Published in final edited form as:
Matern Child Health J. 2013 November ; 17(9): . doi:10.1007/s10995-012-1180-y.

Factors associated with depressive symptoms in the early postpartum period among women with recent gestational diabetes mellitus

Jacinda M Nicklas, MD, MPH, MA[1,2], **Laura J Miller, MD**[3], **Chloe A Zera, MD, MPH**[4], **Roger B. Davis, ScD**[1], **Sue E Levkoff, ScD, SM, MSW**[5,6,7], and **Ellen W Seely, MD**[2]

[1] Division of General Medicine and Primary Care, Beth Israel Deaconess Medical Center, Boston, MA

[2] Division of Endocrinology, Diabetes and Hypertension, Brigham and Women's Hospital; Boston, MA

[3] Department of Psychiatry, Brigham and Women's Hospital, University of South Carolina, Columbia, South Carolina.

[4] Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Brigham and Women's Hospital, University of South Carolina, Columbia, South Carolina.

[5] Division of Women's Health, Department of Medicine, Brigham and Women's Hospital, University of South Carolina, Columbia, South Carolina.

[6] Department of Global Health and Social Medicine, Harvard Medical School, University of South Carolina, Columbia, South Carolina.

[7] College of Social Work, University of South Carolina, Columbia, South Carolina.

Abstract

Objectives—Women with gestational diabetes mellitus (GDM) have a substantial risk of subsequently developing type 2 diabetes. This risk may be mitigated by engaging in healthy eating, physical activity, and weight loss when indicated. Since postpartum depressive symptoms may impair a woman's ability to engage in lifestyle changes, we sought to identify factors associated with depressive symptoms in the early postpartum period among women with recent GDM.

Methods—The participants are part of the baseline cohort of the TEAM GDM (Taking Early Action for Mothers with Gestational Diabetes Mellitus) study, a one-year randomized trial of a lifestyle intervention program for women with a recent history of GDM, conducted in Boston, Massachusetts between June 2010 and September 2012. We administered the Edinburgh Postnatal Depression Scale (EPDS) at 4-15 weeks postpartum to women whose most recent pregnancy was complicated by GDM (confirmed by laboratory data or medical record review). An EPDS score ≥9 indicated depressive symptoms. We measured height and thyroid stimulating hormone, and administered a questionnaire to collect demographic data and information about breastfeeding and sleep. We calculated body mass index (BMI) using self-reported pre-pregnancy weight and

Contact information for corresponding author: Jacinda M. Nicklas Division of Endocrinology, Diabetes and Hypertension Brigham and Women's Hospital 221 Longwood Avenue Boston, MA 02115 617-525-9975 jnicklas1@partners.orgjacindamnicklas@gmail.com.

Factors associated with depressive symptoms in the early postpartum period among women with recent gestational diabetes mellitus

Disclosures
No relationships disclosed.

measured height. We reviewed medical records to obtain data about medical history, including history of depression, mode of delivery, and insulin use during pregnancy. We conducted bivariable analyses to identify correlates of postpartum depressive symptoms, and then modeled the odds of postpartum depressive symptoms using multivariable logistic regression.

Results—Our study included 71 women (mean age 33 years ±5; 59% White, 28% African-American, 13% Asian, with 21% identifying as Hispanic; mean pre-pregnancy BMI 30 kg/m^2±6). Thirty-four percent of the women scored ≥9 on the EPDS at the postpartum visit. In the best fit model, factors associated with depressive symptoms at 6 weeks postpartum included cesarean delivery (aOR 4.32, 95% CI 1.46, 13.99) and gestational weight gain (aOR 1.21 [1.02, 1.46], for each additional 5 lbs gained). Use of insulin during pregnancy, breastfeeding, personal history of depression, and lack of a partner were not retained in the model.

Conclusions—Identifying factors associated with postpartum depression in women with GDM is important since depression may interfere with lifestyle change efforts in the postpartum period. In this study, cesarean delivery and greater gestational weight gain were correlated with postpartum depressive symptoms among women with recent GDM.

Keywords

Postpartum depression; gestational diabetes; diabetes prevention; cesarean delivery; gestational weight gain

Introduction

Gestational diabetes mellitus (GDM) affects approximately 7% of all pregnancies and the prevalence is increasing as rates of overweight and obesity continue to rise among women of childbearing age (1). Women with a history of GDM have a 7-fold increased risk of developing type 2 diabetes within 10 years of the affected pregnancy (2). Lifestyle recommendations for women with a history of GDM include adoption of a healthy diet, weight loss if overweight or obese, regular physical activity, and breastfeeding to prevent or delay the onset of type 2 diabetes (3). Several investigators as well as organizations have identified the postpartum time period as a “window of opportunity” for initiating lifestyle change (3-6) .

