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Gestational weight loss and perinatal outcomes in overweight and obese women subsequent to diagnosis of gestational diabetes mellitus

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Abstract

OBJECTIVE—To investigate whether gestational weight loss after the diagnosis of gestational diabetes mellitus (GDM) in overweight and obese women is associated with improved perinatal outcomes. Obesity and GDM are risk factors for adverse perinatal outcomes, but few studies have investigated weight loss during pregnancy in women with these comorbidities.

METHODS—Retrospective cohort study of 26,205 overweight and obese gestational diabetic women enrolled in the California Diabetes and Pregnancy Program. Women with gestational weight loss (GWL) during program enrollment were compared to those with weight gain. Perinatal outcomes were assessed using chi-square test and multivariable logistic regression analysis. **RESULTS:** 5.2% of women experienced GWL. GWL was associated with decreased odds of macrosomia (aOR 0.63, 95% CI 0.52–0.77), NICU admission (aOR 0.51, 95% CI 0.27–0.95), and cesarean delivery (aOR 0.81, 95% CI 0.68–0.97). Odds of SGA status (aOR 1.69, 95% CI 1.32–2.17) and preterm delivery <34 weeks (aOR 1.71, 95% CI 1.23–2.37) were increased.

CONCLUSIONS—In overweight and obese women with GDM, third trimester weight loss is associated with some improved maternal and neonatal outcomes, although this effect is lessened by increased odds of SGA status and preterm delivery. We recommend further research on weight loss and interventions to improve adherence to weight guidelines in this population.

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CONFLICTS OF INTEREST

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Keywords

obesity; pregnancy; gestational diabetes; gestational weight loss; pregnancy outcomes

INTRODUCTION

Obesity is a growing epidemic in the United States. In 2007, nearly 60% of reproductive-age American women were overweight or obese, and the prevalence of obesity was approximately 30% across many demographic groups.¹ Prepregnancy obesity is a known risk factor for multiple adverse perinatal outcomes.² Gestational diabetes mellitus (GDM) and obesity are frequently comorbid conditions. It is well-established that weight gain is associated with excess risk of adult diabetes outside of pregnancy; additionally, interpregnancy weight gain is associated with an increased risk of subsequent GDM.³⁻⁵ Excessive total gestational weight gain among women with GDM is associated with increased neonatal morbidity.⁶ In addition, the 2009 Institute of Medicine (IOM) revised guidelines for gestational weight gain newly consider the World Health Organization (WHO) Body Mass Index (BMI) categories.⁷⁻⁹ These guidelines include more specific, narrower ranges of recommended weight gain for obese women, as excessive gestational weight gain has been clearly associated with multiple types of neonatal and maternal morbidity and mortality.^{7-8,10-13}

Low overall gestational weight gain, although sometimes associated with increased likelihood of small-for-gestational-age (SGA) status, has been less well studied. Data suggest that for some categories of obese women, there may be room for low weight gain while still balancing the risks associated with inadequate nutrition.¹⁴⁻¹⁷ Obese women with total gestational weight gain less than the 2009 IOM recommendations experienced decreased large-for-gestational-age (LGA) status as well as other beneficial perinatal outcomes, with only a slight increased risk of SGA.¹⁶⁻¹⁹ Although the IOM did not subdivide guidelines by obesity class, obesity severity appears to modify outcomes such that the most morbidly obese women have the most benefit from weight gain less than guidelines, with few of the adverse effects seen when normal weight women have inadequate total gestational weight gain.^{13,17-18, 20}

Few studies have specifically addressed weight loss in pregnancy, as weight loss is generally not promoted in pregnancy and cannot be randomized. Recently, Blomberg found that among a population of non-diabetic and diabetic obese Swedish women (prepregnancy BMI >35), those who had weight loss had decreased odds of cesarean delivery and LGA neonates, with only a small increased risk of SGA neonates and no other increased adverse perinatal outcomes.²¹ Similar association between low total gestational weight gain or weight loss and decreased risk of macrosomia, as well as other favorable perinatal outcomes, was seen in two other studies in international settings.^{22,23} These data would suggest there are potential advantages to weight loss or low weight gain during pregnancy, especially for the most obese women, although the benefits must be balanced with potential small increased risks to neonates. To our knowledge, there are no data studying third trimester weight loss in an overweight and obese American population, particularly those with GDM.

