4)	178	15.0 (11.9 - 18.2)	182	15.2 (12.1 - 18.4)	
$52,001 +	661	27.6 (25.0 - 30.2)	218	20.3 (16.9 - 23.8)	443	34.8 (30.8 - 38.8)	
Missing	814	27.8 (25.0 - 30.3)	434	30.5 (26.6 - 34.4)	380	24.9 (21.4 - 28.4)	

Characteristic (Continued)	Total (n=2,696)		Low Social Support (n= 1,294)		High Social Support (n= 1,402)		
	Number of respondents[a]	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	Rao-Scott Chi-Square P value*
Maternal Education							<0.0001
< High school	415	14.1 (12.1 - 16.2)	251	17.9 (14.6 - 21.1)	164	10.5 (8.0 - 13.0)	
High school graduate	824	30.1 (27.3 - 32.9)	430	31.5 (27.5 - 35.5)	394	28.8 (24.9 - 32.7)	
Some college	734	26.1 (23.5 - 28.8)	343	27.7 (23.8 - 31.6)	391	24.6 (21.0 - 28.2)	
College graduate	723	29.6 (27.0 - 32.3)	270	23.0 (19.6 - 23.4)	453	36.1 (32.1 - 40.1)	
Marital Status							<0.0001
Married	1418	56.7 (53.7 - 59.7)	584	47.8 (43.6 - 52.0)	834	65.3 (61.3 - 39.4)	
Other	1278	43.3 (40.3 - 46.3)	710	52.2 (48.0 - 46.4)	568	34.7 (30.6 - 38.7)	
Previous Diagnosis of Depression							0.24
No	2554	95.2 (93.8 - 96.5)	1216	94.3 (92.4 - 96.3)	1338	96.0 (94.1 - 97.8)	
Yes	142	4.8 (3.5 - 6.2)	78	5.7 (3.7 - 7.6)	64	4.0 (2.2 - 5.9)	
Abuse Before or During Pregnancy							0.003
No	2604	96.8 (95.7 - 97.9)	1226	95.0 (97.4 - 99.6)	1378	98.5 (97.4 - 99.6)	
Yes	92	3.2 (2.1 - 4.3)	68	5.0 (3.1 - 6.8)	24	1.5 (0.4 - 2.6)	
Number of Stressors[d]							<0.0001
0	1331	50.6 (47.6 - 53.6)	599	46.9 (42.7 - 51.2)	732	54.3 (50.0 - 58.4)	
1-2	831	29.7 (26.9 - 32.4)	379	27.9 (24.2 - 31.7)	452	31.3 (27.4 - 35.2)	
3-5	431	16.0 (13.7 - 18.2)	253	19.7 (16.2 - 23.3)	178	12.3 (9.6 - 15.1)	
6+	103	3.7 (2.6 - 4.8)	63	5.4 (3.5 - 7.3)	40	2.1 (0.9 - 3.2)	
Gestational Age							0.83
≤ 27 weeks	44	0.7 (0.3 - 1.1)	22	0.5 (0.2 - 0.9)	22	0.8 (0.1, 1.6)	
28 - 33 weeks	126	2.3 (1.4 - 3.1)	67	2.5 (1.3 - 3.7)	59	2.1 (0.9, 3.3)	
34 - 36 weeks	281	7.4 (5.9 - 8.8)	142	7.0 (5.0 - 9.0)	139	7.7 (5.5 - 9.9)	
≥ 37 weeks	2245	89.7 (87.9 - 91.4)	1063	89.9 (87.7 - 92.2)	1182	89.4 (86.8 - 91.9)	