Postpartum depressive symptoms may interfere with a woman's ability to engage in recommended health promotion behaviors. To our knowledge, there are no studies examining this relationship specifically among women with recent GDM. However, several prospective cohort studies have found depression to be associated with lack of adherence to healthy lifestyle behaviors among postpartum women in general. One study of 146 low-income women found that postpartum depressive symptoms were associated with reduced adherence to dietary guidelines (7), and a study of 850 women found that new-onset postpartum depressive symptoms more than doubled the likelihood that a woman would retain at least 5 kg of excess weight (8). Similarly, in a study of 51 primiparous women, increased postpartum depressive symptoms correlated with less physical activity and higher body mass index (BMI) (9). These findings are consistent with data in other populations for whom lifestyle change is recommended, including evidence that depressive symptoms reduce the likelihood of adherence to dietary and exercise guidelines in patients with diabetes (10, 11), and hamper efforts to lose weight among overweight women in general (12). Although the direction of the association is unclear, several authors have demonstrated an association between early postpartum depressive symptoms and breastfeeding difficulties, including reduced breastfeeding initiation, duration, and perceived self-efficacy (13-15).

Postpartum depression affects 15-20% of women giving birth (16, 17). Although some studies show increased postpartum depression among women with recent GDM (18, 19), others do not (20-24). Little is known about correlates with postpartum depression among women with recent GDM, especially about those factors which may be of particular importance in this population, including overweight and obesity, gestational weight gain, breastfeeding, insulin use during pregnancy, and cesarean delivery. Identifying factors associated with postpartum depression among women with GDM may eventually allow for targeted intervention efforts, and thus increase the likelihood of adopting recommended lifestyle behaviors. In this analysis we sought to identify factors associated with symptoms of postpartum depression in the early postpartum period among women with recent GDM, with a focus on risk factors especially relevant to this population.

Methods and Procedures

Participants

The participants in the study are part of the baseline cohort of the TEAM GDM (Taking Early Action for Mothers with Gestational Diabetes Mellitus) study, a one-year randomized trial of a lifestyle intervention program for women with a recent history of GDM, which was conducted in Boston, Massachusetts between June 2010 and September 2012 (Clinicaltrials.gov NCT01158131). For the TEAM GDM study, we recruited women planning to deliver or who had delivered at the Brigham and Women's Hospital (BWH), a large tertiary care hospital with over 7,000 deliveries annually. Women were recruited into the study during the second or third trimester of their GDM affected pregnancy, at delivery, or during the first 6 weeks of the postpartum period. Specifically, we recruited from two outpatient clinics, one “Diabetes in Pregnancy” clinic located in the main BWH hospital (Boston, MA) and one in a BWH satellite clinic location (Chestnut Hill, MA). Women with GDM from community health centers and private groups in the local area are referred to these clinics. We also recruited participants from inpatient settings at BWH: an antenatal floor for women with pregnancy complications requiring hospitalization (15 beds), and three postpartum floors (75 beds) where women were hospitalized after delivery. In addition, seven women were referred to our study by a provider at an affiliated hospital.

To be eligible for the TEAM GDM trial, participants had to have a diagnosis of GDM in their most recent pregnancy as identified by Carpenter-Coustan criteria (25), or by a documented clinical diagnosis. Other inclusion criteria included: age 18-45 years, self-reported pre-pregnancy BMI 18-50 kg/m^2, no personal history of type 2 diabetes, and delivery ≥ 32 weeks gestation. Women with a BMI <24 kg/m^2 (<22 kg/m^2 for Asian participants) or >50 kg/m^2 at 6 weeks postpartum were excluded from the study. According to the study design, the early postpartum study visit was to take place between 6 and 10 weeks postpartum, and randomization did not take place until the end of the visit. Therefore all measurements for the current analysis were conducted before randomization took place. We excluded three participants who were using antidepressants at the time of the measurement for depressive symptoms. The human subjects committee at Brigham and Women's Hospital approved the study, and all subjects gave written informed consent.

Measurements

Self-reported pre-pregnancy weight was recorded at the time of enrollment into the study, which took place either during pregnancy (59/71, 83%), or after delivery before the study visit (12/71, 17%). The pregnancy weight recorded in the anesthesia record within two days of delivery (67/71, 94%), or the last recorded prenatal weight recorded within 10 days of delivery (4/71, 6%), was used to calculate gestational weight gain. At the postpartum study visit, height was measured and used with the self-reported pre-pregnancy weight obtained at

enrollment to calculate pre-pregnancy BMI. At that same postpartum study visit, all women completed socio-demographic, medical history, and infant feeding questionnaires, and we measured thyroid stimulating hormone (TSH). We reviewed medical records to determine insulin use during pregnancy, mode of delivery, and diagnosis of depression before or during pregnancy in the medical record.