Given this background, we designed a retrospective cohort study of a diverse California population to examine whether third trimester gestational weight loss among overweight and obese women with GDM is associated with adverse perinatal outcomes. We hypothesized that there is a potential beneficial effect to weight loss during the time period of treatment for GDM among this particularly high-risk subgroup of women.

METHODS AND PROCEDURES

We conducted a retrospective cohort study of all women with GDM who were cared for in the Sweet Success California Diabetes and Pregnancy Program (CDAPP) between 2001 and 2004. In California, Sweet Success is the clinical component of CDAPP, which provides technical support and education to providers involved in the care of high-risk pregnant women with pre-existing diabetes and women who develop GDM. As a part of the Maternal, Child, and Adolescent Health Branch of the California Department of Health Services, CDAPP collects data on all women enrolled in Sweet Success, including hemoglobin A1C, weight at enrollment and last visit, maternal outcomes, neonatal outcomes, treatments instituted, and demographic information. CDAPP oversees collection by trained clinicians into standardized data collection forms. Institutional Review Board approval was obtained from the UCSF Committee on Human Research for this study.

The study population includes all overweight and obese women with GDM who were enrolled in the CDAPP program during the years under investigation. Exclusion criteria included: preexisting diabetes mellitus, multi-fetal gestations, and pregnancies with fetal anomalies. Overweight and obese women were specifically chosen because the changes to the IOM recommendations in 2009 focused on these groups and they are at highest risk for morbidity. All data were collected from the CDAPP/Sweet Success data collection forms. Prepregnancy weight was classified using the World Health Organization guidelines for calculation of BMI and used for determination if they were overweight or obese.⁹ Pre-pregnancy weight was provided to CDAPP by self-report or from referring prenatal care providers. Women were classified as having GDM if they screened positive for GDM with at least 2 values beyond the threshold for normal using the Carpenter-Coustan guidelines during routine early third-trimester testing. Once identified, women were classified by weight change from first to last Sweet Success visit. Weight was measured at office visits. For the purpose of using clinician-measured weights rather than the less accurate self-reported weights, and to specifically investigate the effect of weight change in the time period during which the patient was receiving intensive diabetes care, weight change from first to last Sweet Success visits was used to designate gestational weight change, instead of weight change over the entire pregnancy. This value reflected the third trimester gestational weight change. The change in weight was dichotomously categorized as weight loss versus no weight loss.

Deliveries were performed at a variety of academic and community institutions throughout California, with all data reported by CDAPP clinic providers to the centralized CDAPP database. Neonatal outcomes of interest in this study included: preterm delivery before 37 weeks and before 34 weeks, elevated birth weight (>4000g), LGA status (>90th centile by gestational age), SGA status (<10th centile by gestational age), intensive care nursery

admission, and intrauterine fetal demise. Neonatal outcomes were controlled for gestational age at delivery. CDAPP does not collect data on neonatal hypoglycemia or jaundice. Maternal outcomes include all and primary cesarean deliveries; CDAPP does not collect data on preeclampsia. Categorical perinatal outcomes were examined by category of gestational weight change using Pearson chi-square statistic for analysis of trend. A p -value of <0.05 indicated statistical significance. Multivariable logistic regression analysis was utilized to control for potential confounders, including age, race/ethnicity, language, parity and maternal education.

