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Interpregnancy Weight Gain and Cesarean Delivery Risk in Women With a History of Gestational Diabetes

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Abstract

Objective—Along with the rising prevalence of obesity, rates of gestational diabetes mellitus (GDM) and associated adverse outcomes have also increased. We conducted a population-based, retrospective cohort study to assess the association of weight gain between pregnancies with cesarean delivery for the subsequent pregnancy among women with a history of GDM.

Methods—Using linked birth certificate data for women with at least two singleton births in Washington State during 1992-2005, we identified 2,753 women with GDM who delivered vaginally at their baseline pregnancy (first pregnancy on record). The interpregnancy weight change (subsequent - baseline prepregnancy weight) for each woman was calculated and assigned to one of three categories: weight loss (>10 lbs), weight stable (±10 lbs), or weight gain (>10 lbs). Multiple logistic regression was used to calculate the risk (OR) of cesarean delivery at the subsequent pregnancy among the weight gain and weight loss groups relative to the weight-stable category.

Results—Among 2,581 eligible women, 10.9% lost more than10 lbs, 54.0% were weight-stable and 35.1% gained more than10 lbs between pregnancies. Women who gained more than 10 lbs had an adjusted OR for subsequent cesarean delivery of 1.70 (95% CI, 1.16-2.49; 9.7% of women who gained weight) while the adjusted OR for women who lost weight was 0.55 (95% CI, 0.28-1.10; 4.7% of women who lost weight).

Conclusion—Women with a history of GDM who gained greater than10 lbs between pregnancies were at increased risk of future cesarean delivery. Appropriate weight management among women with a history of GDM may result in decreased cesarean delivery rates along with associated excess risks and costs.

Précis—Women with a history of gestational diabetes mellitus who gain more than 10 lbs between pregnancies are at increased risk of future cesarean delivery.

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Introduction

Approximately 1.3 million newborns were delivered by cesarean section in 2005. The cesarean delivery rate has risen steadily over the past several decades from 5.5% in 1970 to 30.3% in 2005 (1), resulting in a $15-16 billion dollar increase in cost to the health care system (2). Cesarean delivery carries maternal and infant risks. Risks for the mother include a higher prevalence of placental abnormalities in subsequent pregnancies (3,4), inherent surgical risks (5-7), thromboembolic events (8,9), and maternal mortality (10). Fetal and infant risks associated with cesarean delivery include iatrogenic prematurity (11), birth trauma (12), and respiratory complications (13,14). Cesarean deliveries are performed for a variety of reasons ranging from maternal choice to clear medical indications necessary for ensuring optimal maternal and neonatal outcomes (2). Identification of women who are at increased risk for cesarean delivery and minimizing any modifiable risk factors they have becomes a very important step towards decreasing rates of cesarean delivery and ultimately improving maternal and outcomes.

Among those at higher risk for cesarean delivery are women with gestational diabetes mellitus (GDM) (15). GDM is defined as glucose intolerance with onset during pregnancy, and it complicates between 2-5% of all pregnancies (16). Obesity and weight gain are important and modifiable risk factors for GDM, and are also independently associated with increased rates of cesarean delivery (4). Complex physiologic processes underlying mechanisms of glucose intolerance create a metabolic environment that increases the propensity to further weight gain over time (17). Thus, a woman with a history of GDM is more likely to gain weight, and hence has the potential to be at even higher risk for cesarean delivery with her future pregnancies.

We therefore sought to estimate among women with GDM whether weight change between pregnancies (“interpregnancy” weight change) influences the risk of cesarean delivery in the subsequent pregnancy. We hypothesized that women who gained more weight (greater than 10 lbs) would be at greater risk than those who remained relatively weight-stable (± 10 lbs), while those who lost weight (greater than 10 lbs) might be at decreased risk.