Depression measures—At the postpartum visit, we administered the Edinburgh Postnatal Depression Scale (EPDS), a 10-item questionnaire that has been validated as a screening tool for postpartum depression. Each question is scored from 0 to 3, with a maximum score of 30 (26). EPDS cut-off scores ranging from 9-14 have been used to identify depressive symptoms and major depression in research studies of postpartum women (16, 27-29). For the purposes of this study, we used a cut-off of 9 so that we would have high sensitivity to detect even relatively mild depressive symptoms that could potentially interfere with adherence to recommended lifestyle changes.

In our clinical trial, all women scoring 9 or higher were assessed by a study physician at the end of the visit, and offered a referral to a social worker. In addition, any woman who responded to the question, “the thought of harming myself has occurred to me,” with “hardly ever,” “sometimes,” or “yes, quite often,” was clinically evaluated, regardless of her total EPDS score.

Statistical Analysis

Several variables were collapsed into two categories for bivariable analysis. Race was recoded as white vs. minority (African-American, Hispanic, Asian). Education level was recoded as more than high school education vs. some or all of high school. Feeding practices at the time of the early postpartum visit were recoded as exclusively or partially breastfeeding vs. no breastfeeding. Since several women refused to answer the question about annual income, this variable was not included in the modeling. We incorporated gestational weight gain into the model as a continuous variable and report the odds ratio for each five pound increment. We conducted a sensitivity analysis by replacing the gestational weight gain variable with whether or not they exceeded the Institute of Medicine (IOM) gestational weight gain recommendations (30).

We first performed bivariable analyses on socio-demographic characteristics and potential correlates using chi-square tests. We built all possible two and three factor multivariable logistic regression models, and the model with the lowest Akaike information criterion (AIC) (31) value was chosen to represent the best fit. We substituted exceeding the IOM weight gain guidelines for gestational weight gain to see if this improved the fit of the model. We eliminated models with excessive collinearity (defined as variables whose standard errors increased by more than 15% when included in the multivariable model compared to the same variable in an unadjusted model). We performed an exploratory post-hoc analysis looking at unplanned cesarean delivery vs. planned cesarean or vaginal delivery to investigate whether unexpected cesarean deliveries were driving the relationship between cesarean delivery and postpartum depressive symptoms. We performed analyses using JMP 9 (SAS Institute Inc., 2011).

Results

Our study included 71 postpartum women whose most recent pregnancy was complicated by GDM. The early postpartum study visit took place at a mean of 7.0 (SD 1.7) weeks postpartum, with just one before 5 weeks (at 4 weeks) and four after 10 weeks (range 11-15 weeks). The mean age of study participants was 33 years. The racial and ethnic composition

of the sample was 59% White, 28% African-American, 13% Asian, with 21% of participants self-identifying as Hispanic. Mean pre-pregnancy BMI was 30 kg/m^2 (range 19-48). Twenty-four (34%) women scored 9 or greater on the EPDS, with a mean score of 11.4 (SD 2.2). As predicted by the design of the study, this was significantly different than the mean for the group not meeting the criteria for depressive symptoms, 3.8 (SD 2.5). Review of medical records identified 9 women (13%) with a history of depression prior to pregnancy (Table 1). Three women delivered prematurely between 32-35 weeks gestation. Although one baby had an extended stay in the Neonatal Intensive Care Unit (NICU) due to prematurity, none of the infants were hospitalized or seriously ill at the time of the early postpartum study visit.

In bivariable analyses, cesarean delivery and greater gestational weight gain were significantly associated with the presence of postpartum depressive symptoms (P<.05). Pre-pregnancy BMI, multiparity, and lack of a partner had P values less than 0.2 and were included in the multivariable logistic regression models. Previous history of depression, age, race, education, insulin use during pregnancy, and breastfeeding were not included in the model due to P>.2. (Table 1) When we compared models, the multivariable model with cesarean delivery, gestational weight gain, and multiparity demonstrated the best fit without excessive collinearity. Substituting whether or not a woman exceeded IOM gestational weight gain requirements for the gestational weight gain variable resulted in similar findings and did not improve the fit of the model (Table 2). In a post-hoc analysis, unplanned cesarean delivery was not more prevalent among women with depressive symptoms, and did not improve the fit of the model.

Discussion

When assessed in the early postpartum period, 34% of women with a recent pregnancy complicated by GDM had depressive symptoms as evidenced by an EPDS score ≥9. In a model adjusted for parity, cesarean delivery and greater gestational weight gain were significantly correlated with greater odds of depressive symptoms. Use of insulin during pregnancy, breastfeeding status, and history of diagnosed depression did not reach the P<.2 criteria in the bivariable analyses and therefore did not qualify for inclusion in the models. Identifying factors associated with postpartum depression in women with GDM is important since depression may interfere with lifestyle change efforts in the postpartum period.

