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Maternal Morbidities and Postpartum Depression: An Analysis Using the 2007 and 2008 Pregnancy Risk Assessment Monitoring System

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A B S T R A C T

Purpose: Postpartum depression (PPD) is common and associated with significant health outcomes and other consequences. Identifying persons at risk may improve screening and detection of PPD. This exploratory study sought to identify the morbidities that associate with 1) PPD symptoms and 2) PPD diagnosis.
Methods: Data from the 2007 and 2008 Pregnancy Risk Assessment Monitoring System were analyzed from 23 states and 1 city ($n = 61{,}733$ pregnancies); 13 antenatal morbidities were included. To determine whether antenatal morbidity predictors of PPD would differ based on PPD symptoms versus a diagnosis, each of the 13 antenatal morbidities were examined in separate logistic regression models with each PPD outcome. For each objective, two samples were examined: 1) Women from all states and 2) women from Alaska and Maine, the two states that included both PPD symptoms and PPD diagnosis measures in their questionnaires. Control variables included demographic and socio-demographic variables, pregnancy variables, antenatal and postpartum health behaviors, and birth outcomes.
Main Findings: Having vaginal bleeding (odds ratio [OR], 1.42; OR, 1.76), kidney/bladder infection (OR, 1.59; OR, 1.63), nausea (OR, 1.50; OR, 1.80), preterm labor (OR, 1.54; OR, 1.51), or being on bed rest (OR, 1.34; OR, 1.56) associated with both PPD symptoms and PPD diagnosis, respectively. Being in a car accident associated with PPD symptoms only (OR, 1.65), whereas having hypertension (OR, 1.94) or a blood transfusion (OR, 2.98) was associated with PPD diagnosis only. Among women from Alaska or Maine, having preterm labor (OR, 2.54, 2.11) or nausea (OR, 2.15, 1.60) was associated with both PPD symptoms and PPD diagnosis, respectively. Having vaginal bleeding (OR, 1.65), kidney/bladder infection (OR, 1.74), a blood transfusion (OR, 3.30), or being on bed rest (OR, 1.87) was associated with PPD symptoms only, whereas having diabetes before pregnancy (OR, 5.65) was associated with PPD diagnosis only.
Conclusions: The findings of this exploratory study revealed differences in the antenatal morbidities that were associated with PPD symptoms versus diagnosis in both samples, and can assist prenatal care providers in prioritizing and screening for these morbidities that are associated with PPD during pregnancy. Additional research is warranted to confirm the results of this study in other samples and populations. Developing strategies to 1) improve general awareness of PPD and the appropriate antenatal morbidity risk factors to focus on in clinical settings, and 2) increase screening for the antenatal morbidities determined to be predictors of PPD in this study are warranted in preventing PPD.

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Among women who are in their childbearing years, depression can be one of the most disabling disorders (O'Hara, 2009). Postpartum depression (PPD), a mood disorder that can occur during the first year after childbirth (Epperson, 1999), 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 (Butler & Lambert, 2010; Wisner,

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Parry, & Piontek, 2002). PPD is divided into three categories: 1) The blues, which affect roughly 50% to 80% of new mothers and is considered to be normal, 2) nonpsychotic PPD, which affects roughly 10% to 15% of new mothers, with the incidence being on average 13%, and 3) postpartum psychosis, which is rarer than the other two types and occurs in roughly one or two out of every thousand pregnancies (Evans & Theofrastous, 1997; Miller, 2002; Negus Jolley & Betrus, 2007; O'Hara & Swain, 1996).

Among depressive disorders, PPD is particularly important because this disorder can affect a woman's parenting practices, which can impact the well-being of the baby (O'Hara, 2009). For example, mothers with PPD may be unresponsive to their infants (or portrayed as being unresponsive); withdraw from, avoid, or neglect their infants; or display behaviors toward their infants that are passive, intrusive, and aggressive, (Lovejoy, Graczyk, O'Hare, & Neuman, 2000; Reck et al., 2004). Long-term consequences of PPD include recurrent episodes of depression (Miller, 2002; Robertson, Celasun, & Stewart, 2003), greater health care costs and utilization compared with nondepressed women (Dagher, McGovern, Dowd, & Gjerdingen, 2012; Petrou, Cooper, Murray, & Davidson, 2002), having children at higher risk for depression (Goodman, 2007; Murray et al., 2009), and having children with difficult temperament and other behavioral problems (Bruder et al., 2007; Goodman & Tully, 2006; Hanington, Ramchandani, & Stein, 2010). Thus, it is imperative to identify the factors that increase a woman's risk for PPD, and/or treat PPD accordingly, because 1) PPD can potentially jeopardize a woman's future health, and 2) the relationship between a mother and baby is crucial for healthy maternal and child health outcomes.