Characteristic (Continued)	Total (n=2,696)		Low Social Support (n= 1,294)		High Social Support (n= 1,402)		
	Number of respondents[a]	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	Number of respondents	Weighted % (95% CI)	Rao-Scott Chi-Square P value*
Pregnancy Intention							0.001
Intended	1335	52.1 (49.1 - 55.1)	543	46.8 (42.5 - 51.0)	792	57.3 (53.1 - 61.5)	
Mistimed	704	23.9 (21.3 - 26.4)	373	25.5 (21.8 - 29.2)	331	22.4 (18.8 - 25.9)	
Unintended	159	5.4 (4.0 - 6.7)	101	7.3 (5.1 - 9.5)	58	3.5 (2.0 - 5.0)	
Unsure	498	18.6 (16.2 - 21.0)	277	20.5 (16.9 - 24.0)	221	16.8 (13.6 - 20.1)	
Cigarette Smoking During Pregnancy[e]							0.67
No	2546	95.7 (94.4 - 96.9)	1205	95.4 (93.7 - 97.1)	1341	95.9 (94.2 - 97.6)	
Yes	150	4.3 (3.1 - 5.6)	89	4.6 (2.9 - 6.3)	61	4.1 (2.4 - 5.8)	
Alcohol Use During Pregnancy[e]							0.42
No	2568	95.2 (94.0 - 96.4)	1237	95.7 (94.0 - 97.4)	1331	94.7 (92.9 - 96.4)	
Yes	128	4.8 (3.6 - 6.0)	57	4.3 (2.6 - 6.0)	71	5.3 (3.6 - 7.1)	
Survey Year							<0.0001
2012/2013	1578	60.0 (58.5 - 61.4)	854	66.3 (64.1 - 68.4)	724	53.9 (51.9 - 55.8)	
2014	1118	40.0 (38.7 - 41.5)	440	33.7 (31.6 - 35.9)	678	46.1 (44.2 - 48.1)	

PRAMS Pregnancy Risk Assessment Monitoring System *PPD* postpartum depression *CI* confidence interval

[a] Unweighted

[b] Social support is categorized as low (0-2 supports) vs high (3+ supports)

[c] Other includes American Indian, Chinese, Japanese, Filipino, other Asian, other race, and mixed race

[d] Stressors include family illness; separation or divorce; recent move; homelessness; partner lost job; mother lost job; reduced work for the mother or partner; military deployment or extended work travel; arguments with partner; partner does not pregnancy; trouble paying bills; mother or partner in jail; drug problems with someone close to the mother; or death of someone close to the mother.

[e] "During Pregnancy" is defined as during the last 3 months of pregnancy

* Statistical significance is defined at p-value < 0.05 (Rao – Scott Chi Square test)

Table 4. Estimated odds ratios (OR) and 95% confidence intervals (CI) between postpartum depressive symptoms and social support, stratified by selected covariates for preliminary effect measure modification assessment, Georgia PRAMS 2012-2014

Stratified Covariate	Adjusted OR	95% CI	Joint Significance of Interaction Terms *p*-value*
Maternal Age			
< 20 years	1.59	(0.69, 3.67)	0.68
20-34 years	1.43	(0.87, 2.34)	
≥ 35 years	2.71	(0.69, 10.55)	
Race/Ethnicity			
White, non-Hispanic	1.47	(0.77, 2.77)	0.90
Black, non-Hispanic	1.50	(0.70, 3.20)	
Hispanic	1.61	(0.49, 5.27)	
Other, non-Hispanic	2.72	(0.60, 12.32)	
Total Household Income			
$0 to $15,000	1.22	(0.53, 2.80)	0.99
$15,001 to $26,000	1.35	(0.41, 4.44)	
$26,001 to $52,000	1.30	(0.45, 3.72)	
$52,001 +	1.75	(0.63, 4.82)	
Missing	1.32	(0.51, 3.40)	
Maternal Education			
< High school	6.91	(2.86, 16.69)	0.003
High school graduate	1.27	(0.61, 2.68)	
Some college	0.69	(0.29, 1.68)	
College graduate	1.79	(0.74, 4.35)	
Marital Status			
Married	2.02	(1.10, 3.70)	0.16
Other	1.09	(0.58, 2.04)	
Previous Diagnosis of Depression			
No	1.53	(0.96, 2.44)	0.96
Yes	1.49	(0.40, 5.51)	
Abuse Before or During Pregnancy			
No	1.58	(1.00, 2.47)	0.17
Yes	0.44	(0.07, 2.56)	
Number of Stressors			
0	1.23	(0.57, 2.59)	0.86
1-2	1.29	(0.57, 2.93)	
3-5	1.21	(0.53, 2.80)	
6+	2.17	(0.68, 6.91)	