RESULTS

Our study cohort consisted of 26,205 women with GDM who were either overweight or obese and met study inclusion criteria. There were 1,367 (5.2%) women who lost weight and 24,838 (94.8%) women who did not lose weight during their care under the Sweet Success program. Average amount of weight loss was 3 pounds, with a mean of 4.3 pounds lost (25th centile=5 pounds loss and 75th centile=1 pound loss). Gestational age at program enrollment was a mean of 26.8 weeks (median 29.5 weeks). Gestational age at last visit was a mean of 34.8 weeks (median 36 weeks). The number of weeks from enrollment to delivery was a mean of 11.2 weeks (median 8.9 weeks). The majority of women (80.1%) were multiparous, and multiparas were more likely to experience weight loss than nulliparas (5.7% vs 3.4%, $p<0.001$). Two-thirds were under age 35 (66.5%); there was no significant difference in proportion of women who lost weight between age groups under and over 35 ($p=0.35$). Approximately 5.4% of Caucasian women, 4.3% of African American women, 5.9% of Latina women, and 2.2% of Asian women experienced gestational weight loss; significantly fewer Asian women experienced weight loss ($p<0.001$). Neither educational attainment nor language was related to whether or not weight loss occurred. Table 1 demonstrates maternal characteristics associated with presence or absence of weight loss (TABLE 1).

Maternal and neonatal outcomes were examined by gestational weight change (TABLE 2). On univariate analysis, weight loss is associated with decreased rate of cesarean delivery, both total and primary cesarean sections. Women with weight loss experienced significantly fewer cesarean deliveries (36.9%) versus those who experienced no weight loss (41.2%). Women with weight loss also experienced statistically significant decreases in neonatal macrosomia and large-for-gestational-age status. There was a statistically significant but perhaps clinically insignificant increase in preterm deliveries less than 34 weeks, and a similarly slightly increased rate of intrauterine fetal demise (IUID). Further, the rate of small-for-gestational-age neonates was slightly increased among those with weight loss.

Multivariable logistic regression analysis was used to control for possible confounders (TABLE 3). Women with GDM who lost weight during their enrollment in diabetes care were compared to the referent group of women who did not lose weight during this time period, controlling for age, parity, education, ethnicity and language. On adjusted analysis, women with weight loss were less likely to have cesarean deliveries, neonatal macrosomia or LGA status. There was a decreased risk of intensive care nursery admissions. However, there was an increased risk of preterm delivery before 34 weeks and of SGA status neonates.

There were no significant associations between weight loss and preterm delivery before 37 weeks, IUFD, or antepartum admission on multivariable analysis. Finally, to further explore the association of gestational weight loss and perinatal outcomes among women who were overweight or obese, we stratified the analysis by BMI categories (25–29.99, 30–34.99, 35–39.99, and 40). Those with a higher BMI were more likely to lose weight. Regarding perinatal outcomes, although we observed similar trends, none of the multivariable logistic regression analyses achieved statistical significance, likely due to insufficient statistical power, as small-cell problem is often encountered with stratification along with rare outcomes of interest.

DISCUSSION

This study investigates the relationship between perinatal outcomes and weight loss during the period of enrollment in a specialized diabetes program in Californian women with GDM who were either overweight or obese. To our knowledge, this study is one of few aiming to investigate the interaction between high maternal prepregnancy BMI and weight loss during pregnancy in women with GDM. In this large cohort of overweight and obese women from California, we observed that women with modest weight loss during the time period subsequent to GDM diagnosis experienced some improved maternal and neonatal perinatal outcomes, although these effects are perhaps lessened by the potential for increased adverse effects. Specifically, overweight and obese women with GDM who lost weight subsequent to their diabetes diagnosis experienced fewer LGA status neonates, less macrosomia, fewer cesarean deliveries, and fewer NICU admissions. While we observed that the frequency of preterm delivery and SGA status were increased in the weight loss group, the overall incidences of these adverse outcomes were low. Although our study examines a different period of time than others, these findings are consistent with the few other studies that have investigated total gestational weight loss in overweight and obese women.^{21–23}

Our findings would suggest that there is indeed room to consider the acceptability of small degrees of gestational weight loss or low gestational weight gain for obese women, subsequent to the diagnosis of GDM. The amount of weight lost over this short time period was small. However, we feel this group of women who lost weight is still clinically distinct, as it is unusual to lose any weight during the third trimester, when the rate of weight gain typically peaks. This weight loss perhaps reflects the positive nutritional changes made by some women during enrollment in Sweet Success, suggesting that even very modest amounts of weight loss in this population may be of some benefit. There is little high-quality evidence to guide weight management in overweight and obese diabetic women during pregnancy. However, these findings and those of similar studies would suggest that obese, diabetic women may benefit from more intensive weight management counseling and education than other populations. For all obese women, counseling regarding weight should take place prior to conception when possible, and then early and regularly during pregnancy, consistent with a recent randomized trial.²⁴ Additional weight counseling at the time of diagnosis with GDM is likely to be particularly important, as our findings focused on this change in weight subsequent to diagnosis of GDM.