Materials and Methods

We identified participants for this population-based, retrospective cohort study from the Washington state longitudinal births database, which is comprised of linked birth certificate data for all women with at least 2 singleton births in Washington State between 1992 and 2005. The Institutional Review Board of the Washington State Department of Health approved the use of these data for the current study. For our analysis, eligible subjects included women with two consecutive live births between 1992 and 2005, diagnosis of GDM at the baseline pregnancy, and vaginal delivery of a live infant during the baseline pregnancy. GDM diagnosis and vaginal delivery were identified by checkbox format and abstracted from the birth certificates. The diagnosis of GDM is typically made when an abnormal response to an oral glucose load is identified at a prenatal visit between 24 and 28 weeks of gestation. We cannot verify how the screening for and diagnosis of GDM were made, as specific practices were not documented. We excluded women with established diabetes at their baseline pregnancy and women whose baseline pregnancy did not result in a live singleton birth. We excluded women who had undergone cesarean delivery at their baseline pregnancy, although we could not exclude women who in theory may have had a cesarean delivery prior to 1992 or a cesarean delivery out-of-state prior to our baseline ascertainment. In addition, we excluded women with a medical indication for cesarean delivery during their subsequent pregnancy (genital herpes, non-vertex or breech presentations, placenta previa and abruptio placenta).

Our exposure of interest was interpregnancy weight change. The interpregnancy weight change for each woman was calculated (prepregnancy weight at subsequent pregnancy - prepregnancy weight at baseline pregnancy) and assigned to one of the following three categories: weight loss (greater than 10 lbs), weight stable (±10 lbs), or weight gain (greater than 10 lbs). Prepregnancy weight is typically the weight measured at the first prenatal visit. However, it is possible that for some women in our cohort prepregnancy weights were self-reported. The outcome of cesarean delivery for the subsequent birth was identified using the checkbox format on the birth certificate.

Using multiple logistic regression, we calculated the odds ratio (OR) and 95% confidence interval (CI) for cesarean delivery separately comparing the weight-loss and weight-gain groups to the weight-stable group (reference group). We identified important variables to adjust for in our analyses *a priori*, based on current evidence. Specifically, we included the following confounding variables in our regression analyses (for the subsequent birth unless otherwise noted): maternal age (<25, 25-34, ≥35 years), maternal race/ethnicity (White, Black, Hispanic, Asian or other), maternal education (<12, 12-15, ≥16 years), interbirth interval (<12, 12-35, ≥36 months), pre-pregnancy weight at the baseline pregnancy (<100, 100-149, 150-199, ≥200 lbs), weight gain during the baseline and subsequent pregnancy (loss, 0-14, 15-24, 25-34, ≥35 lbs), smoking during pregnancy (no/yes), and year of birth (subsequent infant).

We evaluated the dose-response relationship between interpregnancy weight gain tertiles on the risk of cesarean delivery. Finally, a sub-analysis was performed examining the effects of interpregnancy weight change using change in BMI between baseline pregnancy and subsequent pregnancy (prepregnancy BMI at subsequent pregnancy - prepregnancy BMI at baseline pregnancy) among the 83% of subjects for whom BMI data were available, as an additional means to explore our hypothesized associations between interpregnancy weight change and cesarean delivery. BMI categorization was based on a previous study by Villamor *et al* evaluating the relationship of interpregnancy BMI change with risk of adverse pregnancy outcomes in a large Swedish cohort (18). All statistical analyses were performed using Stata 10.0 (StataCorp LP, College Station, TX).

Results

From the 1992 to 2005 Washington state longitudinal birth records, 2753 women were identified with a GDM diagnosis and vaginal delivery at their baseline pregnancy. We excluded women with risk factors for cesarean delivery: genital herpes (n=81), non-vertex or breech presentations (n=78), placenta previa (n=3) and abruptio placenta (n=10) at their subsequent pregnancies. Among the eligible 2,581 women, 281 (10.9%) lost more than 10 lbs, 1,394 (54.0%) were weight stable (± 10 lbs), and 906 (35.1%) gained more than 10 lbs between their baseline and subsequent pregnancies. The average interpregnancy weight loss among the women in the weight-loss category was 27 ± 19 lbs. The average interpregnancy weight gain among women in the weight-gain category was 26 ± 17 lbs.

Women whose weight changed by more than 10 pounds between pregnancies tended to be younger than those whose weight remained stable (Table 1). Black and Hispanic women tended to gain greater than 10 lbs between their baseline and subsequent pregnancies compared to White and Asian women (42% and 41% vs. 35% and 23% within racial/ethnic groups, respectively). Although most women in our cohort were high school graduates, 19% of women who gained weight between pregnancies had less than a high school education compared to 12% of women who lost weight or 14% of women were weight stable. Women who gained weight between pregnancies were more likely to have an interbirth interval greater than three years relative to women who lost weight or were weight stable.