To our knowledge, no studies have looked at correlates for depressive symptoms among women with recent GDM. In a recent analysis of overweight and obese women enrolled in the randomized Active Mothers Postpartum study, only income was significantly associated with postpartum depression (defined as EPDS ≥13) in an adjusted multivariable logistic regression model, while education, marital status, chronic illness and BMI were not significantly correlated (32).

Among the general population of postpartum women, the most robust predictors of postpartum depression include history of major depression, family history of major depression (especially postpartum depression), history of premenstrual dysphoric disorder, stressful life events during pregnancy or in the early puerperium, and low levels of social support (33-36). Other potential predictors identified in studies of general populations of postpartum women include cesarean delivery (37-39), greater gestational weight gain, greater maternal BMI, multiparity, childcare stress, poor relationship with a partner (40), low SES, poor social support (41), difficult infant temperament, and unplanned or unwanted pregnancy (33). Among these, cesarean delivery, gestational weight gain, and greater maternal BMI are particularly relevant in women with GDM.

We found that cesarean delivery was associated with depressive symptoms in the early postpartum period. Several studies demonstrate an association between cesarean delivery and postpartum depression (37-39), while others do not (42-45). In the one randomized trial in which women with breech presentation were randomized to cesarean section or vaginal delivery, there was no increased risk of depression found in the women randomized to cesarean delivery (46). In our study, unplanned cesarean delivery was not associated with significantly greater odds of postpartum depressive symptoms when compared to women with either planned cesarean section or vaginal delivery, suggesting that it may not be the unplanned nature of cesarean deliveries that is driving the relationship. Similarly, a recent study of postpartum Italian women showed a significant relationship between both planned and unplanned cesarean delivery and postpartum depression (47). Given that many observational studies demonstrate increased incidence of cesarean delivery in women with GDM, even when controlling for maternal BMI and pregnancy complications (48-53), the association with postpartum depressive symptoms in this population should be explored further.

Greater gestational weight gain was significantly associated with increased odds of depressive symptoms in the adjusted model, as was exceeding IOM gestational weight gain guidelines. In contrast, Cline and Decker (54) did not find a relationship between postpartum depression and gestational weight gain in non-GDM women, nor did Walker and Kim (55). Gestational weight gain is of particular relevance for women with GDM. Some studies suggest that weight gain in the first trimester may increase risk for acquiring GDM during pregnancy (56-58). Studies also have found that women with GDM who exceed weight gain guidelines are at higher risk for cesarean delivery and poorer neonatal outcomes than those with normal weight gain (59). Gaining excessive weight during pregnancy may make it more difficult for women with GDM to achieve a healthy weight after pregnancy, as has been seen in non-GDM women (60). Herring and colleagues identified an association between weight retention at one-year postpartum and postpartum depression (8). If a relationship between gestational weight gain and postpartum depressive symptoms is confirmed in future studies, this may add to the importance of following weight gain guidelines during pregnancy.

The best fit model controlled for parity, although parity in and of itself did not reach significance. Two meta-analyses of women in the general postpartum population did not find a significant association between parity and postpartum depression (33, 61). The relationship between parity and postpartum depression in women with recent GDM should be explored in further analyses. The lack of a significant association may be due to the small sample size. In a larger sample, one could also explore the importance of number of children.

Women with GDM are encouraged to breastfeed, as are women in general. Breastfeeding may be of particular importance to women with GDM as several studies have demonstrated an association between breastfeeding and lower type 2 diabetes risk (62, 63) and breastfeeding may be protective against obesity in both the mother and the child (64, 65). Previous studies in women without GDM demonstrate an association between depressive symptoms and breastfeeding difficulties, including less initiation and shorter duration; however the direction of the relationship is unclear. Since we used current breastfeeding in our analysis, it may have been too early to detect a relationship between depressive symptoms and breastfeeding duration. We also included insulin use in our analysis, as we hypothesized that women using insulin, and thereby undergoing a more “medicalized” pregnancy and possibly counseled more strongly about future risk for type 2 diabetes, might be more likely to have depressive symptoms in the postpartum period. Of interest, insulin use did not meet the criteria for inclusion in our model. However, given that the participants

were primarily recruited from the Diabetes in Pregnancy clinic at BWH, insulin use was particularly high in this population (75% and 70% in the +EPDS group and the –EPDS group, respectively)