PPD is characterized by a variety of symptoms including mood swings, fatigue, fear, sadness and despair, anxiety, thoughts of compulsion, loss of libido, inconsistent sleeping patterns, and feelings of inadequacy (Horowitz, Damato, Solon, von Metzsch, & Gill, 1995). When these symptoms reach a level of intensity that begins to affect the well-being of a woman and her daily functioning, this may indicate PPD, and a woman should seek treatment. Because a new mother may be unaware of 1) the normal physical changes that occur after giving birth, and 2) her ability to care for her infant, approximately 4 to 6 weeks after the delivery, the American Academy of Pediatrics and the American College of Obstetricians and Gynecologists recommend that a woman should seek a postpartum examination through her physician; this examination should include an evaluation of her current health status, her adaptation to caring for her infant, and a formal assessment for depressive symptoms using instruments with known sensitivity and specificity (American Academy of Pediatrics & the American College of Obstetrics & Gynecologists, 2007; Epperson, 1999; Fetchner-Bates, Coyne, & Schwenk, 1994). Although the Edinburgh Postnatal Depression Scale is the most commonly used tool in screening for PPD, and the sensitivity and specificity have been demonstrated (Gibson, McKenzie-McHarg, Shakespeare, Price, & Gray, 2009), there remains a need to address whether discrepancies exist between self-reported PPD symptoms and PPD diagnosis (e.g., women who are not diagnosed in the presence of symptoms, women who are diagnosed in the absence of symptoms).

A variety of risk factors have been identified for PPD, including demographic and sociodemographic factors (e.g., age, socioeconomic status, marital status), exposures to difficult surroundings (e.g., domestic violence), preexisting mental/mood states (low self-esteem, history of depression and/or anxiety), and characteristics of the infant (e.g., difficult temperament; Appolonio & Fingerhut, 2008; Beck, 2001; Misri & Kostaras, 2002). Although a myriad of risk factors are well-documented in the literature, the extent to which morbidities present during pregnancy act as risk factors for predicting PPD remains unclear. Although pregnancy is often viewed as a special, joyous time in a woman's life, experiencing morbidities and complications resulting from those morbidities (e.g., preeclampsia, gestational diabetes, hemorrhage) may have a significant impact on the well-being of the woman (Hamilton & Lobel, 2008; Hueston & Kasik-Miller, 1998; Misra & Grason, 2006). Thus, it is crucial to promptly diagnose and treat such morbidities as well as understand any psychological implications that can result from undiagnosed and untreated morbidities.

Numerous studies have demonstrated the association between physical morbidities and mental illness over time and across different age groups (Aneshensel, Frerichs, & Huba, 1984; Geerlings, Beekman, Deeg, & Van Tilburg, 2000; Goldberg, 2010; Gunn et al., 2012; Lewinsohn, Seely, Hibbard, Rohde, & Sack, 1996; Smit, Beekman, Cuijpers, de Graaf, & Vollebergh, 2004). Among women in their reproductive years, most studies have examined either the link between 1) physical health problems after childbirth and poorer mental health outcomes (e.g., PPD, poorer emotional health; Brown & Lumley, 2000; Webb et al., 2008; Woolhouse et al., 2014), and/or 2) having general pregnancy and/or delivery complications and PPD (Forman, Videbech, Hedegaard, Salvig, & Secher, 2000; O'Hara & Swain, 1996;Warner, Appleby, Whitton, & Faragher, 1996). Regarding specific antenatal morbidities, only diabetes, gestational diabetes (Kozhimannil, Pereira, & Harlow, 2009) and preeclampsia (Duley, 2009) have been associated with PPD; however, these studies were based on small sample sizes on women receiving Medicaid in New Jersey, and Dutch women, respectively. Apart from these three conditions, given the multitude of morbidities that pregnant women can experience, there remains a need to identify whether there are additional antenatal morbidities that act as risk factors for predicting PPD. By identifying these specific morbidities that associate with PPD, 1) physicians can ideally focus on early identification and diagnosis of these morbidities, and 2) additional medical attention can be provided in treating women who are experiencing these morbidities, minimizing complications and potentially lowering their odds of PPD.

The objectives of this study, which was exploratory in nature, were to examine the associations between a variety of antenatal morbidities and PPD among 1) women with self-reported PPD symptoms and 2) women with a PPD diagnosis by a health care professional, using a national, stratified, random sample of women in the United States. By using an exploratory study design, a better understanding of antenatal morbidities acting as potential risk factors for PPD symptoms and/or diagnosis can be attained.

Methods

Written institutional review board approval was received from the authors' institution for this study. All data were de-identified.

