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Predictors of very early postpartum weight loss in women with recent gestational diabetes mellitus

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Abstract

Objective: Women with gestational diabetes (GDM) have a 7–12 fold increased risk for developing type 2 diabetes later in life. Postpartum weight retention is highly predictive for future obesity, and further increases risk for type 2 diabetes. We sought to identify predictors of losing at least 75% of gestational weight gain by very early postpartum in women with recent GDM.

Methods: We recruited women with GDM during pregnancy or just after delivery. Pre-pregnancy weight was self-reported at recruitment; gestational weight gain, mode of delivery, and insulin use were extracted from medical records. At a mean of 7.2 (± 2.1) weeks postpartum we measured weight and height and administered questionnaires, including: demographics, breastfeeding, Edinburgh Postnatal Depression Scale, sleep, Harvard Food Frequency, and the International Physical Activity Questionnaire. We modeled the odds of 75% loss of gestational weight gain at the study visit using multivariable logistic regression models and selected the model with the lowest Akaike information criterion (AIC) as our final model. Analyses were conducted using JMP 10–13 Pro (SAS Institute Inc.)

Results: Seventy-five women with recent GDM were included in the study. The mean age of study participants was 33 (SD ± 5) years old, of whom 57% were white, 30% were African American, and 20% of the women identified as Hispanic. The mean pre-pregnancy BMI was 31.4 kg/m² (SD ± 5.6) and the mean pregnancy weight gain was 12.5 kg (SD ± 7.8). 52% of participants lost at least 75% of their pregnancy weight gain by the early postpartum study visit. Thirty-seven women (49%) exceeded IOM guidelines for gestational weight gain. In a multivariate model adjusting for weeks postpartum at the time of the study visit, less gestational weight gain (OR 0.56 per kg; 0.39 to 0.73 per kg), increased age (OR 1.48; 95% CI 1.13 to 2.20 per year) and lack of

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Declaration of Interest

The authors report no conflicts of interest.

insulin use during pregnancy (OR 0.08 for use of insulin; 95% CI 0.00 to 0.73) were associated with at least 75% postpartum weight loss. Pre-pregnancy BMI and sleep were not retained in the model. Race/ethnicity, education, breastfeeding, nulliparity, cesarean section, depressive symptoms, dietary composition, glycemic index, and physical activity did not meet criteria for inclusion in the model.

Conclusions: A substantial proportion of women with recent GDM lost at least 75% of their gestational weight gain by early postpartum. Older women, those who didn't use insulin during pregnancy and those who had gained less weight during pregnancy were significantly more likely to have lost 75% of gestational weight by very early postpartum.

Keywords

gestational diabetes; postpartum weight retention; weight loss; overweight; obesity

Introduction

Between 3–13% of pregnancies in the United States are complicated by gestational diabetes (GDM) (1), and the incidence of GDM is increasing globally (2). Women with GDM have a 7–12 fold increased risk for developing type 2 diabetes (3). Among all women who become pregnant, a substantial proportion do not return to pre-pregnancy weight after delivery. Although weight retention at 6 (4) and 12 (5) months is a predictor of future obesity, the typical end of pregnancy care is at six weeks postpartum, at which time women retain an average of 3–7 kg of weight gained during pregnancy, and at least 2/3 of women will still be above their pre-pregnancy weight (6). Since postpartum weight retention after a GDM delivery is predictive for both repeat GDM (7) and future type 2 diabetes (8–10), weight loss in the postpartum period is critically important for women with recent GDM.

There are limited data in the literature regarding factors associated with weight loss in the first postpartum weeks among women with a history of GDM. Observational data suggest that women with GDM retain a similar amount of weight as women without a history of GDM, both when measured in the short term at a mean of 1.4 years (11) and long-term at 20 years (12). Women with a history of GDM are no more likely than women without a history of GDM to adopt healthy lifestyle behaviors in order to prevent chronic disease (13–16). The early postpartum period may therefore be a critical window of opportunity to influence long-term risks mediated by postpartum weight retention. Given that women with prior GDM have an increased risk for type 2 diabetes that may be improved by a return to pre-pregnancy weight, we sought to identify potentially modifiable pregnancy and postpartum factors associated with very early postpartum weight loss.