Limitations

This study is limited by its small sample size, which allowed for the comparison of models containing only two and three potential correlates with postpartum depressive symptoms. We did not measure other factors which could potentially be important, including domestic violence, relationship with partner, infant temperament, and whether or not a pregnancy was desired. Given that this study is cross-sectional in nature, the relationships are correlational, and do not imply cause and effect. We used a self-reported pre-pregnancy weight to calculate pre-pregnancy BMI, which can result in an underestimation of pre-pregnancy BMI. However, Oken, et al (66) showed a high correlation (r=0.99) between self-reported pre-pregnancy weight and measured weights, and others have shown correlations ranging from 0.84-0.98 for self-reported weights in general, even for remote weights (67, 68). Although there was not excessive collinearity detected between multiparity and cesarean delivery, there may be unmeasured confounding factors affecting the association. Given that we used a cut-off for the EPDS designed to maximize sensitivity for depressive symptoms, our prevalence data are not comparable to other studies using different EPDS cut-offs to define postpartum depression. However, our prevalence of 34% is similar to the prevalence of 30% found in one study of 491 overweight and obese postpartum women when an EDPS cut-off of 9 is used (32). Finally, given that the participants in this study agreed to participate in a randomized controlled intervention trial, study findings may lack generalizability to a general population of women with GDM.

Conclusion

In this study of women with recent GDM, we found that 34% of women had postpartum depressive symptoms in the early postpartum period. Cesarean delivery and greater gestational weight gain were independently associated with depressive symptoms. Given that many studies show that women with GDM are more likely to undergo cesarean delivery, and gestational weight gain is of particular importance to women with GDM, these associations with depressive symptoms are important findings. To our knowledge, there have been no intervention studies to try to prevent postpartum depression in women with GDM. If the association between depressive symptoms and increased gestational weight gain is confirmed by future studies, an intervention designed to decrease gestational weight gain may have an impact upon postpartum depressive symptoms. Furthermore, clinicians could be made aware of the increased risk for depressive symptoms in women with GDM who undergo cesarean delivery and target them for heightened surveillance and/or preventive measures.

The prevalence of GDM is continuing to rise as the rates of overweight and obesity increase worldwide (69). Postpartum depression may interfere with lifestyle change efforts in the postpartum period, which are recommended to decrease the risk for type 2 diabetes. Further research should address how depressive symptoms may affect adherence to lifestyle changes and future risk for type 2 diabetes.

Acknowledgments

We thank the TEAM GDM participants without whom this study would not be possible. We thank Abbie Marrale, BS and Liberty Reforma, BA for their work on the TEAM GDM study.

Funding

The TEAM GDM study was supported by the Centers for Disease Control (CDC MM-1094-09/09), and work by the investigators was supported by an Institutional National Research Service Award #T32AT000051 from the National Center for Complementary and Alternative Medicine (NCCAM) at the National Institutes of Health and a K24 from the National Heart Lung and Blood Institute at the National Institutes of Health (9K24HL096141)

