OBESITY AND POSTPARTUM DEPRESSION: DOES PRENATAL CARE UTILIZATION MAKE A DIFFERENCE?

By

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To my parents

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OBESITY AND POSTPARTUM DEPRESSION: DOES PRENATAL CARE UTILIZATION MAKE A DIFFERENCE?

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Using a national continuing population-based survey known as Pregnancy Risk Assessment Monitoring System (PRAMS), this study sought to determine the role that PNC utilization plays in the relationship between pre-pregnancy BMI and PPD symptoms. Two years of data, 2004 and 2005 were analyzed among women from 16 states. Two specific aims were examined: 1) the association between pre-pregnancy BMI and PPD symptoms, and 2) the association between pre-pregnancy BMI and PPD symptoms after considering PNC utilization as a moderating variable. It was predicted for the first specific aim that the odds for PPD symptoms would increase as pre-pregnancy BMI increased. For the second objective, it was predicted that the association from the first specific aim would carry over and remain the same (e.g., obese pre-pregnancy BMI would have the highest odds for PPD symptoms), but that within each pre-pregnancy BMI group, the odds for PPD symptoms would decrease as PNC utilization increased (within obese pre–pregnancy BMI, inadequate PNC would have higher odds than intermediate PNC). The general premise for PNC utilization acting as a moderating variable in this study was that PNC can help address the changes that occur during pregnancy with regards to pre-pregnancy BMI (as a biological and psychosocial stressor). Thus, delivering PNC incorporating

nutrition, weight and shape changes, and addressing a woman's concerns about her weight and shape would in-turn, reduce the odds of PPD symptoms.

Since the sample used in this study included women from all pregnancy risk statuses, two risk-adjustment approaches were carried out to identify an association between pre-pregnancy BMI and PPD symptoms, and a moderating effect of PNC. One approach included all women in the dataset and used statistical analyses to risk-adjust for pregnancy risk status, and the other approach modified the design of the study by truncating the population of women to include healthy pregnancies only. Results initially showed an association between obesity and PPD symptoms, and PNC and PPD symptoms among the bivariate and multivariate analyses. However, the inclusion of a variety of control variables into the multivariate models removed these associations. Overall, for both approaches, there was no indication of a moderating effect of PNC utilization. However, results from the analyses showed that many of the women were significantly affected by a variety of medical and obstetric problems, many of which were high-risk. It is recommended that future research investigate the possible association of these problems with PPD symptoms. For practice, it is suggested that PNC providers identify the medical and obstetric problems faced by their patients, focus on both the physical and the potential psychosocial consequences of those problems, and establish suitable interventions accordingly.

CHAPTER 1
STATEMENT OF PROBLEM

Why is Postpartum Depression of Concern?

Postpartum depression (PPD) is a mood disorder that involves a variety of symptoms including fatigue, fears, anxiety, despair, thoughts of compulsion, loss of libido, and feelings of inadequacy (Horowitz, Damato, Solon, Von Metzsch, & Gill, 1995). The relationship between a mother and baby is crucial for healthy maternal and child health outcomes. A woman can experience PPD anytime during the first year after the birth of her child (Epperson, 1999). Symptoms include mood swings, sadness, anxiety, loneliness, and inconsistent sleeping patterns. However, when these symptoms reach a level of intensity that begins to affect the well-being of a woman and her daily functioning, a woman should seek treatment as these symptoms may indicate PPD. A new mother may be unaware of 1) the normal physical changes that occur after giving birth, and 2) her ability to care for the infant (American Academy of Pediatrics (AAP) & American College of Obstetricians and Gynecologists (ACOG), 1992). Approximately 4-6 weeks after the delivery, the AAP & ACOG (1992) recommend that a woman should see her physician for a postpartum examination that includes evaluation of the mother's current health status and her adaptation to her infant. Since many women experience emotional distress to some extent in the postpartum period, 1) the emotional status of a woman should be evaluated, and 2) any counseling with regards to a woman's postpartum emotional distress should address future health and future pregnancies.

Consequences of PPD include maternal aggression, neglect of the infant, and infanticide (Reck et al., 2004). Other psychosocial factors associated with PPD include child care stress, poor marital satisfaction, and low self-esteem (Appolonio, & Fingerhut, 2008). Mothers with PPD are portrayed as being unresponsive to their infants, passive and intrusive, displaying avoidance and withdrawal, and displaying low levels of influence, or affect (Reck et al., 2004). The processes associated with childbearing (e.g., pregnancy, childbirth, childrearing, etc.) warrant attention because they remain responsible for many maternal morbidities and mortality (e.g., complications such as preeclampsia, hemorrhage, self-acceptance in the postpartum period, etc.) (Misra & Grason, 2006). Thus, not only can these processes have a biological influence on a woman's health, but they can also have a psychosocial influence on a woman's health and well-being that occur during this time (Wisner et al., 2006).

Why is Obesity of Concern?

Obesity continues to burden our society in terms of increased prevalence of other diseases (e.g., heart disease), increased health care costs (e.g. treatment), and poses increased risk for disability and death. In addition to this, obesity presents many social, emotional, and aesthetic problems, especially in developed countries (Rubinstein, 2006). For women who are obese and pregnant, pregnancy-related consequences of obesity that result from high pre-pregnancy body mass indices [(weight in pounds/square of height in inches) x 703] include increased risk for other diseases (e.g., gestational diabetes) and a lower survival rate for premature babies (Colditz, 2002). Obesity and BMI have also been associated independently with delivery complications including excessive blood loss, greater operating time, and increased likelihood for cesearean section (American College of Obstetricians and Gynecologists, 2005). The association between pre-pregnancy BMI and postpartum depressive symptoms has been demonstrated with this association increasing as pre-pregnancy BMI increases (Carter, Wood Baker, Brownell, 2000; LaCoursiere, Baksh, Bloebaum, & Varner, 2006; Andersson, Sundstrom-Poromaa, Wulff, Astrom, & Bixo, 2006).

What is the Importance of Prenatal Care?

Since the health of the infant is determined significantly by the health of the mother, addressing issues during pregnancy itself can minimize adverse maternal and infant as well as child outcomes later on. According to Healthy People 2010 (2000), prenatal care (PNC) should start early on in the pregnancy and continue all through the pregnancy period; the effectiveness of PNC is more likely if PNC is received early in the pregnancy. An ideal setting to discuss issues (e.g., weight) during pregnancy is during prenatal care. It is suggested that pregnancy is a good time to target changes in health behavior due to a woman's motivation to maximize the health of her child (Birdsall, Wvya, Khazaezadeh, & Otegn-Ntim, 2009). Prenatal care (PNC) is defined as the care a woman receives in the period during pregnancy, leading up to the time she gives birth; adequate PNC is vital for both the mother and her developing baby (National Institute of Child Health and Human Development, 2007). Prenatal care (along with obesity) has been noted as two of the four special concerns for women's health (Torpy, Burke, & Glass, 2006).

Gaps in the Literature: Weight Issues Related to the Pregnancy and Postpartum Periods

Regarding previous research, Walker**,** Timmerman, Minseong, & Sterling (2002) found weight as a leading factor for postpartum dissatisfaction among women of all ethnicities. However, their sample size was not nationally representative and did not include all income groups. Lebanon. Fox, & Yamaguchi (1997) found that women who were overweight before pregnancy were more likely to have positive changes in body image during pregnancy compared to normal weight; However, the women who were overweight before pregnancy also had more negative concerns about body shape than normal weight women. This study did not address associations between body weight/body shape and PPD, and the sample size was limited to women in London. Moran, Holt, & Martin (1997) found that among postpartum health concerns, the highest percentage of women in the sample wanted more information on nutrition, exercise, and dieting. However, the study did not look at PPD. LaCoursiere et al. (2006) found a significant association between pre-pregnancy obesity and moderate or greater postpartum depressive symptoms. However, though all BMI categories were included, their sample size was not nationally representative. Andersson et al. (2006) did not find any significant associations between first-trimester BMI and a new-onset episode of postpartum depression. Also, BMI data was missing for 8% of their sample and their sample size was limited to women in Sweden. Carter, Baker, & Brownell (2000) found an association between BMI and anxiety/postpartum depressive symptoms. However, their study had a small sample size and their BMI categories included those with BMI <27, and those with BMI >27.

Gaps in the Literature: Prenatal Care and Postpartum Depression

Chaaya et al. (2002) looked at the determinants of PPD. Though they commented on the importance of PNC in addressing the needs of pregnant women, they did not include PNC or BMI in their analysis, and their sample size was limited to women in Lebanon. El-Kak, Chaaya, Campbell, & Kaddour (2004) found that more PNC visits were associated with fewer cases of PPD. However, their sample size was also limited to women in Lebanon. Nalepka & Coblentz (1995) hypothesized that educating women on PPD prior to childbirth would reduce the likelihood of PPD among the women compared to the women who did not received education; however, they found no significance and the education was delivered in childbirth classes during pregnancy as opposed to PNC, per se.

Therefore, since 1) there are limitations of previous studies on weight and postpartum distress, 2) there is a paucity of literature on prenatal care and postpartum depression, and 3) many significant changes occur during pregnancy, changes which pregnant women can be educated on during the delivery of PNC, the relationship between PNC and PPD in the U.S can further be ascertained in the literature (Merritt, Kuppin, & Wolper, 2001).

Purpose of This Study

Since studies have confirmed both an association between obesity and PPD, and PNC and PPD, I would like to combine these two relationships. I propose that PNC can be seen as a means for addressing weight concerns in order to ensure healthy pregnancy and postpartum outcomes for her and her baby. To my knowledge, no study has determined if 1) an association exists between pre-pregnancy BMI and PPD in the U.S., and 2) if an association exists between pre-pregnancy BMI and PPD after considering PNC utilization as a moderator. The purpose of this study is to determine if any existing association between pre-pregnancy BMI and PPD symptoms is weakened after considering a woman's pre-pregnancy body mass index. Since women from all pre-pregnancy body mass index groups seek PNC, I would like to see if the association of pre-pregnancy BMI and PPD symptoms differ by PNC utilization level. The primary rationale for PNC utilization acting as a moderating variable is based on the premise that PNC can be seen as a means for providers to help women address any negative attitudes towards weight gain and body image that may develop during pregnancy. I hypothesize that PNC plays an important role in reducing the likelihood of PPD among women from all pre-pregnancy body mass index groups. Identifying 1) an association between pre-pregnancy BMI groups and PPD among pregnant women, and 2) seeing if the association differs for women from different PNC utilization groups can substantiate the role (e.g., prevention) that PNC plays in reducing the likelihood of an adverse maternal and child health outcomes (PPD symptoms).

Specific Aims and Hypotheses

Little is known about the relationship of BMI and PPD after considering a woman's PNC utilization. Since the literature has suggested 1) an association between pre-pregnancy BMI and weight gain during pregnancy, 2) an association between weight gain during pregnancy and weight issues postpartum (e.g. weight retention), 3) an association between obesity and depression, 4) an association between pre-pregnancy BMI and PPD, and 5) an association between PNC and PPD, in accordance with the recommendations suggested in the literature, I propose that PNC can help assuage effects that pre-pregnancy BMI (as a biological and psychosocial stressor) and the changes that occur during pregnancy may have on women, such as its influence on any negative attitudes about weight gain and body image that may arise either during pregnancy or in the postpartum period. Consequently, I predict that if health care providers deliver PNC information incorporating nutrition, weight and shape changes, and address a woman's concerns about her weight and shape, this will in-turn, reduce the likelihood of PPD.

The objective of this study is to determine the importance of PNC in acting as a moderating variable in the relationship between pre-pregnancy BMI and PPD (e.g., weight issues and lifestyle behaviors addressed through PNC may reduce the likelihood of weight issues experienced after delivery, and reduce the likelihood of PPD). The specific aims are as follows:

- Specific aim 1: What is the association of pre-pregnancy body mass index (BMI) with subsequent development of postpartum depression (PPD) symptoms?
- Hypothesis: I predict that women who had a pre-pregnancy BMI of obese will have the highest odds for PPD symptoms, followed by overweight BMI, and finally underweight BMI (lowest odds for PPD symptoms). Women who had a normal pre-pregnancy BMI will be the reference group.
- Specific aim 2: Does PNC moderate the relationship between pre-pregnancy BMI and PPD symptoms?
- Hypothesis: Within each pre-pregnancy BMI category, the likelihood a woman will experience PPD symptoms will decrease as prenatal care increases: inadequate PNC will have the highest odds for PPD symptoms, followed by adequate plus PNC, and finally intermediate PNC (lowest odds for PPD symptoms). Women who utilized adequate PNC will be the reference group.

Thus, if PNC acts as a moderating variable, as predicted, after looking at the relationship between pre-pregnancy BMI and PPD symptoms only, that relationship will change as the likelihood for PPD symptoms will change when considering PNC. For example, there will be a difference in a woman with a pre-pregnancy BMI of obese who received adequate plus PNC versus a woman with a pre-pregnancy BMI of obese who received intermediate PNC. The next chapter elaborates on the literature to propose an idea of what occurs during PNC in addressing concerns related to weight that arise during pregnancy, explaining how this may in-turn, reduce the likelihood of PPD symptoms.

CHAPTER 2
LITERATURE REVIEW

Postpartum Depression (PPD)

Postpartum depression (PPD) is a mood disorder that involves a variety of symptoms including fatigue, fears, anxiety, despair, thoughts of compulsion, loss of libido, and feelings of inadequacy (Horowitz et al., 1995). PPD is known to be a very common illness, and affects approximately one in every eight mothers to a point that affects her ability to carry out her maternal responsibilities (Wisner, Parry, & Piontek, 2002). PPD is divided into three categories: 1) blues, which affect roughly 50-80% of new mothers, and is considered to be normal, 2) non-psychotic postpartum depression, which affects roughly 10-15% of new mothers, the incidence being on average 13%, and 3) postpartum psychosis, which is rarer than the other two types and occurs in roughly 1-2 out of every 1000 pregnancies or 0.1-0.2% of mothers (Miller, 2002; Evins & Theofrastous, 1997; Negus Jolley & Betrus, 2007). It is the conditions of labor, delivery, and the postpartum period that are predicted to bring about a traumatic level of stress that can trigger postpartum depressive symptoms (Dietz et al., 2007).

Consequences of PPD

Da Costa, Dritsa, Lowensteyn, & Khalife (2006) showed that women experiencing PPD suffered significant reductions in health related quality of life, with the association continuing even after controlling for depression severity. PPD has been shown to have negative consequences on the child’s behavior and development, mother-child interaction, and parenting practices (Minkovitz et al., 2005). PPD may also affect a mother’s health care utilization for her child. For example, if fewer preventive measures are taken for the child such as lack of vaccinations, this can in-turn, affect the physical health of her child, which can bring about an increase in acute care utilization for the child (Minkovitz et al., 2005). This relationship is suggested because health promotion activities taken on by the mother for her child are associated in part with the functional capacity of the mother. The functional capacity may be affected if the mother's psychological well-being is compromised. (Rahman, Iqbal, Bunn, Lovel, & Harrington, 2004). Also, children of a depressed parent have a higher likelihood of experiencing negative cognitive and social outcomes (e.g., lack of social competence), and have a higher rate of mental illnesses that can continue into adulthood, with this likelihood increasing if both parents experience depression (NICHD Early Child Care Research Network, 1999; Lieberman, 1977; Weissman et al., 2006; Goodman & Gotlib, 1999). Since the primary figure in a child's life tends to be the parent, usually the mother in many families, parental depression may affect the quality of the relationship between the parent and child, and even cause behavioral problems for the child later on in life, such as anxiety (Radke-Yarrow, Cummings, Kuczynski, & Chapman, 1985; Lieberman, 1977). Children of mothers with PPD also have a higher likelihood of receiving lower scores on measures of mental and motor development, have more difficult temperaments, react more negatively to stress, and lower self-esteem (Goodman & Gotlib, 1999). Finally, physical consequences associated with depression for the mother around the time of childbirth include low birth weight and impaired growth for the child (Rahman, Iqbal, Bunn, Lovel, & Harrington, 2004).

Screening for PPD

Recognizing that mental health, as well as physical health, is important for the mother is essential for her overall well-being (Wisner et al., 2006). Since a new mother may be unaware of 1) the normal physical changes that occur after giving birth, and 2) any limits of her ability to care for her infant (AAP & ACOG, 1992), screening is the first step in detecting PPD (Negus Jolley & Betrus, 2007). Approximately 4-6 weeks after she gives birth, the American Academy of Pediatrics and the American College of Obstetricians and Gynecologists (1992) recommend that a woman should see her OB-GYN for a postpartum examination to determine her current health status and her adaptation to her infant. Since many women experience emotional distress to some extent in the postpartum period, the emotional status of a woman should be evaluated during this time. Also, any counseling regarding a woman's postpartum emotional distress should address future health and future pregnancies.

A wealth of literature exists that supports screening as an effective way to combat the consequences of PPD. Identifying women at risk for PPD has been previously identified as a preventive method for PPD (Boyce & Hickey, 2005). A universal screening system for PPD is suggested which includes screening for PPD as soon as two weeks after birth and no later than a year after birth (Wisner et al., 2006). Questions however exist as to whether PPD screening actually leads to improved maternal and child health outcomes (Gaynes et al., 2005). It is advised that detecting for women who are at-risk for PPD symptoms can be done in the late stages of pregnancy (Josefsson, Berg, Nordi, & Sydsjo, 2001). Screening for risk factors and/or depressive symptoms would be conducive to early detection and initiation of treatment (Miller, 2002). This screening can indeed be incorporated into both prenatal clinics (during PNC delivery) and in pediatric clinics (during postpartum check-up visits) (Miller, 2002).

Postpartum Depression (PPD): Women and Men

Research has shown that women are two times more likely than men to suffer from depression (with the dominance of depression affecting women consistent across developed nations), and that the first onset tends to be during the reproductive years (Weissman & Olfson, 1995). In addition, women tend to experience a longer duration of depression and a higher frequency than that of men (Sargeant, Bruce, Florio, & Weissman, 1990). Men experience PPD as well as women; however, the literature suggests that women, unlike men, have a higher likelihood of suffering PPD due to hormonal withdrawal (e.g., gonadal steroids such as estrogen and progesterone) experienced by a woman in the postpartum period, with this likelihood increasing with parity (Bloch et al., 2000). Maternal PPD *is* correlated with paternal PPD, and both can affect family health by affecting other relationships within the family and eventually the well-being of the family (Deater-Deckard, Pickering, Dunn, & Golding, 1998; Goodman, 2004). Since men are becoming more involved in the experience of having a newborn in the house, compared to previous decades, there are now greater possibilities for men to experience PPD (Goodman, 2004). Combined PPD of both the mother and father puts the child at an increased risk for developmental problems than would occur with maternal PPD alone (Goodman, 2004).

Obesity

Obesity is defined as having a body mass index (BMI) of 30 or greater (National Institutes of Health, 1998). Body mass index, a measure that represents the comparative weight to height, is recommended by the Centers for Disease Control (CDC) as a reliable body fat indicator (it is significantly correlated with the total fat content in the body) and as an excellent method for assessing both overweight and obesity (National Institutes of Health, 1998). Obesity has been shown to be associated with an increased risk for other diseases, including hypertension, cardiovascular disease, cholecystectomy, non-insulin dependent diabetes mellitus, and colon cancer (National Institutes of Health, 1998). It is estimated that about 65% of Americans 21 years and older have a BMI more than 25 (overweight classification), 30.5% have a BMI of 30 or more (obese classification), and 4.9% have a BMI of 40 or more (extremely obese classification) (Sarwer, Allison, Gibbons, Markowitz, & Nelson, 2006). Rates of obesity continue to increase, especially among childbearing women. According to Lu et al. (2001) the average maternal weight of women in the initial prenatal care visit increased by 20%, and the percentage of women classified as obese increased from 7.3% to 24.4% over a period of 20 years. Along with the growing rates of obesity and the physical consequences of obesity on health, there exist many psychosocial consequences that can have effects on the mental health of individuals who are obese.

Psychosocial Consequences of Obesity: Stereotypes and Stigmas

In addition to its effects on physical health as identified above, obesity also poses psychosocial consequences. There exists a plethora of negative attitudes and stigmas associated with being obese. Examples include discrimination and prejudice with respect to arenas such as health care and employment (Crerand, Wadden, Foster, & Gary, 2007). This discrimination may have health care access implications for obese postpartum women who are in need of mental health care to address PPD. According to Wooley & Wooley (1979), and apart from skin, having excess body fat is known to be the most stigmatized physical feature. However, unlike skin, excess body fat can be voluntarily controlled. The results of stigmatization of overweight/obese individuals include self-victimization and having to suffer differential treatment due to physical appearance, with women suffering more than men (Wooley & Wooley, 1979). Stereotypes affiliated with being overweight and obese include being self-indulgent, less self-disciplined, less attractive, less happy, and lazier (compared to thin counterparts) (Tiggeman & Rothblum, 1988). Also, it is noted that obesity is more prevalent in women than it is in men (Hedley et al., 2004). Women have double the likelihood over men to experience a major weight gain with an increase over a period of 10-years and overweight women in the 25-44 year age group have the highest incidence for significant weight gain a compared to all other groups (Williamson, Kahn, Remington, & Anda, 1990); these years are crucial regarding child-bearing years. It is suggested that although both men and women experience stigmatization with obesity; the effect is more profound towards women than for men as women possess a greater propensity for obesity (Hebl & Turchin, 2005; De Garine & Pollock, 2005).

Psychosocial Consequences of Obesity: Weight as a Chronic Stressor

Looking at attitudes and beliefs held by many women, there are many chronic stressors that American women experience on a daily basis. The association of a slender figure with attractiveness and beauty and its effects on women's body perceptions and body images remains one of the more significant chronic stressors (Attie & Brooks-Gunn, 1987). This is due to cultural and societal influences that can be influential to an extent that a woman does not question the validity of her perceptions that she is overweight or has an undesirable figure; even if she has alternatives to negative body perceptions (e.g., accepting her weight and body shape), she may face confrontation to these alternative perceptions from outside influences (e.g., peers, spouse, etc.) (Attie & Brooks-Gunn, 1987). For women, especially in the Western world, the body image tends to support a slim body, and there continues to exist a dilemma between desire versus control (De Garine & Pollock, 2005). In fact, many American women tend to experience negative ramifications when their weight exceeds society's expectations (Cameron et al., 1996). What is socially accepted is a thin, lean body, which remains symbolic of characteristics such as self-control, hard work, attractiveness, success, acceptance, being physically fit and healthy, and in general, having desirable personal qualities (Brownell, 1991). The phrase "thin is beautiful" tends to lead to fear of and prejudice against overweight/obese individuals (Attie & Brooks-Gunn, 1987). Women tend to experience greater pressures to conform to being thin as there are more positive attitudes towards thinness (De Garine & Pollock, 2005). Karlsson, Taft, Sjostrom, Torgerson, & Sullivan (2003) found that obese women reported having more psychosocial problems related to weight than men. Society's focus on body image can take a toll on a woman's emotional and physical health to an extent where thinness may take primacy over health (Paquette & Raine, 2004). For example, this focus can cause many women to 1) undertake dangerous weight loss behaviors, 2) experience poor body image and low self-esteem issues, and

3) general unhappiness that could lead to depression (Battle & Brownell, 1996). In fact, many studies have confirmed as association between obesity and depression.

Obesity and Depression

Not only is obesity known as the most common chronic illness in today's society, but depression is considered to be the second most prevalent psychological illness in today's society, following anxiety disorders (Dixon, Dixon, & O'Brien, 2003). Depression is known as the leading cause of disability globally (Kruijshaar, Hoeymans, Spijker, Stouthard, & Essink-Bot, 2005). Depression is an independent risk factor for premature morbidity and mortality, especially when combined with congestive heart failure, hypertension, and/or stroke, and is associated with higher health care utilization and higher total healthcare expenditures, and loss of productivity (Schulz et al., 2000; Olfson & Klerman, 1992; Greenberg et al., 2003).

Both obesity and depression are known to be among the most prevalent and most costly public health problems in the United States, and are associated with increased health care utilization, which can in-turn result in increased health care costs (Kress, Peterson, & Hartzell, 2006). The combined effect of both can increase an individual's risk for loss of function as both may affect one another (Markowitz, Friedman, & Arent, 2008). There is increasing evidence that obesity and depression are related; those who are overweight or obese are more likely to feel depressed at least one week during the month (Aberdour, 2006). Plutchik (1976) found that the greater the degree of being overweight, the greater the tendency to experience problems with depression. Roberts, Deleber, Strawbridge, & Kaplan (2003) found that obesity at baseline was associated with depression and that obesity predicts depression subsequently. Since many obese individuals are forced to endure discrimination and the stigmas associated with obesity, this can certainly contribute to psychosocial distress, if not depression; however, Dixon et al. (2003) confirmed that obesity is associated with depression. Increased BMI is associated with a higher risk for depression, thoughts of suicide, and suicide attempts (Carpenter, Hasin, Allison, & Faith, 2000). Onyike, Crum, Lee, Lykestsos, & Eaton (2003) found that obese persons in their sample had a higher prevalence of depression in the past-month than their normal weight counterparts. For the women in the sample, there was an 82% increase in the odds compared to the 73% higher odds in men (which was non-significant). The prevalence of depression was the highest for those obese who were obese with the strongest association remaining for those who were severely obese (BMI >/= 40). Since treatment for both depression and obesity is costly and only available to few people prevention is important in curbing obesity (Battle & Brownell, 1996).

Women also tend to be at a higher risk for obesity-related costs, and there is an increased risk of depression among women who are obese (Kress, Peterson, & Hartzell, 2006). Research has shown that obesity is associated with depression in females (Dong, Sanchez, & Price, 2004). Heo, Pietrobelli, Fontaine, Sirey, & Faith (2006) found that among young women, those overweight and obese were significantly more likely to have experienced depressive moods compared to young women who were not overweight or obese, with those who are Hispanic being more susceptible. Linde et al. (2007) found that being overweight or being obese is associated with depression, especially among women. Jorm et al. (2003) found that in women, obesity was associated with more depressive symptoms and lower well-being whereas in men, the associations were weak and inconsistent.

Studies have also shown that being underweight is associated with depression. Lox, Osborn, & Pellet (1998) found that women who perceive themselves as underweight experience similar psychosocial issues (e.g., self-esteem, depression, body dissatisfaction, anxiety) as women who perceive themselves as overweight. Carpenter et al. (2000) found a U-shaped relationship among BMI values and their association with increased probability of depression;

low and high BMI values were associated with an increased probability of having experienced major depression. However, since the relationship between obesity and depression has been demonstrated to a greater extent in the literature, suggesting that obese women have a higher likelihood for experiencing mental distress and depression associated with weight, taking this relationship further and looking at a special group of women, postpartum women, could further add to the literature on the effects of weight, specifically obesity, on mental health; in this case, during the postpartum period.

Obesity and PPD

A woman undergoes a significant amount of stress during the course of pregnancy. Since giving birth is an important time in a woman’s life and safely delivering a healthy baby is a critical concern, this can be stressful for a woman in ensuring a healthy pregnancy outcome. In addition, the effect of pregnancy on body perceptions and/or self-esteem can also act as a chronic stressor (Hobfoll & Leiberman, 1987). In fact, even though dietary restraints are less prevalent in pregnant women (Davies, & Wardle, 1994), body perceptions of women tend to be increasingly negative, especially during the early to mid-second trimester of pregnancy (Skouteris, Carr, Wertheim, Paxton, & Duncombe, 2005). Though some research has shown that these perceptions may become less negative in the postpartum period, body perceptions during the postpartum period tend to be less positive than before pregnancy (Strang & Sullivan, 1985). In fact, negative body images are likely to be associated with weight distress during the postpartum period. Obesity has been shown to have a significant association with a new-onset episode of postpartum psychiatric disorder (LaCoursiere, Baksh, Bloebaum, & Varner, 2006; Andersson et al., 2006). In addition, after controlling for marital status and income, pre-pregnancy obesity (defined as having a BMI greater than 29) was found to be associated with having moderate or greater postpartum depressive symptoms, with the strength of this association increasing as body mass increased above the normal BMI range (LaCoursiere et al., 2006.)

Prenatal Care (PNC)

It is believed that what is vital for every person is his/her health and the aptitude to work efficiently. An important resource for society is an infant who is born with the ability to function well in society. If an infant is born at a disadvantage, with a condition that may prevent maximum functioning, this may be detrimental for the individual and the community. The period of pregnancy is a time that provides an opportunity to address lifestyle behaviors that remain important to a woman both during the course of her pregnancy and after she gives birth (e.g., smoking, nutrition, exercise, violence, etc.), many of which may have implications for infant and child outcomes (e.g., maternal obesity is a strong predictor for metabolic syndrome among children) (McCormick & Siegel, 2001; Boney, Verma, Tucker, & Vohr, 2005). One venue that may be used to alter the health behaviors of pregnant women is the advice and encouragement rendered by health care providers through prenatal care (PNC) (Kogan, Kotelchuck, Alexander, & Johnson, 1994). Prenatal care may be seen as a means to allow women to participate in their own health; an example being the change of their health behaviors during pregnancy to incorporate healthy eating (McCormick & Siegel, 2001). American women deem routine PNC to be essential as they strongly believe in the importance and efficacy of PNC and will invest efforts to "make a good baby" (Press & Browner, 1997; Rubin 1984, p.65); that is the message delivered by their health care providers, even though there is limited evidence to support the direct benefits of routine PNC on birth outcomes. For many women, the most significant aspect of PNC observed is that they are provided with information about the pregnancy and the growing fetus. This is information that women find to be encouraging and empowering (Press & Browner, 1997). The purpose of PNC is to 1) find the pregnant women with problems, 2) assure management of the problems identified, 3) prepare both women and their partners for delivery and child care, 4) provide information, 5) provide health education, and 6) provide support to all pregnant women (Hemminki, 1988). Thus, PNC includes services that are intended to improve outcomes for the mother and infant, as well as promote educated decision-making among the mother, family members and friends, with regard to health care during the pregnancy (Daniels, Fuji Noe, & Mayberry, 2006), and even in the postpartum period.

Prenatal care is known as a key preventive service for pregnant women (Kogan, Alexander, Kotelchuck, Nagey, & Jack, 1994) and has been accepted as an important conduit to prevent harm for the mother and child. Prenatal care is rendered in a variety of settings including: 1) private clinics of physicians, osteopaths, and midwives, 2) university hospital clinics, 3) health maintenance organizations, 4) community health centers, 5) public health departments, 6) migrant health centers, 7) community hospital clinics, 8) university hospital clinics, 9) schools, and 10) military facilities. Those involved with the delivery of PNC include family practice physicians, obstetricians and gynecologists, midwives including nurse midwives, osteopaths, nurses, and nurse practitioners (Peoples-Sheps, Kalsbeek, & Siegel, 1988). It is important to note that for many women who are pregnant for the first time, PNC may be the first point of adult contact with the health care system; thus, their experiences with PNC may influence subsequent use of the health care system for themselves, their partners, and their children (Alexander & Kotelchuck, 2001). For all the women who seek PNC, most of them see a physician at some point during the course of their pregnancy; however, many women see multiple providers. (Peoples-Sheps et al., 1988). Given that women are provided with information from their health care providers during the course of their pregnancy, it is believed that pregnancy is a time when a woman has the highest likelihood to make changes in her lifestyle behaviors, more than any other time during her life (Higgins, Frank, & Brown, 1994).

Prenatal Care (PNC), Nutrition, and Weight: Behavior Modifications

It is confirmed that the pregnancy period is a time when women make significant changes in their health behaviors (Baric & MacArthur, 1977) as most women are motivated to do what is necessary to enhance the likelihood of having a healthy baby (Higgins & Woods, 1999); for example, many women are motivated to change and/or modify their nutrition and fitness health behaviors during pregnancy (Wood Baker, Carter, Cohen, & Brownell, 1999). Pregnancy is also an ideal time to encourage women to initiate healthy lifestyle behaviors such as exercise (e.g., walking) and dietary habits (e.g., proper foods) (Morin & Reilly, 2007). The most common modifications made during pregnancy include exercise, nutrition, and reduced substance abuse behaviors (Higgins, Clough, Frank, & Wallerstedt, 1995). Kline, Martin, & Deyo (1998) found that women reported that the pregnancy and postpartum periods motivated them to reduce any risky behaviors due to the fear that their children would be affected. The health behaviors that occur, the quality of the diet consumed, and the amount of weight gained during the pregnancy period are significant because of 1) its impact directly on the health and well-being of the mother (both short-term and long-term), and 2) its impact on the development of the growing fetus (Robb-Todter, 1996). Thus, commonly addressed concerns during pregnancy include weight gain and nutrition (e.g., nutrient intake) because both can affect the health of the mother and infant. Chomitz, Cheung, & Lieberman (1995) suggest that adopting healthy lifestyle behaviors during pregnancy can result in positive long-term health for the women and their infants/children. For example, having a balanced diet is important for women in their reproductive years, especially for women who are pregnant, in order to enhance the health, survival, and development of their children (Mora & Nestel, 2000). Among the things a woman can do to heighten the likelihood of giving birth to a normal, healthy child are modifying lifestyle behaviors such as unhealthy dietary habits that may pose a risk of affecting the likelihood of delivering a healthy infant (Chomitz et al., 1995). Habits that are detrimental can be difficult to modify, but can be done with the support and assistance from family members and other close individuals, the health care system, and society; for example, modifications can be accomplished with the assistance of education that is relayed through PNC (Chomitz et al., 1995). In fact, many women seek pregnancy-related information through their PNC provider. For example, Risica & Phipps (2006) noted that the information topics that were most frequently requested by women to discuss with their PNC provider were eating well and staying fit, followed by caring for a newborn, breastfeeding, healthy weight gain, gestational diabetes, genetic testing for their baby, and smoking cessation. Other requests for information included depression during and after pregnancy, working after giving birth, and preterm labor. Though the success of using written materials to deliver nutrition education has been demonstrated in the literature (Beresford et al., 1997) found that a self-help book endorsed by physicians and given to patients who were looking to modify their dietary lifestyle habits was successful in helping those patients decrease their fat intake over the course of a year and increase their fiber intake), the authors found in their study that the women preferred to receive this information from a PNC nurse or provider rather than from other materials (e.g., printed materials, videos, classes, internet, CD-ROM). Thus, it is the PNC providers that can educate, assist guide, and work with their pregnant patients in helping them make healthy behavioral changes and/or modifications related to nutrition and wellness.

What Should the Content of PNC Entail?

In order to encourage pregnant women to modify and/or adopt healthy behavioral changes related to nutrition and wellness, it is ideal for PNC to be comprehensive and inclusive of care that prioritizes nutrition and wellness. PNC content is generally comprised of prevention (e.g., education), detection (e.g., birth defects), and treatment services as well as interventions designed to focus on psychosocial issues (e.g., stress) and change health behaviors that may prevent healthy pregnancy outcomes (e.g., poor eating habits). Lederman, Alfasi, & Deckelbaum (2002) recommend that PNC should include a significant focus on helping women optimize their weight during pregnancy (e.g., informing women about the Institute of Medicine guidelines on weight gain based on BMI). Many prenatal interventions such as PNC have focused on overweight/obese women in efforts to prevent excessive postpartum weight retention/weight gain (Walker, 2007). Prenatal care discussions should also include what it means to gain weight during pregnancy and how the weight is distributed in the woman’s body (e.g., between the uterus, placenta, fetus, etc.). Also, discussions should include well-balanced diets that are high in protein and would consequently have positive effects on a woman’s body shape and her weight (Moore, 1978).

Since the content of PNC had grown to include services related to nutrition and are considered a vital part component of PNC (Wheatley, Kelley, Peacock, & Delgado, 2008), nutrition education and guidance should be a critical component of all PNC services (Bronner & Baldwin, 1999; Klohe-Lehman et al., 2006). Both the Institute of Medicine (1990), and the American College of Obstetricians and Gynecologists (2005) have issued recommendations for obstetricians-gynecologists including: (Institute of Medicine, 1990):

1) Health care providers should use reliable procedures for measuring height and weight of pregnant women at each visit, set goals for weight gain, and monitor weight gain throughout the term.

2) Calculate the woman's pre-pregnancy BMI

3) Estimate the woman's gestational age

4) Determine a weight gain goal together with the woman at the beginning of her initial prenatal care visit

5) Explain to the woman why weight gain is important

6) Discuss the recommended range of weight gain and the pattern of weight gain depending on her pre-pregnancy BMI: 25-35 lbs for normal weight women, 15-25 lbs for overweight women, and 15 lbs for obese women, record height and weight for women at all PNC visits

7) Monitor the woman's pattern of weight gain throughout her term and identify any abnormal patterns that may necessitate the health care provider intervening.

8) Upon identifying any abnormal patterns (if applicable), determine the cause of the abnormal weight gain and then determine ways to rectify the problem with the woman.

9) Evaluate a woman's dietary habits via a food history or a food frequency questionnaire; include questions about problems or conditions which may affect her dietary habits and behaviors.

10) Offer nutrition consultation to obese women and encourage them to adhere to an exercise program during the pregnancy and postpartum, discuss pregnancy-related complications due to weight.

Overall, it is recommended that PNC care include 1) a routine dietary assessment to determine dietary needs (e.g. nutrient supplementation), and 2) guidance and support for women on achieving a healthy, balanced diet and maintaining healthy behaviors that will support adequate weight gain optimal health for the women and their fetuses (Institute of Medicine, 1990).