Interpregnancy weight change was significantly related to the prevalence of recurrent GDM. Among women who gained weight between pregnancies, 44% were diagnosed with GDM during their subsequent pregnancy compared with 31% of women who lost weight before their subsequent pregnancy and 37% who were weight stable. Women who were in the weight-gain group tended to gain greater amounts of weight (34 ± 15 lbs) during their baseline pregnancy compared to women in the weight-loss (22 ± 13 lbs) or weight-stable (27 ± 12 lbs) groups. In contrast, at the subsequent pregnancy, women in the weight-gain group gained less weight (23 ± 13 lbs) compared to women in the weight-loss (33 ± 16 lbs) or weight-stable (28 ± 13 lbs) groups. Women in the weight-gain group were also more likely to weigh over 200 lbs at their subsequent pregnancy (data not shown).

Approximately 5% of women who were weight stable or lost weight between pregnancies underwent cesarean delivery compared to 10% of women who gained weight (Table 2). Women who gained more than 10 lbs between pregnancies were twice as likely to undergo a cesarean delivery at their subsequent pregnancy (unadjusted OR = 1.92, 95% CI = 1.39-2.66 After adjusting for potential confounders, women who gained more than 10 lbs between pregnancies remained over 70% more likely to undergo a cesarean delivery at their subsequent pregnancy in comparison to weight-stable women (adjusted OR=1.70, 95% CI, 1.16-2.49; 9.7% of women who gained weight). Meanwhile, women who lost more than 10 lbs between pregnancies were not significantly more or less likely to undergo cesarean delivery compared to weight stable women (adjusted OR=0.55, 95% CI, 0.28-1.10; 4.7% of women who lost weight).We evaluated the dose-response relationship to further evaluate support for a potential causal relationship between interpregnancy weight gain in women with GDM and risk of cesarean delivery. We divided the weight-gain group into tertiles (gained 11-16 lbs, gained 17-27 lbs, gained >27 lbs.) to examine this relationship. Comparing each category of weight gain to the weight-stable group, there was a progressive increase in the estimated risk for cesarean delivery with increasing tertiles of weight gain (Table 3, *p trend* = 0.001).

Among the eligible 2581 women, BMI data were available during the first and subsequent pregnancy for 2147 women (83%), such that we could calculate the interpregnancy change in BMI. BMI data was missing for 434 women (17%) due to incomplete ascertainment of height. Women whose BMI increased ≥ 3 units between their first and subsequent pregnancy were at two-fold increased risk for cesarean delivery, although following adjustment, the odds ratio was slightly attenuated (adjusted OR=1.74, 95% CI, 1.04-2.91) (Table 4).

Discussion

GDM, obesity, and excessive weight gain, are all independent risk factors for cesarean delivery. Previous studies examined the relative impact of GDM, obesity, or weight change separately on the risk of cesarean delivery (15,16,19). However, we are not aware of any previous studies that have assessed interpregnancy weight gain on the risk of cesarean delivery in a subsequent pregnancy among women with a history of GDM, a population we hypothesized would be at particularly high risk. For women in our study who lost or maintained their weight between pregnancies, the prevalence of cesarean delivery for their subsequent pregnancy was approximately 5% while it was 10% among women who gained weight. Our estimates agree with the published values ranging from 5-10% when restricting to women without previous history of cesarean delivery and obesity related risk factors (15). We found that women with a history of GDM who gained more than 10 lbs between pregnancies had a 70% increased risk of cesarean delivery, after adjusting for confounding factors. Further, we found an elevated risk when the analysis was performed using BMI as a measure of body weight.. Villamor *et al.* demonstrated that increased interpregnancy BMI change resulted in increased risk of cesarean section and other adverse pregnancy outcomes in a large Swedish population-based study (18). These congruent results lend further support to the association of interpregnancy

weight gain and increased cesarean delivery rates for women with a history of GDM, however our BMI results should be interpreted with some caution given the high percentage of missing data.