Methods and Procedures

Participants

The participants in this study belong to the baseline cohort of the Balance after Baby (BAB) study. BAB was a one-year randomized trial of a lifestyle intervention program for women with a recent pregnancy complicated by GDM conducted in Boston, Massachusetts between June 2010 and September 2012 (17). To be eligible for the BAB study, women had to be

diagnosed with GDM in their most recent pregnancy as defined by either Carpenter-Coustan criteria (18) or by a documented medical record diagnosis by a clinician. Other inclusion criteria included: 18–45 years old, no personal history of type 2 diabetes, delivery 32 weeks gestation, and a BMI $\geq 24 \text{ kg/m}^2$ ($\geq 22 \text{ kg/m}^2$ for Asian participants) or $<50 \text{ kg/m}^2$ at 6 weeks postpartum. Enrollment took place either during pregnancy (63/75, 84%) or after delivery before the early postpartum baseline study visit (12/72, 16%). Women were asked to come in for the early postpartum baseline study visit at ~6 weeks postpartum, and randomization was performed at the end of this visit. The human subjects committee at Brigham and Women's Hospital approved the study. All participants gave written informed consent.

Measurements

We calculated gestational weight gain using self-reported pre-pregnancy weight recorded at the time of enrollment into the study, a measure that has previously demonstrated a strong correlation with measured pre-pregnancy weight (19, 20), and weight recorded in the anesthesia record within two days of delivery (71/75, 95%) or the last recorded prenatal weight recorded within 10 days of delivery (4/75, 5%). We calculated pre-pregnancy BMI using measured height at the baseline postpartum study visit and the self-reported pre-pregnancy weight. During the baseline postpartum visit women completed multiple questionnaires, including: demographics, breastfeeding, Edinburgh Postnatal Depression Scale (EPDS), Harvard Food Frequency, and the International Physical Activity Questionnaire. To assess sleep we used a modified version of the Pittsburgh Sleep Quality Index (21) along with several questions from the Project Viva study (22). For the current analysis we used participants' self-report of the average number of hours of sleep over a 24 hour period in the preceding month. We measured metabolic parameters including a 2 hour oral glucose tolerance test and thyroid stimulating hormone (TSH) levels. We reviewed participants' medical records to determine insulin use during pregnancy and mode of delivery. The primary results for this study have been published demonstrating significantly increased weight loss among women randomized to the intervention arm (19).

Statistical Analysis

Since about half of the cohort had lost at least 75% of their gestational weight gain by the time of the early postpartum visit, we sought to determine which factors were associated with this very early weight loss. We conducted a univariate analysis of factors potentially associated with weight loss at the pre-randomization 6-week postpartum study visit. We modeled the odds of 75% loss of gestational weight gain at the 6-week postpartum study visit using multivariable logistic regression models containing up to 3 variables for univariates with $p < 0.3$ and controlling for the actual number of weeks postpartum at the time of the visit, and selected the model with the lowest Akaike information criterion (AIC) as our final model. We built similar models substituting exceeding the IOM weight gain guidelines for gestational weight gain (23). We tested collinearity of independent variables, and none displayed excessive collinearity. All analyses were conducted using JMP 10–13 Pro (SAS Institute Inc.).

Results

The seventy-five women with recent GDM who underwent the early postpartum visit and were randomized into the study are included in this analysis. The early postpartum study visit occurred at a mean of 7.2 (SD±2.1) weeks postpartum. The mean age of study participants was 33 (SD±5) years old, of whom 57% were white, 30% were African American, and 20% of the women identified as Hispanic. Thirty-four percent were low-income, and 59% had earned a college degree. The mean pre-pregnancy BMI was 31.4 kg/m² (SD±5.6) and the mean pregnancy weight gain was 12.5 kg (SD±7.8). Thirty-seven women (49%) exceeded IOM guidelines for gestational weight gain. Fifty-four women (72%) used insulin during pregnancy. (Table 1) No woman had labs reflecting hypothyroidism at the early postpartum visit.