An association between weight gain advice from PNC providers during pregnancy and actual weight gain during pregnancy has been demonstrated, suggesting that women can be successfully encouraged to gain the appropriate amount of weight during their pregnancy (Taffel, Keppel, & Jones, 1993). Keppel & Taffel (1993) showed that White women who had pregnancy weight gain within the Institute of Medicine's guidelines retained fewer than four pounds in the postpartum period, and had a median of 1.6 pounds. However, White women who gained more weight during pregnancy than the recommended ranges had a higher likelihood of retaining nine pounds or more (with a median of 4.9 pounds) compared to the women who did not exceed the recommended amount of weight gain. As for Black women, they were more likely to retain weight and were thus heavier in the postpartum period than White women (median of seven pounds) even though the gestational weight gain was similar for both groups of women, and they also consume higher total calories, a diet with a higher portion of calories from fat, and less physical activity during the prenatal and postpartum periods than White women (Keppel & Taffel, 1993; Boardley, Sargent, Coker, Hussey, & Sharpe, 1995). Also, as prenatal weight increased, the postpartum weight retained increased. Among 4,218 women in the sample, Carmichael, Abrams, & Selvin, (1997) found that 40% of the women gained weight within the recommended ranges; out of this 40% of women, 53% of them were underweight BMI, 35% of them were normal BMI, 24% of them were overweight BMI, and 27% of them were obese BMI.

While delivering PNC related to nutrition and wellness, PNC providers should be aware and knowledgeable about the attitudes and feelings that many pregnant women hold regarding body image and perceptions, especially closer to childbirth and in the postpartum period, as they tend to be negative during these times (Moore, 1978; Stein & Fairburn, 1996). It is the PNC providers that can assist women in viewing pregnancy and its associated physical changes as ones that are normal and beautiful (Moore, 1978). It is recommended that health care professionals intervene early in the pregnancy to assist women in modifying their dietary patterns to achieve appropriate weight during these periods (Lederman, Paxton, Heymsfield, Wang, Thornton, & Pierson, 1997); Since weight can be a stressor for a number of women during pregnancy and in the postpartum period, health care professionals can 1) help women engage in healthy behaviors to minimize weight retention in the postpartum period, and 2) help women psychosocially (e.g., help women feel better about themselves and their weight) during pregnancy and in the postpartum period.

Weight as a Stressor and the Importance of PNC

Affonso & Mayberry (1990) found that the commonly reported stressors of pregnant women included weight gain and body changes for women in their first and third trimesters (second most commonly reported stressor), and for women in the postpartum period (fourth most commonly reported stressor). Among the total sample, body image changes was the second highest commonly reported stressor. The authors suggest that assessments made in both the prenatal and postpartum periods must address these stressors and determine what they mean to women with regards to body image and body perception judgments, and how they can produce discomfort and uneasiness if a woman feels that she is losing control over managing her body. Addressing these issues during the prenatal period (e.g., during PNC) may assist women in handling the intense emotions that follow childbirth and the imbalances that occur between stressors commonly experienced after childbirth (e.g., weight and body image issues) (Hiser, 1987).

It is known that pregnant women experience a transition as their babies are developing, and this transition includes changes in body images and even during pregnancy (as well as the postpartum period), there is a significant amount of attention and importance that is given to appearance as is in the pre-pregnancy period (McCarthy, 1998). The physical changes that occur during pregnancy are extensive due to 1) growth of the woman due to growth of the child, and 2) changes in boundaries of the body that occur in the third trimester of the childbearing period (e.g., thinning of the abdominal and uterine walls that make the abdomen and uterus tight due to stretching) (Rubin, 1984). The resulting stress that may occur due to changes in body shape and size may cause distress both during the pregnancy and in the postpartum period (O'Hara, Schlechte, Lewis, & Varner, 1991). For some women, the stress may be more profound if the weight gained during pregnancy is excessive.

Pregnancy and Excessive Weight Gain

Women who gain excessive weight during pregnancy may be at a higher likelihood to retain the weight after giving birth. For example, Lederman, Alfasi, & Deckelbaum (2002) found that women who were obese prior to pregnancy were more likely to experience excessive weight gain during pregnancy and postpartum. Wells, Schwalberg, Noonan, & Gabor (2006) showed the following: 1) being underweight was associated with inadequate weight gain, but protective for excessive weight gain during pregnancy, 2) being obese was associated with both excessive and inadequate weight gain during pregnancy, and 3) being overweight was associated with excessive weight gain, but protective against inadequate weight gain during pregnancy. Olafsdottir, Skuladottir, Thorsdottir, Hauksson, & Steingrimsdottir (2006) found after comparing women with a BMI less than 25, and 25 or greater that those in the latter category, specifically those with a pre-pregnancy BMI between 25-29 were the most likely to gain excessive weight during pregnancy. Thus, special attention should be given to women who are overweight before their pregnancy because they are the most likely to experience excessive weight gain during pregnancy. Consequently, they are also the most likely to experience pregnancy and delivery complications such as preeclampsia (LaCoursiere, Bloebaum, Duncan, & Varner, 2005; Saravanakumar, Rao, & Cooper, 2006; Cedergren, 2004; Rosenberg, Garbers, Lipkind, & Chiasson, 2005; Rosenberg, Garbers, Chavkin, & Chiasson, 2003; Mahmood, 2009; Baeten, Bukusi and Lambe, 2001; Cnattingius, Bergstrom, Lipworth, & Kramer, 1998) as well as struggle with overweight/obesity issues after birth. These struggles may consequently result in weight distress in the postpartum period due to issues such as weight retention (e.g., rigorous dieting) (Olafsdottir et al., 2006; Shepard, Hellenbrand, Bracken, 1986).

Postpartum Weight Retention

In general, many women are concerned about excessive weight gain during pregnancy due to their apprehension about postpartum weight retention (Keppel & Taffel, 1993). Excessive weight gain during pregnancy can cause obesity issues postpartum, which may cause women to restrict their food consumption in efforts to lose weight quickly. These restrictions in-turn may weaken breastfeeding capabilities, and thus, obese women may cease breastfeeding earlier than non-obese women due to weight issues (Lederman, Paxton, Heymsfield, Wang, Thornton, & Pierson, 1997). According to Gunderson & Abrams (2000), factors that influence postpartum weight retention include pre-pregnancy weight, race/ethnicity, parity, lactation capabilities, and weight gained during pregnancy. Jenkin & Tiggeman (1989) found that women were more dissatisfied with their postpartum weight than their pre-pregnancy weight, and that postpartum weight was associated with psychological well-being with this association between weight and dissatisfaction increasing as weight increased. The authors concluded that postpartum weight is a predictor of psychological well-being in the postpartum period. Polley, Wing, & Sims, (2002) found a significant and strong association between weight gain during pregnancy and postpartum weight retention. They suggest that normal-weight women tended to retain less than the control group, and for overweight women, they tended to retain more compared to the control group. Lederman, Paxton, Heymsfield, Wang, Thornton, & Pierson (1997) suggest that high pregnancy weight gain is likely to be associated with postpartum weight because many women have difficulty in adjusting to energy intake and expenditure during those periods.

It is suggested that the effects of postpartum weight retention should be studied from a psychosocial context with an emphasis placed on weight management (Walker, 1997). This is because there is a significant amount of distress (associated with higher BMI) that is experienced due to a high dissatisfaction with weight; and this may be followed by a lowered self-esteem

(Walker, 1997). Walker, Timmerman, Kim, & Sterling (2002) found that weight was the area that women in the postpartum period experienced the most dissatisfaction, followed by distress about the waist, hips, legs, and muscle tone (all of which tend to be areas where fat is retained in the postpartum period). This dissatisfaction with body image was significantly associated with postpartum depressive symptoms at six-weeks postpartum among women from all ethnic groups. However, Suttie (1998) found that postpartum women were more concerned about their fitness, less concerned with their appearance, and they also felt healthier compared to non-postpartum women. Results also showed that women in the early postpartum period had similar body images to women in the latter part of the postpartum period; however, the women in the earlier postpartum period reported feeling healthier than the women in the latter part of the postpartum period. Other changes expressed by the women in the postpartum period, though not as distressing as changes with weight and figure included stretch marks, wrinkly skin, and discoloration marks. Hiser (1987) found that concerns of women in the second postpartum week included the following: weight was reported as a worry by 35% of the women, and 40% of the women reported concern regarding having a flabby figure, while stretch marks were reported by 70% of the women as not being a general concern in the postpartum period. In general, the women in the sample cited weight, flabby figure and returning their figures to normal as frequent concerns in the postpartum period.

Given the extent that postpartum weight retention is suggested to pose long-term effects on a woman’s health and well-being (e.g., weight increases later on in life) (Walker, 2007), PNC providers should address this issue during the delivery of PNC, Many women are unaware of the postpartum consequences of not managing weight during pregnancy. Since the body rarely immediately returns to its preconception shape following childbirth, many women tend to be surprised by the extent to which they retain weight after childbirth (Stein & Fairburn, 1996; Wood Baker, Carter, Cohen, & Brownell, 1999). For example, Fairburn & Welch (1990) found in their sample that 38% of the women had no intention of trying to lose weight as they felt their weight would return to normal. It is important for weight gain to be monitored during pregnancy in order to determine if it is within recommended ranges. PNC providers should educate their patients on how to lose weight following delivery in addition to educating women on how much weight to gain during pregnancy (Keppel & Taffel, 1993). Thus, it is important that pregnant women be given information related to food, nutrition, and weight during pregnancy. Olafsdottir et al. (2006) recommend that women should be given guidelines about weight gain and lifestyle modifications during pregnancy. Along with weight gain guidelines, pregnant women should also receive advice on changes with respect to eating patterns and habits, as well as changes in body shape and image that that are common among pregnant women. It has been suggested that women who are overweight and/or obese may overestimate their prenatal physical activity (Lichtman et al., 1992); Hence, if PNC providers work closely with their pregnant patients, monitor physical activity, and engage in discussion about weight, nutrition, and physical activity at PNC visits, this may, in-turn prepare women (e.g., less distress) for managing changes in body shape and weight in the postpartum period (e.g., women who are encouraged to engage in healthy behaviors and do so during pregnancy may carry on these behaviors into the postpartum period).

Relation Between Pregnancy, Weight, and Postpartum Distress

Russell (1974) found that worrying about loss of figure was among the top five concerns experienced by women in the postpartum period and thus, this can significantly affect a woman during this time. Harris, Ellison, & Clement (1999) found that women tend to experience more dissatisfaction with their body during the postpartum period than they were in the preconception period. Four reasons may explain these feelings: 1) It is possible that mothers may experience a stronger drive towards thinness in the postpartum period compared to the preconception period, 2) Mother may perceive that they are heavier postpartum than they were before pregnancy; this may be due to an increase in caloric consumption that often accompanies pregnancy and may carry over into the postpartum period, 3) Mothers may actual be heavier in the postpartum period than they were before pregnancy, and 4) Mothers may put their preconception figures on a pedestal, hence, having a stronger desire to return to those figures after childbirth. Thus, because many women worry about returning to the normal weight and body shape during the postpartum period, they may possess negative attitudes and feelings towards their bodies (Strang & Sullivan, 1985). Strang & Sullivan (1985) found that the women in the sample experienced more negative feelings towards their body image during pregnancy than they did in the preconception period. However, in the postpartum period, the women experienced more positive feelings towards their body image than they did in the last trimester of their pregnancy.

Since body image is comprised of many components (e.g., physical appearance such as weight and skin, posture, sense of fashion, etc.), it can affect a woman's personality, self-image, identity, and behaviors and determine they way she responds to input from others and society (e.g., media, positive feedback, respectively). Changes in body images can be a reflection of what society and others define as beautiful and/or acceptable. Women are highly influenced by the feedback received from others and what society tells us is the paradigm of being fit and attractive; many American women connect beauty and attractiveness with success (Moore, 1978). It is important to note that pregnant women tend to react stronger to feedback received about their body image more so than non-pregnant women, as many feel the need for the endorsement from society regarding their weight gain and body shape changes in order to feel that she is successfully experiencing the pregnancy and is capable of becoming a mother (Moore, 1978). The standards in our society today for weight and body size and shape do not allow women to feel proud of their pregnant and postpartum bodies (Jenkin & Tiggemann, 1997). Therefore, it is important that weight and body image issues be addressed in the pregnancy and the postpartum periods. Women tend to feel that the physical effects of pregnancy on the body (e.g., weight gain, breast changes) can bring about changes in self-esteem and body image; for some women, these changes are negative (e.g., negative body image, lowered self-esteem), and for others, these changes are positive (e.g., interpreting the changes as successful nurturing of the fetus, resulting in increases in self-esteem) (Kline, Martin, & Deyo, 1998). However, in the postpartum period, many women desire to “get their body back” (p.845) as they feel that pregnancy and childbirth is a time when control cannot be taken over the physical changes in the body. Thus, it is the PNC providers who can assist women engaging in proper nutrition and exercise habits, which may potentially result in a more positive self-esteem and body image. Since 1) weight is a prominent concern with respect to a women’s well-being, and 2) weight change is a significant feature of pregnancy, it is suggested that changes in weight and body shape may play an important role in the development of PPD symptoms (Cameron et al., 1996). The attitudinal and behavioral changes with regards to weight that often take place during the course of pregnancy tend to be positive, but nonetheless, concerns about eating habits and weight continue to exist and may even extend into the postpartum period. In fact, a woman entering the postpartum period is vulnerable to experience concerns about her weight, because many women tend to retain more weight, and thus, weigh more than they did in the preconception period. Thus, much of the concerns may be more relentless that they were during the preconception period, *and*, many women do not necessarily attribute weight gain in a positive manner as they did during the pregnancy. However, women's responses toward weight gain during pregnancy may differ depending on acceptance of the role of motherhood that will be undertaken following childbirth, and perceptions of physical changes of the body as indications of fetal growth (Lacey & Smith, 1987). These weight concerns may contribute to anxiety or depressive symptoms in the postpartum period (Carter, Baker, & Brownell, 2000), which may result in more weight loss attempts. Wood Baker et al. (1999) found that few women reported attempts to lose weight during pregnancy in comparing the preconception, pregnancy, and postpartum periods; the most weight loss attempts were made in the postpartum periods. For these women that engage in healthful behaviors during the postpartum period, it is important to be cognizant of the factors that motivate them to engage in exercise and weight management following childbirth (Keller, Allan, & Tinkle, 2005). However, Harris, Ellison, & Clement (1999) found that time for exercise and fitness was compromised among many of the women due to the demands of motherhood. Thus, it is suggested that women adopt a healthy diet/fitness regimen during pregnancy (with the guidance of their PNC provider) that can be easily transitioned into the postpartum period. It is vital that health promotion activities that begin during pregnancy and continue into the postpartum period target sources of chronic stress (e.g., BMI) and work towards supporting women's self-esteem, as they may cultivate positive mental health during both periods (Hall, Kotch, Browne, & Rayens, 1996). In addition, health promotion activities and interventions should seek to determine eating attitudes and behaviors of all women as both can be influential on postpartum distress. This is given that pregnancy is a time when 1) weight and body shape changes are expected, and 2) many women feel that pregnancy is a "license" not to have weight concerns (Stein & Fairburn, 1996; Fairburn & Welch, 1990, p. 158), this can affect the eating attitudes and/or eating behaviors of women during pregnancy.

Expected PNC Content Versus Actual PNC Content

It is important to note that the content of PNC is yet to be standardized and the extent to which prenatal health behavior advice is given to women during their PNC is not consistent among all PNC rendered (Kogan, Kotelchuck, Alexander, & Johnson, 1994). Even though the IOM, ACOG, and the U.S. Public Health Service Expert Content on Prenatal Care have issued guidelines and recommendations on PNC content with respect to nutrition education and guidance, there remains differences in the PNC that is actually delivered. A number of studies have compared and contrasted the content PNC that is actually delivered versus the PNC content that is recommended (without considering a birth outcome in the study). To illustrate the differences that exist among the PNC rendered across the U.S., Appendix A (pp.137-155) summarizes the literature that has been conducted on the content of PNC using nationally representative samples of women. According to Appendix A, there is a considerable amount of variability that exists with respect to the care that is actually delivered. However, the literature in Appendix A suggests that a significant portion of PNC providers in the U.S. are discussing nutritionally-related content in the delivery of PNC (e.g., weight gain, exercise, proper nutrition, etc.). In addition to the literature that exemplifies that PNC providers are carrying out nutrition and wellness within the delivery of PNC, there is a collection of literature addressing the effectiveness of PNC for pregnancy outcomes as well as the potential impact on postpartum outcomes.

Effectiveness of PNC

The efficacy of the content of PNC has been addressed in the literature, though not sufficiently (Alexander & Kotelchuck, 2001). In addressing the effectiveness of PNC, PNC is often publicized as a health care service that is necessary for improving pregnancy outcomes among women in the United States (Alexander & Kotelchuck, 2001). The benefits of receiving early and continuing PNC in the U.S. has been advertised as critical to promoting healthy pregnancy outcomes (Alexander & Kotelchuck, 2001). Some studies have shown that early initiation of PNC (in the first trimester) results in improved pregnancy outcomes as opposed to later or no PNC at all (Daniels et al., 2006). Accurately measuring PNC utilization is vital for determining the need for health services, monitoring trends in health care utilization, and determining associations between PNC and pregnancy outcomes (Kogan et al., 1998). PNC also seems to result in healthier pregnancies even for women who have no disease because PNC appears to associate well with the prevention of adverse pregnancy outcomes (Rosen, 1989). For example, if conditions such as obesity are not addressed in the pre-conception period, as evidence indicates that preconception care can improve pregnancy outcomes (Atrash et al., 2008; Frieder, Dunlop, Culpepper, & Bernstein, 2008), it is recommended that PNC should address risk factors such as obesity as its association with pregnancy complications has been shown (e.g., preeclampsia, respiratory problems, cesarean section, fetal death, etc.) (LaCoursiere et al., 2005; Saravanakumar et al., 2006; Cedergren, 2004; Rosenberg et al., 2003; Rosenberg et al., 2005; Mahmood, 2009; Baeten et al., 2001; Cnattingius et al., 1998). It may also be beneficial for postpartum health to be addressed during PNC delivery.

Prenatal Care (PNC) and Postpartum Outcomes

Alexander & Kotelchuck (2001) suggest that experiences in PNC that occur through education and support services may positively impact the postpartum health of the mother and the infant, including health status, health behaviors, and health care utilization. However, it is important to note that some women may not feel the need to see their PNC provider for a postpartum check-up. This may be due to women believing that unless they experience adverse symptoms in the postpartum period that warrant a postpartum check-up, there is no need for a postpartum evaluation of their health. This is unlike the prenatal period when women are concerned about the health of their fetus and doing what is necessary to reduce the likelihood of pregnancy-related complications.

More research is needed on the relationship between PNC and postpartum behaviors, particularly postpartum depression (PPD) (Alexander & Kotelchuck, 2001). Though there is an absence of literature addressing the impact of PNC on PPD in the U.S., the association between PNC and PPD has been previously demonstrated outside the U.S., with more PNC visits inversely associated with the onset of PPD among high-risk women (El-Kak, Chaaya, Campbell, & Kaddour, 2004). Though the sample of women in this study were Lebanese, this study demonstrates the importance of PNC in preventing adverse postpartum outcomes (e.g., PPD), and warrants attention for the impact of PNC on PPD in the U.S. Since this study suggests an impact of PNC on a postpartum outcome (PPD), *and* thus, the experiences that a woman undergoes through her PNC may affect the outcomes she experiences in the postpartum period (Alexander & Kotelchuck, 2001). If a woman seeks PNC and consequently complies with the advice/recommendations given to her by her PNC provider), this may help prevent adverse postpartum outcomes.

In addition, postpartum care should be aligned with the PNC in addressing similar issues that can impact weight and health during the postpartum period. This would help women obtain access to professional assistance in addressing obesity issues postpartum.

Theoretical Framework

For this study, since PNC as an intervention through which PNC providers can educate help address any concerns with a woman about her weight, and provide guidance to patients, this delivery of health care will be seen as "informational support." Homan & Korenbrot (1998) looked at support delivered at each of five PNC ambulatory practice settings (community clinic, health department, public hospital clinic, private hospital clinic, private physician office).

Support service delivery was defined as “psychosocial, health education, and nutrition” (using the USPHS recommendations) and the authors concluded that a woman who has her needs addressed during PNC (psychological support, nutrition, or health information) has a higher likelihood of experiencing a positive birth outcome (poor obstetric outcomes was defined as experiencing preterm birth, having a low birth weight infant, fetal death, ectopic pregnancy, or spontaneous abortion) than a woman who does not have any of her needs addressed during PNC.

Obesity: Research has shown that an association exists between pre-pregnancy weight and pregnancy weight gain, as well as postpartum weight retention. Pre-pregnancy BMI was chosen as the measure for BMI because it is known to be the strongest predictor of future obesity, including excess perinatal weight gain and future weight gain (Krummel, 2007; Gore, Brown, & Smith West, 2003), and is also suggested to be connected to postpartum BMI distress (Walker, 1998).

Prenatal Care (PNC): The intervention of interest in this study will be PNC (health education and guidance on healthy behaviors during pregnancy). In general, PNC includes 1) risk assessment (e.g., medical and psychosocial history, physical examination, laboratory tests), 2) health promotion activities (e.g., counseling to promote healthy behaviors and providing general knowledge about pregnancy and parenting such as physiological and emotional changes, symptoms of preterm labor, fetal growth and development) and 3) a proposed pregnancy plan that is tailored to each woman’s needs (USPHSEPCPNC, 1989). The following nutritional intervention is recommended for the PNC provider during the delivery of care (Institute of Medicine, 1990):

1) Encourage the women to achieve a healthy, balanced diet to support adequate weight gain (e.g., IOM recommended ranges)
2) Evaluate a woman’s dietary habits (e.g., food history, food frequency questionnaire)

3) Calculate the woman's pre-pregnancy BMI

4) Estimate the woman's gestational age

5) Conduct a routine dietary assessment to determine dietary needs

6) Be aware and knowledgeable about the attitudes and feelings that many pregnant women hold regarding body image and perceptions, especially closer to childbirth and in the postpartum period, as they tend to be negative during these times (Moore, 1978; Stein & Fairburn, 1996). It is the PNC providers that can assist women in viewing pregnancy and its associated physical changes as ones that are normal and beautiful (Moore, 1978).

Postpartum depression symptoms: If a woman engages in healthy nutrition behaviors during pregnancy, her likelihood for PPD symptoms will be reduced.

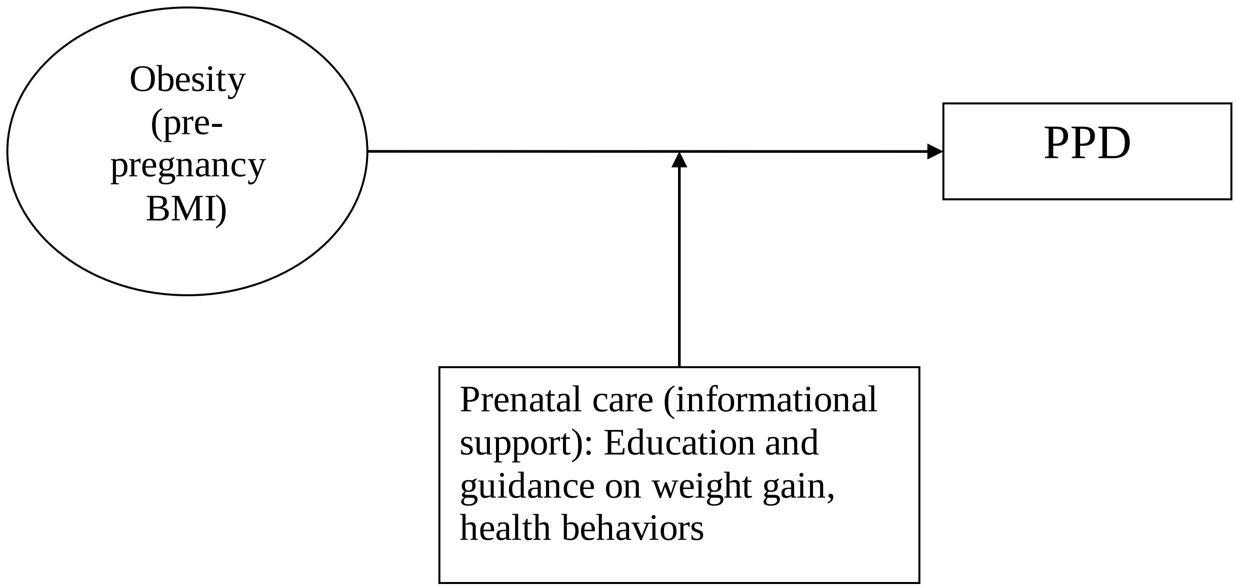

Figure 2-1. Theoretical framework

CHAPTER 3
METHODS

Data Overview: Pregnancy Risk Assessment Monitoring System (PRAMS)

This study used data from the 2004 and 2005 Pregnancy Risk Assessment Monitoring System (PRAMS) (CDC, 2007). This is a continuing population-based survey maintained by the Centers for Disease Control (CDC) that collects data on maternal behaviors, experiences, and characteristics in the pre-pregnancy, pregnancy, and postpartum period among randomly selected woman who delivered a live infant. Started in 1987 because the incidence of low birth weight infants had changed very little during the previous 20 years, and because the infant mortality rate was not decreasing as fast as it had in previous years, this database provides state-specific data. Currently, 30 states participate in PRAMS. States can use these data to measure the performance of health programs and to obtain information on maternal experiences within their respective populations, which can contribute to improving maternal and child health. These data can also be used to 1) identify the women and infants who are at the highest-risk for maternal and child health problems, 2) monitor their health status, and 3) assess their progress in efforts to improve the health of these mothers and their infants.

Data Collection Procedures

Each state that participates samples 1,300 to 3,400 women annually. Women are initially contacted through mail, and those who do not respond are contacted and interviewed via telephone. The questionnaire includes two components: the core questionnaire and the standard questionnaire. The core questionnaire contains 56 questions which all states include in their survey, and the standard questionnaire contains 185-questions from which states can choose which to include in their survey (questions are options for survey inclusion). The standard questionnaire allows the collection of data to best meet the needs of each state. Data collection methods and instruments are standardized across states and occur as follows (CDC, 2007):

1) A preletter is sent to the mother to inform her that she will be receiving a PRAMS questionnaire

2) The initial mail questionnaire packet is sent to all the mothers randomly chosen for the sample 3-7 days after the preletter is sent

3) The tickler is the name given to the thank you note and a reminder to complete the questionnaire. This document is sent 7-10 days after the initial packet

4) The second mail questionnaire packet is sent to all the mothers who do not respond 7-14 days after the tickler is sent out

5) The third mail questionnaire packet is sent to all the mothers who do not respond 7-14 days after the second questionnaire is sent out

6) A telephone follow-up occurs for all the mothers who do not respond 7-14 days after the third questionnaire is sent out (with up to 15 phone attempts in efforts to reach the mother). During this follow-up, interviewers may coordinate times with the mother to administer the questionnaire over the phone. Thus, PRAMS involves mixed methodology: the self-administered questionnaire that is mailed out, or a phone-administered questionnaire in the event the mother does not complete and return the questionnaire prior to the phone follow-up.

The questionnaire packet includes the following: a cover letter that 1) explains PRAMS and why the mother was chosen to participate, 2) provides directions for completion of the survey, 3) describes potential incentives/rewards, and 4) provides a contact number to address further questions. In 2004, the cover letter was divided into two components: an introductory portion, and a document of informed consent. These mailings are sent to the mothers approximately 2-4 months after they have given birth, and the data collection process lasts for approximately 60-95 days. The states included in the final data set that is released include those who achieved a 70% response rate or higher.

Data collection is attempted every month, by randomly selecting a sample of approximately 100-250 women from the current birth certificates, and then sending out the mailings to the mothers chosen. Since the birth certificates are linked to the mothers' responses, variables on the birth certificate can also be accessed for analysis. Some groups of women, who comprise high-risk populations, are sampled at a higher rate so that a sufficient quantity of data are available (CDC, 2007). The oversampling of subpopulations of interest is accomplished by the stratification of the PRAMS sample (Shulman, Gilbert, & Lansky, 2006). For the 2004 and 2005 years of PRAMS data used in this study, the stratification variables included: birthweight, Medicaid, maternal age, geographic area, maternal race/ethnicity, county density, and smoking status (CDC, 2009).

Weighting of Data

Data are weighted to account for characteristics of the mothers that may influence the response rates (e.g., single marital status). These "nonresponse" weights assume that those mothers who did not respond would have given similar answers to questions as mothers who did respond to the questionnaire. For each cell, there are at least 25 respondents. For this study, the following weights were set prior to the analysis: a finite population correction factor (fpc), a strata weight, and a final analysis weight comprised of a non-response weight, a non-coverage weight, and a sampling weight. Thus, the final analysis weight in-part, corrects for groups (e.g., obese pre-pregnancy BMI) that have higher than normal response rates. Weights are applied so that each state's data are representative of the women who gave birth in that state.

Rationale for Using PRAMS Data

The Pregnancy Risk Assessment Monitoring System (PRAMS) is a population-based data set that incorporates random sampling techniques from 30 states, 16 of which are included in the main analysis. For this study, a large sample size was used that was representative of the different regions around the U.S (e.g. Southeast, Northeast, Midwest, etc.) and hence, the different populations that reside in these regions. In addition, PRAMS includes a comprehensive list of variables regarding maternal health and behaviors during the pre-conception, antenatal, and postpartum periods. There exist no other national databases that include the significant amount of variables that PRAMS includes.

Measures/Procedures

Postpartum Depression (Dependent Variable)

PRAMS data include 12 measures of PPD. However, participating states have the option of choosing whether to use measures of PPD, if any (PPD questions are part of the standard questionnaire). For the main analysis, two measures of PPD are used:

1. Since your new baby was born, how often have you felt down, depressed, or hopeless?
    - Always
    - Often
    - Sometimes
    - Rarely
    - Never
2. Since your new baby was born, how often have you had little interest or little pleasure in doing things?
    - Always
    - Often
    - Sometimes
    - Rarely
    - Never

The states that include these PPD questions include: Alaska, Colorado, Georgia, Hawaii, Illinois, Maine, Minnesota, North Carolina, Nebraska, New Mexico, Oregon, Rhode Island, South Carolina, Utah, Vermont, and Washington. Other questions that pertain to PPD in PRAMS include whether a woman received a professional diagnosis and/or whether she sought treatment for her PPD. However, these questions were excluded from the primary analysis because the extent to which a woman is either 1) diagnosed with PPD and/or 2) received treatment for her PPD symptoms may depend on the proactive nature of the provider from whom she 1) sought

PNC from and or 2) sought her postpartum check-up visit from (as they may be two different providers and each may or may not be cognizant of or look out for PPD symptoms).

The main analysis consisted of a logistic regression model, which included the 16 states from which data were requested. Control variables for the main analysis came from the PRAMS Core Questionnaire only, since all the states are mandated to include the core questions in their state surveys (see page 59 for a list of the control variables).

In coding PPD for the logistic regression model as either “1” or “0,” a scoring system similar to the Patient Health Questionnaire was used. The Patient Health Questionnaire (PHQ) is a three-page, patient self-administered, criteria-based instrument that was created to diagnose mental disorders (e.g., major depressive disorder, panic disorder, other anxiety disorders, etc.) (Kroenke, Spitzer, & Williams, 2001). Not only have the sensitivity and specificity been established (e.g., 68-95%, 84-95% respectively) (Kroenke et al., 2001), as well as criterion validity, construct validity, test-retest reliability, and internal reliability, but the condensed 9-item module that is used to diagnose major depression and determine its severity is based on the criteria that are used in the DSM-IV to diagnose depressive disorders. Stemming from the PHQ-9, the PHQ-2 was extracted to offer clinicians a more concise measure of depression diagnosis and severity to accommodate the busy clinical settings that exist in today’s health care system (Kroenke, Spitzer, & Williams, 2003). The following two items comprise the PHQ-2 (Kroenke et al., 2003, p.1285):

“Over the last 2 weeks, how often have you been bothered by any of the following problems?”

a) “Little interest or pleasure in doing things”
b) “Feeling down, depressed, or hopeless”

The response and scoring system are as follows: “Not at all” (score = 0), “several days” (score = 1), “more than half the days” (score = 2), “nearly everyday” (score = 3) (p. 1285). Since a score is given for each of the two question, and the two scores are added to obtain one total score, the highest possible score than can be given is a 6, and the lowest possible score that can be given is a 0. A score of 3 or greater indicates major depressive disorder. The sensitivity and specificity (83% and 92%, respectively) for scores greater than or equal to three, as well as the criterion and construct validities of the entire PHQ-2 have been demonstrated (Kroenke et al., 2003). Since the questions on the PHQ-2 mirror the PRAMS PPD measures that were used for this study, a similar scoring system was used to determine PPD symptoms. However, since the PPD measure consists of a 5-item response scale, and the PHQ-2 consists of a 4-item response scale, the “sometimes” and “rarely” responses were scored as 1. Thus, the following point system was assigned to the PPD responses:

3 = Always
2 = Often
1 = Sometimes
1 = Rarely
0 = Never

For the purpose of this study, scores from 0-2 were coded as “0” (no PPD symptoms), and scores from 3-6 will be coded as “1” (PPD symptoms), similar to the coding of the PHQ-2. In addition to the logistic regression model, an ordinal logistic regression was also estimated in order to test the association of PNC on PPD when PPD is analyzed as a non-dichotomous outcome variable. For the ordinal logistic regression model, since there are two questions to represent the dependent variable (PPD), the PHQ-2 scoring system was also used in the analyses. *Note: the scores for PPD in the logistic regression represent the total score after adding the scores for both PPD questions.

Obesity (Main Independent Variable)

BMI is calculated using the following formula:

$$\text{BMI} = \frac{\text{Weight in pounds}}{\text{Square of height in inches}} \times 703 \text{ (conversion factor)} \qquad (3\text{-}1)$$

However, since maternal pre-pregnancy BMI is a variable included in the PRAMS data, there was no need to separately calculate and categorize a woman's pre-pregnancy BMI. Table 3-1 shows the BMI categories, one of which a woman's pre-pregnancy BMI is classified into.

Prenatal Care Utilization (Moderating Variable)

The Adequacy of Prenatal Care Utilization (APNCU) is an index measure of PNC that considers both the adequacy of PNC initiation, as well as the adequacy of the number of PNC services received (Kotelchuck, 1994). The benefits for using this index are as follows: 1) the APNCU offers a suitable index for assessing the degree of prenatal care utilization once care is initiated, 2) this index also separates the initiation of care from compliance with the number of visits as recommended by the American College of Gynecologists once care is initiated, 3) this index can include women who did not receive any PNC, 4) this index is valuable for research that is aimed towards enhancing PNC, 5) this index has a separate category for high-risk pregnancies (adequate plus care), and 6) this index, among others, provides the most serious depiction of prenatal care utilization (Alexander & Kotelchuck, 1996). The APNCU is calculated based on the time of PNC initiation and the number of PNC visits, adjusting for gestational age. Gestational age refers to the period from the first day of the woman's last menstrual cycle to the date of the baby's birth (National Institutes of Health, 2007). Adjusting for gestational age is important, as it may be associated with the duration of PNC as well as problems experienced during pregnancy/postpartum. The index is defined as the ratio of observed (actual) prenatal care visits (determined from the birth certificate)/expected number of PNC visits (based on recommendations from the American College of Obstetricians and Gynecologists). The percentage obtained is then categorized into one four PNC categories (see Table 3-5) (Kotelchuck, 1994).

The APNCU Index was calculated in this study by the following methods:

1) Gestational age (included in PRAMS as number of weeks) was recoded based on the number of expected visits that should occur based on a woman's gestational age. The rule of thumb is that there should be one PNC visit each month until 28 weeks (or seven months), which then changes to a PNC visit once every 2 weeks until 36 weeks (or nine months) with a PNC visit weekly until a woman gives birth (Kotelchuck, 1994). The month that a woman gave birth was not counted as a PNC visit because it was unclear whether the woman received her PNC visit for that month or not before she gave birth. Table 3-3 lists the number of expected visits dependent on the gestation age.

2) Next, month of PNC initiation was recoded into number of missed visits. Table 3-4 lists the number of missed visits depending on when a woman initiated her first PNC visit. Missed visits were calculated based on the maximum number of PNC visits a woman could miss given the month she initiated her PNC.

3) Since steps 1 and 2 comprise the denominator, a variable was next calculated subtracting the number of missed visits from the number of expected visits. This variable was labeled "indexdenominator."

4) The index was then calculated by dividing the indexdenominator variable into the "actual number of PNC visits" variable (measured in PRAMS).

5) Table 3-5 shows how each index was categorized into one of the APNCU categories. Table 3-6 presents the characteristics of the APNCU Index categories.

6) Since some women many have received the quantity of expected visits even though they initiated PNC late, all women who initiated care after the fourth month who were not initially coded into inadequate care were re-coded into inadequate care. The month of PNC initiation takes precedence over the quantity of visits when determining the APNCU (Kotelchuck, 1994). Thus, women who initiated PNC after the fourth month were filtered out of the sample, and recoded to inadequate care. Finally, the filter was removed to allow those women to remain as part of the sample; however, now with the correct APNCU. Table 3-7 contains the frequencies of women before recoding occurred, while Table 3-8 contains the frequencies of women who were incorrectly coded, and Table 3-9 contains the frequencies after recoding was accomplished.