References

1. Ferrara A. Increasing prevalence of gestational diabetes mellitus: A public health perspective. Diabetes Care. 2007; 30(Suppl 2):S141–6. [PubMed: 17596462]
2. Bellamy L, et al. Type 2 diabetes mellitus after gestational diabetes: A systematic review and meta-analysis. Lancet. 2009; 373(9677):1773–9. [PubMed: 19465232]
3. It's never too early to prevent diabetes.. Tip Sheet. NIH; 2010. Report No.: 08-6019
4. Bentley-Lewis R. Gestational diabetes mellitus: An opportunity of a lifetime. Lancet. 2009; 23(373(9677)):1738. [PubMed: 19465213]
5. Bentley-Lewis R, et al. Gestational diabetes mellitus: Postpartum opportunities for the diagnosis and prevention of type 2 diabetes mellitus. Nat Clin Pract Endocrinol Metab. 2008; 4(10):552–8. [PubMed: 18779843]
6. Ratner RE. Prevention of type 2 diabetes in women with previous gestational diabetes. Diabetes Care. 2007; 30(Suppl 2):S242–5. [PubMed: 17596479]
7. George GC, et al. Compliance with dietary guidelines and relationship to psychosocial factors in low-income women in late postpartum. J Am Diet Assoc. 2005; 105(6):916–2. [PubMed: 15942541]
8. Herring SJ,R, et al. Association of postpartum depression with weight retention 1 year after childbirth. Obesity (Silver Spring). 2008; 16(6):1296–301. [PubMed: 18369338]
9. Vernon MM, Young-Hyman D, Looney SW. Maternal stress, physical activity, and body mass index during new mothers' first year postpartum. Women Health. Sep. 2010; 50(6):544–62. [PubMed: 20981636]
10. Katon WJ, et al. The relationship between changes in depression symptoms and changes in health risk behaviors in patients with diabetes. Int J Geriatr Psychiatry. 2010; 25(5):466–75. [PubMed: 19711303]
11. Wagner JA, Tennen H, Osborn CY. Lifetime depression and diabetes self-management in women with type 2 diabetes: A case-control study. Diabet Med. 2010; 27(6):713–7. [PubMed: 20546294]
12. Linde JA, et al. Binge eating disorder, weight control self-efficacy, and depression in overweight men and women. Int J Obes Relat Metab Disord. 2004; 28(3):418–25. [PubMed: 14724662]
13. Henderson JJ, et al. Impact of postnatal depression on breastfeeding duration. Birth. 2003; 30(3): 175–80. [PubMed: 12911800]
14. Dennis CL, McQueen K. The relationship between infant-feeding outcomes and postpartum depression: A qualitative systematic review. Pediatrics. 2009; 123(4):e736–51. [PubMed: 19336362]
15. Nishioka E, et al. A prospective study of the relationship between breastfeeding and postpartum depressive symptoms appearing at 1-5 months after delivery. J Affect Disord. 2011; 133(3):553–9. [PubMed: 21705090]
16. Gavin NI, et al. Perinatal depression: A systematic review of prevalence and incidence. Obstet Gynecol. 2005; 106(5 Pt 1):1071–83. [PubMed: 16260528]
17. Dave S, et al. Incidence of maternal and paternal depression in primary care: A cohort study using a primary care database. Arch Pediatr Adolesc Med. 2010; 164(11):1038–44. [PubMed: 20819960]
18. Kozhimannil KB, Pereira MA, Harlow BL. Association between diabetes and perinatal depression among low-income mothers. JAMA. 2009; 301(8):842–7. [PubMed: 19244191]
19. Dalfra MG, et al. Quality of life in pregnancy and post-partum: A study in diabetic patients. Qual Life Res. 2012; 21(2):291–8. [PubMed: 21633879]
20. Langer N, Langer O. Comparison of pregnancy mood profiles in gestational diabetes and preexisting diabetes. Diabetes Educ. 2000; 26(4):667–72. [PubMed: 11140075]

21. Katon JG, et al. Diabetes and depression in pregnancy: Is there an association? J Womens Health (Larchmt). 2011; 20(7):983–9. [PubMed: 21668382]
22. Kim C, et al. Changes in health status experienced by women with gestational diabetes and pregnancy-induced hypertensive disorders. J Womens Health (Larchmt). 2005; 14(8):729–36. [PubMed: 16232105]
23. Halkoaho A, et al. Does gestational diabetes affect women's health-related quality of life after delivery? Eur J Obstet Gynecol Reprod Biol. 2010; 148(1):40–3. [PubMed: 19883969]
24. Mautner E, et al. Quality of life outcomes in pregnancy and postpartum complicated by hypertensive disorders, gestational diabetes, and preterm birth. J Psychosom Obstet Gynaecol. 2009; 30(4):231–7. [PubMed: 19845493]
25. Carpenter MW, Coustan DR. Criteria for screening tests for gestational diabetes. Am J Obstet Gynecol. 1982; 144(7):768–73. [PubMed: 7148898]
26. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. development of the 10-item edinburgh postnatal depression scale. Br J Psychiatry. 1987; 150:782–6. [PubMed: 3651732]
27. Wisner KL, Parry BL, Piontek CM. Clinical practice. postpartum depression. N Engl J Med. 2002; 347(3):194–9. [PubMed: 12124409]
28. Wisner KL, et al. Prevention of recurrent postpartum depression: A randomized clinical trial. J Clin Psychiatry. 2001; 62(2):82–6. [PubMed: 11247106]
29. Miller, L.; Gupta, R.; Scremin, A. The evidence for perinatal depression screening and treatment.. In: Handler, A.; Kennelly, J.; Peacock, N., editors. Reducing Racial/Ethnic Disparities in Reproductive and Perinatal Outcomes: The Evidence from Population-Based Interventions. 1st ed.. Springer; 2010. p. 301-324.
30. Institute of Medicine (Subcommittees on Nutritional Status and Weight Gain During Pregnancy and Dietary Intake and Nutrient Supplements During Pregnancy, Committee on Nutritional Status During Pregnancy and Lactation, Food and Nutrition Board). Nutrition during pregnancy: Part I, weight gain; part II, nutrient supplements. National Academy Press; Washington, DC: 1990.
31. Burnham KP, Anderson DR. Multimodel inference: Understanding AIC and BIC in model selection. Sociological Methods and Research. 2004; 33:261–304.
32. Krause KM, Ostbye T, Swamy GK. Occurrence and correlates of postpartum depression in overweight and obese women: Results from the active mothers postpartum (AMP) study. Matern Child Health J. 2009; 13(6):832–8. [PubMed: 18836820]
33. Beck CT. Predictors of postpartum depression: An update. Nurs Res. 2001; 50(5):275–8. [PubMed: 11570712]
34. Dennis CL, Janssen PA, Singer J. Identifying women at-risk for postpartum depression in the immediate postpartum period. Acta Psychiatr Scand. 2004; 110(5):338–46. [PubMed: 15458557]
35. Robertson E, et al. Antenatal risk factors for postpartum depression: A synthesis of recent literature. Gen Hosp Psychiatry. 2004; 26(4):289–95. [PubMed: 15234824]
36. Bloch M, et al. Risk factors for early postpartum depressive symptoms. Gen Hosp Psychiatry. 2006; 28(1):3–8. [PubMed: 16377359]
37. Hannah P, et al. Links between early post-partum mood and post-natal depression. Br J Psychiatry. 1992; 160:777–80. [PubMed: 1617360]
38. Boyce PM, Todd AL. Increased risk of postnatal depression after emergency caesarean section. Med J Aust. 1992; 157(3):172–4. [PubMed: 1635490]
39. Bansil P, et al. Maternal and fetal outcomes among women with depression. J Womens Health (Larchmt). 2010; 19(2):329–34. [PubMed: 20095906]
40. Horowitz JA, Goodman J. A longitudinal study of maternal postpartum depression symptoms. Res Theory Nurs Pract. 2004; 18(2-3):149–63. [PubMed: 15553344]
41. Seguin L, et al. Depressive symptoms in the late postpartum among low socioeconomic status women. Birth. 1999; 26(3):157–63. [PubMed: 10655815]
42. Warner R, et al. Demographic and obstetric risk factors for postnatal psychiatric morbidity. Br J Psychiatry. 1996; 168(5):607–11. [PubMed: 8733800]
43. Forman ND, et al. Postpartum depression: Identification of women at risk. BJOG. 2000; 107(10): 1210–7. [PubMed: 11028570]