As shown in Table 1, of the 75 participants, 39 (52%) lost at least 75% of their gestational weight gain by the postpartum study visit. In the unadjusted analysis, age, pre-pregnancy BMI, gestational weight gain, exceeding IOM guidelines, insulin use during pregnancy, nulliparity, and averaging 6 or more hours of sleep per night met criteria for inclusion in the multivariable model. Dietary factors including glycemic load, fiber intake, added sugars, and total kilocalories as measured by the food frequency questionnaire were similar between those who demonstrated early weight loss and those who did not, and therefore were not included in the multivariate model. Moderate to vigorous physical activity, sedentary time, race/ethnicity, education, income level (with low income defined as at or below 175% of the poverty level), mode of delivery, postpartum depressive symptoms, and breastfeeding were also similar between groups, and therefore not included in the multivariate model. The weeks postpartum at measurement was intentionally retained in the model due to the clinical importance of adjusting for this factor.

The best fit model to predict loss of 75% of gestational weight gain included age, gestational weight gain, and insulin use during pregnancy. In the best fit model including categorical gestational weight gain as exceeding IOM guidelines, increasing pre-pregnancy BMI, and use of insulin during pregnancy were significant predictors. Nulliparity and sleep were included in the multivariable modeling, but were not retained.

Discussion

In this study we investigated predictors of weight loss in the very early postpartum period among women with recent GDM. After controlling for the number of weeks postpartum at the early postpartum visit, less gestational weight gain, increasing maternal age, and lack of insulin use during pregnancy were significantly associated with losing 75% of weight gained during pregnancy when measured on average at seven weeks postpartum. Exceeding IOM guidelines for gestational weight gain was significantly associated with failure to lose weight early in a similar model. There were no significant differences between groups regarding diet, physical activity, race/ethnicity, education, income, mode of delivery, postpartum depressive symptoms, or breastfeeding.

To our knowledge, few studies have sought to identify predictors for postpartum weight retention in women with a history of GDM. Davis et. al looked at a cohort of 888 women

with recent GDM and found that increased intake of fried foods after delivery was associated with increased weight retention at one year postpartum (24). However they did not include non-dietary factors such as gestational weight gain and pre-pregnancy BMI in their analysis.

Many studies looking at postpartum weight retention among normal women without GDM support the finding of gestational weight gain as the strongest predictor of postpartum weight retention measured as early as 6 weeks (25) postpartum, and between 6 and 12 months (26–29) postpartum. Similarly, exceeding IOM guidelines for gestational weight gain has been shown to be associated with increased postpartum weight retention in many studies of non-GDM women. Haugen et. al. evaluated data from over 56,000 Norwegian women, noting that over 50% of overweight and obese women exceeded IOM guidelines, and this was associated with increased postpartum weight retention at 6 and 18 months (30). Similarly, a study in a cohort of Danish women demonstrated a greater risk of postpartum weight retention at one year among women exceeding IOM guidelines. However some (31) studies in non-GDM populations demonstrate that pre-pregnancy BMI is a more important driver than gestational weight gain (32). Since both total gestational weight gain and exceeding IOM guidelines were significantly related to losing at least 75% of the weight gained by very early postpartum in this study, focusing on gestational weight gain may be an important strategy to promote early postpartum weight loss in women with recent GDM (23).