After creating the APNCU, dummy variables were first created for each of the main effects (each pre-pregnancy BMI and each PNC utilization category). Then, dummy variables, labeled as interaction terms, were created for each combination of pre-pregnancy BMI and PNC (9 groups) to detect any differences among any of the combinations. Normal pre-pregnancy BMI and adequate PNC were the reference groups.

1) Obese/Inadequate care
2) Overweight/Inadequate care
3) Underweight/Inadequate care
4) Obese/Intermediate care
5) Overweight/Intermediate care
6) Underweight/Intermediate care
7) Obese/Adequate-plus care
8) Overweight/Adequate-plus care
9) Underweight/Adequate-plus care

Control Variables

Control variables included maternal age, maternal education, maternal income (12 months before), maternal race, maternal ethnicity, birthweight, gender of infant, vaginal delivery, alcohol and smoking behaviors during pregnancy, participation in Women, Infants, and Children, breastfeeding practice, if the infant ended up in the ICU, pregnancy intention, how PNC was paid for (representing insurance), and maternal morbidities. All control variables were categorical except for maternal age.

Analysis

All analyses were conducted using Stata v.10. Both univariate and bivariate analyses were conducted, with chi-square tests used to test significance between groups. Significant association of PPD and maternal age was tested using a t-test, while ANOVA was used to test the association of pre-pregnancy BMI and maternal age, and PNC utilization and maternal age. The primary multivariate analysis held PPD as a dichotomous variable via a logistic regression (logit) model, while a secondary multivariate analyses held PPD as a dichotomous variable via a logistic regression (logit) model, and manually risk-adjusted for high-risk pregnancies after removing observations that met any of the criteria for a high-risk pregnancy. Thus, the sample analyzed in the secondary logistic regression model included healthy pregnancies only.

Primary Risk-Adjusted Logistic Regression

Specific aim 1:

What is the association of pre-pregnancy BMI with subsequent development of postpartum depression (PPD) symptoms?

Hypothesis: Women, who were obese before pregnancy will have the highest likelihood of PPD, followed by overweight women, then underweight women. Women who had a pre-pregnancy BMI of normal were the reference group. A dummy variable was created for each BMI category and the reference group for this analysis was normal pre-pregnancy BMI. Women who had a pre-pregnancy BMI of obese are predicted to have the highest likelihood for PPD. The β coefficients of interest in this model, and in accordance with the hypothesis, were obese pre-pregnancy BMI and underweight pre-pregnancy BMI which were expected to have the most positive (meaning the likelihood will be the highest for women in this group) and the least positive (the PPD likelihood will be the lowest for women in this group) association with PPD, respectively, relative to normal pre-pregnancy BMI (the reference group). The odds ratios were provided by STATA (exponentiating the β coefficients). Thus, it was hypothesized that the women who had a pre-pregnancy BMI of obese, relative to women who had a pre-pregnancy BMI of normal, would have the highest likelihood for PPD symptoms and that the pre-pregnancy BMI of overweight and underweight groups would have the second to highest and lowest likelihoods for PPD symptoms, respectively. Since this is a logistic regression, PPD was analyzed as a dichotomous variable, using the scoring system similar to the Patient Health Questionnaire-2 [for a complete description of the scoring system, see pp.60-61: Postpartum depression (dependent variable)]. The model specification was as follows:

$$\text{logit} = \log\left[\frac{P(Y=1)}{P(Y=0)}\right] = \alpha + \beta_1(\text{underweight}) + \beta_2(\text{overweight}) + \beta 3(\text{obese}) + \beta_k X_k$$

(control variables) + ε (3-2)

Specific aim 2:

Does PNC moderate the relationship between pre-pregnancy BMI and PPD?

Hypothesis: This aim tested whether the association of pre-pregnancy BMI with PPD symptoms varied with the level of PNC. The association between pre-pregnancy BMI and PPD symptoms was expected to remain after estimating PNC as a moderating variable. This means that women who had a pre-pregnancy BMI of obese would continue to have the highest likelihood for PPD symptoms, and women who had a pre-pregnancy BMI of underweight would have the lowest likelihood, relative to women who had a pre-pregnancy BMI of normal. However, for each pre-pregnancy BMI group, it was predicted that relative to women who received adequate PNC, the highest likelihood for PPD symptoms would decrease as follows: inadequate PNC, adequate plus PNC, intermediate PNC. Each pre-pregnancy BMI category had its own reference group: women in the BMI group who received adequate care. For example, obese inadequate, obese intermediate, and obese adequate-plus were compared to obese adequate women. The model specification for the main logistic regression was as follows:

$$\text{logit} = \log\left[\frac{P(Y=1)}{P(Y=0)}\right] = \alpha + \beta_1(\text{obese/adequate plus care}) + \beta_2(\text{overweight/adequate plus care}) + \beta_3(\text{underweight adequate plus care}) + \beta_4(\text{obese/intermediate care}) + \beta_5(\text{overweight/intermediate care}) + \beta_6(\text{underweight/intermediate care}) + \beta_7(\text{obese/inadequate care}) + \beta_8(\text{overweight/inadequate care}) + \beta_9(\text{underweight/inadequate care}) + \beta_k X_k(\text{control variables}) + \varepsilon \quad (3\text{-}3)$$

Secondary Risk-Adjusted Logistic Regression

Adequate plus, sometimes referred to as “intensive” care, is defined as PNC that is initiated by the fourth month (inclusive), and/or a woman received 110% or more of the expected number of PNC visits (Kotelchuck, 1994). A number of women in the adequate plus PNC category are considered to be a high-risk pregnancy group of women who receive more PNC than the standards as established by the American College of Obstetricians and Gynecologists (Kotelchuck, 1994). Compared to the other categories of PNC in the APNCU: inadequate, intermediate, and adequate PNC, a woman may receive adequate plus PNC if she possesses health risks such as medical conditions that can put her at a greater risk for complications and/or adverse pregnancy outcomes; hence, terming the pregnancy as “high-risk” (Chism, 1997; Kotelchuck, 1994). Thus, the increased number of PNC visits in this category is meant to allow for additional monitoring of a woman’s pregnancy by her PNC provider(s). However, some adequate plus PNC is delivered to women who seek extra PNC due to other unobserved characteristics unrelated to risk (e.g., motivation to seek more PNC than necessary because of a woman’s desires to do so). Since the APNCU index does not risk-adjust, but rather, remains a conventional index that looks at the quantity and initiation of PNC (Kotelchuck, 1994), this study sought to risk-adjust for women who received adequate plus PNC in two ways: 1) risk-adjusting by controlling for high-risk characteristics, and 2) risk-adjusting by removing observations with high-risk characteristics (e.g., women with preterm labor) from the sample. Risk-adjustment for the second model was accomplished by removing observations that met one or more of the following criteria during pregnancy:

1) Birthweight less than 2,500 grams
2) Women less than 18 years of age or greater than 40 years of age
3) Diabetes before pregnancy
4) Incompetent cervix
5) Preterm labor
6) Placenta previa or placenta abruptio
7) Bedrest
8) Car crash injury
9) Blood transfusion

10) Medical risk factors
11) Hospitalized during pregnancy

Thus, after removing these observations from the sample, it was assumed that the observations in the sample constituted pregnancies with standard, common characteristics (e.g., nausea, infant birthweight of 2,500 g or greater, etc.). A sub-analysis was estimated for the first risk-adjustment model, holding adequate plus PNC as the dependent variable and subsequently controlling for the significant variables in the main model. A further description of the sub-analysis for the first model is provided in Appendix B (pp. 156-187). A sensitivity analysis was estimated for the second risk-adjustment model. The specific aims, hypotheses, and specification for this model remained the same as the primary risk-adjusted logistic regression model.

Wald Test

Finally, to test the equality of the interaction term coefficients within each BMI category, which would test the moderating effect of PNC on the BMI and PPD association, Wald tests were performed for each model that addressed the second specific aim. Two types of Wald tests were run: 1) to determine if the coefficients were equal to one another, and 2) to determine if the coefficients were equal to 0.

Model Fit

To test the model fit of the primary and secondary logistic regression models, the Del measure was calculated. This goodness of fit measure takes the scope and precision of the model into account.

Pregnancy Risk Assessment Monitoring System (PRAMS) Data Changes: Merging Strata

The PSU in this study was the woman herself. Since STATA would not analyze strata with only one PSU, frequencies were run on the strata weight variable and four strata were identified with less than ten PSUs (1 strata with 1 PSU, 2 stratas with 2 PSUs, and 1 strata with 9 PSUs). These strata were then merged into the strata with the largest number of PSUs, after which the analysis was accomplished.

Pregnancy Risk Assessment Monitoring System (PRAMS) Data Changes: Dropped Cases

Since the loss of an infant can be traumatic for a mother, women who reported having an infant that did not live were removed from the analysis (*N*= 1,032).

Pregnancy Risk Assessment Monitoring System (PRAMS) Data Changes: Imputed Data

Since the income variable included in the analysis had 3,346 missing values (more missing values than most of the other variables included in the analysis), the data were imputed via the conditional means approach using the following steps:

1) An OLS regression was estimated on demographic variables included in the multivariate analyses.
2) Predicated values were calculated after running the OLS regression.
3) The missing values were replaced with the predicted values.

However, prior to imputation, because some states include different types of questions with respect to the same income category, data were collapsed to reflect four income categories. Table 3-10 shows the raw income variable’s categories and Table 3-11 shows the collapsed income variable before it was imputed.

In addition, the variables representing how PNC was paid for, and the maternal morbidities were imputed using a conditional means approach. This was accomplished due to the large number of missing values for some of the variables in these categories.

Table 3-1. Specific aims, dependent, and independent variables

Specific aim	Dependent variable	Independent variable(s)
1	Postpartum depression	Pre-pregnancy BMI
2	Postpartum depression	Pre-pregnancy body mass index (BMI), prenatal care utilization (PNC), pre-pregnancy BMI/PNC interaction terms (moderator)

Table 3-2. Classification of body mass index (BMI)

BMI	Weight status
> 18.5	Underweight
18.5-24.9	Normal
25.0-29.9	Overweight
>/= 30.0	Obese

(National Institutes of Health, 1998)

Table 3-3. Step 1: Gestational age calculation into expected number of visits for the APNCU Index

Gestational age (in weeks)	Expected number of visits
18-20	4
21-24	5
25-28	6
29-30	7
31-32	8
33-34	9
35-36	10
37	11
38	12
39	13
40	14
41	15
42	16
43	17

Table 3-4. Step 2: Month of PNC initiation calculation into number of missed visits for the APNCU Index

Month of PNC initiation	Number of missed visits
1^{st} month	0
2^{nd} month	1
3^{rd} month	2
4^{th} month	3
5^{th} month	4
6^{th} month	5
7^{th} month	6
8^{th} month	8
9^{th} month	10

Table 3-5. Step 3: Categorization of index into categories for the APNCU Index

APNCU group	Included indices
Inadequate	Lowest thru 49.99
Intermediate	50.00 thru 79.99
Adequate	80.00 thru 109.99
Adequate plus	110.00 thru highest

Table 3-6. Characteristics of the APNCU Index groups

APNCU group	Characteristics
Inadequate care	Initiated after the 4th month; under 50% of expected visits were received; can be divided to include those who did not receive PNC
Intermediate care	Initiated by the fourth month; between 50-79% of expected visits were received.
Adequate care	Initiated by the fourth month; 80-109% of expected visits were received
Adequate plus care	Initiated by the fourth month; 110% or more of expected visits were received

(Kotelchuck, 1994)

Table 3-7. Adequacy of Prenatal Care Utilization (APNCU) Index frequencies before recoding

APNCU index	Frequency	Percentage
Inadequate	1,743	3.6%
Intermediate	7,631	15.6%
Adequate	20,678	42.2%
Adequate plus	18,952	38.7%
Total	49,004	100%

Table 3-8. Adequacy of Prenatal Care Utilization (APNCU) Index frequencies of incorrect codings (observations incorrectly coded into other PNC utilization categories that were recoded into “inadequate PNC utilization” based on the month of initiation)

APNCU index	Frequency	Percentage
Intermediate	1,680	42.4%
Adequate	1,237	31.2%
Adequate plus	1,047	26.4%
Total # of observations to be recoded into “inadequate PNC”	3,964	100%

Table 3-9. Step 4: Adequacy of Prenatal Care Utilization (APNCU) Index frequencies after recoding all cases from Table 3-8 into “inadequate PNC utilization”

APNCU Index	Frequency	Percentage
Inadequate	5,707	11.6%
Intermediate	6,584	13.4%
Adequate	19,441	39.7%
Adequate plus	17,272	35.2%
Total	49,004	100%

Table 3-10. Coding for raw income variable categories before collapsing categories

Code	Category
1	Less than 10,000
2	$10,000 to $14,999
3	$15,000 to $19,999
4	$20,000 to $24,999
5	$25,000 to $34,999
6	$35,000 to $49,999
7	$50,000 or more
8	Less than $8,000
9	$8,000 to $9,999
10	$50,000 to $74,999
11	$75,000 or more

Table 3-11. Coding for collapsed income variable categories

Code	Category
1	Less than 10,000
2	$10,000 to $24,999
3	$25,000 to $49,999
4	$50,000 or greater
Changes made	
** 2	Expanded to include income up to $24,999
** 3 and 4	Collapsed into category 2
** 5	Category number changed to 3 and expanded to include income up to $49,999
** 6	Collapsed into category 3
** 7	Category number changed to 4
**8	Collapsed into category 1
**9	Collapsed into category 1
**10	Collapsed into category 4
**11	Collapsed into category 4

CHAPTER 4
RESULTS

In this chapter, 1) the PRAMS sample is described through univariate analyses, and 2) bivariate analyses indicating percentages and chi-square significance for a) the dependent variable (PPD), b) each of the primary independent variables of interest, pre-pregnancy BMI and PNC utilization, and c) adequate plus PNC. Then, the results from the multivariate analyses are discussed via the primary risk-adjusted logistic regression model and the secondary risk-adjusted logistic regression, which removed high-risk pregnancies from the sample.

Univariate Analyses

The description of the sample is presented in Table 4-1 for the categorical variables, and Table 4-2 for the one continuous variable in this study, maternal age. Table 4-1 describes 1) the distribution of the dependent variable (PPD symptoms), 2) the distribution of the main independent variables (pre-pregnancy BMI and PNC utilization), and 3) the distribution of the 39 categorical control variables included in the analyses. Control variables were organized in the table by “main variables,” “demographic control variables,” “insurance control variables,” “pregnancy and delivery control variables,” “high-risk maternal morbidity control variables,” and “non high-risk maternal morbidity control variables.” The latter two labels were added since the secondary analysis sought to distinguish “high-risk” from “healthy” pregnancies. Table 4-2 presents the mean, standard deviation, maximum and minimum values for maternal age. Basic demographic frequencies for the entire sample show that the largest percentage of women in the sample were of White race (63.64%), about half of the women received a secondary education or less (49.45%), and 63.29% of the women were married. Finally, the income distribution consisted of about 20% each for women who received less than $10,000 and women who received between $25,000 to $49,999 (22.80%), and about 30% each for women who received between $10,000 to $24,999 (28.18%) and women who received $50,000 or greater (28.69%).

PPD symptom frequencies for the sample analyzed in the primary risk-adjusted logistic regression (including all pregnancies), and the sample analyzed in the secondary risk-adjusted logistic regression (including healthy pregnancies only) were provided in Table 4-1 to compare the distribution of PPD symptoms in a sample including women comprising healthy and high-risk pregnancies, versus a sample that removed high-risk pregnancies and included healthy pregnancies only. For PPD symptoms, the frequencies showed that among 45,285 women included in the primary risk-adjusted logistic regression model, the prevalence of postpartum "blues" was 84.6%, while the prevalence of PPD symptoms in the sample was approximately 15.4%. Removing the high-risk pregnancies from the analysis, to include only healthy pregnancies with "common" pregnancy characteristics (e.g., nausea) showed that among the 15,443 women included in this sample, the prevalence of postpartum "blues" was higher, at 88.5% and the prevalence of PPD symptoms was lower, at 11.5%.

Frequencies for the primary main effect independent variable, pre-pregnancy BMI, showed a high number of women who had an obese pre-pregnancy BMI (n=10,270; 22.15%). This group of women comprised the second highest group in the sample, following the reference group, women with a normal pre-pregnancy BMI, who comprised about half of the sample (n=23,834; 51.40%). The number and percent of women who had an obese pre-pregnancy BMI was nearly twice as great as those of the group of women who were the lowest in number: women who had an overweight pre-pregnancy BMI (n=5,888; 12.70%). Finally, the number of women who had an underweight pre-pregnancy BMI was not considerably higher than the number of women who had an overweight pre-pregnancy BMI (n=6,379; 13.76%). For the secondary main effect (moderating) independent variable, PNC utilization, the highest percentage was also comprised of the reference group, women who utilized an “adequate” quantity of PNC (n=19,258; 40.03%). However, the second highest number was comprised of women who utilized an “adequate plus” quantity of PNC (n=16,748; 34.82%). This group of women nearly tripled the number of women who utilized an “inadequate” quantity of PNC (n=5,568; 11.58%). Finally, the number of women who utilized an “intermediate” quantity of PNC was not considerably different from the number of women who utilized an “inadequate” quantity of PNC” (n=6,529; 13.57%).

Due to the high number of women who utilized “adequate plus” PNC, it was speculated that reasons for this high number could be attributed to either 1) high-risk status, or 2) a woman’s own desire to seek more PNC than necessary (as established in medical guidelines). In attempts to distinguish pregnancies that were high-risk versus pregnancies that experienced normal, standard pregnancy-related troubles (e.g., nausea), 17 maternal morbidity control variables were included in this study. The morbidity variables representative of high-risk and removed, in-part, from the secondary sample (to include healthy pregnancies only) included nine variables: 1) Diabetes before pregnancy, 2) incompetent cervix, 3) preterm labor, 4) placenta previa or abruptio, 5) bedrest, 6) car crash injury, 7) blood transfusion, 8) having general medical risk factors, and 9) hospitalization during pregnancy. The distribution of the high-risk morbidity variables was as follows: 1) four of the variables were comprised of less than 5% of the sample (less than 5% of the women answered “yes” to having had the morbidity during pregnancy), with the lowest percentage representing women who had a blood transfusion during pregnancy (n=677; 1.31%), 2) one variable was comprised of a percentage between 5-10%, and 3) the remaining four variables were comprised of percentages between 10-40%, with the highest percentage representing women who had general medical risk factors during pregnancy (n=18,209; 35.29%). Since the largest percentage of the high-risk morbidity variables represented a general measure (women who answered "yes" to having had medical risk factors during pregnancy), the highest percentage representing a single, defined morbidity was comprised of about 25% of the sample: women who had preterm labor (n=13,595; 26.35%). Among the non high-risk morbidity variables, the distribution occurred as follows: 1) one variable was comprised of less than 10% of the sample, with the lowest percentage representing women who had gestational diabetes (n=4,786; 9.28%) 2) four variables were comprised of percentages between 10-20%, and 3) the remaining two variables were comprised of percentages between 20-40%, with labor/delivery complications comprising the highest percentage (n=18,131; 35.14%). Similar to the high-risk morbidity variables, since the largest percentage for the non high-risk morbidity variables represented a general measure (women who answered "yes" to having had labor/delivery complications), the highest percentage representing a single, defined morbidity involved a very common morbidity in pregnant women: nausea, comprising about 30% of the sample (n=15,104; 29.27%). To further examine characteristics of women who utilized "adequate plus" PNC versus women who utilized other quantities of PNC, beyond frequencies, chi-square analyses, presented in the next section, were carried out.

Bivariate Analyses

Chi-square analyses, presented in Tables 4-3, 4-5, and 4-6 respectively, were performed to examine relationships between 1) the dependent variable (PPD) and each of the following: a) pre-pregnancy BMI, b) PNC utilization, and c) each of the control variables, 2) the primary main effect independent variable (pre-pregnancy BMI) and each of the control variables, and 3) the secondary main effect independent variable (the moderating variable, PNC utilization) and each of the control variables. Also, since there were many women who utilized adequate plus PNC, the highest quantity of PNC, chi-square analyses, presented in Appendix B (pp. 156-187), were performed with adequate plus PNC to further describe characteristics of women who utilized this quantity of PNC. All chi-square analyses were carried out in order to test the specific aims, and to determine the significance of the relationships between the variables of interest (PPD symptoms, pre-pregnancy BMI, and PNC utilization) and the control variables. Table 4-4 presents the results from the t-test for the continuous variable, maternal age, with PPD symptoms.

Since PPD symptoms was the dependent variable in this study, chi-square analyses were estimated to examine the relationship of characteristics among women who were categorized as experiencing PPD symptoms versus those who were categorized as not experiencing PPD symptoms. Table 4-3 shows that there was a significant difference in percentages of PPD symptoms across the four pre-pregnancy BMI categories ($p<0.05$), with normal pre-pregnancy BMI displaying the highest percentage of PPD symptoms, followed by women who had an obese pre-pregnancy BMI. Overweight pre-pregnancy BMI displayed the lowest percentage of PPD symptoms, while the percentage of women who had an underweight pre-pregnancy BMI was not considerably higher than the percentage of women who had an overweight pre-pregnancy BMI. In fact, the percentage of women who had an obese pre-pregnancy BMI with PPD symptoms was twice as much as the percentage of women who had an overweight pre-pregnancy BMI. As for PNC utilization, there was a significant difference in percentages of PPD symptoms among the four PNC utilization categories. Women who utilized adequate plus PNC displayed the highest percentage for PPD symptoms, followed by women who utilized adequate PNC. Women who utilized intermediate PNC displayed the lowest percentage for PPD symptoms, while the percentage of women who utilized inadequate PNC was not considerably higher. Overall, chi-square results in comparing chi-square statistics for 41 variables showed a significant difference in percentages for PPD symptoms across all the variables ($p<0.05$), except for three variables that did not show any significant difference (PNC paid by: Native American Health Services, gender of the infant, and labor abnormalities), and one variable that was significantly different at a $p<0.10$ (labor/delivery complications).

Since pre-pregnancy BMI was the primary independent variable in this study, chi-square analyses were estimated to examine the relationship of characteristics among women from all four pre-pregnancy BMI categories. Table 4-5 shows that there was a significant difference for prenatal care (PNC) utilization frequencies among all pre-pregnancy BMI groups ($p<0.05$). The percentages of PNC utilization for each pre-pregnancy BMI group were not considerably different from the percentages presented in the univariate analysis for PNC utilization. It was only for obese pre-pregnancy BMI that the percentage of women who utilized adequate plus PNC slightly increased (about 4% higher) than the average percentage for the other pre-pregnancy BMI groups.

Further addressing bivariate results for pre-pregnancy BMI, since women who had an obese pre-pregnancy BMI were the focus of this study, it is especially worthy to note the bivariate characteristics of women who had an obese pre-pregnancy BMI. For example, in looking at the frequencies of the 17 maternal morbidities presented in Table 4-5 with pre-pregnancy BMI, given the 14 morbidities in which there was a significant difference, except for two variables: preterm labor and placental problems (placenta previa or abruptio), women who had an obese pre-pregnancy BMI always comprised the highest percentage of women who experienced those morbidities when comparing the percentages for all four pre-pregnancy BMI groups. The highest percentage for preterm labor and placental problems was for women who had an underweight pre-pregnancy BMI. To further note relevant bivariate statistics, women who had an underweight pre-pregnancy BMI also had the highest percentage (26.6%) of low birth weight babies (between 1,500 to 2,499 grams), while women who had an obese pre-pregnancy BMI had the highest percentage (7.95%) of “very low birth weight” babies (less than 1,500 grams), compared to women from the three other pre-pregnancy BMI groups. Overall, chi-square results in comparing chi-square statistics among women from all pre-pregnancy BMI groups for 40 variables showed a significant difference among all the characteristics ($p<0.05$), except for six variables that did not show any significant difference (PNC paid by the military, gender of the infant, weight gain talk during pregnancy, car crash injury, blood transfusion, and labor/delivery complications).

Since PNC utilization was the secondary independent variable (the moderating variable) in this study, chi-square analyses were estimated to examine the relationship of characteristics among women from all four PNC utilization categories (Table 4-6). Overall, chi-square results among all women in PNC utilization groups for 39 variables showed a significant difference among all the characteristics ($p<0.05$), except for one variable that did not show any significant difference (gender of the infant).

Due to a large number of women who utilized “adequate plus” PNC, chi-square statistics, presented in Appendix B (pp.156-187), were estimated to examine the relationship of characteristics among women who were categorized as utilizing adequate plus PNC versus those who were categorized as utilizing other quantities of PNC. Comparing pre-pregnancy body mass indices (BMIs) among women who did not receive adequate plus PNC versus women who utilized adequate plus PNC, there was a larger percentage of women in each pre-pregnancy BMI group for women who did not receive adequate plus PNC, except for women who had an obese pre-pregnancy BMI; hence, 24.6% of women who utilized adequate plus PNC had an obese pre-pregnancy BMI, while 20.6% of women who “utilized other quantities of PNC” had an obese pre-pregnancy BMI.

Finally, in comparing the morbidity variables among women who utilized adequate plus PNC, overall results showed that the women who received adequate plus PNC were medically and obstetrically high risk. These results provided a basis for controlling for high-risk characteristics in the multivariate analyses.

A number of multivariate models were estimated in addition to 1) the univariate statistics that gave a general overview of the sample characteristics, many of which were noteworthy, and 2) the bivariate statistics that gave an indication of frequencies and significance between each variable of interest: PPD symptoms, pre-pregnancy BMI, PNC utilization, and adequate plus PNC, and the other variables included in this study (e.g., control variables). Since the chi-square analyses demonstrated significant differences between women with PPD symptoms versus women without PPD symptoms, among all four pre-pregnancy BMI groups and all four PNC utilization groups (the two independent variables of interest), a variety of multivariate analyses were conducted to determine if these relationships would remain. The multivariate analyses, which included a variety of logistic regression models, were estimated to 1) determine if significance with the variables of interest (e.g., PPD symptoms, pre-pregnancy BMI) would be demonstrated, thus supporting the specific aims and hypotheses, and 2) find the best model fit for the specific aims and hypotheses proposed for this study.

Multivariate Analyses

A variety of logistic regression (logit) models were estimated in attempts to demonstrate 1) an association between pre-pregnancy BMI and PPD symptoms, and 2) a moderating effect of PNC in the association between pre-pregnancy BMI and PPD symptoms. Logistic regression models for both specific aims were estimated since this study sought to detect a moderating effect of PNC utilization as opposed to a mediating effect. Six of these models are presented in the main analyses, and the other ten models are presented in B (pp.156-187). All odds ratios were calculated using a 95% confidence interval.

Primary Risk-Adjusted Logistic Regression Analysis

Baseline model

Table 4-7 presents the results from the baseline logit model that was estimated for pre-pregnancy BMI and PNC utilization only, without the control variables and interaction effects. This model showed significance for obese pre-pregnancy BMI, suggesting an association between women from this pre-pregnancy BMI category only, and PPD symptoms. Compared to women who had a pre-pregnancy BMI of normal, women who had a pre-pregnancy BMI of obese had 15% greater odds for PPD symptoms (OR=1.15, p=0.02). All PNC utilization categories were significant in the baseline model, suggesting a general association between PNC utilization and PPD symptoms. Compared to women who utilized adequate PNC, women who utilized inadequate PNC had 84% greater odds (OR=1.84, p<0.0001) for PPD symptoms, while women who utilized intermediate PNC had approximately one-fifth greater odds (OR=1.19, p=0.02), and finally, women who utilized the highest quantity of PNC, adequate plus, had 28% greater odds for PPD symptoms (OR=1.28, p<0.0001).

Specific aim 1

The model presented in Table 4-8 sought to detect an association between the main effects of pre-pregnancy BMI and PPD symptoms, while taking into account the control variables identified in the chi-square analyses. However, unlike the baseline model, only borderline significance was found for underweight pre-pregnancy BMI. In contrast to the hypothesis, this group had lower odds for PPD symptoms compared to women who had a normal pre-pregnancy BMI (OR=0.87, p=0.08). Thus, specific aim 1 was not supported. In addition, the association between PNC utilization and PPD symptoms was not found in this controlled analysis.

Specific aim 2

The model presented in Table 4-9 sought to detect a moderating effect of PNC in the association between pre-pregnancy BMI and PPD by including interaction terms between each combination of pre-pregnancy BMI and PNC utilization category. This "all-inclusive" model included the main effects, interaction effects, and control variables. However, despite the significance seen for underweight pre-pregnancy BMI in the previous model, this effect disappeared as significance was not seen for any of these main effects. No moderating effect of PNC was apparent for any of the pre-pregnancy BMI groups either. Figure 4-2 presents a graph of the odds ratios for the interaction effects within each pre-pregnancy BMI group.

Secondary Risk-Adjusted Logistic Regression: Subpopulation With Healthy Pregnancies

Another approach was taken to test the specific aims. The logistic regression models carried out under this approach consisted of women who had normal, healthy pregnancy characteristics. For a list of the characteristics that constituted high-risk characteristics and were removed from these analyses, please refer to pp.68-70. The risk-adjustment process was accomplished by removing high-risk pregnancies from the analysis.

Baseline model

This model, presented in Table 4-11, showed significance in the baseline model among women who utilized inadequate PNC. Compared to women who utilized adequate PNC, they had 97% greater odds (OR=1.97, $p<0.0001$) for PPD symptoms (Table 4-15). Compared to the baseline model for the entire population (Table 4-7), the significant relationship of obese pre-pregnancy BMI with PPD symptoms, and the significant relationships of intermediate and adequate plus PNC utilization with PPD symptoms disappeared.

Specific aim 1

The presented in Table 4-12, which included the main effects and the control variables, did not show any significance among the main effects. Thus, after adding the control variables to the baseline model for the logistic regression that removed high-risk pregnancies, the significance of inadequate PNC also disappeared.

Specific aim 2

The all-inclusive model, presented in Table 4-13, showed borderline significance among women who had a pre-pregnancy BMI of obese and utilized inadequate PNC. However, contrary to what was expected, women who had a pre-pregnancy BMI of obese and utilized inadequate PNC had roughly half the odds (OR=0.51, $p<0.08$) for PPD symptoms compared to women who had a pre-pregnancy BMI of obese and utilized adequate PNC.

Wald Test

Tables 4-10 and 4-14, present the results from the main risk-adjusted logistic regression and the risk-adjusted logistic regression that removed the high-risk pregnancies (respectively). The results of the Wald tests indicated that the PNC categories within each pre-pregnancy BMI group were not different from each other; hence, no moderating effect of PNC was seen after performing these tests.

Model Fit

The Del measures calculated for the primary and secondary logistic regression models were 0.03 and 0.02, respectively. The Del values of both models indicated a poor model fit in the ability to predict PPD symptoms.

Table 4-1. Univariate statistics for all categorical variables included in the bivariate and multivariate analyses

Categorical variables	N	Frequency (%)
Main variables		
Primary analysis dependent variable: Postpartum depressive symptoms (risk-adjusted logistic regression including all pregnancies)	45,285	
No		38,320 (84.62%)
Yes		6,965 (15.38%)
Secondary analysis dependent variable: Postpartum depressive symptoms (risk-adjusted logistic regression including healthy pregnancies only)	15,443	
No		13,662 (88.5%)
Yes		1,781 (11.5%)
Main independent variable: Pre-pregnancy body mass index (BMI)	46,371	
Underweight		6,379 (13.76%)
Normal		23,834 (51.40%)
Overweight		5,888 (12.70%)
Obese		10,270 (22.15%)
Main independent variable: Adequacy of Prenatal Care Utilization (APNCU) Index	48,103	
Inadequate		5,568 (11.58%)
Intermediate		6,529 (13.57%)
Adequate		19,258 (40.03%)
Adequate plus		16,748 (34.82%)
Demographic control variables		
Maternal race: White	49,119	
No		17,858 (36.36%)
Yes		31,261 (63.64%)
Maternal race: Black	49,119	
No		41,400 (84.29%)
Yes		7,719 (15.71%)
Maternal race: Other	49,119	
No		38,980 (79.36%)
Yes		10,139 (20.64%)
Hispanic	48,972	
Not Hispanic		39,792 (81.55%)
Hispanic		9,000 (18.45%)
Maternal education	50,765	
0-8 years		2,266 (4.46%)
9-11 years		7,294 (14.37%)
12 years		15,542 (30.62%)
13-15 years		11,871 (23.38%)
16+ years		13,792 (27.17%)

Table 4-1. Continued

Categorical variables	N	Frequency (%)
Income (12 months prior)	51,600	
Less than $10,000		10,489 (20.33%)
$10,000 to $24,999		14,542 (28.18%)
$25,000 to $49,999		11,765 (22.80%)
$50,000 or more		14,804 (28.69%)
Marital status	51,564	
Married		32,635 (63.29%)
Other		18,929 (36.71%)
Insurance control variables		
PNC paid by income	51,600	
No		41,349 (80.13%)
Yes		10,251 (19.87%)
PNC paid by insurance/HMO	51,600	
No		25,598 (49.61%)
Yes		26,002 (50.39%)
PNC paid by Medicaid	51,600	
No		30,395 (58.91%)
Yes		21,205 (39.16%)
PNC paid by military	51,600	
No		50,488 (97.84%)
Yes		1,112 (2.16%)
PNC paid by Native American Health Services	51,600	
No		51,097 (99.03%)
Yes		503 (0.009%)
Pregnancy and delivery control variables		
Birthweight	51,559	
Less than 1,500 g		2,754 (5.34%)
1,500 g -2,499 g		10,920 (21.18%)
2,500 g or greater		37,885 (73.48%)
Smoking during pregnancy	51,147	
No		45,569 (89.09%)
Yes		5,578 (10.91%)
Vaginal delivery	51,544	
No		16,286 (31.60%)
Yes		35,258 (68.40%)
Gender of infant	51,599	
Male		26,061 (50.51%)
Female		25,538 (49.49%)
Infant in the intensive care unit (ICU)	50,758	
No		40,259 (79.32%)
Yes		10,499 (20.68%)

Table 4-1. Continued

Categorical variables	N	Frequency (%)
Pregnancy intention	50,893	
No		26,143 (51.37%)
Yes		24,750 (48.63%)
Breastfed (ever)	50,408	
No		9,454 (18.75%)
Yes		40,954 (81.25%)
Alcohol consumption in the last three months of pregnancy	50,603	
No		47,291 (93.45%)
Yes		3,312 (6.55%)
Women, Infants, and Children (WIC) during pregnancy	50,878	
No		27,037 (53.14%)
Yes		23,841 (46.86%)
Subpopulation variable (Appendix B): Weight gain talk during pregnancy	9,377	
No		2,088 (22.27%)
Yes		7,289 (77.73%)
High-risk maternal morbidity control variables		
Diabetes before pregnancy	51,600	
No		50,505 (97.88%)
Yes		1,095 (2.12%)
Incompetent cervix	51,600	
No		50,640 (98.14%)
Yes		960 (1.86%)
Preterm labor	51,600	
No		38,005 (73.65%)
Yes		13,595 (26.35%)
Placenta previa or placenta abruptio	51,600	
No		48,142 (93.30%)
Yes		3,458 (6.70%)
Bedrest	51,600	
No		40,099 (77.71%)
Yes		11,501 (22.29%)
Car crash injury	51,600	
No		50,698 (98.25%)
Yes		902 (1.75%)
Blood transfusion	51,600	
No		50,923 (98.69%)
Yes		677 (1.31%)
Medical risk factors	51,600	
No		33,391 (64.71%)
Yes		18,209 (35.29%)

Table 4-1. Continued

Categorical variables	N	Frequency (%)
Hospitalized during pregnancy	51,600	
No		41,638 (80.69%)
Yes		9,962 (19.31%)
Non high-risk maternal morbidity control variables		
Gestational diabetes	51,600	
No		46,814 (90.73%)
Yes		4,786 (9.28%)
Kidney/bladder infection	51,600	
No		42,178 (81.74%)
Yes		9,422 (18.26%)
Nausea	51,600	
No		36,496 (70.73%)
Yes		15,104 (29.27%)
High blood pressure	51,600	
No		43,739 (84.77%)
Yes		7,861 (15.23%)
Vaginal bleeding	51,600	
No		42,682 (82.70%)
Yes		8,918 (17.28%)
Premature rupture of membrane (PROM)	51,600	
No		46,282 (89.69%)
Yes		5,318 (10.31%)
Labor abnormalities	51,600	
No		40,934 (79.33%)
Yes		10,666 (20.67%)
Labor/delivery complications	51,600	
No		33,469 (64.86%)
Yes		18,131 (35.14%)

The dependent variable for this table was postpartum depression (PPD) symptoms, while the main independent variables were pre-pregnancy body mass index (BMI) and prenatal care (PNC) utilization. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005.

Table 4-2. Univariate statistics (continuous variable)

Variable (continuous)	N	Mean	Standard deviation	Minimum	Maximum
Maternal age	51,596	27.46	6.195	12	55

The dependent variable for this table was postpartum depression (PPD) symptoms, while the main independent variable was maternal age. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005.