Other investigators have demonstrated a relationship between prepregnancy weight and the risk of cesarean delivery. Women weighing 200-299 lbs and greater than 300 lbs had an increased odds of 1.89 (95% 1.81-1.97) and 2.59 (95% CI 2.13-3.15) of having a cesarean delivery compared to women weighing 150-199 lbs (20). Similarly, obesity (BMI ≥ 30 kg/m^2) increased the risk of cesarean delivery by 2.5-fold (95% CI 1.68 - 3.71) (15). Prepregnancy weight did not modify the relationship between interpregnancy weight gain and cesarean risk in our analysis (p=0.60). Our restricted patient population, women with previously diagnosed GDM, may explain these seemingly incongruent findings. Women with GDM are typically overweight or obese, thus it becomes difficult to determine the contribution of prepregnancy weight as an independent risk factor in this population.

Our findings should be considered in the context of several limitations. This is a retrospective cohort study, and so inferring a causal relationship is limited due to factors such as incomplete ascertainment, misclassification, and measurement error.. Birth certificate data have inherent limitations including missing information, misclassification of covariates, inaccurate determination of prepregnancy weight, and lack of information on how GDM is diagnosed. An important limitation lies in the classification of the exposure, interpregnancy weight change. The prepregnancy weight reported on the birth certificate is typically derived from the recorded weight at the first prenatal visit, but may also be self-reported. Women are known to underestimate their weight and women who are overweight underestimate their weight to a greater degree (22). This underestimation could result in differential misclassification if the effect was to minimize their weight so that their interpregnancy weight change decreased enough to categorize them as weight stable rather than as weight gainers. This would result in an attenuated OR of cesarean delivery. Weight gain is usually minimal during the first trimester, so a first trimester weight would be a reasonable estimate of the true prepregnancy weight. However, this would not be the case for a weight recorded after the first trimester. We evaluated this effect by excluding women whose first prenatal visit was after the first trimester in either pregnancy (n=793). The adjusted OR for women who gained more than 10 pounds was 2.28 (95% CI: 1.41-3.68). The adjusted OR for women who lost weight was 0.57 (95% CI: 0.24-1.35). Consistency between the results of this subanalysis and our overall results suggest that this is not an important source of bias. Finally, although others have found that race/ethnicity is an important factor modifying the relationship between obesity and cesarean delivery rates (19), we were unable to assess this relationship as Whites represented over 70% of subjects in our study.

Despite these limitations, we feel these data were adequate to evaluate the relationship between interpregnancy weight change and cesarean delivery in our population. Decreasing the rate of cesarean delivery is an important step towards decreasing morbidity and mortality for infants and mothers as well as decreasing healthcare costs. Obstetric and other medical providers should counsel women with GDM about not gaining excessive weight between pregnancies. Adding the prospect of future cesarean delivery to the other risks associated with GDM and weight gain will give women a very tangible reason to motivate their lifestyle change.