Despite the growing understanding about the importance of appropriate weight gain during pregnancy for both maternal and fetal health, there is a disconnect between the IOM guidelines and actual patient outcomes for gestational weight gain. A recent study of women with GDM demonstrated that 38% exceeded IOM guidelines for weight gain, with a rate of 58% among obese women. Among all pregnant women, approximately half gain more than recommended (20) (33), while women who are overweight and obese are even more likely than normal weight women to gain more than guidelines (34). Several studies suggest a need for better patient education regarding gestational weight gain. In one study, up to one-third of pregnant women reported that they received no weight gain advice from their provider(35). In another study, 79% of healthy weight women, but only 54% of overweight and 65% of obese reported receiving information about gestational weight gain, and of these 45% received information inconsistent with the guidelines (33).

A previous study among 1300 non-GDM women with a median follow-up time of 1.5 years after their index pregnancy noted that older women were less likely than younger women to become overweight following pregnancy (36). Previous studies in non-GDM populations have shown conflicting results when looking at the relationship between postpartum weight retention and parity, as well as postpartum weight retention and race. Although some studies demonstrate that nulliparous women have greater gestational weight gain and more weight retention than multiparous women (28, 37), the opposite has also been shown (27), and one recent meta-analysis demonstrated no direct relationship (38) between parity and postpartum weight retention. In our study, although parity was not significant in the univariate analyses, the association with increased age and increased postpartum weight loss may be driven, at least in part, by increasing parity at older ages. Some studies demonstrate that black women

are more likely to retain weight than white women (27). This was not a significant factor in our study, however our study was likely too small to adequately assess the impact of race.

In this study, we did not demonstrate an association between decreased weight retention early postpartum and breastfeeding. In general, the results have been mixed regarding whether or not breastfeeding is associated with postpartum weight loss when looked at more remotely from pregnancy. A recent systematic review found that 21/35 studies reported no significant relationship between breastfeeding and weight change but noted many methodological limitations (39). Among the prospective studies with more robust methods however, lactation was associated with less postpartum weight retention, particularly at when evaluated at 12 months or longer (39). Few studies have looked at the association between breastfeeding and weight loss in the early postpartum period.

Interestingly, in the current study, use of insulin during pregnancy was associated with a lower chance of very early postpartum weight loss. This is despite the finding that women with higher BMIs were more likely to achieve early weight loss. Although insulin use during pregnancy has been associated with greater gestational weight gain in at least one case control study (40), it does not appear that increased weight gain is driving the relationship in our study. It is possible that significant insulin resistance, which would be associated with insulin use in pregnancy, impairs weight loss in the postpartum period; further study is needed to investigate whether modifying insulin resistance pharmacologically would potentially aid postpartum weight loss.

Our findings must be interpreted in context of several important limitations. The sample size is small, particularly when compared to findings from large cohort studies. In addition, the small sample size limits the number of factors that can be included in the models. Since the data are cross-sectional, the relationships are correlational and not necessarily causative. Some of the data were self-reported, including prepregnancy weight and sleep. However other studies have demonstrated a strong correlation between clinically measured weight and self-reported prepregnancy weight (19, 20). The women in this study agreed to participate in a randomized interventional trial, and therefore the findings may lack generalizability.

Given the importance of postpartum weight retention among women with a history of GDM, identifying factors leading to greater postpartum weight loss may be helpful. The findings from this study support recent calls from clinicians and researchers to limit gestational weight gain and improve adherence to gestational weight gain guidelines. The finding that older women were more likely to demonstrate early postpartum weight loss is reassuring given that rates of gestational diabetes increase with age (41), and the overall population of childbearing women is increasing in age as well (42). It is possible that early weight loss could provide postpartum women with motivation for continuing to lose weight gained during pregnancy and decrease weight retention longer term. Future studies should seek to further ascertain the long-term implications of very early postpartum weight loss in women with GDM, as well as determining the importance of modifiable factors such as gestational weight gain.