Table 4-3. Chi-square analyses comparing 41 characteristics among women with postpartum depressive (PPD) symptoms versus women without postpartum depressive (PPD) symptoms

Categorical variables	Dependent variable: No PPD symptoms (Frequency, %)	n for no PPD symptoms	Dependent variable: Yes PPD symptoms (Frequency, %)	n for yes PPD symptoms	N	P-value
Main variables						
Main independent variable: Pre-pregnancy body mass index (BMI)		34,427		6,291	40,718	<0.0001*
Underweight	4,663 (13.5%)		903 (14.4%)			
Normal	17,921 (52.1%)		2,979 (47.4%)			
Overweight	4,352 (12.6%)		806 (12.8%)			
Obese	7,491 (21.8%)		1,603 (25.5%)			
Main independent variable: Adequacy of Prenatal Care Utilization Index (APNCU)		35,802		6,413	42,215	<0.0001*
Inadequate	3,841 (10.7%)		1,026 (16.0%)			
Intermediate	4,848 (13.5%)		913 (14.2%)			
Adequate	14,641 (40.9%)		2,218 (34.6%)			
Adequate plus	12,472 (34.8%)		2,256 (35.2%)			
Demographic control variables						
Maternal race: White		36,163		6,666	42,829	<0.0001*
No	12,733 (35.2%)		3,039 (45.6%)			
Yes	23,430 (64.8%)		3,672 (55.1%)			
Maternal race: Black		36,163		6,666	42,829	<0.0001*
No	31,220 (86.3%)		5,299 (79.5%)			
Yes	4,943 (13.7%)		1,367 (20.5%)			
Maternal race: Other		36,163		6,666	42,829	<0.0001*
No	28,373 (78.5%)		4,994 (74.9%)			
Yes	7,790 (21.5%)		1,672 (25.1%)			

Table 4-3. Continued

Categorical variables	Dependent variable: No PPD symptoms (Frequency, %)	n for no PPD symptoms	Dependent variable: Yes PPD symptoms (Frequency, %)	n for yes PPD symptoms	N	P-value
Hispanic		35,957		6,614	42,571	<0.0001*
Not Hispanic	29,905 (83.2%)		5,377 (81.3%)			
Hispanic	6,052 (16.8%)		1,237 (18.7%)			
Maternal education		37,695		6,836	44,531	<0.0001*
0-8 years	1,486 (3.94%)		347 (5.08%)			
9-11 years	4,824 (12.8%)		1,492 (21.8%)			
12 years	11,252 (29.9%)		2,497 (36.5%)			
13-15 years	9,021 (23.9%)		1,559 (22.8%)			
16+ years	11,112 (29.5%)		941 (13.8%)			
Income (12 months prior)		38,320		6,965	45,285	<0.0001*
Less than $10,000	6,913 (18.0%)		2,316 (33.3%)			
$10,000 to $24,999	10,258 (26.8%)		2,289 (32.9%)			
$25,000 to $49,999	9,177 (23.9%)		1,392 (20.0%)			
$50,000 or more	11,972 (31.2%)		968 (13.9%)			
Marital status		38,292		6,961	45,253	<0.0001*
Married	25,517 (66.6%)		3,425 (49.2%)			
Other	12,775 (33.4%)		3,536 (50.8%)			
Insurance control variables						
PNC paid by income		38,320		6,965	45,285	<0.0001*
No	30,259 (79.0%)		5,739 (82.4%)			
Yes	8,061 (21.0%)		1,226 (17.6%)			
PNC paid by insurance/HMO		38,320		6,965	45,285	<0.0001*
No	17,779 (46.4%)		4,528 (65.0%)			
Yes	20,541 (53.6%)		2,437 (35.0%)			
PNC paid by Medicaid		38,320		6,965	45,285	<0.0001*
No	23,928 (62.4%)		3,108 (44.6%)			
Yes	14,392 (37.6%)		3,857 (55.4%)			
PNC paid by military		38,320		6,965	45,285	<0.0001*
No	37,335 (97.4%)		6,849 (98.3%)			
Yes	985 (2.57%)		116 (1.67%)			

Table 4-3. Continued

Categorical variables	Dependent variable: No PPD symptoms (Frequency, %)	n for no PPD symptoms	Dependent variable: Yes PPD symptoms (Frequency, %)	n for yes PPD symptoms	N	P-value
PNC paid by Native American Health Services		38,320		6,965	45,285	0.18
No	37,921 (98.9%)		6,880 (98.8%)			
Yes	399 (1.04%)		85 (1.22%)			
Pregnancy and delivery control variables						
Birthweight		38,294		6,952	45,246	<0.0001*
Less than 1,500 g	1,914 (5.00%)		526 (7.57%)			
1,500 g to 2,499 g	7,702 (20.1%)		1,589 (22.9%)			
2,500 g or greater	28,678 (74.9%)		4,837 (69.6%)			
Smoking during pregnancy		37,954		6,906	44,860	<0.0001*
No	34,126 (98.9%)		5,647 (81.8%)			
Yes	3,828 (10.1%)		1,259 (18.2%)			
Vaginal delivery		38,276		6,956	45,232	0.025*
No	11,933 (31.2%)		2,263 (32.5%)			
Yes	26,343 (68.8%)		4,693 (67.5%)			
Gender of infant		38,319		6,965	45,284	0.49
Male	19,370 (50.5%)		3,552 (51.0%)			
Female	18,949 (49.5%)		3,413 (49.0%)			
Infant in the intensive care unit (ICU)		37,966		6,843	44,809	<0.0001*
No	30,591 (80.6%)		5,150 (75.3%)			
Yes	7,375 (19.4%)		1,693 (24.7)			
Pregnancy intention		37,849		6,859	44,708	<0.0001*
No	18,514 (48.9%)		4,440 (64.7%)			
Yes	19,335 (51.1%)		2,419 (35.3%)			
Breastfed (ever)		37,778		6,711	44,489	<0.0001*
No	6,589 (17.4%)		1,564 (23.3%)			
Yes	31,189 (82.6%)		5,147 (76.7%)			

Table 4-3. Continued

Categorical variables	Dependent variable: No PPD symptoms (Frequency, %)	n for no PPD symptoms	Dependent variable: Yes PPD symptoms (Frequency, %)	n for yes PPD symptoms	N	P-value
Alcohol consumption in the last three months of pregnancy		37,749		6,841	44,590	0.034*
No	35,359 (93.7%)		6,361 (93.0%)			
Yes	2,390 (6.33%)		480 (7.00%)			
Women, Infants, and Children (WIC) during pregnancy		37,921		6,874	44,795	<0.0001*
No	21,370 (56.4%)		2,641 (38.4%)			
Yes	16,551 (43.6%)		4,233 (61.6%)			
Subpopulation variable (Appendix B): Weight gain talk during pregnancy		4,990		804	5,794	<0.0001*
No	1,084 (21.7%)		224 (27.9%)			
Yes	3,906 (78.3%)		580 (72.1%)			
High-risk maternal morbidity control variables						
Diabetes before pregnancy		38,320		6,965	45,285	<0.0001*
No	37,576 (98.0%)		6,746 (96.9%)			
Yes	744 (1.94%)		219 (3.14%)			
Incompetent cervix		38,320		6,965	45,285	<0.0001*
No	37,661 (98.3%)		6,794 (97.5%)			
Yes	659 (1.72%)		171 (2.46%)			
Preterm labor		38,320		6,965	45,285	<0.0001*
No	28,714 (74.9%)		4,510 (64.8%)			
Yes	9,606 (25.1%)		2,455 (35.2%)			
Placenta previa or placenta abruption		38,320		6,965	45,285	<0.0001*
No	35,818 (93.5%)		6,409 (92.0%)			
Yes	2,502 (6.53%)		556 (7.98%)			
Bedrest		38,320		6,965	45,285	<0.0001*
No	30,153 (78.7%)		4,918 (70.6%)			
Yes	8,167 (21.3%)		2,047 (29.3%)			

Table 4-3. Continued

Categorical variables	Dependent variable: No PPD symptoms (Frequency, %)	n for no PPD symptoms	Dependent variable: Yes PPD symptoms (Frequency, %)	n for yes PPD symptoms	N	P-value
Car crash injury		38,320		6,965	45,285	<0.0001*
No	37,686 (98.4%)		6,797 (97.6%)			
Yes	634 (1.65%)		168 (2.41%)			
Blood transfusion		38,320		6,965	45,285	<0.0001*
No	37,895 (98.9%)		6,812 (97.8%)			
Yes	425 (1.11%)		153 (2.20%)			
Medical risk factors		38,320		6,965	45,285	<0.0001*
No	25,029 (65.3%)		4,304 (61.8%)			
Yes	13,291 (34.7%)		2,661 (38.2%)			
Hospitalized during pregnancy		38,320		6,965	45,285	<0.0001*
No	31,156 (81.3%)		5,269 (75.6%)			
Yes	7,164 (18.7%)		1,696 (24.4%)			
High-risk maternal morbidity control variables						
Gestational diabetes		38,320		6,965	45,285	<0.0001*
No	34,890 (91.0%)		6,210 (89.2%)			
Yes	3,430 (8.95%)		755 (10.8%)			
Kidney/bladder infection		38,320		6,965	45,285	<0.0001*
No	31,839 (83.1%)		5,172 (74.3%)			
Yes	6,481 (16.9%)		1,793 (25.7%)			
Nausea		38,320		6,965	45,285	<0.0001*
No	27,787 (72.5%)		4,137 (59.4%)			
Yes	10,533 (27.4%)		2,828 (40.6%)			
High blood pressure		38,320		6,965	45,285	<0.0001*
No	32,478 (84.8%)		5,760 (82.7%)			
Yes	5,842 (15.2%)		1,205 (17.3%)			

Table 4-3. Continued

Categorical variables	Dependent variable: No PPD symptoms (Frequency, %)	n for no PPD symptoms	Dependent variable: Yes PPD symptoms (Frequency, %)	n for yes PPD symptoms	N	P-value
Vaginal bleeding		38,320		6,965	45,285	<0.0001*
No	31,937 (83.3%)		5,486 (14.3%)			
Yes	6,383 (16.7%)		1,479 (21.2%)			
Premature rupture of membrane (PROM)		38,320		6,965	45,285	<0.0001*
No	34,536 (90.1%)		6,119 (87.9%)			
Yes	3,784 (9.87%)		846 (12.1%)			
Labor abnormalities		38,320		6,965	45,285	0.19
No	29,741 (77.6%)		5,356 (76.9%)			
Yes	8,579 (22.4%)		1,609 (23.1%)			
Labor/delivery complications		38,320		6,965	45,285	0.06**
No	25,010 (65.3%)		4,463 (64.1%)			
Yes	13,310 (34.7%)		2,502 (35.9%)			

The dependent variable for this table was postpartum depression (PPD), while the main independent variables were pre-pregnancy body mass index (BMI) and prenatal care (PNC) utilization. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005.

Table 4-4. Maternal age (continuous variable) and postpartum depression (PPD) symptoms t-test results

Group (PPD symptoms)	Observations	Mean	Standard error	Standard deviation	95% Confidence interval (lower, upper)
No	38,317	27.65	.0313	6.12	(27.58, 27.71)
Yes	6,964	25.95	.0749	6.25	(25.81, 26.10)
Combined	45,281	27.38	.0290	6.17	(27.33, 27.44)
Difference	--------	1.692	.0799	--------	(1.535, 1.849)

The dependent variable for this table was postpartum depression (PPD), while the main independent variable was maternal age. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005.

Table 4-5. Chi-square analyses comparing 40 characteristics among women from four body mass index (BMI) groups

Categorical variable	Dependent variable: Underweight pre-pregnancy BMI	n	Dependent variable: Normal pre-pregnancy BMI	n	Dependent variable: Overweight pre-pregnancy BMI	n	Dependent variable: Obese pre-pregnancy BMI	n	N	P-value
Main variable										
Adequacy of Prenatal Care Utilization Index (APNCU)		5,964		22,266		5,495		9,513	43,238	<0.0001*
Inadequate	747 (12.5%)		2,460 (11.1%)		642 (11.7%)		1,058 (11.1%)			
Intermediate	798 (13.4%)		3,243 (14.6%)		757 (13.8%)		1,190 (12.5%)			
Adequate	2,374 (39.8%)		9,179 (41.2%)		2,216 (40.3%)		3,579 (37.6%)			
Adequate plus	2,045 (34.3%)		7,384 (33.2%)		1,880 (34.2%)		3,686 (38.7%)			
Demographic control variables										
Maternal race: White		6,342		23,687		5,847		10,188	46,064	<0.0001*
No	2,349 (37.0%)		7,976 (33.7%)		2,223 (38.0%)		4,236 (41.6%)			
Yes	3,993 (63.0%)		15,711 (66.3%)		3,624 (62.6%)		5,952 (58.4%)			
Maternal race: Black		6,342		23,687		5,847		10,188	46,064	<0.0001*
No	5,507 (86.8%)		20,525 (86.7%)		4,764 (81.5%)		7,909 (77.6%)			
Yes	835 (13.2%)		3,162 (13.3%)		1,083 (18.5%)		2,279 (22.4%)			
Maternal race: Other		6,342		23,687		5,847		10,188	46,064	<0.0001*
No	4,828 (76.1%)		18,873 (79.7%)		4,707 (80.5%)		8,231 (80.8%)			
Yes	1,514 (23.9%)		4,814 (20.3%)		1,140 (19.5%)		1,957 (19.2%)			
Hispanic		6,287		23,513		5,793		10,140	45,733	<0.0001*
Not Hispanic	5,458 (86.8%)		19,895 (84.6%)		4,717 (18.4%)		8,511 (83.9%)			
Hispanic	829 (13.2%)		3,618 (15.4%)		1,076 (18.6%)		1,629 (16.1%)			
Maternal education		6,255		23,458		5,790		10,111	45,614	<0.0001*
0-8 years	187 (3.00%)		639 (2.70%)		226 (3.90%)		347 (3.43%)			
9-11 years	1,080 (17.3%)		3,075 (13.1%)		803 (13.7%)		1,357 (13.4%)			
12 years	1,944 (31.1%)		6,711 (28.6%)		1,835 (31.7%)		3,570 (35.3%)			
13-15 years	1,309 (20.9%)		5,374 (22.9%)		1,499 (25.9%)		2,898 (28.7%)			
16+ years	1,735 (27.7%)		7,659 (32.6%)		1,427 (24.6%)		1,939 (19.2%)			

Table 4-5. Continued

Categorical variable	Dependent variable: Underweight pre-pregnancy BMI	n	Dependent variable: Normal pre-pregnancy BMI	n	Dependent variable: Overweight pre-pregnancy BMI	n	Dependent variable: Obese pre-pregnancy BMI	n	N	P-value
Income (12 months prior)		6,379		23,834		5,888		10,270	46,371	<0.0001*
Less than $10,000	1,485 (23.3%)		4,402 (18.5%)		1,150 (19.5%)		2,166 (21.1%)			
$10,000 to $24,999	1,899 (29.8%)		6,105 (25.6%)		1,691 (28.7%)		3,103 (30.2%)			
$25,000 to $49,999	1,248 (19.6%)		5,229 (21.9%)		1,418 (24.1%)		2,684 (26.1%)			
$50,000 or more	1,747 (27.4%)		8,098 (34.0%)		1,629 (27.7%)		2,317 (22.6%)			
Marital status		6,376		23,832		5,884		10,262	46,354	<0.0001*
Married	3,836 (60.2%)		15,630 (65.6%)		3,737 (63.5%)		6,345 (61.8%)			
Other	2,540 (39.8%)		8,202 (34.4%)		2,147 (36.5%)		3,917 (38.2%)			
Insurance control variables										
PNC paid by income		6,379		23,834		5,888		10,270	46,371	0.02*
No	5,170 (81.0%)		18,964 (79.6%)		4,747 (80.6%)		8,272 (80.5%)			
Yes	1,209 (19.0%)		4,870 (20.4%)		1,141 (19.4%)		1,998 (19.5%)			
PNC paid by insurance/HMO		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	3,364 (52.7%)		10,677 (44.8%)		2,917 (49.5%)		5,365 (52.2%)			
Yes	3,015 (47.3%)		13,157 (55.2%)		2,971 (50.5%)		4,905 (47.8%)			
PNC paid by Medicaid		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	3,647 (57.2%)		15,148 (63.6%)		3,418 (58.1%)		5,441 (53.0%)			
Yes	2,732 (42.8%)		8,686 (36.4%)		2,470 (41.9%)		4,829 (47.0%)			
PNC paid by military		6,379		23,834		5,888		10,270	46,371	0.15
No	6,237 (97.8%)		23,237 (97.5%)		5,750 (97.7%)		10,053 (97.9%)			
Yes	142 (2.23%)		597 (2.50%)		138 (2.34%)		217 (2.11%)			
PNC paid by Native American Health Services		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	6,343 (99.4%)		23,615 (99.1%)		5,801 (98.5%)		10,129 (98.6%)			
Yes	36 (0.56%)		219 (0.92%)		87 (1.48%)		141 (1.37%)			

Table 4-5. Continued

Categorical variable	Dependent variable: Underweight pre-pregnancy BMI	n	Dependent variable: Normal pre-pregnancy BMI	n	Dependent variable: Overweight pre-pregnancy BMI	n	Dependent variable: Obese pre-pregnancy BMI	n	N	P-value
Pregnancy and delivery control variables										
Birthweight		6,373		23,819		5,880		10,265	46,337	<0.0001*
Less than 1,500 g	318 (4.99%)		1,075 (4.51%)		338 (5.74%)		816 (7.95%)			
1,500 g to 2,499 g	1,697 (26.6%)		5,052 (21.2%)		1,127 (19.2%)		2,000 (19.5%)			
2,500 g or greater	4,358 (68.4%)		17,692 (74.3%)		4,415 (75.1%)		7,449 (72.6%)			
Smoking during pregnancy		6,327		23,623		5,837		10,176	45,963	<0.0001*
No	5,522 (87.3%)		21,258 (90.0)		5,216 (89.4%)		9,000 (88.4%)			
Yes	805 (12.7%)		2,365 (10.0%)		621 (10.6%)		1,176 (11.6%)			
Vaginal delivery		6,373		23,807		5,880		10,258	46,318	<0.0001*
No	1,586 (24.9%)		6,847 (28.8%)		1,946 (33.1%)		4,381 (42.7%)			
Yes	4,787 (75.1%)		16,960 (71.2%)		3,934 (66.9%)		5,877 (57.3%)			
Gender of infant		6,379		23,833		5,888		10,270	46,370	0.332
Male	3,161 (49.6%)		12,019 (50.4%)		3,014 (51.2%)		5,195 (50.6%)			
Female	3,218 (50.4%)		11,814 (49.6%)		2,874 (48.8%)		5,075 (49.4%)			
Infant in the intensive care unit (ICU)		6,260		23,486		5,810		10,127	45,683	<0.0001*
No	5,002 (79.9%)		18,922 (80.6%)		4,605 (79.3%)		7,633 (75.4%)			
Yes	1,258 (20.1%)		4,564 (19.4%)		1,205 (20.7%)		2,494 (24.6%)			
Pregnancy intention		6,292		23,547		5,820		10,138	45,797	<0.0001*
No	3,451 (54.9%)		11,634 (49.4%)		3,051 (52.4%)		5,566 (54.9%)			
Yes	2,841 (45.1%)		11,913 (50.6%)		2,769 (47.6%)		4,572 (45.1%)			
Breastfed (ever)		6,205		23,334		5,767		10,022	45,328	<0.0001*
No	1,219 (19.6%)		3,885 (16.6%)		1,161 (20.1%)		2,315 (23.1%)			
Yes	4,986 (80.4%)		19,449 (83.4%)		4,606 (79.9%)		7,707 (76.9%)			

Table 4-5. Continued

Categorical variable	Dependent variable: Underweight pre-pregnancy BMI	N	Dependent variable: Normal pre-pregnancy BMI	n	Dependent variable: Overweight pre-pregnancy BMI	n	Dependent variable: Obese pre-pregnancy BMI	n	N	P-value
Alcohol consumption in the last three months of pregnancy		6,259		23,381		5,779		10,111	45,530	0.034*
No	5,837 (93.3%)		21,631 (92.5%)		5,437 (94.1%)		9,657 (95.5%)			
Yes	422 (6.74%)		1,750 (7.48%)		342 (5.91%)		454 (4.49%)			
Women, Infants, and Children (WIC) during pregnancy		6,291		23,512		5,813		10,145	45,761	<0.0001*
No	3,364 (53.5%)		13,885 (59.1%)		3,002 (51.6%)		4,629 (45.6%)			
Yes	2,927 (46.5%)		9,627 (40.9%)		2,811 (49.4%)		5,516 (54.4%)			
Subpopulation variable (Appendix B): Weight gain talk during pregnancy		1,008		3,543		835		1,365	6,751	0.359
No	213 (21.1%)		830 (23.4%)		199 (23.8%)		328 (24.0%)			
Yes	795 (78.9%)		2,713 (76.6%)		636 (76.2%)		1,037 (76.0%)			
High-risk maternal morbidity control variables										
Diabetes before pregnancy		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	6,327 (99.2%)		23,531 (98.7%)		5,752 (97.7%)		9,808 (95.5%)			
Yes	52 (0.82%)		303 (1.27%)		136 (2.30%)		462 (4.50%)			
Incompetent cervix		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	6,268 (98.3%)		23,440 (98.3%)		5,762 (97.9%)		10,023 (97.6%)			
Yes	111 (1.74%)		394 (1.65%)		126 (2.14%)		247 (2.40%)			
Preterm labor		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	4,462 (69.9%)		17,673 (74.2%)		4,352 (73.9%)		7,476 (72.8%)			
Yes	1,917 (30.1%)		6,161 (25.8%)		1,536 (26.1%)		2,794 (27.2%)			

Table 4-5. Continued

Categorical variable	Dependent variable: Underweight pre-pregnancy BMI	n	Dependent variable: Normal pre-pregnancy BMI	n	Dependent variable: Overweight pre-pregnancy BMI	n	Dependent variable: Obese pre-pregnancy BMI	n	N	P-value
Placenta previa or placenta abruption		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	5,872 (92.1%)		22,261 (93.4%)		5,521 (93.8%)		9,542 (92.9%)			
Yes	507 (7.94%)		1,573 (6.60%)		367 (6.23%)		728 (7.10%)			
Bedrest		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	4,978 (78.0%)		18,914 (79.4%)		4,509 (76.6%)		7,372 (71.8%)			
Yes	1,401 (22.0%)		4,920 (20.6%)		1,379 (23.4%)		2,898 (28.2%)			
Car crash injury		6,379		23,834		5,888		10,270	46,371	0.34
No	6,261 (98.2%)		23,435 (98.3%)		5,785 (98.3%)		10,070 (98.1%)			
Yes	118 (1.85%)		399 (1.67%)		103 (1.75%)		200 (1.95%)			
Blood transfusion		6,379		23,834		5,888		10,270	46,371	0.15
No	6,278 (98.4%)		23,516 (98.7%)		5,819 (98.3%)		10,145 (98.8%)			
Yes	101 (1.58%)		318 (1.33%)		69 (1.17%)		125 (1.22%)			
Medical risk factors		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	4,366 (68.4%)		16,083 (67.5%)		3,750 (63.7%)		5,776 (56.2%)			
Yes	2,013 (31.6%)		7,751 (32.5%)		2,138 (36.3%)		4,494 (43.8%)			
Hospitalized during pregnancy		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	5,122 (80.3%)		19,436 (81.5%)		4,761 (80.9%)		7,881 (76.7%)			
Yes	1,257 (19.7%)		4,398 (18.5%)		1,127 (19.1%)		2,389 (23.3%)			
Non high-risk maternal morbidity control variables										
Gestational diabetes		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	6,023 (94.4%)		22,191 (93.1%)		5,244 (89.1%)		8,641 (84.1%)			
Yes	356 (5.58%)		1,643 (6.89%)		644 (10.9%)		1,629 (15.9%)			
Kidney/bladder infection		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	5,166 (81.0%)		19,781 (83.0%)		4,770 (81.0%)		8,110 (79.0%)			
Yes	1,213 (19.0%)		4,053 (17.0%)		1,118 (19.0%)		2,160 (21.0%)			

Table 4-5. Continued

Categorical variable	Dependent variable: Underweight pre-pregnancy BMI	n	Dependent variable: Normal pre-pregnancy BMI	n	Dependent variable: Overweight pre-pregnancy BMI	n	Dependent variable: Obese pre-pregnancy BMI	n	N	P-value
Nausea		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	4,504 (70.6%)		17,330 (72.7%)		4,101 (69.7%)		6,880 (67.0%)			
Yes	1,875 (29.4)		6,504 (27.3%)		1,787 (30.3%)		3,390 (33.3%)			
High blood pressure		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	5,848 (91.7%)		20,768 (87.1%)		4,850 (82.4%)		7,655 (74.5%)			
Yes	531 (8.32%)		3,066 (12.9%)		1,038 (17.6%)		2,615 (25.5%)			
Vaginal bleeding		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	5,277 (82.7%)		19,844 (83.3%)		4,849 (82.4%)		8,305 (80.9%)			
Yes	1,102 (17.3%)		3,990 (16.7%)		1,039 (17.6%)		1,965 (19.1%)			
Premature rupture of membrane (PROM)		6,379		23,834		5,888		10,270	46,371	0.007*
No	5,683 (89.1%)		21,465 (90.1%)		5,289 (89.8%)		9,135 (88.9%)			
Yes	696 (10.9%)		2,369 (9.94%)		599 (10.2%)		1,135 (11.1%)			
Labor/delivery complications		6,379		23,834		5,888		10,270	46,371	0.36
No	4,181 (65.5%)		15,554 (65.3%)		3,814 (64.8%)		6,614 (64.4%)			
Yes	2,198 (34.5%)		8,280 (34.7%)		2,074 (35.2%)		3,656 (35.6%)			
Labor abnormalities		6,379		23,834		5,888		10,270	46,371	<0.0001*
No	5,197 (81.5%)		19,288 (80.9%)		4,667 (79.3%)		7,888 (76.8%)			
Yes	1,182 (18.5%)		4,546 (19.1%)		1,221 (20.7%)		2,382 (23.2%)			

The dependent variable for this table was pre-pregnancy body mass index (BMI), while the main independent variables were pre-prenatal care (PNC) utilization and control variables The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005.

Table 4-6. Chi-square analyses comparing 39 characteristics among women from four prenatal care (PNC) utilization groups

Categorical variable	Dependent variable: Inadequate PNC utilization	n	Dependent variable: Intermediate PNC utilization	n	Dependent variable: Adequate PNC utilization	n	Dependent variable: Adequate plus PNC utilization	n	N	P-value
Demographic control variables										
Maternal race: White		5,425		6,369		18,305		15,701	45,800	<0.0001*
No	2,579 (47.5%)		2,652 (41.6%)		6,057 (33.1%)		4,912 (31.3%)			
Yes	2,846 (52.5%)		3,717 (58.4%)		12,248 (66.9%)		10,789 (68.7%)			
Maternal race: Black		5,425		6,369		18,305		15,701	45,800	<0.0001*
No	4,336 (79.9%)		5,412 (85.0%)		15,922 (87.0%)		13,093 (83.4%)			
Yes	1,089 (20.1%)		957 (15.0%)		2,383 (13.0%)		2,608 (16.6%)			
Maternal race: Other		5,425		6,369		18,305		15,701	45,800	<0.0001*
No	3,935 (72.5%)		4,674 (73.4%)		14,631 (79.9%)		13,397 (85.3%)			
Yes	1,490 (27.5%)		1,695 (26.6%)		3,674 (20.1%)		2,304 (14.7%)			
Hispanic		5,403		6,317		18,206		15,602	45,528	<0.0001*
Not Hispanic	3,974 (73.6%)		4,956 (78.5%)		14,986 (82.3%)		13,322 (85.4%)			
Hispanic	1,429 (26.4%)		1,361 (21.5%)		3,220 (17.7%)		2,280 (14.6%)			
Maternal education		5,448		6,419		19,600		16,565	47,438	<0.0001*
0-8 years	462 (8.48%)		357 (5.56%)		719 (3.67%)		530 (3.20%)			
9-11 years	1,443 (26.5%)		985 (15.4%)		2,282 (11.6%)		2,013 (12.2%)			
12 years	1,937 (35.6%)		1,965 (30.6%)		5,523 (28.2%)		5,048 (30.5%)			
13-15 years	1,027 (18.9%)		1,494 (23.3%)		4,547 (23.2%)		4,046 (24.4%)			
16+ years	579 (10.6%)		1,618 (25.2%)		5,935 (30.3%)		4,928 (29.8%)			
Income (12 months prior)		5,568		6,529		19,258		16,748	48,103	<0.0001*
Less than $10,000	2,023 (36.3%)		1,403 (21.5%)		3,237 (16.8%)		2,944 (17.6%)			
$10,000 to $24,999	2,096 (37.6%)		1,918 (29.4%)		4,973 (25.8%)		4,495 (26.8%)			
$25,000 to $49,999	900 (16.2%)		1,473 (22.6%)		4,754 (24.7%)		3,887 (23.2%)			
$50,000 or more	549 (9.86%)		1,735 (26.7%)		6,294 (32.7%)		5,422 (32.4%)			
Marital status		5,564		6,528		19,253		16,730	48,075	<0.0001*
Married	2,362 (42.5%)		4,083 (62.5%)		13,125 (68.2%)		11,142 (66.6%)			
Other	3,202 (57.5%)		2,445 (37.5%)		6,128 (31.8%)		5,588 (33.4%)			
Insurance control variables										
PNC paid by income		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	4,590 (82.4%)		5,299 (81.2%)		15,239 (79.1%)		13,294 (79.4%)			
Yes	978 (17.6%)		1,230 (18.8%)		4,019 (20.9%)		3,454 (3454%)			
PNC paid by insurance/HMO		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	4,168 (74.9%)		3,478 (53.3%)		8,500 (44.1%)		7,418 (44.3%)			
Yes	1,400 (25.1%)		3,051 (46.7%)		10,758 (55.9%)		9,330 (55.7%)			

Table 4-6. Continued

Categorical variable	Dependent variable: Inadequate PNC utilization	n	Dependent variable: Intermediate PNC utilization	n	Dependent variable: Adequate PNC utilization	n	Dependent variable: Adequate plus PNC utilization	n	N	P-value
PNC paid by Medicaid		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	2,326 (41.8%)		3,800 (58.2%)		12,308 (63.9%)		10,143 (60.6%)			
Yes	3,242 (58.2%)		2,729 (41.8%)		6,950 (36.1%)		6,605 (39.4%)			
PNC paid by military		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	5,489 (98.6%)		6,247 (95.7%)		18,874 (98.0%)		16,526 (98.7)			
Yes	79 (1.42%)		282 (4.32%)		474 (2.46%)		222 (1.33%)			
PNC paid by Native American Health Services		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	5,472 (98.3%)		6,410 (98.2%)		19,096 (99.2%)		16,649 (99.4%)			
Yes	96 (1.72%)		119 (1.82%)		162 (0.84%)		99 (0.59%)			
Pregnancy and delivery control variables										
Birthweight		5,564		6,529		19,254		16,748	48,095	<0.0001*
Less than 1,500 g	304 (5.46%)		157 (2.41%)		403 (2.09%)		1,622 (9.68%)			
1,500 g to 2,499 g	1,178 (21.2%)		846 (13.0%)		2,531 (13.2%)		5,664 (33.8%)			
2,500 g or greater	4,082 (73.4%)		5,526 (84.6%)		16,320 (84.8%)		9,462 (56.5%)			
Smoking during pregnancy		5,508		6,484		19,170		16,668	47,830	<0.0001*
No	4,558 (82.8%)		5,840 (90.1%)		17,420 (90.9%)		14,793 (88.8%)			
Yes	950 (17.2%)		644 (9.93%)		1,750 (9.13%)		1,875 (11.2%)			
Vaginal delivery		5,567		6,527		19,246		16,737	48,077	<0.0001*
No	1,538 (27.6%)		1,708 (26.2%)		5,335 (27.7%)		6,542 (39.1%)			
Yes	4,029 (72.4%)		4,819 (73.8%)		13,911 (72.3%)		10,195 (60.9%)			
Gender of infant		5,568		6,529		19,258		16,747	48,102	0.332
Male	2,785 (50.0%)		3,360 (51.5%)		9,758 (50.7%)		8,437 (50.4%)			
Female	2,783 (50.0%)		3,169 (48.5%)		9,500 (49.3%)		8,310 (49.6%)			
Infant in the intensive care unit (ICU)		5,408		6,411		19,028		16,493	47,340	<0.0001*
No	4,267 (78.9%)		5,502 (85.8%)		16,633 (87.4%)		11,308 (68.6%)			
Yes	1,141 (21.1%)		909 (14.2%)		2,395 (12.6%)		5,185 (31.4%)			
Pregnancy intention		5,484		6,338		19,001		16,523	47,446	<0.0001*
No	3,870 (70.6%)		3,382 (53.4%)		9,098 (47.9%)		7,822 (47.3%)			
Yes	1,614 (29.4%)		3,056 (48.2%)		9,903 (52.1%)		8,701 (52.7%)			
Breastfed (ever)		5,298		6,365		18,936		16,430	47,029	<0.0001*
No	1,337 (25.2%)		1,066 (16.7%)		3,148 (16.6%)		3,256 (19.8%)			
Yes	3,961 (74.8%)		5,299 (83.3%)		15,788 (83.4%)		13,174 (80.2%)			

Table 4-6. Continued

Categorical variable	Dependent variable: Inadequate PNC utilization	n	Dependent variable: Intermediate PNC utilization	n	Dependent variable: Adequate PNC utilization	n	Dependent variable: Adequate plus PNC utilization	n	N	P-value
Alcohol consumption in the last three months of pregnancy		5,419		6,381		18,935		16,446	47,181	0.034*
No	5,074 (93.6%)		5,932 (93.0%)		17,616 (93.0%)		15,486 (94.2%)			
Yes	345 (6.37%)		449 (7.0%)		1,319 (6.97%)		960 (5.84%)			
Women, Infants, and Children (WIC) during pregnancy		5,451		6,439		19,017		16, 533	47,440	<0.0001*
No	2,137 (39.2%)		3,313 (51.5%)		10,953 (57.6%)		9,066 (54.8%)			
Yes	3,314 (60.8%)		3,126 (48.5%)		8,064 (42.4%)		7,467 (45.2%)			
Subpopulation variable (Appendix B): Weight gain talk during pregnancy		830		694		3,969		3,366	8,859	<0.0001*
No	225 (27.1%)		176 (25.4%)		887 (22.4%)		691 (20.5%)			
Yes	605 (72.9%)		518 (74.6%)		3,082 (77.7%)		2,675 (79.5%)			
High-risk maternal morbidity control variables										
Diabetes before pregnancy		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	5,427 (97.5%)		6,446 (98.7%)		18,986 (98.6%)		16,245 (97.0%)			
Yes	141 (2.53%)		83 (1.27%)		272 (1.41%)		503 (3.00%)			
Incompetent cervix		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	5,468 (98.2%)		6,448 (98.8%)		19,044 (98.9%)		16,271 (97.2%)			
Yes	100 (1.80%)		81 (1.24%)		214 (1.11%)		477 (2.84%)			
Preterm labor		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	4,159 (74.7%)		5,334 (81.7%)		15,482 (80.4%)		10,528 (62.9%)			
Yes	1,409 (25.3%)		1,195 (18.3%)		3,776 (19.6%)		6,220 (37.1%)			
Placenta previa or placenta abruption		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	5,281 (94.8%)		6,242 (95.6%)		18,289 (95.0%)		15,111 (90.2%)			
Yes	287 (5.15%)		287 (4.4%)		969 (5.03%)		1,637 (9.77%)			
Bedrest		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	4,467 (80.2%)		5,526 (84.6%)		16,144 (83.8%)		11,295 (67.4%)			
Yes	1,101 (19.8%)		1,003 (15.4%)		3,114 (16.2%)		5,453 (32.6%)			
Car crash injury		5,568		6,529		19,258		16,748	48,103	0.04*
No	5,464 (98.1%)		6,435 (98.6%)		18,948 (98.4%)		16,431 (98.1%)			
Yes	104 (1.87%)		94 (1.44%)		310 (1.61%)		317 (1.89%)			
Blood transfusion		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	5,469 (98.2%)		6,460 (98.9%)		19,093 (99.1%)		16,466 (98.3%)			
Yes	99 (1.78%)		69 (1.06%)		165 (0.09%)		282 (1.68%)			

Table 4-6. Continued

Categorical variable	Dependent variable: Inadequate PNC utilization	n	Dependent variable: Intermediate PNC utilization	n	Dependent variable: Adequate PNC utilization	n	Dependent variable: Adequate plus PNC utilization	n	**N**	P-value
Medical risk factors		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	3,464 (62.2%)		4,636 (71.0%)		13,217 (68.6%)		9,553 (57.0%)			
Yes	2,104 (37.8%)		1,893 (29.0%)		6,041 (31.4%)		7,195 (43%)			
Hospitalized during pregnancy		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	4,582 (82.3%)		5,733 (87.8%)		16,932 (87.9%)		11,641 (69.5%)			
Yes	986 (17.7%)		796 (12.2%)		2,326 (12.1%)		5,107 (30.5%)			
Non high-risk maternal morbidity control variables										
Gestational diabetes		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	5,130 (92.1%)		6,051 (92.7%)		17,774 (92.3%)		14,739 (88.0%)			
Yes	438 (7.87%)		478 (7.32%)		1,484 (7.71%)		2,009 (12.0%)			
Kidney/bladder infection		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	4,360 (78.3%)		5,477 (83.9%)		16,131 (83.8%)		13,405 (80.0%)			
Yes	1,208 (21.7%)		1,052 (16.1%)		3,127 (16.2%)		3,343 (20.0%)			
Nausea		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	3,940 (70.8%)		4,761 (72.9%)		14,024 (72.8%)		11,378 (67.9%)			
Yes	1,628 (29.2%)		1,768 (27.1%)		5,234 (27.2%)		5,370 (32.1%)			
High blood pressure		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	4,778 (85.8%)		5,850 (89.6%)		17,108 (88.8%)		13,027 (77.8%)			
Yes	790 (14.2%)		679 (10.4%)		2,150 (11.2%)		3,721 (22.2%)			
Vaginal bleeding		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	4,771 (85.9%)		5,641 (86.3%)		16,435 (85.3%)		12,944 (77.3%)			
Yes	797 (14.3%)		888 (13.6%)		2,823 (14.7%)		3,804 (22.7%)			
Premature rupture of membrane (PROM)		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	5,033 (90.4%)		6,097 (93.4%)		18,147 (94.2%)		3,949 (83.3%)			
Yes	535 (9.60%)		432 (6.61%)		1,111 (5.77%)		2,799 (16.7%)			
Labor abnormalities		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	4,385 (78.8%)		5,193 (79.5%)		15,800 (82.0%)		13,543 (80.9%)			
Yes	1,183 (21.2%)		1,336 (20.5%)		3,458 (18.0%)		3,205 (19.1%)			
Labor/delivery complications		5,568		6,529		19,258		16,748	48,103	<0.0001*
No	3,507 (63.0%)		4,401 (67.4%)		12,593 (65.4%)		10,298 (61.5%)			
Yes	2,061 (37.0%)		2,128 (32.6%)		6,665 (34.6%)		6,450 (38.5%)			

The dependent variable for this table was prenatal care (PNC) utilization, while the main independent variables were pre-pregnancy body mass index (BMI) and the control variables. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005.