Our study is not without limitations. The first is that this is a retrospective cohort study, which is prone to confounding bias. While we attempt to control for potential confounding factors by implementing multivariable logistic regression analyses to estimate the association between gestational weight loss and perinatal outcomes, there may be residual confounding from unmeasured or unobserved factors for which we did not have information or could not account for by statistical models. For example, it is possible that some women lost weight because of factors that placed them at risk of SGA neonates, but we are unable to fully explore these links. Additionally, our analysis is restricted to the variables collected by the CDAPP program. There are a number of outcomes associated with diabetes in pregnancy which we could not examine due to lack of information collection. For example, ideally, we would like to examine the association between gestational weight loss and preeclampsia, and other maternal outcomes such as postpartum hemorrhage, severe lacerations, indications for cesarean and operative vaginal deliveries, and degree of glycemic control to further ascertain the role of gestational weight loss in women with GDM. We would speculate that there would be reduced risk of some maternal complications in women with gestational weight loss but are unable to investigate these specific adverse outcomes. We additionally do not know the reasons for preterm delivery in this population, although we suspect that the rate of preterm delivery reflects the underlying risk of having GDM, as literature suggests women with GDM have an increased risk of both spontaneous and iatrogenic preterm birth.^{25–26} Further, we could not examine neonatal outcomes often associated with pregnancies complicated by insulin resistance, such as neonatal hypoglycemia, jaundice and other metabolic derangements. One additional limitation is that these data are from a specific population of overweight and obese women receiving specialized care in a population program; as a result, these data may not be generalizable to other populations. Further, because of the observational nature of this data, we cannot claim a causal relationship between gestational weight loss and adverse outcomes. As there are no prior data that examine perinatal outcomes and gestational weight loss among women with GDM and since it is not possible to perform randomized controlled studies of weight loss versus gain, we believe that the large sample size and statistical models may provide valid information that may be useful in caring for this high-risk population.

In addition, we do not know the reasons for weight loss in this population. It is unlikely that significant nausea or vomiting led to malnutrition-related weight loss for these women, as the majority of pregnancy-associated nausea and vomiting resolves by the third trimester.²⁷ The incidence of hyperemesis beyond 20 weeks requiring hospitalization is reported to be 0.1 per 1,000 pregnant women, suggesting this is highly unlikely to be a major contributor to weight loss.²⁸ However, there are no data describing reasons for weight loss in pregnancy in the general population or in gestational diabetic women. Although literature demonstrates excessive gestational weight gain to be associated with worse glycemic control in GDM, there are inadequate data to support the inverse relationship, that women with better glycemic control are likely to have weight loss.^{22,29} We hypothesize that women who experienced weight loss likely made lifestyle changes subsequent to their diagnosis of GDM due to the counseling they received, but further investigation is required to elucidate reasons for weight loss in this population.

Finally, for this study, the weights measured during enrollment in the Sweet Success program were used to assess weight change. As the diagnosis of GDM typically is made during the third trimester, this weight change reflects the latter portion of pregnancy. The Sweet Success-documented weight change thus served as a proxy for total gestational weight change, and represents weight change that occurred during the time period in which women received care for their diagnosis of GDM. These weights were chosen in order to use the most accurate measurements available (using clinician-recorded weights in a standardized prenatal care program rather than self-reported pre-pregnancy weight), as well as to choose the most clinically useful time period, from the point of diagnosis with GDM onward. Although we did not study total pregnancy weight change, the time period studied is felt to be most relevant to providers caring for overweight and obese women with GDM, as it is not possible to intervene on weight gain for women with GDM until they have received this diagnosis. However, we recommend that further research examine the role of total pregnancy weight loss in this population.