Data

This study used data from the 2007 and 2008 Pregnancy Risk Assessment Monitoring System (PRAMS). PRAMS is a continuing, national, population-based survey maintained by the U.S. Centers for Disease Control and Prevention, and collects state-specific

data on maternal behaviors, experiences, and characteristics in the prepregnancy, pregnancy, and postpartum periods among randomly selected woman who delivered a live infant (Centers for Disease Control and Prevention, 2007). PRAMS data are available for 40 states and New York City, with each participating state/city sampling between 1,300 and 3,400 women annually, using a stratified, random sampling strategy. PRAMS uses two questionnaires: A core questionnaire, containing questions that are asked from all participants, and a standard questionnaire, containing questions that are optional for each participating state/city.

PPD

PPD was measured using two parts from the PRAMS standard questionnaire, one assessing symptoms and the other assessing diagnosis. The measure for PPD symptoms contain two items: a) "Since your new baby was born, how often have you felt down, depressed, or hopeless?" and b) "Since your new baby was born, how often have you had little interest or little pleasure in doing things?" Responses included "Always," "Often," "Sometimes," "Rarely," and "Never." The measure for a PPD diagnosis asked the following: "Since your new baby was born, has a doctor, nurse, or other health care worker diagnosed you with depression?" Responses included "Yes" or "No." Table 1 lists the 22 states that include PPD depressive symptoms, and the three states and one city that include PPD diagnosis in their questionnaire. All the states noted in Table 1 were included in the study sample. Because there were differences in the states that included the measures for PPD symptoms and the measures for PPD diagnosis, three separate samples were created for this study to a) maximize the generalizability of the results and b) compare results for PPD symptoms versus PPD diagnosis among women from the same states:

1. All the women from states that included the PPD symptoms measures on their PRAMS questionnaire;
2. All the women from states that included the PPD diagnosis measure on their PRAMS questionnaire; and
3. Women from Alaska and Maine only, the two states that included both the PPD symptoms measures and the PPD diagnosis measure on their PRAMS questionnaire.

Coding PPD symptoms for the multivariate analyses used a scoring system similar to the Patient Health Questionnaire-2 (PHQ-2). The PHQ-2 stems from the PHQ, a patient self-administered DSM-IV criteria-based instrument used to diagnose mental disorders (e.g., major depressive disorder, panic disorder; Kroenke, Spitzer, & Willians, 2001). The PHQ-2, which offers a more concise measure of depression diagnosis and severity to accommodate busy clinical settings is comprised of the following two items (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, and b) Feeling down, depressed, or hopeless?" (Kroenke, Spitzer, & Willians, 2003).

The response and scoring system in the PHQ-2 are as follows: 0 (Not at all), 1 (several days), 2 (more than half the days), or 3 (nearly every day; p. 1285). A score is given for each item, and both scores are added to obtain a total score; thus, 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 greater than or equal to 3 indicates major depressive disorder. Both the sensitivity and specificity (83% and 92%, respectively) for scores greater than or equal to 3 and the criterion and construct validities of the entire PHQ-2 have all been demonstrated (Kroenke et al., 2003). Because the framing of the PRAMS questions for PPD symptoms matches the PHQ-2 (with the exception of a postpartum indicator in PRAMS), rather than create a new scoring system, a scoring system similar to the PHQ-2 was used to determine PPD symptoms. However, because the PRAMS questions consist of a 5-item response scale, and the PHQ-2 consists of a 4-item response scale, "sometimes" and "rarely" were both scored as 1, and the following point system was assigned to the responses for PPD symptoms: 3 (always), 2 (often), 1 (sometimes), 1 (rarely), or 0 (never). A score of 3 or greater indicated having PPD symptoms. Both PPD symptoms and PPD diagnosis measures were analyzed using logistic regression.

Antenatal Maternal Morbidities

An antenatal maternal morbidity was defined as a medical/obstetric problem, condition, or complication occurring during pregnancy. PRAMS includes 13 maternal morbidities in their core questionnaire. Because there were no specific hypotheses regarding which morbidities would associate with PPD symptoms and diagnosis, and given the exploratory nature of this study, all the morbidities included in the PRAMS question were included as predictor variables of interest and were each tested for association with PPD symptoms and diagnosis. These morbidities were measured through PRAMS as follows: "Did you have any of these problems during your most recent pregnancy?" and included the following items.