44. Patel RR, Murphy DJ, Peters TJ. Operative delivery and postnatal depression: A cohort study. BMJ. 2005; 330(7496):879. [PubMed: 15734748]
45. Carter FA, Frampton CM, Mulder RT. Cesarean section and postpartum depression: A review of the evidence examining the link. Psychosom Med. 2006; 68(2):321–30. [PubMed: 16554400]
46. Hannah ME, et al. Outcomes at 3 months after planned cesarean vs planned vaginal delivery for breech presentation at term: The international randomized term breech trial. JAMA. 2002; 287(14):1822–31. [PubMed: 11939868]
47. Barbadoro P, et al. Socio-economic determinants and self-reported depressive symptoms during postpartum period. Women Health. 2012; 52(4):352–68. [PubMed: 22591232]
48. Beucher G, et al. Maternal outcome of gestational diabetes mellitus. Diabetes Metab. 2010; 36(6 Pt 2):522–37. [PubMed: 21163418]
49. Fadl HE, et al. Maternal and neonatal outcomes and time trends of gestational diabetes mellitus in Sweden from 1991 to 2003. Diabet Med. 2010; 27(4):436–41. [PubMed: 20536516]
50. Patel RR, et al. Prenatal risk factors for caesarean section. analyses of the ALSPAC cohort of 12,944 women in England. Int J Epidemiol. 2005; 34(2):353–67. [PubMed: 15659468]
51. Catalano PM, et al. The hyperglycemia and adverse pregnancy outcome study: Associations of GDM and obesity with pregnancy outcomes. Diabetes Care. 2012; 35(4):780–6. [PubMed: 22357187]
52. Naylor CD, et al. Cesarean delivery in relation to birth weight and gestational glucose tolerance: Pathophysiology or practice style? Toronto trihospital gestational diabetes investigators. JAMA. 1996; 275(15):1165–70. [PubMed: 8609683]
53. Gorgal R, et al. Gestational diabetes mellitus: A risk factor for non-elective cesarean section. J Obstet Gynaecol Res. 2012; 38(1):154–9. [PubMed: 21995455]
54. Cline KM, Decker J. Does weight gain during pregnancy influence postpartum depression? J Health Psychol. 2012; 17(3):333–42. [PubMed: 21824894]
55. Walker LO, Kim M. Psychosocial thriving during late pregnancy: Relationship to ethnicity, gestational weight gain, and birth weight. J Obstet Gynecol Neonatal Nurs. 2002; 31(3):263–74.
56. Hedderson MM, Gunderson EP, Ferrara A. Gestational weight gain and risk of gestational diabetes mellitus. Obstet Gynecol. 2010; 115(3):597–604. [PubMed: 20177292]
57. Tovar A, et al. The impact of gestational weight gain and diet on abnormal glucose tolerance during pregnancy in Hispanic women. Matern Child Health J. 2009; 13(4):520–3. [PubMed: 18597166]
58. Gibson KS, Waters TP, Catalano PM. Maternal weight gain in women who develop gestational diabetes mellitus. Obstet Gynecol. 2012; 119(3):560–5. [PubMed: 22353954]
59. Cheng YW, et al. Gestational weight gain and gestational diabetes mellitus: Perinatal outcomes. Obstet Gynecol. 2008; 112(5):1015–22. [PubMed: 18978100]
60. Gunderson EP, Abrams B. Epidemiology of gestational weight gain and body weight changes after pregnancy. Epidemiol Rev. 2000; 22(2):261–74. [PubMed: 11218377]
61. O'Hara MW, Swain AM. Rates and risk of postpartum depression: A meta-analysis. Int Rev Psychiatr. 1996; 8(1):37.
62. Schwarz EB, et al. Lactation and maternal risk of type 2 diabetes: A population-based study. Am J Med. 2010; 123(9):863.e1, 863.e6. [PubMed: 20800156]
63. Stuebe AM, et al. Duration of lactation and incidence of type 2 diabetes. JAMA. 2005; 294(20): 2601–10. [PubMed: 16304074]
64. Stuebe AM, Rich-Edwards JW. The reset hypothesis: Lactation and maternal metabolism. Am J Perinatol. 2009; 26(1):81–8. [PubMed: 19031350]
65. Harder T, et al. Duration of breastfeeding and risk of overweight: A meta-analysis. Am J Epidemiol. 2005; 162(5):397–403. [PubMed: 16076830]
66. Oken E, et al. Gestational weight gain and child adiposity at age 3 years. Am J Obstet Gynecol. 2007; 196(4):322.e1, 322.e8. [PubMed: 17403405]
67. Troy LM, et al. The validity of recalled weight among younger women. Int J Obes Relat Metab Disord. 1995; 19(8):570–2. [PubMed: 7489028]