In summary, our findings suggest that overweight and obese women with GDM may have some improved perinatal outcomes associated with weight loss subsequent to their diagnosis of GDM. These findings validate prior limited data suggesting that at-risk obese women may benefit from minimal weight gain. However, these findings are to be treated cautiously without further data. We encourage further research on gestational weight loss in American populations to support our findings and those of the international populations, including additional work to understand the risks of weight loss or limited gestational weight gain. Ultimately, whether the goal for overweight and obese women is weight loss or limited weight gain, it remains unclear how to best help women achieve these goals. Further research is additionally required to better understand how to perform successful interventions to optimize pregnancy weight change in a diabetic population.

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What is already known about this subject?

- Pre-pregnancy obesity, excessive gestational weight gain, and gestational diabetes are all independent risk factors for adverse maternal and neonatal outcomes.
- Limited data suggest that weight loss or low gestational weight gain in obese women may be associated with favorable perinatal outcomes, but this has not been studied in an American population of overweight and obese women with gestational diabetes.

What this study adds

- Overweight and obese pregnant women with gestational diabetes mellitus who lost modest amounts of weight during the last trimester of pregnancy experienced some improved maternal and neonatal outcomes compared to those who gained weight.
- Few studies have investigated the interaction between high maternal prepregnancy BMI and weight loss during pregnancy in women with gestational diabetes.
- Findings suggest that diabetic, obese women may benefit from modest weight loss or minimal gain subsequent to the diagnosis of gestational diabetes.

TABLE 1

Demographic Characteristics

	Weight loss (%)	No weight loss (%)	p-value
Parity			<0.001
Nulliparous (N=4999)	3.4%	96.6%	
Multiparous (N=20870)	5.7%	94.3%	
Ethnicity			<0.001
White (N=5617)	5.4%	94.6%	
Black (N=1021)	4.3%	95.7%	
Latina (N=15874)	5.9%	94.1%	
Asian (N=3551)	2.2%	97.8%	
Maternal age			0.35
< 35 years (N=16362)	5.1%	94.9%	
> 35 years (N=8253)	5.4%	94.62%	
Language			0.44
English (N=14023)	5.2%	94.8%	
Other (N=12736)	5.4%	94.6%	
Education			0.75
12 th grade education (N=17748)	5.3%	94.7%	
Some college or more (N=6583)	5.2%	94.8%	

TABLE 2

Adverse perinatal outcomes associated with gestational weight loss

Perinatal outcome	Weight loss N (%)	No weight loss N (%)	p-value
Total cesarean (N=9921)	467 (36.9%)	9454 (41.2%)	0.003
Primary cesarean (N=5033)	207 (17.0%)	4826 (21.2%)	<0.001
PTD < 37 weeks (N=2938)	151 (11.1%)	2787 (11.2%)	0.842
PTD < 34 weeks (N=616)	45 (3.3%)	571 (2.3%)	0.018
Birth weight > 4000g (N=3054)	108 (9.1%)	2946 (13.1%)	<0.001
LGA > 90%ile (N=4139)	148 (12.5%)	3991 (17.8%)	<0.001
SGA < 10%ile (N=1206)	89 (7.5%)	1117 (5.0%)	<0.001
NICU admission (N=1233)	59 (8.5%)	1174 (9.8%)	0.251
IUFD (N=135)	13 (0.97%)	122 (0.5%)	0.021
Antepartum admission (N=442)	24 (3.4%)	418 (3.6%)	0.784

(% is of women with or without weight loss, not of women with that outcome)

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TABLE 3

Multivariable analysis of adverse perinatal outcomes associated with gestational weight loss

Perinatal outcome	aOR	95% CI
Total cesarean	0.86	0.75–0.98
Primary cesarean	0.81	0.68–0.97
PTD < 37 weeks	1.09	0.90–1.32
PTD < 34 weeks	1.71	1.23–2.37
Birth weight > 4000g	0.66	0.53–0.83
LGA > 90%ile	0.63	0.52–0.77
SGA < 10%ile	1.69	1.32–2.17
NICU admission	0.51	0.27–0.95
IUFD	1.77	0.77–4.07
Antepartum admission	0.62	0.35–1.08

* Adjusted for maternal age, race/ethnicity, parity, education, primary language