Medical conditions and events

i. Diabetes before pregnancy
ii. Car accident

Obstetric conditions

i. Gestational diabetes
ii. Vaginal bleeding
iii. Kidney/bladder infection
iv. Nausea (severe nausea, vomiting, or dehydration)
v. Incompetent cervix
vi. Hypertension
vii. Placenta previa or abruptio
viii. Preterm labor
ix. Premature rupture of membranes

Table 1
Pregnancy Risk Assessment Monitoring System States Included in the Study Samples

Postpartum Depressive Symptoms States		Postpartum Depression Diagnosis States
Alaska*	Nebraska	Alaska*
Colorado	New York	Illinois
Delaware	Ohio	Maine*
Georgia	Oregon	New York City
Hawaii	Rhode Island	
Massachusetts	South Carolina	
Maryland	Tennessee	
Maine*	Utah	
Minnesota	Washington	
Missouri	Wisconsin	
North Carolina	Wyoming	

* States that included postpartum depression symptoms and postpartum depression diagnosis measures in their questionnaires.

x. Blood transfusion
xi. Bed rest

"Bed rest" was included under "obstetric conditions" to represent any morbidity warranting additional rest during pregnancy to prevent complications. Thus, it was assumed that 1) women in the sample who indicted being on bed rest were doing so owing to an underlying morbidity during pregnancy, and 2) these morbidities warranting additional rest could be medical conditions/events or obstetric conditions included in this study and those events/conditions not included in this study.

Control variables adjusted for in the analyses included demographic and sociodemographic variables (maternal age, race, ethnicity, education, income marital status, pregnancy variables (pregnancy intention, prepregnancy body mass index, prenatal care utilization, domestic violence, weight gain), antenatal and postpartum health behaviors (smoking during pregnancy, alcohol consumption during pregnancy, breastfeeding), and birth outcomes (birthweight, birth defect, etc.).

Statistical Analysis

Analyses were conducted using the survey procedures of STATA v.10 to account for the complex sampling strategy of PRAMS (StataCorp LP, 2007). The multivariate analyses consisted of logistic regression (logit) models that were used to separately analyze each of the 13 antenatal morbidities with PPD symptoms (objective 1), and each of the 13 morbidities with PPD diagnosis (objective 2). For each objective, two samples were examined: 1) Women from all states that included PPD symptoms on their questionnaires (main sample), and 2) women from Alaska and Maine, the two states that included both PPD symptoms and PPD diagnosis measures in their questionnaires (Table 1). The former sample was analyzed to increase the external validity of this study, and the latter sample was analyzed to compare results of symptoms versus diagnosis from the same sample.

Results

Univariate Analysis

The sample descriptions are presented in Table 2 (main sample) and Table 3 (women from Alaska and Maine only). Among the main sample, the prevalence of PPD symptoms was approximately 13.8% (n = 55,246), whereas the prevalence of PPD diagnosis was 7.6% (n = 7,496). For maternal morbidities, the prevalence ranged from 1.8% (incompetent cervix) to 29.7% (nausea). A high prevalence was noted for preterm labor (24.8%), bed rest (20.3%), kidney/bladder infection (17.8%), gestational diabetes (17.6%), and hypertension (15.0%).

Crosstab Statistics

Among 2,651 women who answered questions on PPD symptoms and PPD diagnosis (from Alaska and Maine, the two states that assess for both variables on their PRAMS questionnaires), 91 (3.4%) reported having had PPD symptoms and were diagnosed with PPD by a health care professional; 116 (4.4%) were coded as not having PPD symptoms, but ended up receiving a PPD diagnosis, and 266 (10%) women who were coded as having PPD symptoms did not end up receiving a PPD diagnosis.

Table 2
Univariate Statistics of Outcome, Predictor, and Control Variables among Women from All States