Table 4-7. Primary baseline logistic regression with the main effect independent variables

Dependent variable: Postpartum (PPD) depression symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Underweight	1.047	0.54	(0.905, 1.212)
Overweight	1.05	0.52	(0.903, 1.224)
Obese	1.15	0.02*	(1.023, 1.302)
Main effect independent variable: PNC utilization			
Inadequate	1.84	<0.0001*	(1.589, 2.142)
Intermediate	1.19	0.02*	(1.025, 1.380)
Adequate plus	1.28	<0.0001*	(1.141, 1.438)

The dependent variable for this table was postpartum depression (PPD) symptoms, while the main independent variables were pre-pregnancy body mass index (BMI) and prenatal care (PNC) utilization. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval (CI).

Table 4-8. Specific aim 1: Primary risk-adjusted logistic regression with the main effect independent variables and control variables

Dependent variable: Postpartum depression (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal (reference)	1.00	---------	----------------
Underweight	0.87	0.08**	(0.735, 1.018)
Overweight	0.94	0.46	(0.798, 1.107)
Obese	0.91	0.15	(0.792, 1.036)
Main effect independent variable: PNC utilization			
Adequate (reference)	1.00	---------	----------------
Inadequate	1.10	0.26	(0.931, 1.309)
Intermediate	1.08	0.33	(0.923, 1.273)
Adequate plus	1.08	0.23	(0.952, 1.232)
Demographic control variables			
Maternal race: White (reference)	1.00	---------	----------------
Maternal race: Black	1.36	<0.0001*	(1.159, 1.592)
Maternal race: Other	1.51	<0.0001*	(1.305, 1.741)
Hispanic ethnicity	0.997	0.97	(0.848, 1.172)
Maternal education	0.91	0.003*	(0.851, 0.969)
Maternal age	0.99	0.14	(0.981, 1.003)
Higher income: $50,000 or more (reference)	1.00	---------	----------------
Very low income: Less than $10,000	2.14	<0.0001*	(1.689, 2.712)

Table 4-8. Continued

Dependent variable: Postpartum depression (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
Low income: $10,000-$24,999	1.68	<0.0001*	(1.366, 2.065)
Moderate income: $25,000-$49,999	1.51	<0.0001*	(1.269, 1.785)
Marital status	1.01	0.86	(0.882, 1.163)
Insurance control variables			
PNC paid by income (reference)	1.00	---------	----------------
PNC paid by insurance/HMO	0.90	0.18	(0.764, 1.051)
PNC paid by Medicaid	1.09	0.30	(0.926, 1.280)
PNC paid by military	0.89	0.56	(0.592, 1.325)
PNC paid by Native American/Alaskan HS	0.73	0.06**	(0.518, 1.016)
Pregnancy and delivery control variables			
Birthweight	1.05	0.45	(0.927, 1.184)
Smoking during pregnancy	0.79	0.004*	(0.676, 0.930)
Vaginal delivery	0.91	0.11	(0.805, 1.021)
Gender of infant	1.06	0.28	(0.954, 1.177)
Infant in the intensive care unit (ICU)	1.27	0.006*	(1.073, 1.504)
Pregnancy intention	0.82	0.001*	(0.722, 0.919)
Breastfed	0.93	0.31	(0.818, 1.065)
Alcohol during pregnancy	1.27	0.02*	(1.033, 1.569)
Women, Infants, and Children during pregnancy	1.05	0.47	(0.912, 1.220)
High-risk maternal morbidity control variables			
Diabetes before pregnancy	1.36	0.12	(0.928, 1.980)
Cervix sewn shut (incompetent)	0.95	0.80	(0.629, 1.427)
Preterm labor	1.44	<0.0001*	(1.262, 1.641)
Placenta previa or placenta abruptio	1.04	0.76	(0.826, 1.297)
Bedrest during pregnancy	1.16	0.047*	(1.002, 1.333)
Medical risk factors	1.12	0.07**	(0.992, 1.247)
Hospitalized during pregnancy	1.06	0.50	(0.900, 1.241)
Gestational diabetes	1.18	0.08**	(0.979, 1.424)
Vaginal bleeding	1.27	0.001*	(1.100, 1.455)
Kidney/bladder infection	1.46	<0.0001*	(1.282, 1.656)
High blood pressure	0.95	0.54	(0.814, 1.114)
Premature rupture of membrane (PROM)	0.69	0.001*	(0.549, 0.862)

The dependent variable for this table was postpartum depression (PPD) symptoms, while the main independent variables were pre-pregnancy body mass index (BMI) and prenatal care (PNC) utilization. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval and a double asterisk corresponds to a 90% confidence interval (CI).

Table 4-9. Specific aim 2: Primary risk-adjusted logistic regression with the main effect independent variables, interaction effect variables, and control variables

Dependent variable: Postpartum depression (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal (reference)	1.00	---------	----------------
Underweight	0.84	0.18	(0.656, 1.081)
Overweight	0.86	0.25	(0.656, 1.116)
Obese	0.92	0.43	(0.746, 1.133)
Main effect independent variable: PNC utilization			
Adequate (reference)	1.00	---------	----------------
Inadequate	1.11	0.40	(0.874, 1.400)
Intermediate	1.05	0.67	(0.836, 1.324)
Adequate plus	1.06	0.55	(0.882, 1.266)
Interaction effect variables: Pre-pregnancy BMI/PNC utilization			
Obese BMI/Adequate PNC (reference)	1.00	---------	----------------
Obese BMI/Inadequate PNC	0.71	0.11	(0.459, 1.083)
Obese BMI/Intermediate PNC	1.20	0.36	(0.813, 1.770)
Obese BMI/Adequate plus PNC	0.99	0.97	(0.735, 1.343)
Overweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Overweight BMI/Inadequate PNC	1.40	0.19	(0.848, 2.318)
Overweight BMI/Intermediate PNC	0.95	0.83	(0.588, 1.528)
Overweight BMI/Adequate plus PNC	1.18	0.42	(0.793, 1.743)
Underweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Underweight BMI/Inadequate PNC	1.13	0.63	(0.697, 1.822)
Underweight BMI/Intermediate PNC	0.98	0.92	(0.587, 1.620)
Underweight BMI/Adequate plus PNC	1.03	0.86	(0.703, 1.522)
Demographic control variables			
Maternal race: White (reference)	1.00	---------	----------------
Maternal race: Black	1.36	<0.0001*	(1.159, 1.591)
Maternal race: Other	1.50	<0.0001*	(1.303, 1.737)
Hispanic ethnicity	0.997	0.97	(0.848, 1.162)
Maternal education	0.91	0.003*	(0.850, 0.968)
Maternal age	0.99	0.17	(0.981, 1.003)
Higher income: $50,000 or more (reference)	1.00	---------	----------------
Very low income: Less than $10,000	2.16	<0.0001*	(1.702, 2.736)
Low income: $10,000-$24,999	1.69	<0.0001*	(1.371, 2.073)
Moderate income: $25,000-$49,999	1.50	<0.0001*	(1.267, 1.784)
Marital status	1.01	0.86	(0.882, 1.163)
Insurance control variables			
PNC paid by income (reference)	1.00	---------	----------------

Table 4-9. Continued

Dependent variable: Postpartum depression (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
PNC paid by insurance/HMO	0.90	0.18	(0.764, 1.051)
PNC paid by Medicaid	1.09	0.29	(0.928, 1.283)
PNC paid by military	0.89	0.58	(0.596, 1.335)
PNC paid by Native American/Alaskan HS	0.73	0.07**	(0.521, 1.022)
Pregnancy and delivery control variables			
Birthweight	1.05	0.44	(0.929, 1.186)
Smoking during pregnancy	0.79	0.004*	(0.677, 0.930)
Vaginal delivery	0.91	0.11	(0.806, 1.022)
Gender of infant	1.06	0.28	(0.954, 1.177)
Infant in the intensive care unit (ICU)	1.28	0.004*	(1.080, 1.514)
Pregnancy intention	0.82	0.001*	(0.724, 0.922)
Breastfed	0.93	0.31	(0.818, 1.065)
Alcohol during pregnancy	1.27	0.03*	(1.028, 1.564)
Women, Infants, and Children during pregnancy	1.05	0.49	(0.910, 1.218)
High-risk maternal morbidity control variables			
Diabetes before pregnancy	1.35	0.12	(0.929, 1.975)
Cervix sewn shut (incompetent)	0.95	0.81	(0.631, 1.432)
Preterm labor	1.44	<0.0001*	(1.261, 1.640)
Placenta previa or placenta abruptio	1.03	0.80	(0.822, 1.291)
Bedrest during pregnancy	1.16	0.04*	(1.006, 1.337)
Medical risk factors	1.11	0.07**	(0.992, 1.247)
Hospitalized during pregnancy	1.05	0.55	(0.894, 1.235)
Gestational diabetes	1.18	0.08**	(0.981, 1.433)
Vaginal bleeding	1.27	0.001*	(1.103, 1.459)
Kidney/bladder infection	1.46	<0.0001*	(1.282, 1.655)
High blood pressure	0.96	0.61	(0.817, 1.118)
Premature rupture of membrane (PROM)	0.69	0.001*	(0.553, 0.869)

The dependent variable for this table was postpartum depression (PPD) symptoms, while the main independent variables were pre-pregnancy body mass index (BMI), prenatal care (PNC) utilization, and the pre-pregnancy BMI/PNC utilization interaction effect variables. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval and a double asterisk corresponds to a 90% confidence interval (CI).

Table 4-10. Wald tests for pre-pregnancy BMI/PNC interaction terms: Primary risk-adjusted logistic regression

Interaction effect variables	P-value
Interaction effect variables tested equal to each other within a pre-pregnancy BMI group	
Obese BMI/Inadequate PNC - Obese BMI/Intermediate PNC = 0	0.11
Obese BMI/Inadequate PNC – Obese BMI/Adequate plus PNC = 0	
Overweight BMI/Inadequate PNC – Overweight BMI/Intermediate PNC = 0	0.42
Overweight BMI/Inadequate PNC - Overweight BMI/Adequate plus PNC = 0	
Underweight BMI/Inadequate PNC - Underweight BMI/Intermediate PNC = 0	0.89
Underweight BMI/Inadequate PNC - Underweight BMI/Adequate plus PNC = 0	
Each interaction effect variable tested equal to 0	
Obese BMI/Inadequate PNC = 0	0.21
Obese BMI/Intermediate PNC = 0	
Obese BMI/Adequate plus PNC = 0	
Overweight BMI/Inadequate PNC = 0	0.48
Overweight BMI/Intermediate PNC = 0	
Overweight BMI/Adequate plus PNC = 0	
Underweight BMI/Inadequate PNC = 0	0.96
Underweight BMI/Intermediate PNC = 0	
Underweight BMI/Adequate plus PNC = 0	

The dependent variable for this table was postpartum depression (PPD) symptoms, while the main independent variables were the pre-pregnancy BMI/PNC utilization interaction effect variables. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005.

Table 4-11. Secondary baseline logistic regression (healthy pregnancies only) with the main effect independent variables

Dependent variable: Postpartum depression (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Underweight	0.97	0.82	(0.744, 1.263)
Overweight	1.13	0.36	(0.870, 1.475)
Obese	1.12	0.30	(0.900, 1.403)
Main effect independent variable: PNC utilization			
Inadequate	1.97	<0.0001*	(1.529, 2.541)
Intermediate	1.05	0.68	(0.827, 1.336)
Adequate plus	1.11	0.37	(0.885, 1.388)

The dependent variable for this table was postpartum depression (PPD) symptoms, while the main independent variables were pre-pregnancy body mass index (BMI) and prenatal care (PNC) utilization. The population for this table included healthy pregnancies only, and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval and a double asterisk corresponds to a 90% confidence interval (CI).

Table 4-12. Specific aim 1: Secondary risk-adjusted logistic regression (healthy pregnancies only) with the main effect independent variables, interaction effect variables, and control variables

Dependent variable: Postpartum depression (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal (reference)	1.00	---------	----------------
Underweight	0.89	0.44	(0.672, 1.187)
Overweight	1.00	0.98	(0.746, 1.329)
Obese	0.94	0.62	(0.737, 1.199)
Main effect independent variable: PNC utilization			
Adequate (reference)	1.00	---------	----------------
Inadequate	1.17	0.30	(0.872, 1.562)
Intermediate	0.94	0.67	(0.729, 1.223)
Adequate plus	1.03	0.83	(0.805, 1.312)
Demographic control variables			
Maternal race: White (reference)	1.00	---------	----------------
Maternal race: Black	1.32	0.07**	(0.977, 1.778)
Maternal race: Other	1.81	<0.0001*	(1.426, 2.300)
Hispanic ethnicity	1.08	0.58	(0.820, 1.424)
Maternal education	0.94	0.30	(0.843, 1.055)
Maternal age	0.99	0.23	(0.965, 1.009)
Higher income: $50,000 or more (reference)	1.00	---------	----------------
Very low income: Less than $10,000	2.29	<0.0001*	(1.523, 3.445)
Low income: $10,000-$24,999	1.52	0.02*	(1.080, 2.147)
Moderate income: $25,000-$49,999	1.36	0.03*	(1.031, 1.802)
Marital status	1.01	0.91	(0.780, 1.287)
Insurance control variables			
PNC paid by income (reference)	1.00	---------	----------------
PNC paid by insurance/HMO	0.99	0.93	(0.749, 1.302)
PNC paid by Medicaid	1.34	0.046*	(1.005, 1.774)
PNC paid by military	1.15	0.66	(0.617, 2.142)
PNC paid by Native American/Alaskan HS	1.33	0.51	(0.575, 3.066)
Pregnancy and delivery control variables			
Smoking during pregnancy	0.82	0.23	(0.591, 1.135)
Vaginal delivery	0.86	0.19	(0.693, 1.075)
Gender of infant	1.16	0.12	(0.963, 1.386)
Infant in the intensive care unit (ICU)	1.22	0.30	(0.839, 1.764)
Pregnancy intention	0.86	0.15	(0.698, 1.056)
Breastfed	1.09	0.50	(0.850, 1.397)
Alcohol during pregnancy	1.14	0.47	(0.804, 1.610)
Women, Infants, and Children during pregnancy	0.94	0.62	(0.730, 1.205)

Table 4-12. Continued

Dependent variable: Postpartum depression (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
Non high-risk maternal morbidity control variables			
Gestational diabetes	1.49	0.09**	(0.940, 2.376)
Vaginal bleeding	0.80	0.15	(0.541, 1.096)
Kidney/bladder infection	1.63	<0.0001*	(1.267, 2.092)
High blood pressure	0.83	0.43	(0.528, 1.314)
Nausea	1.57	<0.0001*	(1.259, 1.948)
Premature rupture of membrane (PROM)	1.58	<0.0001*	(1.259, 1.948)
Labor abnormalities	1.32	0.01*	(1.057, 1.640)
Labor/delivery complications	0.94	0.60	(0.756, 1.177)

The dependent variable for this table was postpartum depression (PPD) symptoms, while the main independent variables were pre-pregnancy body mass index (BMI) and prenatal care (PNC) utilization. The population for this table included healthy pregnancies only, and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval and a double asterisk corresponds to a 90% confidence interval (CI).

Table 4-13. Specific aim 2: Secondary risk-adjusted logistic regression (healthy pregnancies only) with the main effect independent variables, interaction effect variables, and control variables

Dependent variable: Postpartum depression (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal (reference)	1.00	---------	----------------
Underweight	0.90	0.61	(0.606, 1.343)
Overweight	0.81	0.33	(0.531, 1.236)
Obese	1.15	0.42	(0.819, 1.612)
Main effect independent variable: PNC utilization			
Adequate (reference)	1.00	---------	----------------
Inadequate	1.25	0.26	(0.847, 1.836)
Intermediate	0.98	0.92	(0.692, 1.394)
Adequate plus	1.03	0.85	(0.743, 1.435)
Interaction effect variables: Pre-pregnancy BMI/PNC utilization			
Obese BMI/Adequate PNC (reference)	1.00	---------	----------------
Obese BMI/Inadequate PNC	0.51	0.08**	(0.243, 1.090)
Obese BMI/Intermediate PNC	0.87	0.67	(0.456, 1.654)
Obese BMI/Adequate Plus PNC	0.61	0.11	(0.331, 1.126)
Overweight BMI/Adequate PNC (reference)	1.00	---------	----------------

Table 4-13. Continued

Dependent variable: Postpartum depression (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
Overweight BMI/Inadequate PNC	1.70	0.21	(0.738, 3.902)
Overweight BMI/Intermediate PNC	1.03	0.93	(0.465, 2.299)
Overweight BMI/Adequate Plus PNC	1.73	0.16	(0.810, 3.698)
Underweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Underweight BMI/Inadequate PNC	0.88	0.70	(0.373, 2.062)
Underweight BMI/Intermediate PNC	0.89	0.78	(0.386, 2.046)
Underweight BMI/Adequate Plus PNC	1.13	0.75	(0.538, 2.367)
Demographic control variables			
Maternal race: White (reference)	1.00	---------	----------------
Maternal race: Black	1.31	0.08**	(0.969, 1.770)
Maternal race: Other	1.82	<0.0001*	(1.430, 2.307)
Hispanic ethnicity	1.08	0.57	(0.823, 1.430)
Maternal education	0.95	0.33	(0.846, 1.058)
Maternal age	0.99	0.26	(0.966, 1.009)
Higher income: $50,000 or more (reference)	1.00	---------	----------------
Very low income: Less than $10,000	2.30	<0.0001*	(1.527, 3.451)
Low income: $10,000-$24,999	1.53	0.02*	(1.082, 2.153)
Moderate income: $25,000-$49,999	1.35	0.03*	(1.023, 1.789)
Marital status	1.03	0.82	(0.810, 1.303)
Insurance control variables			
PNC paid by income (reference)	1.00	---------	----------------
PNC paid by insurance/HMO	0.99	0.94	(0.750, 1.304)
PNC paid by Medicaid	1.34	0.04*	(1.010, 1.785)
PNC paid by military	1.18	0.61	(0.633, 2.184)
PNC paid by Native American/Alaskan HS	1.27	0.59	(0.535, 2.994)
Pregnancy and delivery control variables			
Smoking during pregnancy	0.82	0.23	(0.594, 1.134)
Vaginal delivery	0.86	0.19	(0.693, 1.076)
Gender of infant	1.16	0.12	(0.965, 1.389)
Intensive care unit	1.23	0.27	(0.849, 1.780)
Pregnancy intention	0.86	0.15	(0.700, 1.058)
Breastfed	1.09	0.48	(0.852, 1.403)
Alcohol during pregnancy	1.12	0.52	(0.790, 1.591)
Women, Infants, and Children during pregnancy	0.94	0.61	(0.730, 1.203)
Non high-risk maternal morbidity control variables			
Gestational diabetes	1.48	0.096**	(0.933, 2.355)
Vaginal bleeding	0.76	0.14	(0.536, 1.088)
Kidney/bladder infection	1.63	<0.0001*	(1.266, 2.090)
High blood pressure	0.83	0.43	(0.525, 1.315)
Nausea	1.57	<0.0001*	(1.261, 1.952)
Premature rupture of membrane (PROM)	1.65	0.49	(0.393, 6.955)

Table 4-13. Continued

Dependent variable: Postpartum depression (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
Labor abnormalities	1.31	0.02*	(0.052, 0.491)
Labor/delivery complications	0.93	0.53	(0.746, 1.163)

The dependent variable for this table was postpartum depression (PPD) symptoms, while the main independent variables were pre-pregnancy body mass index (BMI), prenatal care (PNC) utilization, and the pre-pregnancy BMI/PNC utilization interaction effect variables. The population for this table included healthy pregnancies only, and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval and a double asterisk corresponds to a 90% confidence interval (CI)

Table 4-14. Wald tests for pre-pregnancy BMI/PNC interaction terms: Secondary risk-adjusted logistic regression (healthy pregnancies only)

Interaction effect variables	P-value
Interaction effect variables tested equal to each other within a pre-pregnancy BMI group	
Obese BMI/Inadequate PNC - Obese BMI/Intermediate PNC = 0	0.46
Obese BMI/Inadequate PNC – Obese BMI/Adequate plus PNC = 0	
Overweight BMI/Inadequate PNC – Overweight BMI/Intermediate PNC = 0	0.47
Overweight BMI/Inadequate PNC - Overweight BMI/Adequate plus PNC = 0	
Underweight BMI/Inadequate PNC - Underweight BMI/Intermediate PNC = 0	0.77
Underweight BMI/Inadequate PNC - Underweight BMI/Adequate plus PNC = 0	
Each interaction effect variable tested equal to 0	
Obese BMI/Inadequate PNC = 0	0.22
Obese BMI/Intermediate PNC = 0	
Obese BMI/Adequate plus PNC = 0	
Overweight BMI/Inadequate PNC = 0	0.37
Overweight BMI/Intermediate PNC = 0	
Overweight BMI/Adequate plus PNC = 0	
Underweight BMI/Inadequate PNC = 0	0.92
Underweight BMI/Intermediate PNC = 0	
Underweight BMI/Adequate plus PNC = 0	

The dependent variable for this table was postpartum depression (PPD) symptoms, while the main independent variables were the pre-pregnancy BMI/PNC utilization interaction effect variables. The population for this table included healthy pregnancies only, and the years of PRAMS data collection were for 2004 & 2005.

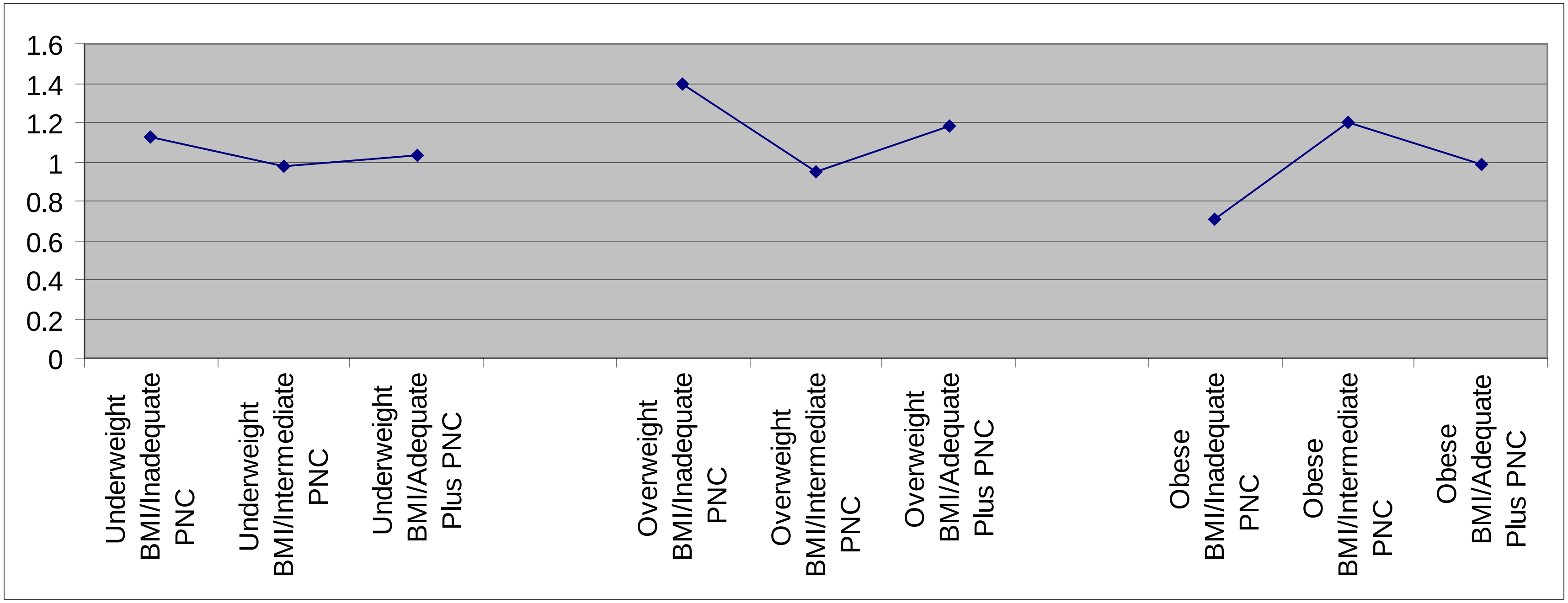

Figure 4-1. Primary risk-adjusted logistic regression with postpartum depression (PPD) symptom odds ratios for each interaction effect variable (Note: Odds ratios for PPD symptoms are presented on the vertical axis; interaction groups are presented on the horizontal axis).

CHAPTER 5
DISCUSSION

This study sought to determine the role that PNC utilization plays in the relationship between pre-pregnancy BMI and postpartum depression (PPD) symptoms among a sample of 51,600 women in the United States. These women represented 16 states across the nation: Alaska, Colorado, Georgia, Hawaii, Illinois, Maine, Minnesota, North Carolina, Nebraska, New Mexico, Oregon, Rhode Island, South Carolina, Utah, Vermont, and Washington. Even though a consistent moderating effect of PNC was not seen throughout the association between pre-pregnancy BMI and PPD symptoms, patterns that warrant attention and provide insight into this model with pre-pregnancy BMI, PNC utilization, and PPD symptoms were seen among the univariate analyses, the bivariate analyses, and the multivariate analyses

Univariate Analyses

The frequencies reported in the univariate analyses showed that there are characteristics of the sample that call for discussion. With regards to the frequencies of the dependent variable, PPD symptoms, removing the high-risk pregnancies from the analysis did not change the prevalence drastically. In comparing the frequencies of PPD symptoms with previous literature, the prevalence of postpartum “blues” was a little higher than what has been reported in previous literature, approximately 50-80%, while the prevalence of PPD symptoms was within the average range for PPD symptoms as reported in previous literature for non-psychotic PPD, or approximately 10-15% (Miller, 2002; Evins & Theofrastous, 1997; Negus Jolley & Betrus, 2007). However, in comparing PPD frequencies between this study and previous studies, it should be noted that the PPD measure used for this study was self-reported PPD symptoms whereas many of the frequencies reported in previous literature reflect those obtained from screening instruments that were used to diagnose PPD (not self-reported). However, given that the measure was self-reported, the methodology used to categorize observations into PPD symptoms versus "no" PPD symptoms mirrored an instrument that has demonstrated sensitivity and specificity, criterion and construct validities for diagnosing major depressive disorder (Kroenke et al., 2003). Also, with regard to these PPD frequencies, it is important to note that the method of categorizing PPD symptoms (e.g., "blues" versus actual depressive symptoms) for the primary risk-adjusted logistic regression model and the secondary risk-adjusted logistic regression model that removed high-risk pregnancies may have included both women who self-reported non-psychotic PPD symptoms *and* women who reported PPD psychosis symptoms. Scores of 3 or greater in the PHQ-2 are not meant to diagnose the severity of depression, but are rather used to screen for depression (Kroenke et al., 2003). Therefore, the prevalence for non-psychotic PPD symptoms in this study may have been less than 15.4% and 11.5% (as reported in this study) for the risk-adjusted primary and secondary logistic regression models, respectively.

Frequencies for the main effect independent variables showed some results that call for discussion. Though frequencies for pre-pregnancy BMI showed that over half of the women in the sample were classified as having had a normal pre-pregnancy BMI (the high number of women in this group was expected), the next highest percentage in the sample was for women who had an obese pre-pregnancy BMI (n =10,270). Some groups of women, who comprise high-risk populations, are sampled at a higher rate, via stratification variables in PRAMS, so that a sufficient quantity of data are available (CDC, 2007). Since obesity is a risk-factor that has been associated with outcomes such as complications during pregnancy (e.g., preeclampsia, respiratory problems, etc.) (LaCoursiere et al., 2005; Saravanakumar et al., 2006; Cedergren, 2004), in this study, obesity was considered to be a general risk factor for PPD symptoms. However, since the stratification variables in PRAMS for the 2004 and 2005 years of data (see p.

53 for a list of the stratification variables) did not include pre-pregnancy BMI, this group was not oversampled. If response rates are higher than normal for groups of women in PRAMS, they are automatically adjusted for by the analysis weight that was incorporated into the PRAMS dataset and used in the analyses for this study. However, in comparing these percentages with two previous studies that used PRAMS to look at pre-pregnancy BMI, Kim, Dietz, England, Morrow, & Callaghan (2007), who looked at 2002-2003 PRAMS data, showed the following ranges for pre-pregnancy BMI among 9 states: underweight (13%-16%), normal (45%-54%), overweight (11%-14%), and obese (18%-26%), while D'Angelo et al. (2007) showed the following ranges for pre-pregnancy BMI among 26 states using 2004 PRAMS data: underweight (10%-17%), normal (reference group), overweight (11%-15%), and obese (15%-26%). Thus, even though the PRAMS dataset used for this study was for 2004 and 2005, the percentages of pre-pregnancy BMI in this study were within average ranges compared to previous studies. However, the percentages of this study differ (in descending order) from the results demonstrated by LaCoursiere et al. (2006), who also sampled women through the PRAMS 2000-2001 years of data (in the state of Utah only). Results from their study showed that the highest percentage of women had a normal pre-pregnancy BMI (who represented about half of their sample), women who had an underweight pre-pregnancy BMI were the second largest in percentage (about 20% of the sample), women who had an obese pre-pregnancy BMI comprised the next group at 16%, and then women who had an overweight pre-pregnancy BMI was the lowest percentage in the sample (about 11%).

For PNC utilization, it was expected that the highest percentage would be comprised of women who utilized an "adequate" quantity of PNC. However, the next highest percentage, which included "high-risk" pregnancies, was comprised of women who utilized an "adequate plus" quantity of PNC. Even though adequacy of PNC was previously a stratification variable in PRAMS (e.g., 1990 and 1991 PRAMS data, 1995 PRAMS data) (Goodwin et al., 2006, Centers for Disease Control, 1995), it was not one of the stratification variables in the 2004 and 2005 years of data from which oversampling occurred. Thus, as mentioned for women who had an obese pre-pregnancy BMI, the high response rate for women in this PNC utilization group was adjusted for by the analysis weight that was incorporated into the PRAMS dataset and used in the analyses for this study. Comparing these percentages with trends in PNC over time, according to Kogan et al. (1998), who used national birth records, the percentage of utilization (according to the APNCU Index) occurred as follows: there was a decrease in inadequate PNC utilization from 12% in 1981 to 8.9% in 1995, there was a decrease in intermediate PNC utilization from 23.2% in 1981 to 17.2% in 1995, there was a slight decrease in adequate PNC utilization from 45.1% in 1981 to 43.9% in 1995, and there was a significant increase in adequate plus PNC (intensive) from 18.4% in 1981 to 28.8% in 1995. Thus, given the 10-year gap between Kogan et al. (1998) and the use of the APNCU Index, calculated from the PNC information provided on the birth certificates and linked with the PRAMS data, it seems that there were slight decreases in intermediate and adequate PNC utilization, as slight increases in inadequate and adequate plus PNC utilization with the data used for this study.

To further explain characteristics that may, in part, have contributed to the large number of adequate plus PNC observations, a variety of maternal morbidities that affected women in the sample were investigated, many of which provide insight into the risk-status of a large portion of the women in the sample. The univariate results for the maternal morbidities showed that there were a variety of potential health risks (maternal morbidities) that may have prompted the delivery of adequate plus PNC, as it appears that there were a number of women in the sample who possessed high-risk characteristics. One thing that is unclear, however, is whether women who answered “yes” to having medical risk factors during pregnancy in the PRAMS questionnaire had risk factors that actually warranted utilization of adequate plus PNC.

Bivariate Analyses

Given that there was a high number of women (as shown in the univariate results) who had a normal pre-pregnancy BMI, this may explain that the highest percentage of women who experienced PPD symptoms was also women from this BMI category; however, the result showing that one-fourth of women with PPD symptoms had an obese pre-pregnancy BMI, with this result being statistically significant ($p<0.0001$*) provides evidence for a significant difference in percentages for PPD symptoms across all pre-pregnancy BMI categories. The chi-square results presented for pre-pregnancy BMI and PPD symptoms mostly countered the results for pre-pregnancy BMI and PPD symptoms by LaCoursiere et al. (2006). This study showed a significant difference in percentages for PPD symptoms across pre-pregnancy BMI categories in the following order: women who had a normal pre-pregnancy BMI, who had the highest percentage of PPD symptoms, followed by women who had an obese pre-pregnancy BMI, then followed by women who had an underweight pre-pregnancy BMI, and finally, women who had an overweight pre-pregnancy BMI, who had the lowest percentage of PPD symptoms. LaCoursiere et al. (2006) showed the highest percentage of PPD symptoms among women who had an obese pre-pregnancy BMI, followed by women who had an underweight pre-pregnancy BMI, then followed by women who had an overweight pre-pregnancy BMI, and finally, women who had a normal pre-pregnancy BMI, who had the lowest percentage of PPD symptoms. The results for women without PPD symptoms for this study matched the results for women with PPD symptoms (in order), but were shown as different by LaCoursiere et al. (2006) as highest for women who had a normal pre-pregnancy BMI, followed by women who had an underweight pre-pregnancy BMI, then followed by women who had an obese pre-pregnancy BMI, and finally, women who had an overweight pre-pregnancy BMI, who had the lowest percentage. So surprisingly, and contrary to what was hypothesized for this study, these results demonstrated that women who had an overweight pre-pregnancy BMI reported the lowest percentage of self-reported PPD symptoms, whereas LaCoursiere et al. (2006) demonstrated that women who had a normal pre-pregnancy BMI reported the lowest percentage of self-reported “moderate” or “greater” PPD symptoms.

It was not surprising that there was a significant difference in percentages for PPD symptoms across the four PNC utilization groups. It is worthy to note that the highest percentage for PPD symptoms was among women who utilized adequate plus PNC. Though the outcome was a birth outcome and not a postpartum outcome, Kotelchuck (1994) revealed a “U-shaped” association between PNC utilization and low birthweight rates, with women who utilized inadequate PNC and adequate plus PNC having the highest rates of low birthweight babies. Though the adequate plus groups were on the highest end in both this study and Kotelchuck (1994), on the low end, inadequate was higher than intermediate in this study, but not as high so as to form a “U-shape” as was the case for Kotelchuck (1994); rather, the shape in this study was a “J-shape.”

Considering the variables in which there were no significant differences in percentages for PPD symptoms, it was surprising that “gender of the infant” did not demonstrate a significant difference. This is considering that women receive pressures, especially in Asian cultures, to give birth to a boy, and, giving birth to a girl, when a boy is expected, has been found to increase the risk for PPD with this risk increasing as the number of female children increase (Chan, Levy, Chung, & Lee, 2002, Dindar & Erdogan, 2007; Patel, Rodrigues, & DeSouza, 2002; Rahman, Iqbal, & Harrington, 2003). Given that the women in the sample comprised a variety of races/ethnicities, it was expected that "gender of the infant" would demonstrate a significant difference in percentages for PPD symptoms between women who gave birth to a female versus a male infant.