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Characteristics and odds ratios for women losing greater than or equal to, or less than, 75% of gestational weight gain by very early postpartum

Table 1:

Characteristic	75% gestational weight lost by 6 weeks postpartum (n=39)	< 75% gestational weight lost by 6 wks (n=36)	P value	Unadjusted Odds Ratio	95% CI
*Age, mean (SD)	34.8 (4.5)	31.8 (5.7)	0.0103	1.83 (per 5 yr)	(1.15,3.12)
Race: White, N (%) African American, N (%) Asian, N (%)	20 (51%) 13 (33%) 6 (15%)	23 (64%) 10 (28%) 3 (8%)	0.54	--	--
*Hispanic/Latina N (%)	9 (23%)	6 (17%)	0.49	1.5	(0.48,4.97)
Education level attained: Some or all of high school Some college College graduate	76 (18%) 7 (18%) 24 (63%)	6 (17%) 11 (31%) 19 (53%)	0.47*	--	--
*Low-income	12 (32%)	12 (36%)	0.67	0.81	(0.30,2.17)
*Pregnancy BMI	32.0 (5.8)	28.7 (5.7)	0.0143	1.1 per unit	(1.02,1.22)
*Gestational wt gain, kg (SD)	7.4 (4.5)	18.0 (6.7)	<0001	0.65 (per kg)	(0.51, 0.77)
*Exceeded IOM guidelines	9 (23%)	28 (78%)	<0001	0.09	(0.03,0.24)
*Insulin use during pregnancy	24 (65%)	28 (80%)	0.28	0.57	(0.20,1.58)
*Nulliparous	14 (36%)	19 (52%)	0.14	0.50	(0.20,1.25)
*C-Section	16 (41%)	16 (44%)	0.76	0.87	(0.35,2.18)
*Postpartum depressive symptoms	13 (34%)	13 (36%)	0.86	0.92	(0.35,2.40)
*Exclusively breastfeeding	12 (31%)	10 (28%)	0.77	1.16	(0.43,3.18)
*Have partner, n (%)	32 (82%)	29 (83%)	0.93	0.95	(0.28,3.17)
Average 6 or more hours sleep per night	9 (23%)	13 (37%)	0.0390	0.36	(0.13,0.95)
*Weeks postpartum at measurement	6.9 (1.5)	7.5 (2.6)	0.23	0.87	(0.66,1.09)
150 min moderate/vigorous physical activity per week	14 (36%)	11 (31%)	0.62	0.79	(0.29,2.06)
Sit fewer than 5 hours per day	17 (47%)	16 (44%)	0.81	1.12	(0.44, 2.85)
Glycemic load per 1000 kcal, mean (SE)	68.9 (2.2)	69.5 (2.4)	0.85	0.99	(0.96, 1.03)
Grams of fiber per 1000 kcal, mean (SE)	12.1 (0.53)	11.7 (0.72)	0.65	1.03	(0.91, 1.16)
Grams of added sugar per 1000 kcal, mean (SE)	29.9 (3.5)	32.8 (3.8)	0.57	0.99	(0.97, 1.01)
Total kcal, mean (SE)	2116 (147)	2048 (148)	0.75	1.00	(1.00,1.00)
*Impaired fasting glucose or impaired glucose tolerance	12 (31%)	12 (33%)	0.81	0.89	(0.33,2.36)

Table 2:

Best fit models for predictors of losing at least 75% of gestational weight gain among early postpartum women with recent gestational diabetes

Predictor	Odds Ratio	95% CI	P value
Model 1: Using gestational weight gain			
Gestational weight gain	0.56 per kg	(0.39 to 0.73)	0.0003
Age	1.48 per year	(1.13 to 2.20)	0.0017
Insulin use during pregnancy	0.08	(0.00 to 0.73)	0.0448
Number of weeks postpartum	0.03	(0.00 to 5.66)	0.2899
Model 2: Using exceeding IOM guidelines			
Exceeding IOM guidelines	0.03	(0.01 to 0.13)	<0.0001
Increasing prepregnancy BMI	1.23 per unit	(1.09 to 1.41)	0.0003
Insulin use during pregnancy	0.10	(0.01 to 0.51)	0.0043
Number of weeks postpartum	0.88 per week	(0.60 to 1.17)	0.4176