Outcome Variables	*N*	Frequency, *n* (%)
Main analysis dependent variable: Postpartum depressive symptoms (all pregnancies in 22 states)	55,246	7,594 (13.75)
Main analysis dependent variable: Postpartum depression diagnosis (all pregnancies in 3 states and 1 city)	7,496	6,927 (7.6)
Predictor variables: Antenatal maternal morbidities		
Diabetes before pregnancy	60,776	1,317 (2.17)
Gestational diabetes	60,663	10,691 (17.62)
Vaginal bleeding	60,732	6,052 (9.97)
Kidney infection	60,683	10,773 (17.75)
Nausea	60,762	18,072 (29.74)
Incompetent cervix	60,558	1,099 (1.81)
Hypertension	60,732	9,113 (15.01)
Placenta previa/abruptio	60,511	4,077 (6.74)
Preterm labor	60,721	15,037 (24.76)
Premature rupture of membrane	60,688	5,990 (9.87)
Blood transfusion	60,725	966 (1.59)
Car accident	60,788	992 (1.63)
Bed rest	61,733	12,529 (20.30)
Demographic and sociodemographic control variables		
Maternal age (y)	61,733	
<17		1,860 (3.01)
18–24		18,170 (29.43)
25–34		31,316 (50.73)
≥35		10,384 (16.82)
Maternal race	61,733	
White		38,317 (62.07)
Black		9,639 (15.61)
Other		13,777 (22.32)
Hispanic	60,859	10,555 (17.34)
Maternal education (y)	61,733	
0–8		2,568 (4.16)
9–12		24,934 (40.39)
13–15		15,130 (24.51)
≥16		18,253 (29.57)
Income (12 months prior), U.S.$	61, 733	
<20,000		20,086 (35.44)
20,000–34,999		9,823 (15.91)
35,000–49,999		6,086 (9.86)
≥50,000		20,675 (36.48)
Marital status (married)	61,699	23,348 (37.84)
Pregnancy control variables		
Pregnancy intention (wanted baby)	60,828	30,191 (49.63)
Prepregnancy BMI	61,733	
Underweight		7,510 (12.17)
Normal		29,554 (47.87)
Overweight		13,243 (21.45)
Obese		7,618 (12.34)
Prenatal care utilization	57,698	
Inadequate prenatal care		3,519 (5.70)
Intermediate prenatal care		13,394 (21.70)
Adequate prenatal care		40,785 (66.07)
Adequate-plus prenatal care		4,035 (6.54)
Domestic violence	61,733	2,162 (3.50)
Antenatal and postpartum health behavior control variables		
Smoking during pregnancy	61,206	6,558 (10.71)
Alcohol consumption during pregnancy	60,302	4,134 (6.86)
Breastfeeding	60,032	49,441 (82.36)
Birth outcome control variables		
Birth defect	60,833	1,514 (2.49)
Birthweight	61,733	
Normal		45,708 (74.04)
Low		16,025 (25.96)
Continuous variable		
Weight gain during pregnancy* (29.4 ± 0.06 lb; 95% CI, 29.3–29.5)	57, 938	

Abbreviation: BMI, body mass index.
* Mean value ± standard deviation.

Table 3
Univariate Statistics of Outcome, Predictor, and Control Variables among Women from Alaska and Maine

Outcome Variables	*n*	Frequency (%)
Main analysis dependent variable: Postpartum depressive symptoms (all pregnancies in 22 states)	4,891	600 (12.27)
Main analysis dependent variable: Postpartum depression diagnosis (all pregnancies in 3 states and 1 city)	2,721	215 (7.90)
Predictor variables: Antenatal maternal morbidities		
Diabetes before pregnancy	4,991	108 (2.16)
Gestational diabetes	4,982	487 (9.78)
Vaginal bleeding	4,986	936 (18.77)
Kidney infection	4,975	901 (18.11)
Nausea	4,972	1,538 (30.93)
Incompetent cervix	4,966	78 (1.57)
Hypertension	4,982	871 (17.48)
Placenta previa/abruptio	4,961	386 (7.78)
Preterm labor	4,957	1,307 (26.37)
Premature rupture of membrane	4,974	549 (11.04)
Blood transfusion	4,980	61 (1.22)
Car accident	4,991	71 (1.42)
Bed rest	3,227	1,129 (34.99)
Demographic and sociodemographic control variables		
Maternal age (y)	5,033	
<17		130 (2.58)
18–24		1,787 (35.51)
25–34		2,422 (48.12)
3 ≥ 35		693 (13.77)
Maternal race	5,033	
White		3,357 (66.70)
Black		141 (2.80)
Other		1,535 (30.50)
Hispanic	4,947	209 (4.22)
Maternal education (y)	5,033	
0–8		68 (1.35)
9–12		2,518 (50.03)
13–15		1,190 (23.64)
≥16		1,132 (22.49)
Income (12 months prior), U.S.$	4,596	
<20,000		1,509 (32.83)
20,000–34,999		918 (18.24)
35,000–49,999		575 (11.42)
≥50,000		1,594 (34.68)
Marital status (married)	5,031	2,931 (58.26)
Pregnancy control variables		
Pregnancy intention (wanted baby)	4,984	2,485 (49.86)
Prepregnancy BMI	5,033	
Underweight		476 (9.46)
Normal		2,503 (49.73)
Overweight		1,260 (25.03)
Obese		604 (12.00)
Prenatal care utilization	5,033	
Inadequate prenatal care		368 (7.31)
Intermediate prenatal care		1,088 (21.62)
Adequate prenatal care		3,332 (66.20)
Adequate-plus prenatal care		245 (4.87)
Domestic violence	5,033	167 (3.32)
Antenatal and postpartum health behavior control variables		
Smoking during pregnancy	5,001	899 (17.98)
Alcohol consumption during pregnancy	4,940	274 (5.55)
Breastfeeding	4,866	4,168 (85.66)
Birth outcome control variables		
Birth defect	5,030	97 (1.93)
Birthweight	5,033	
Normal		3,561 (70.75)
Low		1,472 (29.25)
Continuous variable		
Weight gain during pregnancy* (29.02 ± 14.17 lb; 95% CI, 28.6–29.4)	4,744	

Abbreviation: BMI, body mass index.
* Mean value ± standard deviation.