68. Stevens J, et al. Accuracy of current, 4-year, and 28-year self-reported body weight in an elderly population. Am J Epidemiol. 1990; 132(6):1156–63. [PubMed: 2260547]

69. Finucane MM, et al. National, regional, and global trends in body-mass index since 1980: Systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. Lancet. 2011; 377(9765):557–6. [PubMed: 21295846]

Table 1

Bivariable analyses for participants meeting and not meeting criteria for depressive symptoms (n=71)

Characteristic	Does not meet criteria (EPDS <9) (n=47)	Meets criteria (EPDS ≥9) (n=24)	P value
Edinburgh score, mean (SD)	3.8 (2.5)	11.4 (2.2)	<.0001
Age, mean (SD)	33.1 (5.5)	34.1 (5.1)	0.44
Minority (Black, Asian, Hispanic), N (%)	29 (62%)	13 (54%)	0.54
More than high school education, N (%)	39 (85%)	20 (83%)	0.87
Multiparous, N (%)	22 (47%)	16 (67%)	0.11*
History of depression, N (%)	6 (13%)	3 (13%)	0.97
Has a partner, N (%)	37 (79%)	22 (92%)	0.15*
Pre-pregnancy BMI (kg/m^2), mean (SD)	29.4 (6.2)	32.0 (5.5)	0.09*
Gestational weight gain (lbs), mean (SD)	25.3 (14.4)	34.3 (20.5)	0.035*
Exceeded IOM gestational weight gain guidelines, N (%)	27 (57%)	16 (67%)	0.05**
Cesarean delivery, N (%)	15 (32%)	16 (67%)	0.005*
Unplanned cesarean delivery, N (%)	9 (19%)	4 (17%)	0.80
Used insulin during pregnancy, N (%)	33 (70%)	18 (75%)	0.67
Exclusively or partially breastfeeding at early postpartum visit, N (%)	39 (83%)	17 (71%)	0.24

* Met criteria to be included in model due to P<.2

** Used in sensitivity analysis

Table 2

Multivariable logistic regression analysis for meeting criteria for depressive symptoms (EPDS ≥9)

	Odds ratio	95% CI	P value
Model 1			
Cesarean delivery	4.32	1.46 - 13.99	0.0102
Pregnancy Weight gain (per 5 lb)	1.21	1.02 - 1.46	0.0323
Multiparity	2.83	0.92 - 9.61	0.0795
Model 2			
Cesarean delivery	5.08	1.69 - 17.07	0.0033
Exceeded IOM weight gain guidelines	3.64	1.19 - 12.50	0.0229
Multiparity	2.46	0.81 - 8.09	0.1132