With regards to the chi-square analyses on pre-pregnancy BMI, the lack of a significance difference in percentages for weight gain discussion during PNC across the four pre-pregnancy BMI groups was surprising as significant difference was expected for this variable. This is considering that 1) obesity has been shown in a number of studies as a risk-factor for complications during pregnancy and/or adverse pregnancy outcomes LaCoursiere et al., 2005; Saravanakumar et al., 2006; Cedergren, 2004; Rosenberg et al., 2003; Rosenberg et al., 2005; Mahmood, 2009; Baeten et al., 2001; Cnattingius et al., 1998), 2) it has been found that women who were overweight or obese prior to pregnancy were more likely to experience excessive weight gain during pregnancy (Lederman et al., 2002; Olafsdottir et al., 2006), and 3) women who have an underweight pre-pregnancy BMI have a higher odds for delivering a preterm infant (Siega-Riz, Adair, & Hobel, 1996). However, it is recommended that 1) clinicians support and encourage women during PNC delivery in gaining the appropriate amount of weight during pregnancy (Lederman, 2001), and 2) young obese women who are planning a pregnancy be cautioned of the possible complications during pregnancy and/or at birth (Dietl, 2005). Further considering that obesity has been previously shown as a risk-factor for complications during pregnancy and/or adverse pregnancy outcomes LaCoursiere et al., 2005; Saravanakumar et al., 2006; Cedergren, 2004; Rosenberg et al., 2003; Rosenberg et al., 2005; Mahmood, 2009; Baeten et al., 2001; Cnattingius et al., 1998), it was expected that labor/delivery complications would be significantly different in percentages across the four pre-pregnancy BMI groups. However, in comparing this result with results from the multivariate analyses, significance was not demonstrated for labor/delivery complications as a high-risk variable (p. 167) with the logit model holding adequate plus PNC as the dependent variable, and for the secondary logistic regression models (that removed the high-risk pregnancies form the analyses), this variable was not significant for either specific aim 1 or specific aim 2. Thus, consistency remained with the results of this variable.

Though this may or may not have been related to PPD symptoms in this study, the chi-square analyses addressing pre-pregnancy BMI and the maternal morbidities (Table 4-5) suggest that the majority of these morbidities affected women who had an obese pre-pregnancy BMI the most (compared to the three other pre-pregnancy BMI groups). Interestingly enough, the bivariate results showed that the highest percentage of preterm labor was among women who had an underweight pre-pregnancy BMI, with these women also having the highest percentage of low birth weight babies (between 1,500 to 2,499 grams). This may be expected considering a consequence of preterm birth for the infant may be low birth weight. Surprisingly, women who had an obese pre-pregnancy BMI had the highest percentage of “very low birth weight” babies (less than 1,500 grams), compared to women from the three other pre-pregnancy BMI groups. This result is surprising considering that previous studies have found higher/excessive pre-pregnancy weight to be associated with giving birth to a macrosomic infant (Baeten et al., 2001; Rosenberg, Garbers, Chavkin, & Chiasson, 2003; Cedergren, 2004). Though it is unclear in this sample whether giving birth to a very low birth weight baby caused enough postpartum distress (e.g., depression) for a woman that was at a non-psychotic severity, previous studies have suggested an association between low birth weight and psychological distress that may call for emotional support (Singer et al., 1999; Kersting et al., 2004).

Further addressing maternal morbidities, depending on the number of morbidities a woman had, as well as the duration and severity of those morbidities, future research should seek to determine the impact of these factors, after stratifying by pre-pregnancy BMI on postpartum distress, if not on the severity of PPD. Though there are many studies to support an association between pregnancy and/or delivery complications and PPD (Josefsson et al., 2002; Leidner, Singer, Sicherman, Francoise, & Divon, 2008; Adewuya, Fatoye, Ola, Ijaodola, & Ibigbami, 2005; Campbell & Cohen, 1991), and studies that refute the association between pregnancy and/or delivery complications and PPD (Nielsen, Videbech, Hedegaard, Dalby, & Secher, 2000; Johnstone, Boyce, Hickey, Morris-Yates, & Harris, 2001), it is recommended that the study of the pathophysiology of PPD include, in-part, pregnancy complications such as bedrest, gestational diabetes, and preeclampsia (Stowe & Nemeroff, 1995).

Regarding the chi-square analyses addressing PNC utilization, it was not surprising that there was no significant difference in percentages for “gender of the infant” across the four PNC utilization groups, considering that there are no previous studies that have confirmed an association between these two variables.

With regards to the chi-square analyses that compared women who utilized adequate plus PNC versus women who utilized “other quantities of PNC,” the results showed a significant difference in percentages across the four pre-pregnancy BMI. Women who had an obese pre-pregnancy BMI were the only group of women with a higher percentage in the group that utilized adequate plus PNC, compared to the group that utilized “other quantities of PNC.” This result is worthy to note considering that 1) there were a large number of women who utilized adequate plus PNC, and 2) the primary population of focus in this study was women who had an obese pre-pregnancy BMI.

Multivariate Analyses: Primary Risk-Adjusted Logistic Regression Analysis

Baseline Model

Baseline results for the main model were somewhat consistent with conclusions made by Carter et al. (2000), and LaCoursiere et al. (2006) in that higher pre-pregnancy BMI is associated with a higher likelihood for PPD symptoms; a linear trend was seen in this study in that higher pre-pregnancy BMI increased odds for PPD symptoms. However, as for significance, it was only women in the highest pre-pregnancy BMI category, obese, which had significantly greater odds of having PPD symptoms relative to women who had a normal pre-pregnancy BMI in these models; this result matched what was predicted for women who had an obese pre-pregnancy BMI.

Looking into the association between PNC and PPD symptoms, the baseline model demonstrated that the highest likelihood for PPD symptoms among levels of PNC utilization was for inadequate PNC, followed by adequate plus PNC, and intermediate PNC, relative to adequate PNC. However, after including control variables and risk-adjusting for high-risk pregnancies that received adequate plus PNC due to a medical necessity, the statistical significance disappeared for all PNC utilization levels, demonstrating that there is no association between PNC utilization and PPD symptoms. These results were contrary to the one previous study that has looked at quantity of PNC and PPD: El-Kak et al. (2004). The authors demonstrated a linear relationship between PNC and PPD for high-risk women, where a higher number of PNC visits were associated with fewer cases of PPD. However, even though El-Kak et al. (2004) controlled for a variety of characteristics (e.g., parity, education, area of residence, employment during pregnancy) as this study also controlled for a variety of characteristics, this study varied in the measures used for PNC and PPD (compared to El-Kak et al., 2004). For example, this study used the APNCU Index (Kotelchuck, 1994) to categorize PNC utilization into inadequate, intermediate, adequate, and adequate plus, by considering the frequency of PNC visits, gestational age, and the timing of PNC initiation. El-Kak et al. (2004) analyzed each PNC measure separately: the initiation of the first PNC visit was categorized by trimester (1^{st}, 2^{nd}, 3^{rd}), the frequency of PNC visits was categorized into three categories (1–4, 5–9 and 10 + visits), and gestational age was categorized into “preterm” or “term.” With regards to pregnancy risk-status, they stratified risk status into two categories (low-risk versus high-risk), whereas this study used two different approaches to risk-adjustment: 1) including high-risk characteristics as control variables, and 2) removing the high-risk pregnancies from the analyses. This study used a 5-tier likert scale (from the PRAMS questionnaire) to categorize PPD symptoms into yes/no, whereas El-Kak et al. (2004) categorized PPD into yes/no based on the occurrence of PPD symptoms for the women in their sample. Thus, it is postulated that the differences seen in the results for both studies can be explained by the difference in the measures used for both studies.

Regarding previous studies that have used PNC indices to examine adequacy of PNC with birth outcomes, many studies have examined the effectiveness of PNC on low birth weight. Though some studies have shown that adequacy of PNC is not associated with birth weight, several studies, many of which have used indices as measures to represent PNC (Alexander & Kotelchuck, 1996), have shown the benefits of PNC utilization on birth weight (Gortmaker, 1979; Showstack, Budetti, & Minkler, 1984; Quick, Greenlick, & Roghmann, 1981; Mustard & Roos, 1994). Though the moderating effect of PNC utilization on a postpartum outcome, PPD symptoms, was not demonstrated in this study, it is recommended that research look further into the relationship between the effects of PNC on postpartum preventive behaviors (Alexander & Kotelchuck, 2001), while perhaps focusing on women who are experiencing different severities of PPD (e.g., postpartum blues versus non-psychotic PPD).

Specific Aim 1

"What is the association of pre-pregnancy body mass index (BMI) with subsequent development of postpartum depression (PPD) symptoms?"

It was predicted in the hypothesis that women who had an obese pre-pregnancy BMI would have the highest odds of PPD symptoms, followed by women who had an overweight BMI, and finally women who had an underweight BMI, who would have the lowest odds for PPD symptoms (compared to women who had a pre-pregnancy BMI of normal). The results for this logistic regression showed borderline significance only among women who had an underweight pre-pregnancy BMI, with this significance apparent at a 90% confidence interval only. Contrary to the hypothesis, this group of women had lower odds for PPD symptoms compared to women who had a normal pre-pregnancy BMI. Thus, the significant relationships demonstrated for obese pre-pregnancy BMI, and all the PNC utilization groups, all of which displayed significant higher odds for PPD symptoms in the baseline primary risk-adjusted logistic regression, disappeared after adding all the control variables. A new significant relationship for women who had an underweight pre-pregnancy BMI appeared in that they had lower odds for PPD symptoms compared to women who had a normal pre-pregnancy BMI. This result was contrary to the initial hypothesized that women who had an underweight pre-pregnancy BMI would have greater odds for PPD symptoms. The significance that appeared for women who had an underweight pre-pregnancy BMI only after adding control variables can be attributed to controlling for variables in this model that were associated with underweight pre-pregnancy BMI and positively associated with PPD symptoms. Hence, not controlling for those variables initially in the baseline model did not allow for the borderline significant association between underweight pre-pregnancy BMI and PPD symptoms to appear; after controlling for these variables, this significance was revealed. Future research should further study the significant control variables included in this model to determine which variables (e.g., race, education, income, etc.) are positively associated with PPD symptoms and associated with the appearance of this borderline significance for underweight pre-pregnancy BMI upon its inclusion in the model.

To explain the disappearance of the significance for obese pre-pregnancy BMI and all the PNC utilization groups, it might be that one or more of the control variables included in this model that was significantly associated with PPD symptoms was also confounding variable (associated with obese pre-pregnancy BMI and the PNC utilization groups in the previous model (but not controlled for). Thus, after adding the control variable(s) in the model, there was no "true association" of either obese pre-pregnancy BMI or any of the PNC utilization groups with PPD symptoms. Fifteen control variables added in this model were significantly associated with PPD symptoms; it is hypothesized that one or more of these variables were responsible for (but not controlled for) the initial significance seen for the four variables in the baseline model. Future research should seek to determine the control variables that were responsible for the significance seen for each of the four variables in the baseline model (as confounders)

Specific Aim 2

"Does PNC moderate the relationship between pre-pregnancy BMI and PPD symptoms?"

It was predicted in the hypothesis that within each pre-pregnancy BMI category, the likelihood a woman will experience PPD symptoms would decrease as PNC increased: Women who utilized inadequate PNC would have the highest odds for PPD symptoms, followed by women who utilized adequate plus PNC, and finally women who utilized intermediate PNC, who would have the lowest odds for PPD symptoms (compared to women who received adequate PNC). The results showed that there were no significant relationships present among the main effects (pre-pregnancy BMI and PNC utilization) or the pre-pregnancy BMI/PNC utilization interaction variables (no moderating effect of PNC). Thus, the significance demonstrated for underweight pre-pregnancy BMI disappeared after including the interaction variables in the model. It appeared that interacting the quantity of PNC utilization with women who had an underweight pre-pregnancy BMI removed the previous significant association seen with underweight pre-pregnancy BMI and PPD symptoms. So, there was an overall effect seen for underweight pre-pregnancy BMI previously that was the “average” effect of all the interaction terms. However, after including the interaction terms, the specific effect of each interaction term was subsequently removed from that “average” effect, leaving only the effect of underweight pre-pregnancy BMI alone in the main effect variable; hence, although the direction of the effect remained the same and contrary to what was initially hypothesized (women who had an underweight pre-pregnancy BMI had lower odds instead for PPD symptoms compared to women who had a normal pre-pregnancy BMI), underweight pre-pregnancy BMI was no longer significant.

Multivariate Analyses: Secondary Risk-Adjusted Logistic Regression (Subpopulation With Healthy Pregnancies)

Baseline Model

After adjusting for high-risk pregnancies in the logistic regression model, the significance seen in the primary logistic regression model for women who had an obese pre-pregnancy BMI disappeared. Even though a linear trend was seen in that increasing pre-pregnancy BMI increased odds for PPD symptoms, none of these effects were significant; thus, refuting conclusions made by Carter et al. (2000) and LaCoursiere et al. (2006) in that higher pre-pregnancy BMI is associated with a higher likelihood for PPD symptoms. However, in comparing the sample characteristics of this analysis versus those of the studies conducted by Carter et al. (2000) and LaCoursiere et al. (2006) this study used two risk-adjustment approaches: 1) controlling for the characteristics associated with high-risk pregnancies and 2) removing the high-risk pregnancies from the analysis. It was not evident that Carter et al. (2000) and LaCoursiere et al. (2006) risk-adjusted for the women in their samples via their exclusion criteria or in the description of their samples. Thus, in this study, comparing the primary analysis that included all pregnancies versus the secondary analysis that included only the healthy pregnancies showed that significance is only demonstrated for women who had an obese pre-pregnancy BMI when the high-risk pregnancies are also included. Since 1) obesity has been shown in a number of studies as a risk-factor for complications during pregnancy and/or adverse pregnancy outcomes (LaCoursiere et al., 2005; Saravanakumar et al., 2006; Cedergren, 2004; Rosenberg et al., 2003; Rosenberg et al., 2005; Mahmood, 2009; Baeten et al., 2001; Cnattingius et al., 1998), and 2) previous studies support an association between pregnancy and/or delivery complications and PPD (Josefsson et al., 2002; Leidner et al., 2008; Adewuya et al., 2005; Campbell & Cohen, 1991), it is hypothesized that it might be the high-risk pregnancies, among women who had an obese pre-pregnancy BMI, that were responsible for the significant association seen in the primary analysis between obese pre-pregnancy BMI and PPD symptoms. The chi-square results for pre-pregnancy BMI suggest that many of the women who had an obese pre-pregnancy BMI experienced high-risk morbidities. For example, among the nine high-risk morbidities analyzed in the chi-square analyses, women who had an obese pre-pregnancy BMI had the highest percentage for seven of the nine morbidities.

What is especially worth further noting is that the significance in the baseline model disappeared for women who utilized adequate plus PNC after adding control variables in the primary analyses (models for specific aims 1 and 2). These control variables included the high-risk maternal morbidities. What was surprising was that unlike the baseline model for the primary analysis, which included all pregnancies and did not control for high-risk characteristics, the baseline model for the secondary analysis, which included healthy pregnancies only, did not demonstrate significance for women who utilized adequate plus. Thus, after risk-adjusting by 1) controlling for high-risk characteristics by including the maternal morbidities as appropriate control variables (primary analyses), and 2) modifying the design of the model by removing the high-risk pregnancies from the sample (secondary analyses), the significance for women who utilized adequate plus ceased to appear as it had appeared in a model that did not include any control variables and included women from all pregnancy risk-statuses. What may explain this result is that the high-risk pregnancies were responsible for the significance that previously appeared, and that among all the women in the sample who utilized adequate plus PNC, it is only the women who are high-risk that are the women who are subsequently at higher odds for PPD symptoms, compared to women who utilized adequate PNC that were not high-risk.

Specific Aim 1

"What is the association of pre-pregnancy body mass index (BMI) with subsequent development of postpartum depression (PPD) symptoms?"

Similar to the risk-adjusted primary logistic regression model, it was also predicted in the hypothesis for this model that women who had an obese pre-pregnancy BMI would have the highest odds for PPD symptoms, followed by women who had an overweight BMI, and finally women who had an underweight BMI, who would have the lowest odds for PPD symptoms (compared to women who had a pre-pregnancy BMI of normal). Results showed there was no significance among the pre-pregnancy BMI main effects. However, the main effects for PNC utilization showed that significance among women who utilized inadequate PNC disappeared. Similar to the reasoning provided for the disappearance of significance for obese pre-pregnancy BMI, and the PNC utilization main effects between the primary baseline logistic regression and the primary logistic regression that addressed the first specific aim, it might be that one or more of the control variables included in this model that was significantly associated with PPD symptoms was also a confounding variable in the previous model (but not controlled for). Thus, after adding the control variable(s) in the model, there was no "true association" of inadequate PNC utilization on PPD symptoms. Eight control variables added in this model were significantly associated with PPD symptoms; it is hypothesized that one or more of these variables were responsible for (but not controlled for) the initial significance seen in the baseline model. Future research should seek to determine the control variables that were responsible for the significance seen for the four variables in the secondary baseline logistic regression model (as confounders).

Specific Aim 2

"Does PNC moderate the relationship between pre-pregnancy BMI and PPD symptoms?"

Similar to the risk-adjusted primary logistic regression model, it was also predicted in the hypothesis for this model that within each pre-pregnancy BMI category, the likelihood a woman will experience PPD symptoms would decrease as PNC increased. That is, women who utilized inadequate PNC would have the highest odds for PPD symptoms, followed by women who utilized adequate plus PNC, and finally women who utilized intermediate PNC, who would have the lowest odds for PPD symptoms (compared to women who received adequate PNC). However, after removing high-risk pregnancies from the sample, the results for this model showed that there was no significance among any of the main effects (pre-pregnancy BMI or PNC utilization). Surprisingly, significance appeared for an interaction variable, but in the opposite direction to what was hypothesized: women who had an obese pre-pregnancy BMI and utilized inadequate PNC had lower odds for PPD symptoms compared to women who had an obese pre-pregnancy BMI and utilized adequate PNC. Thus, even though the results support that a significant moderating effect for one interaction group only appeared after adding the interaction terms, the effect was in an unexpected direction, opposing what was initially hypothesized. One reason to explain why women who had an obese pre-pregnancy BMI and utilized inadequate PNC had lower odds for PPD symptoms compared to women who had an obese pre-pregnancy and utilized adequate PNC is that women in the former group were 1) healthy, 2) content with their weight and their bodies, or 3) if they feel healthy, they may not see the need to seek PNC (their self-perceived health status is excellent/healthy). Since this model included healthy pregnancies only, it is possible that women in this group had a high self-perception of their health status during pregnancy. Other reasons for utilizing inadequate PNC, previously found in one study, include denial and/or concealment of pregnancy, or financial reasons, as concluded by Friedman, Heneghan, & Rosenthal (2009).

The significance seen for inadequate PNC utilization disappeared in this model after adding the interaction terms. Similar to the reasoning provided for the disappearance of significance for women who had an underweight pre-pregnancy BMI after adding the interaction variables to the model, the significance seen initially in the model with only the main effect variables (pre-pregnancy BMI and PNC utilization) and the control variables was an overall, "average" effect of all the pre-pregnancy BMI inadequate PNC groups. However, after including the interaction terms between each pre-pregnancy BMI group and inadequate PNC, the specific effect of each interaction term was subsequently removed from that "average" effect, leaving only the effect of inadequate PNC alone in the main effect variable; hence, inadequate PNC was no longer significant.

Summary of Multivariate Results

Overall, the inconsistency of results between the baseline logistic regression models, the primary and secondary logistic regression models addressing the first specific aim, and the primary and secondary logistic regression models addressing the second specific aim showed that there is no moderating effect of PNC on the relationship between pre-pregnancy BMI and PPD symptoms. However, the inconsistency of results with respect to some groups of women (e.g., women who had an underweight pre-pregnancy BMI) shed some light, possibly warranting further exploration on these groups of women to determine reasons and additional variables responsible for the inconsistency of results. For example, this study revealed that many medical and obstetric problems are faced by women during pregnancy, and should be further examined. Perhaps further exploring an unexpected result in this study, specifically, lower odds for PPD symptoms among women who had an obese pre-pregnancy BMI who sought little to minimal (inadequate) PNC (compared to women who had an obese pre-pregnancy BMI who received adequate PNC), and the extent to which these women are affected by medical and obstetric problems, would prove to be valuable. Also, another population to further investigate would be women who utilized adequate plus PNC who are high-risk. This study showed that the significance for having a higher odds for PPD symptoms among women who utilized adequate plus PNC, compared to women who utilized adequate PNC, disappeared after incorporating two different approaches of risk-adjustment, suggesting that it is the high-risk adequate plus PNC women who are at risk for PPD symptoms. Thus, further research that looks into women who utilize adequate plus PNC may confirm this, and/or provide insight as to why the significance between women who utilized adequate plus PNC and PPD symptoms was present when control variables (including morbidity control variables as predictors of PPD) were not included, and the sample represented by that result included both high-risk women and non high-risk women.

Overall, this inconsistency of results did not agree with results from previous studies (e.g., an association between pre-pregnancy BMI and PPD symptoms). Reasons to explain the inconsistency of results within this study may be attributed to the paucity of variables in the data to address the content of PNC with respect to nutrition and wellness (e.g., excessive weight gain, exercise, etc.) discussions, discussion of PPD during the delivery of PNC, discussion of what to possibly expect regarding weight retention in the postpartum period (e.g., returning back to pre-pregnancy weight), the type and number of PNC provider(s) since different disciplines may be trained to deliver PNC differently to some extent and having multiple providers may affect the content and quality of PNC delivered, and a weight gain discussion measure for all the states to include. The one question on weight gain discussion was only available for two states. However, if this question were included in the PRAMS Core Questionnaire (mandated for all states to ask), the results might have been affected; this is hypothesized considering the results for the logistic regression estimated on a subpopulation of women who received weight gain discussion from their PNC (pp.186-187) showed significance for three variables ($p<0.05$), all within the same pre-pregnancy BMI group: underweight pre-pregnancy BMI, and two interaction groups for underweight pre-pregnancy BMI: inadequate and intermediate PNC. The PNC questions included in PRAMS referred to topics such as the discussion of vitamins, if the women got PNC as early as she wanted, how satisfied she was with the staff and the waiting time. Many of the PNC variables that are suggested, and were not a part of the data, may alter the results shown in this study, possibly leading to more consistency. Though the database was extensive and included a variety of variables, many of which were included as control variables, the lack of variables related to the discussion of delivery of PNC related to nutrition and wellness leaves much room for questions on the standardization of the content of PNC among the 51,600 women included in the study. Appendix A (pp.137-155), which includes a collection of literature on the content of PNC, suggests that though many PNC providers are discussing nutrition and wellness matters in the delivery of PNC, there is still a considerable amount of variability that exists in the delivery of PNC with respect to nutrition and wellness. Hence, this may have had an impact on the results of this study since there were minimal measures representing this content of PNC.

This study included 34 control variables in the primary logistic regression models and 29 control variables in the secondary logistic regression models. The inclusion of a variety of control variables in the model helped to limit the amount of omitted variable bias in this study. Had some of the control variables not been included in the multivariate analyses, further significance may have been demonstrated with the variables of interest (e.g., interaction terms), but the significance would not have been a "true" significance. Though the results suggested that the inclusion of many control variables removed the significance demonstrated among some of the variables of interest in the absence of those control variables (e.g., PNC utilization), it simultaneously assured that overall, there is no "true" moderating effect of PNC in this sample.

Limitations

Since PRAMS is a self-reported survey, the likelihood of recall bias (e.g. frequency a woman experienced depressive symptoms, pre-pregnancy weight) remains among the participants. A woman may not remember her pre-pregnancy weight, especially because it was her weight more than nine months ago. If pre-pregnancy weight is reported inaccurately, this could cause error in the frequency of women within a pre-pregnancy BMI category, which could in-turn bias regression estimates. Second, regarding the reporting of PPD symptom severity, because of the stigmas that exist regarding mental disorders in general, a woman may have a tendency to under-report her symptom severity and/or overlook the frequency and severity of her symptoms (e.g., for fear of being termed a "bad mother"). This may be especially so if societal pressures to be a good mother and a mother's desire to try and do everything she feels is necessary for her baby prompt her to not want to succumb to openly admitting to PPD symptoms (Epperson, 1999). If symptom severity was inaccurately reported, the prevalence of PPD symptoms would be under-reported for the purpose of this study. Third, the amount of weight a woman gained during pregnancy was not controlled for, and there were no measures indicating if a woman experienced pregnancy-related obesity or eating disorders that some women experience during pregnancy. Evidence exists that both are predictors of postpartum distress (Krummel, 2007; Franko & Spurrell, 2000). Not controlling for either of these factors can undermine the true effect that pre-pregnancy BMI may have on PPD symptoms. Fourth, it is expected that in a self-reported survey, women may have the tendency to either under-report or over-report their weight. For women who had a pre-pregnancy BMI of obese or overweight, they may have a higher tendency to under-report their weight, and for women who had a pre-pregnancy BMI of underweight, they may have a tendency to over-report their weight; thus, the weight indicated on the survey may not be reliable for some of the women. Similar to the reasoning explained previously for recall bias, if pre-pregnancy weight is reported inaccurately, this could cause error in the frequency of women within a pre-pregnancy BMI category, which could in-turn bias regression estimates. Fifth, the APNCU does not include quality or content of PNC in its measure, which could impact the likelihood of PPD. For example, the satisfaction a woman feels during the delivery of her PNC may impact whether she seeks "adequate PNC," especially if she feels uncomfortable in discussing certain pregnancy (psychosocial) issues with her PNC provider and/or she feels that she is unable to reap the benefits of PNC due to the lack of the duration for each visit. Not accounting for the quality of PNC could either underestimate the effectiveness that PNC may have on reducing the likelihood for PPD symptoms. However, the sub-analyses included a model on a subpopulation of women who had weight gain discussed during their pregnancy; this is one measure regarding the content of PNC that was included, though the quality of this content was not included. Sixth, there may be other variables that could impact

PPD symptomatology and were not controlled for in this study; hence, resulting in omitted variable bias. However, given the breadth of the database used for the analysis, this study attempted to control for the factors that would be most associated with pre-pregnancy BMI, PNC utilization, and PPD symptoms based on the existing literature. Seventh, this study did not control for depression history or depressive episodes during pregnancy, both of which are shown to increase the likelihood of PPD symptoms (Gotlib, 1989; Gotlib, Whiffen, Wallace, & Mount, 1991; Beck, 2001). Having a systematic form of screening both during pregnancy and monitoring women who show symptoms of depression during pregnancy may help prevent depression postpartum, especially because many women suffer depression silently during pregnancy (Marcus, Flynn, Blow, & Barry, 2003; Smith et al., 2004). Not controlling for depression history could also undermine the effect of the association between pre-pregnancy BMI and PPD in that a woman may have had an even higher likelihood for PPD symptoms because of previous episodes of depression. Eighth, because it was unclear whether the woman included in this study received an actual diagnosis of PPD, any conclusions were made with respect to PPD symptomatology, and not PPD itself. There could be a significant difference between a woman's perception of her PPD symptoms versus a professional diagnosis of PPD symptoms; a woman may not recognize the severity of her symptoms (Epperson, 1999). The effect of this could lead to a misconception of the true prevalence of PPD in this study. Finally, and most importantly, this study was observational in nature and not causal.

Importance of This Study/Implications

Though this study determined through multiple models and two different approaches to risk-adjustment (e.g., statistically risk-adjusting versus truncating the population) that there is no consistent moderating effect of PNC in the association between pre-pregnancy BMI and PPD symptoms, this study provides a great deal of insight regarding PNC delivery, for researchers, policymakers, and clinicians, much of which involve and can be heightened with collaboration. Further research should look in-depth into discussions between pregnant women and a variety of health care providers (e.g., physicians, nurses, midwives, etc.), while also looking into the relationships between women and each of these health care providers to assess interpersonal communication that may provide some insight into the BMI/PNC/PPD relationship among different providers. Even though the purpose of this study sought to find that pre-pregnancy BMI is a potential marker for imminent PPD symptoms, the risk-adjustment processes carried out in this study generated strong evidence that many of the women experienced an array of medical and obstetric problems during pregnancy, many of which were associated with PPD symptoms in this study. Thus, further research should also look into the content of discussions between patients and providers regarding 1) the identification of problems and the risk factors that prompt providers to deliver suitable interventions, and 2) the extent to which one or more of these medical and/or obstetric problems are associated with PPD symptoms and/or other psychosocial consequences.

In general, research focusing on the content of PNC in addition to the quantity of PNC delivered over the recent years could determine if the results are consistent with the existing literature and the protocols to be followed during PNC delivery. Ongoing research should address whether different PNC providers are adhering to PNC guidelines and to what extent they are adhering to them. In today’s practice, if it is found that there is an inconsistency with the delivery of PNC content regarding weight, nutrition, and wellness, perhaps policymakers should seek to standardize the delivery of PNC through policy initiatives such as periodic accountability. Policy regarding evaluation of PNC in a variety of settings with a variety of providers may also provide insight into the quality and content of PNC delivered such as the strengths and weaknesses of current PNC.

Regarding the discussion of PPD as a disorder that may affect women in the year following the birth of the child, research should look into the extent to which PNC providers are discussing this with their patients in the pregnancy period. Also, PNC providers should address postpartum depression and educate patients during PNC, as many women may be unaware of this disorder and/or when the severity of symptoms necessitates medical attention. With regard to access to health care in the postpartum period, it may be of worth to look into the extent to which woman are undiagnosed with PPD symptoms, if not PPD itself, due to a lack of access to health care that ceases to exist after a woman’s six-week postpartum check-up. It is suggested that preventive care resources tend to be available during pregnancy, but may not be as readily available during other times outside of pregnancy (Kopelman et al., 2008). Since 1) PPD is underdiagnosed and/or overlooked in the United States (O’Hara, & Gorman, 2004; Clayton, 2004), 2) the use of screening instruments for PPD remains uncommon in the U.S. (Seehusen, Baldwin, Runkle, & Clark, 2005; Georgiopoulous, Bryan, Wollan, & Yawn, 2001), and 3) the association of PPD screening with higher rates of symptom recognition, diagnosis, and treatment as well as the feasibility and appropriateness of screening has been suggested (Georgiopoulous et al., 1999; Georgiopoulous et al., 2001), policy initiatives should seek to facilitate PPD screening periodically during the first-year postpartum, working towards standardizing PPD screening. Policy initiatives should also seek to train health care providers in being cognizant of signs/symptoms of PPD, screening for PPD, and the importance of addressing and screening for PPD during pregnancy, hospitalization for delivery, and in the postpartum period (Seehusen et al., 2005). Further research should also investigate screening for women at-risk for PPD symptoms during PNC as it has been suggested that detection rates for depressive disorders are lower in obstetric settings compared to other primary care settings (Smith et al., 2004). Looking at the extent to which PPD screening takes place during PNC delivery would help 1) identify those women who are at-risk for PPD due to previous and/or current history of depression, and 2) subsequently provide additional medical attention to those women who are identified as having a history of depression. The research implications suggested from the results of this study also encourage policy initiatives to help cultivate research for PPD as a plethora of questions remain regarding PPD in general among women in the United States.

This study makes many contributions. First, this study is among the first in the United States that stratified the quantity of PNC among women of different pre-pregnancy BMI groups, while looking at the effect on the likelihood of PPD symptoms. Secondly, because women from a variety of PPD symptom severities were included in this study, the importance of both screening for PPD during PNC, the delivery and postpartum hospitalization period, and the six-week postpartum check-up are stressed, because all severities of PPD symptoms are prevalent among women in the U.S., according to the data. Thus, PNC, the hospitalization period, and the postpartum check-up remain critical points to screen for PPD. Also, if a postpartum woman seeks her postpartum check-up visit through her PNC provider, this study can affirm the importance of PNC providers in facilitating a healthy relationship with their patients (e.g., tailoring PNC to each woman's needs, supporting an environment that is conducive for a woman to openly address her concerns as a pregnant individual by encouraging open discussion, etc.). This may increase the likelihood that patients will seek care from their PNC provider in the postpartum period through a postpartum check-up visit. Also, because some relationships were found among BMI and PPD after stratifying by PNC utilization, this study adds to the literature that stresses the importance of addressing obesity and PPD because both are rising public health concerns in the United States and globally. Finally, and most importantly, although the results showed that there is no association between pre-pregnancy BMI and PPD symptoms (after including suitable control variables), and PNC utilization does not generally moderate this relationship, the results uncovered that many of the women were significantly affected by a variety of medical and obstetric problems, many of which were high-risk and associated with PPD symptoms. For future research, it is strongly recommended that the possible association of these problems with PPD symptoms be further investigated. For practice, it is suggested that 1) PNC providers recognize the risk factors for and the prevalence of medical and obstetrical morbidities during pregnancy, including, but not limited to those featured in this study, 2) identify and diagnose the morbidities that surface in their patients, 3) establish suitable interventions, and finally, 4) follow-up on their patients accordingly.