Stratified Covariate (Continued)	Adjusted OR	95% CI	Joint Significance of Interaction Terms *p*-value*
Gestational Age			
≤ 27 weeks	31.04	(1.79, 539.2)	0.22
28 - 33 weeks	2.03	(0.41, 9.95)	
34 - 36 weeks	1.12	(0.20, 6.16)	
≥ 37 weeks	1.55	(0.97, 2.46)	
Pregnancy Intention			
Intended	1.42	(0.71, 2.83)	0.74
Mistimed	1.11	(0.51, 2.41)	
Unintended	1.74	(0.50, 5.98)	
Unsure	2.27	(0.80, 6.45)	
Cigarette Smoking During Pregnancy			
No	1.37	(0.87, 2.15)	0.01
Yes	6.56	(2.12, 20.24)	
Alcohol Use During Pregnancy			
No	1.66	(1.05, 2.63)	0.71
Yes	1.25	(0.30, 5.17)	
Survey Year			
2012/2013	1.75	(1.02, 2.98)	0.63
2014	1.40	(0.68, 2.89)	

PPD postpartum depression *PRAMS* Pregnancy Risk Assessment Monitoring System *CI* confidence interval

* Statistical significance is defined at $p < 0.20$

Table 5. Unadjusted odds ratios and 95% confidence intervals for selected characteristics with PPD and categorized social support, Georgia PRAMS 2012-2014

	PPD			Low Social Support		
Covariate	**Unadjusted OR**	**95% CI**	**p-value***	**Unadjusted OR**	**95% CI**	**p-value***
Maternal Age						
< 20 years	1.35	(0.62, 2.92)	0.44	1.83	(1.08, 3.11)	0.02
20-34 years	1.07	(0.54, 2.13)	0.84	0.90	(0.64, 1.27)	0.55
≥ 35 years		Reference			Reference	
Race/Ethnicity						
White, non-Hispanic		Reference			Reference	
Black, non-Hispanic	1.3	(0.81, 2.01)	0.28	1.77	(1.35, 2.32)	<0.0001
Hispanic	1.5	(0.78, 2.87)	0.22	1.47	(1.00, 2.16)	0.05
Other, non-Hispanic	0.91	(0.35, 2.39)	0.85	1.78	(1.04, 3.06)	0.04
Total Household Income						
$0 to $15,000	4.57	(2.43, 8.59)	<0.0001	3.17	(2.14, 4.70)	<0.001
$15,001 to $26,000	1.38	(0.62, 3.06)	0.43	1.70	(1.14, 2.54)	0.010
$26,001 to $52,000	2.58	(1.25, 5.32)	0.010	1.69	(1.13, 2.52)	0.01
$52,001 +		Reference			Reference	
Missing	0.95	(0.48, 1.89)	0.88	2.1	(1.52, 2.90)	<0.0001
Maternal Education						
< High school	1.87	(0.97. 3.58)	0.06	2.67	(1.91, 3.95)	<0.0001
High school graduate	1.76	(0.99, 3.12)	0.05	1.72	(1.26, 2.36)	0.0007
Some college	1.00	(0.54, 1.88)	0.99	1.77	(1.28, 2.44)	0.0006
College graduate		Reference			Reference	
Marital Status						
Married		Reference			Reference	
Other	1.44	(0.94, 2.20)	0.10	2.06	(1.61, 2.64)	<0.0001
Previous Diagnosis of Depression						
No		Reference			Reference	
Yes	3.40	(1.75, 6.63)	0.0003	1.44	(0.78, 2.65)	0.24
Abuse Before or During Pregnancy						
No		Reference			Reference	
Yes	5.25	(3.40, 11.49)	<0.0001	3.43	(1.47, 8.00)	0.005