Multivariate Analysis

Women from all states

As shown in Table 4, of the 13 morbidities examined, 5 were highly significant with PPD symptoms and PPD diagnosis (99% CI), respectively: Vaginal bleeding (odds ratio [OR], 1.42, 1.76), kidney/bladder infection (OR, 1.59, 1.63), nausea (OR, 1.50, 1.80), preterm labor (OR, 1.54, 1.51), and bed rest (OR, 1.34, 1.56). Another predictor of PPD symptoms was car accident (OR, 1.65), whereas other predictors of PPD diagnosis included hypertension (OR, 1.98) and blood transfusion (OR, 2.98).

Women from Alaska and Maine

As shown in Table 5, preterm labor (OR, 2.54, 2.11) and nausea (OR, 2.15, 1.60) increased the odds for both PPD symptoms and PPD diagnosis, respectively. Other highly significant (99% CI) predictors of PPD symptoms included: vaginal bleeding (OR, 1.65), kidney/bladder infection (OR, 1.74), blood transfusion (OR, 3.30), and bed rest (OR, 1.87), while one other highly significant (99% CI) predictor of PPD diagnosis was diabetes before pregnancy (OR, 5.65).

Bonferroni Correction

At the Bonferroni corrected *p* value (.004), among the main sample, vaginal bleeding, kidney/bladder infection, and nausea remained significant predictors for PPD symptoms and PPD diagnosis. Preterm labor, car accident, and bed rest remained significant for PPD symptoms only, whereas incompetent cervix and hypertension remained significant for PPD diagnosis only. Among women from Alaska and Maine, preterm labor remained significant for PPD symptoms and PPD diagnosis. Vaginal bleeding, kidney/bladder infection, nausea, and bed rest remained significant for PPD symptoms only, whereas diabetes before pregnancy remained significant for PPD diagnosis only.

Discussion

The objectives of this exploratory study were to identify the antenatal morbidities that associate with and predict PPD through measures of 13 morbidities, PPD symptoms, and PPD diagnosis. The prevalence of PPD in this study, as determined by a self-reported measure of symptoms, was 13.8%. This result aligns with previous studies, which have noted the prevalence of PPD to be between 10% and 15%, with the average being 13% (Evans & Theofrastous, 1997; Miller, 2002; Negus Jolley & Betrus, 2007). The prevalence of PPD diagnosis was 7.6%; however, this measure was only representative of three states and one city, as opposed to the self-reported measure that was more nationally representative. Other reasons that could explain this lower PPD prevalence are that health care providers may either be missing PPD symptoms presented by their postpartum patients or not discussing symptoms with their patients, not properly screening for PPD, or misdiagnosing PPD after considering the symptoms and risk factors presented by their patients. Thus, this prevalence may represent an underdiagnosis of PPD.

The main findings of this study revealed a greater odds for PPD symptoms and PPD diagnosis among women who had vaginal bleeding, a kidney/bladder infection, nausea, preterm labor, or who were on bed rest during pregnancy. This extends our previous knowledge on predictors of PPD, and includes

Table 4
Antenatal Morbidity Predictors of Postpartum Depression (PPD) Symptoms and PPD Diagnosis among Women from All States: Results of Logistic Regression Analysis

Antenatal Morbidity	PPD Symptoms, OR (95% CI)	*N*	*p* Value	PPD Diagnosis, OR (95% CI)	*n*	*p* Value
Diabetes before pregnancy	1.16 (0.78–1.59)	45,669	.39	1.31 (0.45–3.06)	5,924	.56
Gestational diabetes	1.13 (0.93–1.30)	45,642	.14	0.96 (0.64–1.52)	5,919	.89
Vaginal bleeding	1.42 (1.23–1.59)	45,594	<.001	1.76 (1.26–2.45)	5,910	<.01
Kidney/bladder infection	1.59 (1.40–1.76)	45,615	<.001	1.63 (1.22–2.23)	5,916	<.01
Nausea	1.50 (1.36–1.69)	45,662	<.001	1.80 (1.40–2.46)	5,914	<.001
Incompetent cervix	1.35 (0.95–2.05)	45,561	.11	3.68 (1.55–8.62)	5,905	<.01
Hypertension	1.05 (0.89–1.19)	45,660	.48	1.98 (1.36–2.76)	5,923	<.001
Placenta previa or abruptio	1.02 (0.82–1.23)	45,518	.86	1.50 (0.91–2.49)	5,899	.12
Preterm labor	1.54 (1.38–1.73)	45,641	<.001	1.51 (1.15–2.20)	5,911	.01
Premature rupture of membrane	1.09 (0.92–1.33)	45,626	.31	1.14 (0.75–1.95)	5,911	.59
Blood transfusion	1.39 (0.97–2.04)	45,664	.08	2.98 (1.17–6.26)	5,922	<.01
Car accident	1.65 (1.20–2.25)	45,675	<.01	1.71 (0.68–4.27)	5,929	.24
Bed rest	1.34 (1.19–1.54)	27,557	<.001	1.56 (1.11–2.19)	3,561	.01