APPENDIX A
SUMMARY OF LITERATURE ON PNC CONTENT

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Covington & Rice (1997)	To explore the association between patient receipt of recommended prenatal care interventions and infant birth weight	Prenatal care initial interventions (weighted and measured), health promotion advice received (eat proper foods, gain weight), birth weight	3,905 African-American women	1988 National Maternal and Infant Health Survey	U.S. Public Health Service Expert Panel on the Content of Prenatal Care	1) Height/weight taken at initial PNC visit a) 98% with a VLBW infant (<1,500 grams) or a "moderately low birth weight" (1,500-2,499 grams) infant b) 97% with a normal birth weight infant (2,500 grams or greater) 2) Receiving advice on proper foods a) 92% with a VLBW infant b) 93% with a MLBW infant c) 90% with a NBW infant 3) Receiving advice on weight gain: a) 64% with a VLBW infant b) 65% with a MLBW infant c) 71% with a NBW infant 3) Association between women who did not receive all types of health promotion advice and birth weight: OR: 1.28 to give birth to a VLBW infant (adjusted for LBW risk)

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Freda, Andersen, Damus, & Merkatz (1993)	To compare the type of information given to women who sought prenatal care in public and private clinics and the degree to which the women were satisfied with the information they were given during their prenatal care	Prenatal care information received, prenatal care delivery site	159 women (80 who received care in a public setting, 79 who received care in a private setting) in Bronx, New York.	Questionnaires	U.S. Public Health Service Expert Panel on the Content of Prenatal Care (1989)	1) Nutrition information received a) Private settings: 85% of women b) Public settings: 96% of women 2) Exercise during pregnancy a) Private settings: 56% of women b) Public settings: 64% of women at public settings reported receiving this information (p=0.3) 3) Patient satisfaction with information received: patients were more likely to experience satisfaction on any PNC topic if providers initiated discussion

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Kogan, Alexander, Kotelchuck, Nagey, & Jack (1994)	What percent of women reported receiving PHS recommended procedures and health behavior advice and how do they differ based on health insurance, site of care, and sociodemographics?	USPHS recommended national guidelines for prenatal care (health behavior advice and prenatal care procedures), reports of receiving different types of prenatal care procedures and health behavior advice	9,932 women, nationally representative	1988 National Maternal and Infant Health Survey	U.S. Public Health Service's Expert Panel on the Content of Prenatal Care Report (1989)	Percentages reported for: 1) Weight/height taken at 1st or 2nd visit: a) Maternal education: 95.3-98.2% b) Household income, 95.8-98.5% c) Marital status: 96.7-98% d) Race/ethnicity: 92.4-98.7% e) Trimester care began: 94.6-98% f) Site of care: 96-98.3% 2) Proper foods advice: a) Maternal education: 87.5-94.2% b) Maternal age: 90.8-93.4% c) Household income: 90.6-94.4% d) Marital status: 91.5-93.3% e) Race/ethnicity: 88.3-94% f) Parity: 91.4-94.3 g) APNCU: 85.7-94.2% 3) Weight gain advice: a) Maternal education: 64.9-73 b) Maternal age: 64.9-74.7 c) Household income: 68.9-74.4 d) Marital status: 70.9-76.6 e) Race/ethnicity: 62.2-74.1 f) Parity: 64.7-78 g) APNCU: 59.7-74.5

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Kogan, Alexander, Kotelchuck, & Nagey (1994)	To examine the relationship between maternal reports of health behavior advice received and initial prenatal care procedures performed during the first two visits and low birth weight	Health behavior advice and initial prenatal care procedures, low birth weight (<2,500 g)	9,394 women (nationally representative)	1988 National Maternal and Infant Health Survey	U.S. Public Health Service's Expert Panel on the Content of Prenatal Care Report (1989)	1) Health behavior advice: the following results were reported a) 8,670 women who received advice on proper diet: 5.6% gave birth to LBW infants ($p=0.06$) b) 6,770 women who received advice on weight gain: 5.3% gave birth to LBW infants ($p<0.01$) 2) For initial prenatal care procedures, among 9,159 women who had their weight recorded, 5.6% gave birth to LBW infants ($p=0.03$)

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Kotelchuck, Kogan, Alexander, & Jack (1997)	To assess if site of prenatal care delivery influences the content of prenatal care given to low-income women	Recommended initial prenatal care procedures, recommended prenatal care advice, site of prenatal care delivery	3,405 low income women	1988 National Maternal and Infant Health Survey	U.S. Public Health Service Expert Panel on the Content of Prenatal Care	1) Between 89.6-92.6% of the women reported received advice on proper foods to eat during pregnancy (not-significant) and 64.5-79.9% of women reported receiving advice on weight gain during pregnancy ($p<0.001$) 2) Comparing the content of PNC at different sites, between 95.1-97.9% of women were measured and weighed at their initial PNC visit ($p=0.006$), and between 75.4-87.4% of women had their health history taken ($p<0.001$) 3) Women who received their PNC at a private office were 1.52 times (CI: 1.18-1.95) more likely not to receive all the PNC procedures (e.g., blood pressure taken, height and weight measured, blood work taken, etc.) at their initial visit, and 1.76 times (CI: 1.34-2.32) more likely not to receive all the types of PNC advice (e.g., alcohol and smoking cessation, proper foods to eat, vitamins to take, weight to gain, etc.) as recommended by the U.S. Public Health Service. 4) Women who received care at sites other than a private office, public clinic, an HMO, or a hospital clinic were 1.73 times (CI: 1.04-2.83) more likely not to receive all the PNC procedures at their initial visit

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Libbus & Sable (1991)	To examine the relationship between absence of prenatal care educational content and the risk of adverse birth outcomes	Six educational prenatal care content areas, 10 risk areas, term low birthweight, and preterm low birthweight	1,484 women from three regions in Missouri	Data from a previous study on barriers to prenatal care sponsored by the Missouri Department of Health and the Missouri Perinatal Association	Though no source is mentioned in choosing the areas of prenatal content, the Institute of Medicine and the U.S. Public Health Service Expert Panel on the Content of Prenatal Care were included in the reference list.	1) 20.4% of the women reported receiving diet counseling 2) 14.2% of the women possessed a nutritional risk 3) Not receiving diet education was significantly associated with the risk of delivering a preterm low birthweight infant in the bivariate analyses, but not in the multivariate analyses. 4) Adequacy of care (care initiated w/in 1st 4 months of gestation & atleast 8 visits (term infants) or 5 visits (infants born </= 37 weeks) (RR=2.45) a) Adequate care: 720 women: 13.2% did not receive diet counseling b) Inadequate care: 764 women: 27.1% did not receive diet counseling

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Sable & Herman (1997)	To 1) examine the relationship between the U.S. Public Health Service Expert Panel on the Content of Prenatal Care recommendations and the risk of low birth weight, and 2) to describe the type and frequency of health behavior advice given to a sample of pregnant women.	Prenatal care advice, birth weight	2,205 women from the state of Missouri	National Institute of Child Health and Human Development/ Missouri Maternal and Infant Health Survey	U.S. Public Health Service Expert Panel on the Content of Prenatal Care	1) 54.8% of the women received advice on improving diet and nutrition and eating proper foods 2) Regarding weight gain, 62.1% of women received this advice during the course of their parental care 3) For receiving advice on diet and nutrition, 31.6% of the women were told to watch their caloric intake and to avoid excessive weight gain 4) Regarding exercise factors, 29.3% of women were told to get more exercise, and 16.7% of women were told to restrict their exercise 5) In looking at birth weight, women who did not report receiving all the seven types of advice during their PNC as recommended by the U.S. Public Health Service Expert Panel were 1.49 times (CI:1.10-1.88) more likely to give birth to a baby that was of “very low birth weight” (less than 1,500 grams) than they were to give birth to a baby of normal birth weight

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Baldwin, Raine, Jenkins, Hart, & Rosenblatt (1994)	To what extent do obstetric providers follow ACOG guidelines?	Components of first prenatal care visit, number of prenatal care visits, ACOG recommended laboratory tests, prenatal content monitoring (subsequent visits)	Providers: 54 urban OB-GYN's, 29 rural OB-GYN's, 59 urban FP's, 67 rural FP's, 43 urban MW's; 2,357 female patients	The Content of Obstetrical Care Study	American College of Obstetricians and Gynecologists	1) Pre-pregnancy weight was recorded as follows (ANOVA, p</= 0.001): UOB: 83%; ROB: 68%; UFP: 83%; RFP: 79%; UNW: 98% 2) Maternal weight at 1^{st} visit (ANOVA, p</= 0.01), UOB: 87%; ROB: 98%; UFP: 95%; RFP: 90%; UNW: 96% 3) Maternal height at 1^{st} visit (ANOVA, p </= 0.001), UOB: 80%; ROB: 73%; UFP: 58%; RFP: 59%; UNW: 98% 4) Weight at subsequent visits (ANOVA, p </= 0.05), UOB: 97%; ROB: 99%; UFP: 96%; RFP: 98%; UNW; 98%

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Conway & Kutinova (2006)	To determine the efficacy of prenatal care and the policies designed to improve access to prenatal care (Medicaid)	Adequate care index (APNCU=1), prenatal are measures: advice about weight gain, advice about eating, excessive maternal hospitalization, BMI status change (became overweight after conception; become underweight after conception)	7,464 observations	1988 National Maternal and Infant Health Survey	American College of Obstetricians and Gynecologists	1) Statistical significance was found between receiving advice about eating and excessive maternal hospitalization (if the mother's length of stay was longer than her infant). No significant associations were found between receiving weight gain advice and excessive maternal hospitalization. 2) Receiving advice about eating was significantly associated with having a BMI change to "underweight" after birth. 3) A significant association was found for receiving advice about weight gain, and a change in BMI status after birth to "underweight." 4) Inverse associations were found for receiving advice about weight gain and having a change in BMI status after birth to "overweight." No significant associations however were found between receiving either advice about eating or weight gain during pregnancy, and a change in BMI status to "overweight." 5) For women with "adequate PNC" (APNCU index), approximately 93-94% of the women received advice about eating. For the women who did not receive "adequate care," 87-94% of the women received advice about eating. 6) 70-75% of women who received "adequate care" received advice about weight gain during pregnancy. 7) 61-72% of women who did not receive "adequate care," received advice about weight gain during pregnancy.

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Yu & Jackson (1995)	To determine the prevalence nutrition advice received by women who sought prenatal care (self-report)	Nutrition advice (seven categories), maternal characteristics	9,639 mothers who gave birth to a live infant, 4,955 mothers who did not give birth to a live infant	1988 National Maternal and Infant Health Survey	Though no guidelines were noted in the literature review, the American Academy of Pediatrics, American College of Obstetrics and Gynecology, and the Institute of Medicine were included in the reference list.	1) Among mothers who gave birth to a live infant, 72.8% of White women received advice about weight gain during pregnancy, 70.1% of Black women received advice about weight gain during pregnancy, 63% of Asian and Pacific Islander women received advice about weight gain during pregnancy, and 73.8% of Eskimo, Aleut, and American Indian women received advice about weight gain during pregnancy 2) Regarding eating properly, this advice was received by 93% of White women, 92.7% of Black women, 90.2% of Asian and Pacific Islander women, and 89.3% of Eskimo, Aleut, and American Indian women 3) Among mothers who did not give birth to a live infant, 87.3% received advice on eating properly, and 63.8% received advice on weight gain

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Cogswell, Scanlon, Fein, & Schieve (1999)	To evaluate if weight gain advice given from a health care provider, a woman's target gestational weight gain, and actual weight gain are in congruence with the IOM guidelines	Advised weight gain, target weight gain, and actual weight gain	2,237 women	Prenatal questionnaire, neonatal questionnaire	Institute of Medicine	1) 27% did not receive weight gain advice during PNC 2) Advice about weight gain and IOM recommendations a) 14% were advised to gain less weight than IOM guidelines b) 22% advised to gain more weight than IOM guidelines 3) Target weight gain and IOM recommendations a) 19% had a target weight gain less than IOM guidelines b) 22% had a target weight gain higher than IOM guidelines 3) Actual weight gain and IOM recommendations a) 23% actually gained less than IOM guidelines b) 42% of women gained more than IOM guidelines 4) Women in the "very high" pre-pregnancy BMI category were 15 times more likely to receive advice to gain more weight than as recommended by the IOM and 0.9 times as likely to receive advice to gain less weight than as recommended by the IOM 5) Women in the "high" pre-pregnancy BMI category were 31.8 times more likely to receive advice to gain more weight than as recommended by the IOM and 0.1 times as likely to receive advice to gain less weight than as recommended by the IOM 6) Women in the "low" pre-pregnancy BMI category were 0.5 times as likely to receive advice to gain more weight than as recommended by the IOM and 0.8 times as likely to receive advice to gain less weight than as recommended by the IOM

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Stotland, Haas, Brawarsky, Jackson, Fuentes-Afflick, & Escobar (2005)	To study the relationship between pre-pregnancy BMI, women's target gestational weight gain, and provider weight gain advice	Pre-pregnancy BMI, women's target gestational weight gain, provider weight gain advice	1,198 women in the state of California who received PNC at 1) an urban public hospital, 2) an urban community hospital, 3) a university hospital, or 4) 1 of 3 medical centers affiliated with an MCO. Weight gain advice was received from either a physician, nurse, or a nutrition counselor.	Project WISH (Women and Infants Starting Healthy)	Institute of Medicine	1) Relationship between BMI and pregnancy target weight gain that was below IOM guidelines: a) "Low" BMI (OR: 0.63) b) "Overweight" BMI (OR: 0.05) c) "Obese" BMI (OR: 0.18) 2) Relationship between BMI and pregnancy target weight gain that was above IOM guidelines: a) "Overweight" BMI (OR: 3.79) b) "Obese" BMI (OR: 2.39) 3) Association between provider advice and a woman's target weight gain during her pregnancy a) Advice to gain weight gain below IOM guidelines and target weight gain below IOM guidelines (OR: 3.17) b) Advice to gain weight above IOM guidelines and target weight gain above IOM guidelines (OR: 3.39) c) No advice and target weight gain below IOM guidelines (OR: 1.72)

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Petersen, Connelly, Martin, & Kupper (2001)	To determine 1) the prevalence of preventive health counseling given during prenatal care, 2) the prevalence of women who are in higher need of counseling about specific health concerns, and 3) if women who are in higher need of counseling are more likely than the women in lower need to have received counseling.	Reports of preventive health counseling during prenatal care (e.g., nutrition)	24,620 women from 14 states	Pregnancy Risk Assessment Monitoring System	The U.S. Preventive Services Task Force Guide to Clinical Preventive Services	Between 84-92% of the women (depending on the state) received counseling on nutrition during pregnancy

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Levine, Wigren, Chapman, Kerner, Bergman, & Rivlin (1993)	To examine the degree to which primary care physicians in the U.S. report practicing the basic nutritional competencies in the delivery of care.	Nutrition related attitude statements, nutrition-related behaviors	3,416 primary care physicians	A demographic survey, an attitude survey, and a behavior survey	N/A	1) 75% or more of the physicians agreed or strongly agreed with the following: a) Continuing medical education courses should devote time to nutritional-related issues, b) it is important to have an understanding of food composition and preparation to provide reliable nutritional counseling, c) in many cases, medication could be reduced or eliminated if patients followed a recommended diet, d) nutrition will have an increasingly important role in the prevention and treatment of disease, e) doctors should spend more time exploring dietary habits during patient evaluation 2) Statements towards which 75% or greater of physicians in the sample disagreed or strongly disagreed, this included: a) Most doctors are very knowledgeable about nutrition, b) physicians are well prepared to provide nutritional counseling, c) nutrition is important only in certain medical specialties, d) dietary counseling is a waste of time because people don’t change their

	habits anyway, and e) nutrition education is not the responsibility of the physician. 3) Regarding specific nutritional advice on what physicians usually or always practice, the authors found that a) 61% of the physicians reported advising or teaching their patients about the rationale for dietary modifications, b) 60% of the physicians reported advising or teaching their patients about achievements and maintenance of health habits such as exercise, c) 56% of physicians reported advising or teaching their patients about the achievements of desirable weight, d) 55% of physicians reported prescribing to their patients dietary modifications such as sugar or salt intake reductions, weight reduction, e) 54% of physicians reported monitoring their patients' nutrition status and progress in response to treatments recommended, and f) 52% of physicians reported prescribing to their patients exercise depending on their age, physical condition(s), and their health status.

Authors	Objectives	Independent/ dependent variables	Sample characteristics	Data	Type of prenatal care guidelines	Results (statistical tests, p-values)
Splett, Reinhardt, & Fleming (1994)	To 1) identify physicians' need and expectations regarding quality nutrition services rendered in prenatal care 2) to rank the characteristics of the services rendered by importance in making nutrition referral decisions, and 3) identify nutrition services physicians would most likely add to their delivery of care.	Nutrition care services, availability of services: currently available/likely to add/unlikely to add; physicians' rating of nutrition services	130 prenatal care OB-GYN physicians	Quality Service Management Model	Though no guidelines were noted in the literature review, the Institute of Medicine was included on the reference list	1) 63.8% of the physicians had an ongoing monitoring of patient weight gain and dietary patterns, while 16.9% of physicians reported that they would likely start practicing the service, and 13.1% of the physicians reported that they would unlikely to start practicing the service 2) Regarding initial PNC screening of women to detect their nutritional risk, 61.5% of physicians reported that they provided that service, 24.6% of physicians reported that they would likely start practicing the service, and 10.8% of the physicians reported that they would unlikely start practicing the service 3) Regarding follow-up of women who were identified as having nutrition problems during their pregnancy, 42.3% reported that they currently provided the service, 43.8% reported that they would likely start practicing the service, and 5.4% of the physicians reported that they would unlikely start practicing the service 4) Regarding nutritional consultation for each woman during her PNC, 40% of the physicians reported providing the

service, 43.1% of the physicians reported that they would likely start practicing the service, and 11.5% of the physicians reported that they would unlikely start practicing the service

5) Nutritional assessment and planning of care for women with a “high-risk” pregnancy, was currently conducted by 36.2% of physicians, while 53.8% reported that they would likely start practicing the service, and 6.2% of physicians reported that they would unlikely start practicing the service

6) 26.2% of physicians reported that they currently practice postpartum weight counseling, while 61.5% of physicians reported that they would likely start practicing the service, and 6.2% of physicians reported that they would unlikely start practicing the service.

7) 32% of the women engaged in discussions with their physician for seeking advice on nutrition problems, while 12% of the women engaged in discussions with a registered dietitian, 8% sought information from PNC classes, 8% sought information from brochures and pamphlets given in the office where the PNC was provided, and 3% sought assistance through WIC

APPENDIX B
MULTIVARIATE SUB-ANALYSES

In addition to the main logit models (PPD), sub-analyses were conducted to further test the moderating effect of PNC in the association between pre-pregnancy BMI and PPD symptoms. One of the sub-analysis logit models was estimated by specifying the dependent variable (PPD symptoms) differently (a sensitivity analysis via an ordinal logistic regression model), while another model was estimated with a different dependent variable (adequate plus PNC), and five of the sub-analysis logit models comprised of five different subpopulations: one consisting of women who utilized WIC services, and each of the four remaining models comprising a different subpopulation income group.

Adequate Plus

Unlike the secondary analysis that risk-adjusted for high-risk pregnancies by removing observations that met any of the high-risk criteria defined for this study, a logistic regression was estimated holding adequate plus as the dependent variable, to determine high-risk characteristics (denoted by significance). Seventeen morbidities, among other characteristics (e.g., demographics) were included in this model to determine factors that could label a pregnancy as "high-risk." These morbidities included:

1) Pre-pregnancy diabetes
2) Gestational diabetes
3) Vaginal bleeding
4) Kidney/bladder infection
5) Nausea
6) Hospitalization
7) Preterm labor
8) Premature rupture of membranes (PROM)
9) Placenta abrutio or placenta previa
10) Incompetent cervix (cervix closed)
11) High blood pressure
12) Blood transfusion
13) Car crash injury
14) Bed rest

15) Labor/delivery complications (in general)
16) Pregnancy abnormalities (in general)
17) Medical risk factors (in general)

Sensitivity Analysis: Ordinal Logistic Regression

To further test the moderating effect of PNC, a sensitivity analysis employed an ordinal logistic regression and kept PPD symptom response as seven categories (scores of 0-6), prior to grouping the scores into “yes” or “no” to create a dichotomous variable for the primary logit model. This model was used to estimate PPD symptoms as an ordinal, categorical variable to determine whether the results are sensitive to the way in which the dependent variable is specified. Reference groups remained the same as the primary logistic regression model. With the dependent variable specified into seven categories, it was also predicted that the highest likelihood for increasing in PPD severity was for women who had a pre-pregnancy BMI of obese and received inadequate care.

As shown in the model specification below, each PPD response (assigned a score) had its own α_j value (while the β coefficients of the independent variables for each PPD response remained the same):

$$\text{logit} = \log\left[\frac{P(Y \le j)}{(1 - P(Y \le j))}\right] = \alpha_j + \beta_1(\text{obese/adequate plus care}) + \beta_2(\text{overweight/adequate plus care}) + \beta_3(\text{underweight adequate plus care}) + \beta_4(\text{obese/intermediate care}) + \beta_5(\text{overweight/intermediate care}) + \beta_6(\text{underweight/intermediate care}) + \beta_7(\text{obese/inadequate care}) + \beta_8(\text{overweight/inadequate care}) + \beta_9(\text{underweight/inadequate care}) + \beta_k X_k(\text{control variables}) + \varepsilon \qquad \text{(B-1)}$$

(Where j represents the PPD score assigned to each woman)

Women, Infants, and Children (WIC)

A logistic regression was estimated only on women who received WIC services during their pregnancy. Eligibility for WIC during pregnancy is based on socioeconomic status. This program is a food and nutrition service that primarily targets low-income women, infants, and children, who may be nutritionally at-risk, in order to provide health care referrals, information on nutrition, and nutritious food to these women. Since this program may be a potential avenue for women to receive advice and guidance on nutrition, weight, and fitness during pregnancy, a model inclusive of this sub-population of women was estimated to determine if a moderating effect of PNC could be detected among women who also received WIC services in addition to the quantity of PNC received.

Income

To determine if there is a PNC moderating effect after stratifying by income category, and to see if PNC is more effective for certain income groups versus others, a logistic regression was estimated for each income sub-population. Each logit model mirrored the main PPD analysis, but included only women from each income group. Income groups were stratified as follows:

1) Less than $10,000
2) $10,000 to $24,999
3) $25,000- $49,999
4) $50,000 or more

Weight Gain Discussion

Since discussion of weight gain during PNC, in addition to nutrition and wellness during pregnancy, is the premise of the theory posed for this study, a logistic regression model was estimated with a sub-population of women who answered “yes” to the following question: “Did your health care professional discuss how much weight to gain?” The weight gain discussion variable was selected from the PRAMS Standard Questionnaire. This model included the same variables as the main PPD analysis (PNC, BMI, and the control variables). However, because this additional control variable is optional for inclusion in state surveys, the sample size only contained women from Utah and Vermont; thus, reducing the sample size and limiting the external validity.

Results of Sub-Analyses

Sub-analyses were estimated with six logit models, each using a different sub-population of women from the sample used originally for the main models (PPD). Table B-1 presents the chi-square results to describe the model of women who received adequate plus PNC versus women who received other quantities of PNC. Table B-2 presents the t-test results with maternal age and adequate plus PNC. Table B-3 presents the results from the logit model for adequate plus PNC, including the twelve maternal morbidities that were significant ($p<0.1$). Table B-4 presents the results of the ordinal logistic regression model inclusive of the main effects and control variables. Similar to the primary logistic regression model that addressed the first specific aim, this model also showed that women who had an underweight pre-pregnancy BMI had lower odds for PPD symptoms compared to women who had a normal pre-pregnancy BMI. Thus, women who had a normal pre-pregnancy BMI had 11% greater odds for PPD symptoms compared to women who had an underweight pre-pregnancy BMI (OR=0.90, $p<0.05$). However, in continuing to comparing this model with the primary logistic regression model addressing the first specific aim, the significance for women who had an underweight pre-pregnancy BMI increased: $p<0.10$ versus $p<0.05$, respectively. In addition, the odds of PPD symptoms for women with a normal pre-pregnancy BMI slightly decreased. The first logistic regression (logit) model held adequate plus PNC as the dependent variable in order to determine the maternal morbidities predictive of high-risk adequate plus PNC.

The next logit model (Table B-5) included a sub-population of women who received services during pregnancy from Women, Infants, and Children (WIC). Results showed that for the main effects in this model, only overweight pre-pregnancy BMI had a significant association with PPD symptoms. However, the odds for PPD symptoms among women who had a pre-pregnancy BMI of normal were *greater* by 64% compared to women who had a pre-pregnancy

BMI of overweight (OR=0.61, p=0.005). This model also demonstrated a moderating effect of PNC for two pre-pregnancy BMI groups of women who received inadequate PNC. Women who had an obese pre-pregnancy BMI and received adequate PNC had 59% greater odds for PPD symptoms compared to women who had an obese pre-pregnancy BMI and received inadequate PNC (OR=0.63, p=0095). However, the reverse moderating effect of PNC was seen for women who had an overweight pre-pregnancy BMI and received inadequate PNC in that *they* had 92% greater odds for PPD symptoms compared to women who had an overweight pre-pregnancy BMI and received adequate PNC (OR=1.92, p=0.048). For women who received WIC services, it is suggested that among women who had an obese pre-pregnancy BMI, compared to women who received adequate PNC, those who received inadequate PNC were perhaps healthy and happy with their bodies and/or pregnancy and did not see a need to seek PNC. Also, women who received adequate PNC may have been the women who were more anxious and worried about their pregnancy. However, for women who had an overweight pre-pregnancy BMI, the PNC may have been beneficial along with the WIC services; thus, resulting in the higher odds for PPD symptoms among women who received inadequate PNC and the lower odds for PPD symptoms among women who received adequate PNC. Looking at a sub-population of women who received WIC services in this model appeared to show a moderating effect of PNC to some extent. Further research should address whether receiving PNC and WIC services simultaneously during pregnancy (in which weight, nutrition, and wellness are addressed in both) has a beneficial effect on reducing the likelihood for PPD symptoms.

The next four logit models were estimated using a sub-population of women from each income category to see if PNC was more effective for one income category versus another. These models were estimated in efforts to demonstrate a moderating effect of PNC after stratifying the sample by income category. The first logit model, estimated on women with an income of less than $10,000 (Table B-6), showed a moderating effect of PNC for women from two pre-pregnancy BMI groups of women. Women who had an obese pre-pregnancy and received adequate PNC had 96% greater odds for PPD symptoms compared to women who had an obese pre-pregnancy BMI and received inadequate PNC (OR=0.51, p=0.07). On the other hand, women who had an overweight pre-pregnancy BMI and received inadequate PNC had 2.32 times greater odds for PPD symptoms compared to women who had an overweight pre-pregnancy BMI and received adequate PNC (OR=2.32, p=0.06). It is interesting to note that these results remain consistent with the results shown for the logit model estimated on women who received WIC services during their pregnancy, because WIC primarily targets low-income women. These results also support further research to focus on women who receive WIC services and PNC services simultaneously, to see if there is additional benefit, compared to women who receive either one or the other.

The next logit model, estimated using a sub-population of women with an income between $10,000 and $24,999 (Table B-7) did not show a consistent moderating effect of PNC as shown in the two previous logit models (with sub-populations of WIC and women with an income of less than $10,000). In fact, there was no significance for any of the main effects and PPD symptoms, nor the interaction effects and PPD symptoms. Since this model did not show a similar moderating effect as shown in the logit models estimated with WIC women and women with an income of less than $10,000, it is suggested that perhaps, when considering women who receive WIC services during pregnancy but get minimal to no PNC (inadequate PNC), the moderating effect occurs more readily for women with a very low income as opposed to a low income, as stratified in this study. It is surprising though that among women who received WIC services during pregnancy (Table B-5), women with an income less than $10,000 had a higher odds for PPD (OR=1.96, p=0.002) compared to women who had an income of $50,000 or greater, while women with an income between $10,000 and $24,000 (OR=1.48, p=0.07) compared to women who had an income of $50,000 or greater.

Next, in the logit model inclusive of women with an income between $25,000 and $49,000 (Table B-8), only inadequate PNC was significant with PPD symptoms in that women from this PNC utilization category had 72% greater odds compared to women who received adequate PNC (OR=1.72, p=0.046). Though a moderating effect of PNC was not seen after interacting each pre-pregnancy BMI group with each PNC utilization category, the significance shown for inadequate PNC among this group of women with an income between $25,000 and $49,999 suggests further studying the relationship between weight and PPD symptoms amongst women from this income group who receive no to minimal PNC. Understanding the reasons that play a role in explaining why some women from this income group seek no to minimal PNC may help explain these results, especially because it appears that PNC has a beneficial effect on women from this income group who received adequate PNC.

Finally, a logit model estimated for a sub-population of women with an income of $50,000 or greater (Table B-9) did not show significance between any of the main effects and PPD symptoms, but a moderating effect was seen for one group of women. Women who had a pre-pregnancy BMI of underweight and received intermediate PNC had a 2.4 times greater odds for PPD symptoms compared to women who had a pre-pregnancy BMI of underweight and received adequate PNC (OR=2.40, p=0.06). It is interesting to note that despite lack of significance, women from this pre-pregnancy BMI category who received inadequate PNC had 28% greater odds for PPD symptoms compared to women who had an underweight pre-pregnancy BMI who received adequate PNC. These odds are lower than the women who received the next level of PNC quantity (as the reverse was predicted). For women from this income group and from this pre-pregnancy BMI category, it may be of worth to ascertain psychosocial reasons to explain why it is that women in between those receive no to minimal PNC, and those who receive adequate PNC, have more than double the odds for PPD symptoms than those who receive no to minimal PNC. In comparing the overall results from the logit models estimated on a sub-population of women from each income group, it seems that a moderating effect of PNC was the most worthy to note in the model that included women with an income of less than $10,000 (very low income).

Table B-10 presents the results from the logistic regression that looked a subpopulation of women who had weight gain discussed during their PNC. The variables “PNC paid by military” and “PNC paid by Native American health services” were not included in this model due to collinearity. For example, women who answered “yes” to receiving payment for PNC from either of these organizations also answered “yes” to having weight gain discussed by their PNC provider, hence, resulting in collinearity where the variables (not the women) were automatically removed from the model by Stata. Looking at the main effects, among women who had weight gain discussed by their PNC provider, women who had a normal pre-pregnancy BMI had double the odds of PPD symptoms compared to women who had an underweight pre-pregnancy BMI (OR=0.48, p=0.02). However, when looking at the interaction effects among women who had an underweight pre-pregnancy BMI, those who received inadequate PNC had about four times greater odds for PPD symptoms (OR=4.10, p=0.01), and women who received intermediate PNC had about 12.8 times greater odds for PPD symptoms (OR=12.79, p=0.002). To explain this inconsistency of results, table 4-5 shows that among women who had weight gain discussed during their PNC, 795 of women who had an underweight pre-pregnancy BMI had the discussion versus 2,713 women with a normal pre-pregnancy BMI who had the discussion. Thus, when comparing pre-pregnancy BMI groups, only, even with the higher number of women with a normal pre-pregnancy BMI who had weight gain discussed, it was beneficial more-so for women who had an underweight pre-pregnancy BMI as these women had lower odds for PPD symptoms. However, when looking only at women who had an underweight pre-pregnancy BMI, there were some women in which weight gain discussion was not beneficial; thus, these women at a higher odds for PPD symptoms compared to women in that same pre-pregnancy BMI group who received adequate PNC. It is suggested that perhaps there that women who receive inadequate and intermediate levels of PNC may be more sensitive about their weight, which may prompt them not to seek as much PNC as women who had an underweight pre-pregnancy BMI and received adequate PNC. The latter may also be more proactive about gaining the right amount of weight for their health of their baby. Hence, a selection effect may be the reason to explain these results. Further research should seek to determine the feelings and attitudes of women who are underweight towards receiving weight gain discussion from their PNC provider(s).

Table B-1. Chi-square analyses comparing 40 characteristics among women who utilized adequate plus PNC versus women who utilized "other quantities of PNC"

Categorical control variable	No for adequate plus PNC (Frequency, %)	n (no adequate plus PNC)	Yes for adequate plus PNC (Frequency, %)	n (yes for adequate plus PNC)	N	P-value
Main variable:						
Pre-pregnancy body mass index (BMI)		28,243		14,995	43,238	<0.0001*
Underweight	3,919 (13.9%)		2,045 (13.6%)			
Normal	14,882 (52.7%)		7,384 (49.2%)			
Overweight	3,615 (12.8%)		1,880 (12.5%)			
Obese	5,827 (20.6%)		3,686 (24.6%)			
Demographic control variables						
Maternal race: White		30,099		15,701	45,800	<0.0001*
No	11,288 (37.5%)		4,912 (31.3%)			
Yes	18,811 (62.5%)		10,789 (68.7%)			
Maternal race: Black		30,099		15,701	45,800	<0.0001*
No	25,670 (85.3%)		13,093 (83.4%)			
Yes	4,429 (14.7%)		2,608 (16.6%)			
Maternal race: Other		30,099		15,701	45,800	<0.0001*
No	23,240 (77.2%)		13,397 (85.3%)			
Yes	6,859 (22.8%)		2,304 (14.7%)			
Hispanic		29,926		15,602	45,528	<0.0001*
Not Hispanic	23,916 (79.9%)		13,322 (85.4%)			
Hispanic	6,010 (20.1%)		2,280 (14.6%)			

Table B-1. Continued

Categorical control variable	No for adequate plus PNC (Frequency, %)	n (no adequate plus PNC)	Yes for adequate plus PNC (Frequency, %)	n (yes for adequate plus PNC)	N	P-value
Maternal education		30,873		16,565	47,438	<0.0001*
0-8 years	1,538 (4.98%)		530 (3.19%)			
9-11 years	4,710 (15.3%)		2,013 (12.2%)			
12 years	9,425 (30.5%)		5,048 (30.5%)			
13-15 years	7,068 (22.9%)		4,046 (24.4%)			
16+ years	8,132 (26.3%)		4,928 (29.7%)			
Income (12 months prior)		31,355		16,748	48,103	<0.0001*
Less than $10,000	6,663 (21.3%)		2,944 (17.6%)			
$10,000 to $24,999	8,987 (28.7%)		4,495 (26.8%)			
$25,000 to $49,999	7,127 (22.7%)		3,887 (23.2%)			
$50,000 or more	8,578 (27.4%)		5,422 (32.4%)			
Marital status		31,345		16,730	48,075	<0.0001*
Married	19,570 (62.4%)		11,142 (66.6%)			
Other	11,775 (37.6%)		5,588 (33.4%)			
Insurance control variables						
PNC paid by income		31,355		16,748	48,103	0.047*
No	25,128 (80.1%)		13,294 (79.4%)			
Yes	6,227 (19.9%)		3,454 (20.6%)			
PNC paid by insurance/HMO		31,355		16,748	48,103	<0.0001*
No	16,146 (51.5%)		7,418 (44.3%)			
Yes	15,209 (48.5%)		9,330 (55.7%)			

Table B-1. Continued

Categorical control variable	No for adequate plus PNC (Frequency, %)	n (no adequate plus PNC)	Yes for adequate plus PNC (Frequency, %)	n (yes for adequate plus PNC)	N	P-value
PNC paid by Medicaid		31,355		16,748	48,103	<0.0001*
No	18,434 (58.8%)		10,143 (60.6%)			
Yes	12,921 (41.2%)		6,605 (39.4%)			
PNC paid by military		31,355		16,748	48,103	<0.0001*
No	30,520 (97.3%)		16,526 (98.7%)			
Yes	835 (2.67%)		222 (1.32%)			
PNC paid by Native American Health Services		31,355		16,748	48,103	<0.0001*
No	30,978 (98.8%)		16,649 (99.4%)			
Yes	377 (1.20%)		99 (0.59%)			
Pregnancy and delivery control variables						
Birthweight		31,347		16,748	48,095	<0.0001*
<1,500 g	864 (27.6%)		1,622 (9.68%)			
1,500 g to 2,499 g	4,555 (14.5%)		5,664 (33.8%)			
2,500+ g	25,928 (82.7%)		9,462 (56.5%)			
Smoking during pregnancy		31,162		16,668	47,830	0.08**
No	27,818 (89.3%)		14,793 (88.8%)			
Yes	3,344 (10.7%)		1,875 (11.2%)			
Vaginal delivery		31,340		16,737	48,077	0.025*
No	8,581(27.4%)		6,542 (39.1%)			
Yes	22,759 (72.6%)		10,195 (60.9%)			

Table B-1. Continued

Categorical control variable	No for adequate plus PNC (Frequency, %)	n (no adequate plus PNC)	Yes for adequate plus PNC (Frequency, %)	n (yes for adequate plus PNC)	N	P-value
Gender of infant		31,355		16,747	48,102	0.48
Male	15,903 (50.7%)		8,437 (50.4%)			
Female	15,452 (49.6%)		8,310 (49.6%)			
Infant in the intensive care unit (ICU)		30,847		16,493	47,340	<0.0001*
No	26,402 (85.6%)		11,308 (68.6%)			
Yes	4,445 (14.4%)		5,185 (31.4%)			
Pregnancy intention		30,923		16,523	47,446	<0.0001*
No	16,350 (52.9%)		7,822 (47.3%)			
Yes	14,573 (47.1%)		8,701 (52.7%)			
Breastfed (ever)		30,599		16,430	47,029	<0.0001*
No	5,551 (18.1%)		3,256 (19.8%)			
Yes	25,048 (81.9%)		13,174 (80.2%)			
Alcohol consumption in the last three months of pregnancy		30,735		16,446	47,181	0.034*
No	28,622 (93.1%)		15,486 (94.2%)			
Yes	2,113 (6.87%)		960 (5.84%)			
Women, Infants, and Children during pregnancy		30,907		16,533	47,440	<0.0001*
No	16,403 (53.1%)		9,066 (54.8%)			
Yes	14,504 (46.9%)		7,467 (45.2%)			

Table B-1. Continued

Categorical control variable	No for adequate plus PNC (Frequency, %)	n (no adequate plus PNC)	Yes for adequate plus PNC (Frequency, %)	n (yes for adequate plus PNC)	N	P-value
Weight gain talk during pregnancy		5,493		3,366	8,859	0.0001*
No	1,288 (23.4%)		691 (20.5%)			
Yes	4,205 (76.6%)		2,675 (79.5%)			
High-risk maternal morbidity control variables						
Diabetes before pregnancy		31,355		16,748	48,103	<0.0001*
No	30,859 (98.4%)		16,245 (97.0%)			
Yes	496 (1.58%)		503 (3.00%)			
Incompetent cervix		31,355		16,748	48,103	<0.0001*
No	30,960 (98.7%)		16,271 (97.2%)			
Yes	395 (1.26%)		477 (2.85%)			
Preterm labor		31,355		16,748	48,103	<0.0001*
No	24,975 (79.7%)		10,528 (62.9%)			
Yes	6,380 (20.3%)		6,220 (37.1%)			
Placenta previa or placenta abruptio		31,355		16,748	48,103	<0.0001*
No	29,812 (95.1%)		15,111 (90.2%)			
Yes	1,543 (4.92%)		1,637 (9.77%)			
Bedrest		31,355		16,748	48,103	<0.0001*
No	26,137 (83.4%)		11,295 (67.4%)			
Yes	5,218 (16.6%)		5,453 (32.6%)			
Car crash injury		31,355		16,748	48,103	0.03*
No	30,847 (98.4%)		16,431 (98.1%)			
Yes	508 (1.62%)		317 (1.89%)			

Table B-1. Continued

Categorical control variable	No for adequate plus PNC (Frequency, %)	n (no adequate plus PNC)	Yes for adequate plus PNC (Frequency, %)	n (yes for adequate plus PNC)	N	P-value
Blood transfusion		31,355		16,748	48,103	<0.0001*
No	31,022 (98.9%)		16,466 (98.3%)			
Yes	333 (1.06%)		282 (1.68%)			
Medical risk factors		31,355		16,748	48,103	<0.0001*
No	21,317 (68.0%)		9,553 (57.0%)			
Yes	10,038 (32.0%)		7,195 (43.0%)			
Hospitalized during pregnancy		31,355		16,748	48,103	<0.0001*
No	27,247 (86.9%)		11,641 (69.5%)			
Yes	4,108 (13.1%)		5,107 (30.5%)			
Non high-risk maternal morbidity control variables						
Gestational diabetes		31,355		16,748	48,103	<0.0001*
No	28,955 (92.3%)		14,739 (88.0%)			
Yes	2,400 (7.65%)		2,009 (12.0%)			
Kidney/bladder infection		31,355		16,748	48,103	<0.0001*
No	25,968 (82.8%)		13,405 (80.0%)			
Yes	5,387 (17.2%)		3,343 (20.0%)			
Nausea		31,355		16,748	48,103	<0.0001*
No	22,725 (72.5%)		11,378 (67.9%)			
Yes	8,630 (27.5%)		5,370 (32.1%)			

Table B-1. Continued

Categorical control variable	No for adequate plus PNC (Frequency, %)	n (no adequate plus PNC)	Yes for adequate plus PNC (Frequency, %)	n (yes for adequate plus PNC)	N	P-value
High blood pressure		31,355		16,748	48,103	<0.0001*
No	27,736 (88.5%)		13,027 (77.8%)			
Yes	3,619 (11.5%)		3,721 (22.2%)			
Vaginal bleeding		31,355		16,748	48,103	<0.0001*
No	26,847 (85.6%)		12,944 (77.3%)			
Yes	4,508 (14.4%)		3,804 (22.7%)			
Premature rupture of membrane (PROM)		31,355		16,748	48,103	<0.0001*
No	29,277 (93.4%)		13,949 (83.3%)			
Yes	2,078 (6.62%)		2,799 (16.7%)			
Labor abnormalities		31,355		16,748	48,103	0.84
No	25,378 (80.9%)		13,543 (80.9%)			
Yes	5,977 (19.1%)		3,205 (19.1%)			
Labor/delivery complications		31,355		16,748	48,103	<0.0001*
No	20,501 (65.4%)		10,298 (61.5%)			
Yes	10,854 (34.6%)		6,450 (38.5%)			

The dependent variable for this table was adequate plus PNC, while the main independent variable was pre-pregnancy body mass index (BMI). The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval (CI) and a double asterisk corresponds to a 90% confidence interval (CI).