Covariate (Continued)	PPD			Low Social Support		
	Unadjusted OR	95% CI	p-value*	Unadjusted OR	95% CI	p-value*
Number of Stressors						
0		Reference			Reference	
1-2	1.93	(1.10, 3.38)	0.02	1.03	(0.78, 1.36)	0.82
3-5	4.81	(2.75, 8.39)	<0.0001	1.85	(1.30, 2.64)	0.0070
6+	7.62	(3.62, 16.08)	<0.0001	2.97	(1.50, 5.89)	0.0020
Gestational Age						
≤ 27 weeks	1.79	(0.29, 10.98)	0.53	0.64	(0.20, 1.99)	0.44
28 - 33 weeks	1.43	(0.55, 3.77)	0.46	1.18	(0.55, 2.56)	0.67
34 - 36 weeks	0.68	(0.28, 1.65)	0.39	0.91	(0.59, 1.42)	0.66
≥ 37 weeks		Reference			Reference	
Pregnancy Intention						
Intended		Reference			Reference	
Mistimed	2.02	(1.21, 3.40)	0.008	1.40	(1.04, 1.88)	0.03
Unintended	2.64	(1.26, 5.52)	0.01	2.56	(1.46, 4.49)	0.001
Unsure	1.71	(0.96, 3.07)	0.07	1.49	(1.06, 2.08)	0.02
Cigarette Smoking During Pregnancy						
No		Reference			Reference	
Yes	3.45	(1.67, 7.15)	0.0009	1.14	(0.63, 2.05)	0.67
Alcohol Use During Pregnancy						
No		Reference			Reference	
Yes	3.35	(1.60, 7.01)	0.001	0.80	(0.46, 1.38)	0.42
Survey Year						
2012/2013		Reference			Reference	
2014	1.03	(0.66, 1.61)	0.880	0.60	(0.46, 0.77)	<0.0001

PPD postpartum depression *PRAMS* Pregnancy Risk Assessment Monitoring System *CI* confidence interval

* Statistical significance is defined at $p < 0.30$

Table 6. Fully adjusted social support model for predicting PPD symptoms, Georgia PRAMS 2012-2014

Characteristic	Adjusted OR[a]	95% CI
Social Support		
Low	1.15	(0.72, 1.83)
High	Reference	
Maternal Age		
< 20 years	0.81	(0.35, 1.89)
20-34 years	0.87	(0.44, 1.72)
≥ 35 years	Reference	
Race/Ethnicity		
White, non-Hispanic	Reference	
Black, non-Hispanic	1.27	(0.76, 2.12)
Hispanic	1.47	(0.68, 3.18)
Other, non-Hispanic	0.92	(0.36, 2.38)
Maternal Education		
< High school	1.58	(0.68, 3.70)
High school graduate	1.48	(0.73, 3.01)
Some college	0.69	(0.34, 1.41)
College graduate	Reference	
Marital Status		
Married	Reference	
Other	1.08	(0.64, 1.83)
Abuse Before or During Pregnancy		
No	Reference	
Yes	2.87	(1.14, 7.21)
Number of Stressors		
0	Reference	
1-2	2.01	(1.14, 3.54)
3-5	4.75	(2.67, 8.46)
6+	6.46	(2.82, 14.77)

PPD postpartum depression *PRAMS* Pregnancy Risk Assessment Monitoring System *CI* confidence interval

[a]Adjusted for maternal age, maternal race/ethnicity, maternal education, marital status, abuse before or during pregnancy, and number of stressors