Abbreviation: OR, odds ratio.

results from a very large, representative U.S. sample. However, differences existed in some morbidities that were associated with either PPD measure. This included a greater odds for PPD symptoms among women who were in a car accident during pregnancy, and a greater odds for PPD diagnosis among women who experienced hypertension or a blood transfusion during pregnancy. One explanation for these differences relates to vascular depression and supports the significant association between hypertension and PPD diagnosis (Alexopoulous et al., 1997); previous studies have suggested an association between hypertension and depression (Rabkin, Charles, & Kass, 1983; Steffens, 2004; Scalco, Scalco, Azul, & Neto, 2005). Second, it could be that the morbidities that are higher in severity could also be the morbidities that necessitated more prenatal care visits and more medical intervention among women; thus, those women were more likely to be screened for and diagnosed with PPD. Differences may have also resulted because health care providers are focusing on risk factors and symptoms that do not lead to an accurate PPD diagnosis. Thus, this difference in focus leads to a misdiagnosis of PPD. Another possible reason could be that the PPD symptoms that are self-reported (the extent of feeling "down, depressed, or hopeless" or having "little interest or pleasure in doing things") are not accurately reported by the women represented in this study's sample (e.g., underreporting, or women having different interpretations of each item on the scale); thus, the estimates are biased.

After examining a limited sample of women in Alaska and Maine, results showed that women who had diabetes before pregnancy had more than five times the odds of receiving a PPD diagnosis. This association was not seen in the sample inclusive of women from all the states. Thus, it is suggested that health care providers in these two states additionally monitor their pregnant patients with this condition. Additional research is needed to confirm these results and/or ascertain reasons as to why women from these states who have diabetes before pregnancy have a much higher odds for receiving a PPD diagnosis.

In interpreting the results, this study has a few limitations that should be taken into consideration. Because PRAMS is a self-reported survey, a likelihood of recall bias and/or misclassification remains when recalling the extent of feeling "down, depressed, or hopeless" or "having little interest or pleasure in doing things" since birth (PPD symptoms). Women may have also intentionally underreported these feelings owing to fear in admitting to having these feelings in the postpartum period and, thus, being stigmatized. Underreporting of these feelings could potentially bias regression estimates. It is also possible that there were women who had PPD but were not officially diagnosed by their health care provider. Thus, there could be a discrepancy between self-reported PPD symptoms versus PPD diagnosis by a health care provider. A bivariate analysis revealed that among 2,651 women who answered questions on PPD symptoms and PPD diagnosis (from Alaska and Maine, the two states that assess for both variables on their PRAMS questionnaires), 3% reported having had PPD symptoms and were diagnosed with PPD by a health care professional, 4% reported not having PPD symptoms but ended up receiving a PPD diagnosis, and 10% had PPD

Table 5
Antenatal Morbidity Predictors of postpartum Depression (PPD) Symptoms and PPD Diagnosis among Women from Alaska and Maine: Results of Logistic Regression Analysis