Table B-2. Maternal age (continuous variable) and adequate plus PNC t-test results

Group (Adequate plus PNC)	Observations	Mean	Standard error	Standard deviation	95% Confidence interval (Lower, Upper)
No	31353	27.22	.0347	6.14	(27.15, 27.28)
Yes	16746	27.96	.0481	6.22	(27.86, 28.05)
Combined	48099	27.48	.0282	6.18	(27.42, 27.53)
Difference	--------	-.7374	.0591	-.8531	-.6215

The dependent variable for this table was adequate plus PNC, while the main independent variable was maternal age. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005.

Table B-3. Logistic regression for adequate plus PNC to determine significant predictors of adequate plus PNC

Dependent variable: Adequate plus PNC	Odds ratio	P-value	95% Confidence interval (Lower, Upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal (reference)	1.00	---------	----------------
Obese	1.09	0.07**	(0.994, 1.193)
Overweight	0.95	0.33	(0.848, 1.056)
Underweight	1.12	0.04*	(1.006, 1.252)
Demographic control variables			
Maternal race: White (reference)	1.00	---------	----------------
Maternal race: Black	0.89	0.049*	(0.801, 0.999)
Maternal race: Other	0.71	<0.0001*	(0.638, 0.798)
Hispanic ethnicity	0.80	<0.0001*	(0.720, 0.898)
Maternal education	1.05	0.02*	(1.007, 1.096)
Maternal age	1.01	0.02*	(1.001, 1.016)
Higher income: $50,000 or more (reference)	1.00	---------	----------------
Very low income: Less than $10,000	0.74	<0.0001*	(0.635, 0.850)
Low income: $10,000-$24,999	0.80	<0.0001*	(0.705, 0.901)
Moderate income: $25,000-$49,999	0.86	0.004*	(0.781, 0.953)
Marital status	0.92	0.07**	(0.830, 1.008)
Pregnancy and delivery control variables			
Birthweight	0.52	<0.0001*	(0.486, 0.565)
Smoking during pregnancy	1.02	0.76	(0.989, 1.160)
Vaginal delivery	0.85	<0.0001*	(0.782, 0.915)
Alcohol during pregnancy	0.76	<0.0001*	(0.662, 0.875)
Women, Infants, and Children during pregnancy	1.21	<0.0001*	(1.100, 1.327)
Maternal morbidity control variables			
Diabetes before pregnancy	1.75	<0.0001*	(1.345, 2.284)
Gestational diabetes	1.35	<0.0001*	(1.190, 1.522)
Vaginal bleeding	1.13	0.01*	(1.030, 1.248)
Kidney/bladder infection	1.12	0.02*	(1.017, 1.226)
Cervix sewn shut (incompetent)	1.35	0.048*	(1.002, 1.821)
High blood pressure during pregnancy	1.36	<0.0001*	(1.225, 1.509)
Nausea	1.01	0.89	(0.928, 1.090)
Preterm labor	1.46	<0.0001*	(1.328, 1.595)
Premature rupture of membrane (PROM)	1.49	<0.0001*	(1.272, 1.736)
Placenta previa or placenta abruptio	1.16	0.065**	(0.991, 1.351)
Bedrest	1.47	<0.0001*	(1.337, 1.617)
Car crash injury	0.81	0.14	(0.609, 1.072)
Blood transfusion	0.79	0.18	(0.556, 1.119)
Medical risk factors	1.17	<0.0001*	(1.081, 1.259)
Labor abnormalities	1.07	0.15	(0.977, 1.169)
Labor/delivery complications	0.96	0.35	(0.893, 1.041)
Hospitalized during pregnancy	1.26	<0.0001*	(1.127, 1.411)

The dependent variable for this table was adequate plus PNC, while the main independent variable was pre-pregnancy body mass index (BMI). The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval (CI) and a double asterisk corresponds to a 90% confidence interval (CI).

Table B-4. Risk-adjusted ordinal logistic regression sensitivity analysis with the main effect independent variables, interaction effect variables, and control variables

Dependent variable: Postpartum depressive (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (Lower, Upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal BMI (reference)	1.00	---------	----------------
Underweight	0.94	0.43	(0.820, 1.087)
Overweight	0.96	0.60	(0.830, 1.114)
Obese	1.06	0.36	(0.937, 1.198)
Main effect independent variable: PNC utilization			
Adequate (reference)	1.00	---------	----------------
Inadequate	0.99	0.93	(0.829, 1.188)
Intermediate	1.08	0.26	(0.946, 1.229)
Adequate plus	1.04	0.52	(0.930, 1.156)
Interaction effect variables: Pre-pregnancy BMI/PNC utilization			
Obese BMI/Adequate PNC (reference)	1.00	---------	----------------
Obese BMI/Inadequate PNC	0.87	0.38	(0.635, 1.188)
Obese BMI/Intermediate PNC	0.84	0.20	(0.645, 1.096)
Obese BMI/Adequate plus PNC	1.01	0.95	(0.833, 1.216)
Overweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Overweight BMI/Inadequate PNC	1.15	0.53	(0.747, 1.764)
Overweight BMI/Intermediate PNC	1.10	0.50	(0.836, 1.441)
Overweight BMI/Adequate plus PNC	0.998	0.99	(0.782, 1.273)
Underweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Underweight BMI/Inadequate PNC	1.05	0.79	(0.720, 1.540)
Underweight BMI/Intermediate PNC	0.75	0.07**	(0.546, 1.027)
Underweight BMI/Adequate plus PNC	0.94	0.64	(0.744, 1.199)
Demographic control variables			
Maternal race: White (reference)	1.00	---------	----------------
Maternal race: Black	0.87	0.03*	(0.775, 0.988)
Maternal race: Other	1.12	0.03*	(1.013, 1.241)
Hispanic ethnicity	0.83	0.001*	(0.741, 0.931)
Maternal education	1.05	0.03*	(1.005, 1.096)
Maternal age	0.99	0.09**	(0.987, 1.001)
Higher income: $50,000 or more (reference)	1.00	---------	----------------
Very low income: Less than $10,000	1.80	<0.0001*	(1.541, 2.106)
Low income: $10,000-$24,999	1.36	<0.0001*	(1.209, 1.536)
Moderate income: $25,000-$49,999	1.27	<0.0001*	(1.163, 1.382)
Marital status	1.07	0.20	(0.967, 1.178)
Insurance control variables			
PNC paid by income (reference)	1.00	---------	----------------

Table B-4. Continued

Dependent variable: Postpartum depressive (PPD) symptoms	Odds ratio	P-value	95% Confidence interval (lower, upper)
PNC paid by insurance/HMO	1.05	0.37	(0.944, 1.169)
PNC paid by Medicaid	1.04	0.56	(0.922, 1.162)
PNC paid by military	0.95	0.66	(0.737, 1.215)
PNC paid by Native American/Alaskan HS	0.72	0.005*	(0.566, 0.904)
Pregnancy and delivery control variables			
Birthweight	1.10	0.05**	(0.999, 1.204)
Smoking during pregnancy	0.83	0.004*	(0.726, 0.941)
Vaginal delivery	0.94	0.11	(0.873, 1.014)
Gender of infant	0.97	0.29	(0.904, 1.031)
Infant in the intensive care unit (ICU)	1.13	0.06**	(0.995, 1.283)
Pregnancy intention	0.79	<0.0001*	(0.731, 0.847)
Breastfed	1.13	0.01*	(1.027, 1.246)
Alcohol during pregnancy	1.48	<0.0001*	(1.318, 1.660)
Women, Infants, and Children during pregnancy	1.02	0.68	(0.924, 1.129)
High-risk maternal morbidity control variables			
Diabetes before pregnancy	1.27	0.18	(0.897, 1.784)
Gestational diabetes	1.19	0.01*	(1.040, 1.351)
Vaginal bleeding	1.24	<0.0001*	(1.130, 1.369)
Kidney/bladder infection	1.38	<0.0001*	(1.255, 1.524)
Cervix sewn shut (incompetent)	0.75	0.10	(0.531, 1.061)
High blood pressure during pregnancy	1.01	0.84	(0.909, 1.124)
Preterm labor	1.38	<0.0001*	(1.262, 1.518)
Premature rupture of membrane (PROM)	0.82	0.01*	(0.698, 0.953)
Placenta previa or placenta abruptio	1.08	0.33	(0.926, 1.256)
Bedrest during pregnancy	1.11	0.05**	(0.999, 1.222)
Medical risk factors during pregnancy	1.05	0.22	(0.973, 1.128)
Hospitalized during pregnancy	1.05	0.39	(0.934, 1.191)

The dependent variable for this table was postpartum depressive (PPD) symptoms, while the main independent variables were Pre-pregnancy body mass index (BMI), prenatal care (PNC) utilization, pre-pregnancy BMI/PNC utilization interaction terms. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval (CI) and a double asterisk corresponds to a 90% confidence interval (CI).

Table B-5. Logistic regression for women who received WIC services during pregnancy

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women who received WIC during pregnancy	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal (reference)	1.00	---------	----------------
Underweight	0.86	0.38	(0.608, 1.207)
Overweight	0.61	0.005*	(0.424, 0.861)
Obese	0.88	0.37	(0.664, 1.164)
Main effect independent variable: PNC utilization			
Adequate (reference)	1.00	---------	----------------
Inadequate	1.10	0.53	(0.818, 1.475)
Intermediate	1.08	0.65	(0.780, 1.489)
Adequate plus	0.97	0.80	(0.747, 1.250)
Interaction effect variables: Pre-pregnancy BMI/PNC utilization			
Obese BMI/Adequate PNC (reference)	1.00	---------	----------------
Obese BMI/Inadequate PNC	0.63	0.095**	(0.370, 1.083)
Obese BMI/Intermediate PNC	1.27	0.37	(0.755, 2.121)
Obese BMI/Adequate plus PNC	0.97	0.88	(0.647, 1.449)
Overweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Overweight BMI/Inadequate PNC	1.92	0.048*	(1.005, 3.653)
Overweight BMI/Intermediate PNC	1.23	0.51	(0.655, 2.327)
Overweight BMI/Adequate plus PNC	1.54	0.11	(0.912, 2.602)
Underweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Underweight BMI/Inadequate PNC	1.20	0.55	(0.657, 2.206)
Underweight BMI/Intermediate PNC	0.97	0.94	(0.491, 1.927)
Underweight BMI/Adequate plus PNC	0.93	0.79	(0.543, 1.595)
Demographic control variables			
Maternal race: White (reference)	1.00	---------	----------------
Maternal race: Black	1.32	0.004*	(1.095, 1.591)
Maternal race: Other	1.47	<0.0001*	(1.214, 1.767)
Hispanic ethnicity	0.96	0.68	(0.787, 1.168)
Maternal education	0.94	0.16	(0.865, 1.024)
Maternal age	0.99	0.07**	(0.973, 1.001)
Higher income: $50,000 or more (reference)	1.00	---------	----------------
Very low income: Less than $10,000	1.96	0.002*	(1.271, 3.012)
Low income: $10,000-$24,999	1.48	0.07**	(0.970, 2.247)
Moderate income: $25,000-$49,999	1.36	0.16	(0.889, 2.096)
Marital status	1.02	0.80	(0.867, 1.204)

Table B-5. Continued

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women who received WIC during pregnancy	Odds ratio	P-value	95% Confidence interval (lower, upper)
Insurance control variables			
PNC paid by income (reference)	1.00	---------	----------------
PNC paid by insurance/HMO	0.96	0.71	(0.789, 1.175)
PNC paid by Medicaid	0.98	0.82	(0.813, 1.177)
PNC paid by military	1.06	0.84	(0.610, 1.831)
PNC paid by Native American/Alaskan HS	0.71	0.10	(0.466, 1.069)
Pregnancy and delivery control variables			
Birthweight	1.15	0.09**	(0.979, 1.356)
Smoking during pregnancy	0.81	0.03*	(0.666, 0.982)
Vaginal delivery	0.84	0.03*	(0.715, 0.985)
Gender of infant	0.99	0.88	(0.859, 1.139)
Infant in the intensive care unit (ICU)	1.43	0.002*	(1.144, 1.783)
Pregnancy intention	0.94	0.44	(0.799, 1.104)
Breastfed	0.89	0.16	(0.757, 1.047)
Alcohol during pregnancy	1.42	0.03*	(1.037, 1.937)
High-risk maternal morbidity control variables			
Diabetes before pregnancy	1.12	0.62	(0.712, 1.763)
Gestational diabetes	1.11	0.39	(0.871, 1.423)
Vaginal bleeding	1.49	<0.0001*	(1.232, 1.802)
Kidney/bladder infection	1.45	<0.0001*	(1.237, 1.706)
Cervix sewn shut (incompetent)	1.04	0.88	(0.623, 1.743)
High blood pressure during pregnancy	0.92	0.43	(0.750, 1.131)
Preterm labor	1.49	<0.0001*	(1.253, 1.760)
Premature rupture of membrane (PROM)	0.69	0.01*	(0.519, 0.917)
Placenta previa or placenta abruptio	1.02	0.91	(0.747, 1.385)
Bedrest during pregnancy	1.17	0.11	(0.968, 1.405)
Medical risk factors during pregnancy	1.21	0.01	(1.039, 1.404)
Hospitalized during pregnancy	1.07	0.519	(0.870, 1.317)

The dependent variable for this table was postpartum depressive (PPD) symptoms, while the main independent variables were Pre-pregnancy body mass index (BMI), prenatal care (PNC) utilization, pre-pregnancy BMI/PNC utilization interaction terms. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval (CI) and a double asterisk corresponds to a 90% confidence interval (CI).

Table B-6. Logistic regression for women with very low income

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women with very low income (less than $10,000)	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal (reference)	1.00	---------	----------------
Underweight	0.98	0.92	(0.595, 1.600)
Overweight	0.89	0.67	(0.517, 1.531)
Obese	0.88	0.57	(0.574, 1.356)
Main effect independent variable: PNC utilization			
Adequate (reference)	1.00	---------	----------------
Inadequate	1.12	0.59	(0.749, 1.664)
Intermediate	0.996	0.99	(0.634, 1.566)
Adequate plus	1.05	0.81	(0.716, 1.535)
Interaction effect variables: Pre-pregnancy BMI/PNC utilization			
Obese BMI/Adequate PNC (reference)	1.00	---------	----------------
Obese BMI/Inadequate PNC	0.51	0.07**	(0.246, 1.049)
Obese BMI/Intermediate PNC	1.49	0.29	(0.712, 3.121)
Obese BMI/Adequate plus PNC	0.97	0.93	(0.526, 1.801)
Overweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Overweight BMI/Inadequate PNC	2.32	0.06**	(0.979, 5.504)
Overweight BMI/Intermediate PNC	0.75	0.56	(0.283, 1.971)
Overweight BMI/Adequate plus PNC	1.08	0.86	(0.468, 2.469)
Underweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Underweight BMI/Inadequate PNC	0.93	0.85	(0.415, 2.060)
Underweight BMI/Intermediate PNC	0.65	0.37	(0.258, 1.646)
Underweight BMI/Adequate plus PNC	0.81	0.58	(0.371, 1.748)
Demographic control variables			
Maternal race: White (reference)	1.00	---------	----------------
Maternal race: Black	1.18	0.22	(0.907, 1.537)
Maternal race: Other	1.16	0.29	(0.886, 1.505)
Hispanic ethnicity	0.89	0.42	(0.670, 1.183)
Maternal education	1.02	0.74	(0.907, 1.148)
Maternal age	1.01	0.62	(0.985, 1.026)
Marital status	0.996	0.98	(0.778, 1.276)
Insurance control variables			
PNC paid by income (reference)	1.00	---------	----------------
PNC paid by insurance/HMO	0.76	0.14	(0.530, 1.091)
PNC paid by Medicaid	0.87	0.36	(0.652, 1.169)
PNC paid by military	0.36	0.02*	(0.148, 0.874)
PNC paid by Native American/Alaskan HS	0.84	0.60	(0.436, 1.614)

Table B-6. Continued

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women with very low income (less than $10,000)	Odds ratio	P-value	95% Confidence interval (lower, upper)
Pregnancy and delivery control variables			
Birthweight	1.04	0.74	(0.832, 1.294)
Smoking during pregnancy	0.89	0.38	(0.689, 1.151)
Vaginal delivery	0.89	0.32	(0.702, 1.121)
Gender of infant	0.91	0.39	(0.747, 1.120)
Infant in the intensive care unit (ICU)	1.32	0.09**	(0.955, 1.812)
Pregnancy intention	1.08	0.55	(0.845,1.370)
Breastfed	0.85	0.16	(0.670, 1.066)
Alcohol during pregnancy	0.96	0.84	(0.644, 1.427)
Women, Infants, and Children	0.998	0.99	(0.755, 1.321)
High-risk maternal morbidity control variables			
Diabetes before pregnancy	2.14	0.007*	(1.237, 3.706)
Gestational diabetes	0.87	0.42	(0.611, 1.229)
Vaginal bleeding	1.18	0.25	(0.892, 1.554)
Kidney/bladder infection	1.53	<0.0001*	(1.217, 1.928)
Cervix sewn shut (incompetent)	0.98	0.94	(0.524, 1.824)
High blood pressure during pregnancy	0.81	0.175	(0.605, 1.095)
Preterm labor	1.30	0.03*	(1.030, 1.650)
Premature rupture of membrane (PROM)	0.77	0.17	(0.523, 1.120)
Placenta previa or placenta abruptio	1.08	0.73	(0.703, 1.652)
Bedrest during pregnancy	1.33	0.02*	(1.040, 1.710)
Medical risk factors during pregnancy	1.15	0.20	(0.928, 1.433)
Hospitalized during pregnancy	0.96	0.75	(0.728, 1.258)

The dependent variable for this table was postpartum depressive (PPD) symptoms, while the main independent variables were Pre-pregnancy body mass index (BMI), prenatal care (PNC) utilization, pre-pregnancy BMI/PNC utilization interaction terms. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval (CI) and a double asterisk corresponds to a 90% confidence interval (CI).

Table B-7. Logistic regression for women with low income

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women with low income ($10,000 to $24,999)	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal (reference)	1.00	---------	----------------
Underweight	0.77	0.26	(0.485, 1.214)
Overweight	0.69	0.11	(0.430, 1.095)
Obese	0.90	0.58	(0.613, 1.316)
Main effect independent variable: PNC utilization			
Adequate (reference)	1.00	---------	----------------
Inadequate	0.91	0.66	(0.610, 1.370)
Intermediate	1.28	0.23	(0.855, 1.928)
Adequate plus	0.92	0.62	(0.662, 1.277)
Interaction effect variables: Pre-pregnancy BMI/PNC utilization			
Obese BMI/Adequate PNC (reference)	1.00	---------	----------------
Obese BMI/Inadequate PNC	0.97	0.94	(0.472, 2.001)
Obese BMI/Intermediate PNC	0.98	0.95	(0.489, 1.962)
Obese BMI/Adequate plus PNC	1.22	0.47	(0.715, 2.082)
Overweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Overweight BMI/Inadequate PNC	1.26	0.58	(0.558, 2.857)
Overweight BMI/Intermediate PNC	0.74	0.47	(0.331, 1.657)
Overweight BMI/Adequate plus PNC	1.45	0.27	(0.746, 2.806)
Underweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Underweight BMI/Inadequate PNC	1.44	0.39	(0.630, 3.284)
Underweight BMI/Intermediate PNC	0.75	0.56	(0.287, 1.957)
Underweight BMI/Adequate plus PNC	1.32	0.42	(0.673, 2.598)
Demographic control variables			
Maternal race: White (reference)	1.00	---------	----------------
Maternal race: Black	1.22	0.13	(0.941, 1.599)
Maternal race: Other	1.74	<0.0001*	(1.368, 2.222)
Hispanic ethnicity	1.08	0.57	(0.832, 1.401)
Maternal education	0.96	0.46	(0.859, 1.071)
Maternal age	0.98	0.06**	(0.963, 1.001)
Marital status	1.02	0.83	(0.832, 1.257)
Insurance control variables			
PNC paid by income (reference)	1.00	---------	----------------
PNC paid by insurance/HMO	1.14	0.27	(0.901, 1.453)
PNC paid by Medicaid	1.19	0.16	(0.936, 1.512)
PNC paid by military	1.01	0.98	(0.489, 2.091)
PNC paid by Native American/Alaskan HS	0.32	0.001*	(0.167, 0.630)

Table B-7. Continued

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women with low income ($10,000 to $24,999)	Odds ratio	P-value	95% Confidence interval (lower, upper)
Pregnancy and delivery control variables			
Birthweight	1.21	0.08**	(0.978, 1.506)
Smoking during pregnancy	0.69	0.005*	(0.536, 0.896)
Vaginal delivery	0.83	0.07**	(0.671, 1.016)
Gender of infant	1.11	0.26	(0.924, 1.333)
Infant in the intensive care unit (ICU)	1.41	0.02*	(1.069, 1.872)
Pregnancy intention	0.81	0.047*	((0.654, 0.997)
Breastfed	0.85	0.14	(0.676, 1.058)
Alcohol during pregnancy	1.78	0.003*	(1.210, 2.627)
Women, Infants, and Children	0.99	0.95	(0.795, 1.240)
High-risk maternal morbidity control variables			
Diabetes before pregnancy	0.88	0.74	(0.417, 1.867)
Gestational diabetes	1.36	0.06**	(0.988, 1.877)
Vaginal bleeding	1.31	0.03*	(1.024, 1.688)
Kidney/bladder infection	1.46	0.001*	(1.172, 1.811)
Cervix sewn shut (incompetent)	0.76	0.43	(0.386, 1.497)
High blood pressure during pregnancy	1.07	0.61	(0.817, 1.409)
Preterm labor	1.43	0.003*	(1.129, 1.804)
Premature rupture of membrane (PROM)	0.76	0.21	(0.487, 1.175)
Placenta previa or placenta abruptio	0.83	0.37	(0.557, 1.242)
Bedrest during pregnancy	1.28	0.05**	(0.998, 1.649)
Medical risk factors during pregnancy	1.10	0.33	(0.904, 1.345)
Hospitalized during pregnancy	1.14	0.37	(0.860, 1.505)

The dependent variable for this table was postpartum depressive (PPD) symptoms, while the main independent variables were Pre-pregnancy body mass index (BMI), prenatal care (PNC) utilization, pre-pregnancy BMI/PNC utilization interaction terms. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval (CI) and a double asterisk corresponds to a 90% confidence interval (CI).

Table B-8. Logistic regression for women with moderate income

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women with moderate income ($25,000 to $49,999)	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal (reference)	1.00	---------	----------------
Underweight	0.87	0.61	(0.504, 1.498)
Overweight	0.999	0.99	(0.599, 1.670)
Obese	0.92	0.68	(0.617, 1.373)
Main effect independent variable: PNC utilization			
Adequate (reference)	1.00	---------	----------------
Inadequate	1.72	0.046*	(1.009, 2.934)
Intermediate	0.76	0.28	(0.459, 1.251)
Adequate plus	1.06	0.73	(0.744, 1.522)
Interaction effect variables: Pre-pregnancy BMI/PNC utilization			
Obese BMI/Adequate PNC (reference)	1.00	---------	----------------
Obese BMI/Inadequate PNC	0.72	0.51	(0.277, 1.887)
Obese BMI/Intermediate PNC	1.46	0.36	(0.651, 3.256)
Obese BMI/Adequate plus PNC	0.90	0.73	(0.496, 1.632)
Overweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Overweight BMI/Inadequate PNC	0.66	0.50	(0.194, 2.227)
Overweight BMI/Intermediate PNC	1.12	0.82	(0.420, 2.990)
Overweight BMI/Adequate plus PNC	1.17	0.69	(0.540, 2.535)
Underweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Underweight BMI/Inadequate PNC	1.06	0.92	0.360, 3.124)
Underweight BMI/Intermediate PNC	1.75	0.33	(0.571, 5.332)
Underweight BMI/Adequate plus PNC	0.81	0.63	(0.345, 1.906)
Demographic control variables			
Maternal race: White (reference)	1.00	---------	----------------
Maternal race: Black	1.77	0.001*	(1.247, 2.502)
Maternal race: Other	1.53	0.01*	(1.104, 2.109)
Hispanic ethnicity	1.02	0.93	(0.712, 1.451)
Maternal education	0.79	0.001*	(0.688, 0.901)
Maternal age	0.995	0.68	(0.973, 1.018)
Marital status	0.94	0.66	(0.694, 1.262)
Insurance control variables			
PNC paid by income (reference)	1.00	---------	----------------
PNC paid by insurance/HMO	0.85	0.30	(0.628, 1.155)
PNC paid by Medicaid	1.13	0.48	(0.801, 1.600)
PNC paid by military	1.27	0.42	(0.713, 2.267)

Table B-8. Continued

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women with moderate income ($25,000 to $49,999)	Odds ratio	P-value	95% Confidence interval (lower, upper)
PNC paid by Native American/Alaskan HS	1.21	0.53	(0.662, 2.229)
Pregnancy and delivery control variables			
Birthweight	0.96	0.75	(0.723, 1.263)
Smoking during pregnancy	0.79	0.23	(0.538, 1.163)
Vaginal delivery	0.94	0.64	(0.732, 1.211)
Gender of infant	1.09	0.46	(0.873, 1.353)
Infant in the intensive care unit (ICU)	1.18	0.36	(0.827, 1.690)
Pregnancy intention	0.77	0.03*	(0.607, 0.971)
Breastfed	1.02	0.88	(0.761, 1.375)
Alcohol during pregnancy	1.06	0.82	(0.634, 1.783)
Women, Infants, and Children	1.07	0.64	(0.809, 1.412)
High-risk maternal morbidity control variables			
Diabetes before pregnancy	1.52	0.33	(0.661, 3.496)
Gestational diabetes	1.02	0.92	(0.675, 1.545)
Vaginal bleeding	1.63	0.001*	(1.222, 2.161)
Kidney/bladder infection	1.34	0.04*	(1.021, 1.762)
Cervix sewn shut (incompetent)	1.60	0.41	(0.526, 4.883)
High blood pressure during pregnancy	1.01	0.95	(0.735, 1.387)
Preterm labor	1.47	0.006*	(1.114, 1.937)
Premature rupture of membrane (PROM)	0.59	0.03*	(0.371, 0.941)
Placenta previa or placenta abruptio	1.13	0.64	(0.682, 1.865)
Bedrest during pregnancy	0.84	0.25	(0.618, 1.134)
Medical risk factors during pregnancy	1.14	0.64	(0.682, 1.865)
Hospitalized during pregnancy	1.10	0.61	(0.763, 1.590)

The dependent variable for this table was postpartum depressive (PPD) symptoms, while the main independent variables were Pre-pregnancy body mass index (BMI), prenatal care (PNC) utilization, pre-pregnancy BMI/PNC utilization interaction terms. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval (CI).

Table B-9. Logistic regression for women with higher income

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women with higher income ($50,000 or more)	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal (reference)	1.00	---------	----------------
Underweight	0.78	0.37	(0.460, 1.334)
Overweight	0.96	0.88	(0.527, 1.736)
Obese	0.90	0.68	(0.553, 1.475)
Main effect independent variable: PNC utilization			
Adequate (reference)	1.00	---------	----------------
Inadequate	0.72	0.45	(0.303, 1.689)
Intermediate	0.98	0.95	(0.604, 1.602)
Adequate plus	1.32	0.14	(0.912, 1.919)
Interaction effect variables: Pre-pregnancy BMI/PNC utilization			
Obese BMI/Adequate PNC (reference)	1.00	---------	----------------
Obese BMI/Inadequate PNC	1.23	0.76	(0.315, 4.830)
Obese BMI/Intermediate PNC	1.37	0.51	(0.538, 3.512)
Obese BMI/Adequate Plus PNC	0.84	0.62	(0.426, 1.662)
Overweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Overweight BMI/Inadequate PNC	1.40	0.70	(0.253, 7.690)
Overweight BMI/Intermediate PNC	1.89	0.22	(0.685, 5.199)
Overweight BMI/Adequate Plus PNC	1.01	0.98	(0.412, 2.486)
Underweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Underweight BMI/Inadequate PNC	1.28	0.74	(0.297, 5.524)
Underweight BMI/Intermediate PNC	2.40	0.06*	(0.967, 5.975)
Underweight BMI/Adequate Plus PNC	1.29	0.55	(0.558, 2.970)
Demographic control variables			
Maternal race: White (reference)	1.00	---------	----------------
Maternal race: Black	1.90	0.008*	(1.180, 3.053)
Maternal race: Other	1.55	0.008*	(1.123, 1.235)
Hispanic ethnicity	0.92	0.75	(0.563, 1.509)
Maternal education	0.84	0.02*	(0.714, 0.976)
Maternal age	0.99	0.30	(0.958, 1.013)
Marital status	1.34	0.28	(0.786, 2.275)
Insurance control variables			
PNC paid by income (reference)	1.00	---------	----------------
PNC paid by insurance/HMO	0.92	0.68	(0.611, 1.376)
PNC paid by Medicaid	1.22	0.57	(0.613, 2.434)
PNC paid by military	0.30	0.02*	(0.110, 0.801)
PNC paid by Native American/Alaskan HS	0.66	0.33	(0.290, 1.516)

Table B-9. Continued

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women with higher income ($50,000 or more)	Odds ratio	P-value	95% Confidence interval (lower, upper)
Pregnancy and delivery control variables			
Birthweight	0.92	0.58	(0.673, 1.247)
Smoking during pregnancy	1.09	0.81	(0.549, 2.165)
Vaginal delivery	1.08	0.58	(0.827, 1.405)
Gender of infant	1.13	0.32	(0.889, 1.440)
Intensive care unit	1.15	0.55	(0.726, 1.821)
Pregnancy intention	0.67	0.003*	(0.518, 0.869)
Breastfed	1.28	0.23	(0.856, 1.921)
Alcohol during pregnancy	1.36	0.12	(0.923, 2.004)
Women, Infants, and Children	0.99	0.97	(0.566, 1.734)
High-risk maternal morbidity control variables			
Diabetes before pregnancy	0.75	0.64	(0.230, 2.451)
Gestational diabetes	1.70	0.02*	(1.108, 2.613)
Vaginal bleeding	0.96	0.78	(0.707, 1.298)
Kidney/bladder infection	1.46	0.04*	(1.022, 2.098)
Cervix sewn shut (incompetent)	0.82	0.67	(0.315, 2.105)
High blood pressure during pregnancy	0.98	0.92	(0.669, 1.438)
Preterm labor	1.64	0.003*	(1.179, 2.280)
Premature rupture of membrane (PROM)	0.64	0.08**	(0.391, 1.059)
Placenta previa or placenta abruptio	1.25	0.35	(0.783, 1.994)
Bedrest during pregnancy	1.07	0.72	(0.752, 1.508)
Medical risk factors during pregnancy	0.97	0.81	(0.741, 1.263)
Hospitalized during pregnancy	0.91	0.65	(0.603, 1.371)

The dependent variable for this table was postpartum depressive (PPD) symptoms, while the main independent variables were Pre-pregnancy body mass index (BMI), prenatal care (PNC) utilization, pre-pregnancy BMI/PNC utilization interaction terms. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval (CI) and a double asterisk corresponds to a 90% confidence interval (CI).

Table B-10. Logistic regression for women who received weight gain discussion

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women who received weight gain discussion during PNC	Odds ratio	P-value	95% Confidence interval (lower, upper)
Main effect independent variable: Pre-pregnancy BMI			
Normal (reference)	1.00	---------	----------------
Underweight	0.48	0.02*	(0.258, 0.908)
Overweight	0.61	0.19	(0.293, 1.267)
Obese	1.59	0.12	(0.892, 2.830)
Main effect independent variable: PNC utilization			
Adequate (reference)	1.00	---------	----------------
Inadequate	0.90	0.75	(0.475, 1.708)
Intermediate	0.60	0.29	(0.233, 1.543)
Adequate plus	1.40	0.18	(0.858, 2.280)
Interaction effect variables: Pre-pregnancy BMI/PNC utilization			
Obese BMI/Adequate PNC (reference)	1.00	---------	----------------
Obese BMI/Inadequate PNC	0.67	0.50	(0.212, 2.143)
Obese BMI/Intermediate PNC	1.47	0.63	(0.304, 7.103)
Obese BMI/Adequate plus PNC	0.48	0.14	(0.177, 1.287)
Overweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Overweight BMI/Inadequate PNC	0.81	0.81	(0.142, 4.642)
Overweight BMI/Intermediate PNC	1.86	0.63	(0.148, 23.35)
Overweight BMI/Adequate plus PNC	0.79	0.74	(0.193, 3.205)
Underweight BMI/Adequate PNC (reference)	1.00	---------	----------------
Underweight BMI/Inadequate PNC	4.10	0.01*	(1.409, 11.95)
Underweight BMI/Intermediate PNC	12.79	0.002*	(2.616, 62.50)
Underweight BMI/Adequate plus PNC	1.65	0.31	(0.624, 4.376)
Demographic control variables			
Maternal Race: White (reference)	1.00	---------	----------------
Maternal Race: Black	0.75	0.71	(0.162, 3.452)
Maternal Race: Other	1.86	0.049	(1.002, 3.438)
Hispanic ethnicity	0.68	0.13	(0.418, 1.117)
Maternal education	0.79	0.01*	(0.653, 0.945)
Maternal age	1.01	0.70	(0.971, 1.044)
Higher income: $50,000 or more (reference)	1.00	---------	----------------
Income: Very low income: Less than $10,000	1.51	0.25	(0.745, 3.061)
Income: Low income: $10,000-$24,999	1.24	0.48	(0.674, 2.296)
Income: Moderate income: $25,000-$49,999	1.11	0.68	(0.673, 1.842)
Marital status	1.58	0.03*	(1.043, 2.385)
Insurance control variables			
PNC paid by income (reference)	1.00	---------	----------------

Table B-10. Continued

Dependent variable: Postpartum depressive (PPD) symptoms Subpopulation: Women who received weight gain discussion during their PNC	Odds ratio	P-value	95% Confidence interval (lower, upper)
PNC paid by insurance/HMO	0.98	0.93	(0.612, 1.565)
PNC paid by Medicaid	1.63	0.05**	(0.997, 2.651)
Pregnancy and delivery control variables			
Birthweight	0.91	0.61	(0.646, 1.293)
Smoking during pregnancy	0.82	0.47	(0.470, 1.419)
Vaginal delivery	0.79	0.20	(0.544, 1.135)
Gender of infant	0.79	0.14	(0.579, 1.076)
Infant in the intensive care unit (ICU)	0.84	0.52	(0.488, 1.437)
Pregnancy intention	0.61	0.005*	(0.427, 0.859)
Breastfed	0.75	0.21	(0.480, 1.174)
Alcohol during pregnancy	0.81	0.57	(0.392, 1.671)
Women, Infants, and Children during pregnancy	0.64	0.02*	(0.434, 0.935)
High-risk maternal morbidity control variables			
Diabetes before pregnancy	2.76	0.096**	(0.834, 9.148)
Gestational diabetes	0.85	0.64	(0.425, 1.697)
Vaginal bleeding	1.05	0.81	(0.696, 1.590)
Kidney/bladder infection	1.65	0.006*	(1.152, 2.376)
Cervix sewn shut (incompetent)	0.85	0.86	(0.131, 5.485)
High blood pressure during pregnancy	0.84	0.48	(0.5151, 1.368)
Preterm labor	1.10	0.63	(0.753, 1.599)
Premature rupture of membrane (PROM)	0.63	0.13	(0.3445, 1.152)
Placenta previa or placenta abruptio	1.48	0.19	(0.825, 2.671)
Bedrest during pregnancy	1.31	0.17	(0.888, 1.925)
Medical risk factors during pregnancy	0.73	0.05**	(0.530, 1.001)
Hospitalized during pregnancy	1.04	0.88	(0.604, 1.796)

The dependent variable for this table was postpartum depressive (PPD) symptoms, while the main independent variables were Pre-pregnancy body mass index (BMI), prenatal care (PNC) utilization, pre-pregnancy BMI/PNC utilization interaction terms. The population for this table included all pregnancies and the years of PRAMS data collection were for 2004 & 2005. An asterisk corresponds to a 95% confidence interval (CI) and a double asterisk corresponds to a 90% confidence interval (CI).

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BIOGRAPHICAL SKETCH

Swathy Sundaram was born in Hamilton, Ontario, Canada. She moved with her parents to the United States at the age of five and has lived in Florida since then. She always possessed an interest in health and medicine, in both her personal and academic life. She graduated with a bachelor's in microbiology/molecular biology from the University of Central Florida in 2002. Interested in pursuing further education in health and medicine, she received a master's in public health from Nova Southeastern University in 2004. While in her master's program, she developed an interest in research. Wanting to pursue a field in which she could incorporate health, medicine, and research, she enrolled in a doctoral program in health services research at the University of Florida in 2005. During the course of the program, she developed a strong interest in maternal and child health. In 2008, she became an American Public Health Association maternal and child health student fellow from which, she furthered her interests in maternal and child health. She received her doctoral degree in the summer of 2009.