Antenatal Morbidity	PPD Symptoms, OR (95% CI)	*n*	*p* Value	PPD Diagnosis, OR (95% CI)	*n*	*p* Value
Diabetes before pregnancy	1.62 (0.93–3.94)	4,134	.21	5.65 (1.72–15.37)	2,136	<.01
Gestational diabetes	1.20 (0.81–1.86)	4,128	.40	1.38 (0.70–2.79)	2,135	.35
Vaginal bleeding	1.65 (1.21–2.22)	4,132	<.01	1.40 (0.79–2.46)	2,133	.22
Kidney/bladder infection	1.74 (1.35–2.37)	4,125	<.001	1.43 (0.86–2.38)	2,130	.15
Nausea	2.15 (1.70–2.81)	4,124	<.001	1.60 (0.99–2.41)	2,124	.04
Incompetent cervix	1.81 (0.76–4.05)	4,119	.17	2.87 (0.70–11.74)	2,126	.13
Hypertension	1.37 (1.04–2.01)	4,131	.07	1.48 (0.85–2.61)	2,135	.16
Placenta previa or abruptio	1.57 (0.93–2.34)	4,113	.06	1.33 (0.58–2.85)	2,120	.48
Preterm labor	2.54 (1.91–3.32)	4,119	<.001	2.11 (1.36–3.52)	2,120	<.01
Premature rupture of membrane	1.56 (0.93–2.80)	4,124	.11	1.46 (0.68–3.93)	2,128	.39
Blood transfusion	3.30 (1.44–7.68)	4,133	<.01	3.20 (0.78–13.68)	2,135	.10
Car accident	0.73 (0.25–2.27)	4,135	.58	1.09 (0.29–3.96)	2,138	.90
Bed rest	1.87 (1.38–2.52)	2,658	<.001	1.46 (0.86–2.55)	1,375	.17

Abbreviation: OR, odds ratio.

symptoms but never received a diagnosis. Future research should examine the reasons why women who experience the symptoms of PPD do not receive an actual diagnosis. It is probable that these women did not want to be stigmatized or they experienced fear in receiving an actual depression diagnosis.

Next, even though the scoring system used for PPD symptoms in this study matched that of the PHQ-2, which has demonstrated superior psychometric properties, it is possible that the PPD measures may not possess the same psychometric properties as the PHQ-2, because the PPD measures are only indicative of PPD symptoms, not an actual PPD diagnosis. Regarding the samples used for this study, all states that include the PPD measures on their PRAMS questionnaires were included to maximize the generalizability of the results. Because the states that include PPD symptoms differ from states that include PPD diagnosis, additional analyses were conducted on Alaska and Maine, the two states that include both PPD symptoms and PPD diagnosis on their questionnaires; however, this limited the generalizability of the study. Additionally, depression history, a risk factor for PPD, was not controlled for in the analyses, which could have biased regression estimates (Beck, 2001; Gotlib, 1989; Gotlib, Whiffen, Wallace, & Mount, 1991). Although PRAMS has a measure for antenatal depression, because this is a measure on the standard questionnaire, and the states that include this question are different from the states that include the PPD measures, the antenatal depression measure was not included in this study. In addition, it is possible that antenatal depression could be associated with one or more of the morbidities examined in this study. Because antenatal depression has been associated with PPD in previous literature, and if antenatal depression is associated with any of the examined morbidities, this could bias regression estimates (Beck, 2001; Milgrom et al., 2007; Robertson, Grace, Wallington, & Stewart, 2004). Also, because complications resulting from any of the tested morbidities were not controlled for, there is a possibility that the complications of these morbidities, rather than the morbidities themselves, could have had an impact on PPD. Previous studies have suspected PPD to result from the complications of morbidities, and not the morbidities directly (Duley, 2009; Hoedjes et al., 2011). Further, it should be noted that the sample consisted of observations with missing values for the outcome, predictor, and control variables. These observations were not included in the study, and it is possible that the noninclusion of these observations could bias regression estimates. Next, this study did not examine whether women had comorbidities, and it is possible that having comorbidities during pregnancy could increase the odds for PPD. Finally, and most important, this study was observational in nature, and the results do not imply causality.

In conclusion, this study was among the first in the United States to test the odds of a variety of antenatal maternal morbidities on both PPD symptoms and a PPD diagnosis among a nationally representative sample of women. Results from this study demonstrated that the women were affected by a variety of antenatal morbidities (medical and obstetric conditions/events), many of which were associated with PPD symptoms and PPD diagnosis. Thus, receiving health care during the antenatal and postpartum periods remain critical in 1) diagnosing women for any morbidities during pregnancy determined to be significant predictors of PPD (including those confirmed in this study), consequently identifying women at risk for PPD, 2) screening for and diagnosing women for PPD as early as possible, and 3) assisting these women in seeking treatment options for both antenatal morbidities and PPD. Additionally, the findings revealed the specific antenatal morbidities that should be considered and prioritized as risk factors for PPD symptoms and actual PPD. These findings also encourage and can assist health care providers in looking out for and screening for the specific morbidities that are associated with PPD during pregnancy. Additional research is warranted to confirm the results of this study in other samples and populations. For example, a hypothesis testing approach on the examined antenatal morbidities would help to establish causality between these risk factors and PPD. Nevertheless, developing strategies to 1) improve the general awareness of PPD, especially in the populations of women affected by the antenatal morbidities known to be predictors of PPD, and 2) increase screening for these antenatal morbidities, and for PPD during pregnancy and postpartum are all warranted in preventing PPD.

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