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References

1. Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, Kirmeyer S, Munson ML. Births: final data for 2005. Natl Vital Stat Rep 2007;56:1–103. [PubMed: 18277471]
2. Resnik R. Can a 29% cesarean delivery rate possibly be justified? Obstet Gynecol 2006;107:752–754. [PubMed: 16582108]
3. Getahun D, Oyelese Y, Salihu HM, Ananth CV. Previous cesarean delivery and risks of placenta previa and placental abruption. Obstet Gynecol 2006;107:771–778. [PubMed: 16582111]
4. Usta IM, Hobeika EM, Musa AA, Gabriel GE, Nassar AH. Placenta previa-accreta: risk factors and complications. Am J Obstet Gynecol 2005;193:1045–1049. [PubMed: 16157109]
5. Hawkins JL, Koonin LM, Palmer SK, Gibbs CP. Anesthesia-related deaths during obstetric delivery in the United States, 1979-1990. Anesthesiology 1997;86:277–284. [PubMed: 9054245]
6. Martens MG, Kolrud BL, Faro S, Maccato M, Hammill H. Development of wound infection or separation after cesarean delivery. Prospective evaluation of 2,431 cases. J Reprod Med 1995;40:171–175. [PubMed: 7776298]
7. Petitti DB. Maternal mortality and morbidity in cesarean section. Clin Obstet Gynecol 1985;28:763–769. [PubMed: 4075629]
8. Gherman RB, Goodwin TM, Leung B, Byrne JD, Hethumumi R, Montoro M. Incidence, clinical characteristics, and timing of objectively diagnosed venous thromboembolism during pregnancy. Obstet Gynecol 1999;94:730–734. [PubMed: 10546719]
9. Simpson EL, Lawrenson RA, Nightingale AL, Farmer RD. Venous thromboembolism in pregnancy and the puerperium: incidence and additional risk factors from a London perinatal database. Bjog 2001;108:56–60. [PubMed: 11213005]
10. Sachs BP, Yeh J, Acker D, Driscoll S, Brown DA, Jewett JF. Cesarean section-related maternal mortality in Massachusetts, 1954-1985. Obstet Gynecol 1988;71:385–388. [PubMed: 3347424]
11. Nielsen TF, Hokegard KH. Cesarean section and intraoperative surgical complications. Acta Obstet Gynecol Scand 1984;63:103–108. [PubMed: 6730921]
12. Dessole S, Cosmi E, Balata A, Uras L, Caserta D, Capobianco G, Ambrosini G. Accidental fetal lacerations during cesarean delivery: experience in an Italian level III university hospital. Am J Obstet Gynecol 2004;191:1673–1677. [PubMed: 15547541]
13. Gerten KA, Coonrod DV, Bay RC, Chambliss LR. Cesarean delivery and respiratory distress syndrome: does labor make a difference? Am J Obstet Gynecol 2005;193:1061–1064. [PubMed: 16157112]
14. Levine EM, Ghai V, Barton JJ, Strom CM. Mode of delivery and risk of respiratory diseases in newborns. Obstet Gynecol 2001;97:439–442. [PubMed: 11239653]
15. Ehrenberg HM, Durnwald CP, Catalano P, Mercer BM. The influence of obesity and diabetes on the risk of cesarean delivery. Am J Obstet Gynecol 2004;191:969–974. [PubMed: 15467574]
16. Metzger BE. Summary and recommendations of the Third International Workshop-Conference on Gestational Diabetes Mellitus. Diabetes 1991;40(Suppl 2):197–201. [PubMed: 1748259]
17. Schwartz MW, Woods SC, Porte D Jr. Seeley RJ, Baskin DG. Central nervous system control of food intake. Nature 2000;404:661–671. [PubMed: 10766253]
18. Villamor E, Cnattingius S. Interpregnancy weight change and risk of adverse pregnancy outcomes: a population-based study. Lancet 2006;368:1164–1170. [PubMed: 17011943]
19. Ramos GA, Caughey AB. The interrelationship between ethnicity and obesity on obstetric outcomes. Am J Obstet Gynecol 2005;193:1089–1093. [PubMed: 16157117]
20. Rosenberg TJ, Garbers S, Lipkind H, Chiasson MA. Maternal obesity and diabetes as risk factors for adverse pregnancy outcomes: differences among 4 racial/ethnic groups. Am J Public Health 2005;95:1545–1551. [PubMed: 16118366]

TABLE 1

Characteristics of women from the Washington State longitudinal birth records (1992-2005) at the subsequent pregnancy (unless otherwise noted) presented by categories of interpregnancy weight change. Women had gestational diabetes and underwent a vaginal delivery at their baseline pregnancy

	Weight loss (Greater than 10 lbs) n=281		Stable (±10 lbs) n=1394		Weight gain (Greater than 10 lbs) n=906	
	n	%	n	%	n	%
Demographics and lifestyle						
Age (years)						
Less than 25	55	19.6	166	11.9	197	21.7
25 to 34	162	57.7	867	62.2	520	57.4
Greater than 34	64	22.8	361	25.9	189	20.9
Race/Ethnicity						
White	215	76.5	972	69.8	638	70.5
Black	6	2.1	27	1.9	34	3.8
Hispanic	23	8.2	170	12.2	136	15.0
Asian	26	9.3	197	14.1	68	7.5
Other	11	3.9	27	1.9	29	3.2
Maternal Education (years)						
Less than 12	33	12.0	186	14.0	165	18.8
12-15	164	59.9	722	54.4	550	62.5
Greater than 15	77	28.1	419	31.6	165	18.8
Smoking						
No	233	83.2	1,244	90.1	781	87.2
Yes	47	16.8	137	9.9	115	12.8
Diabetes						
None	173	62.2	826	60.0	460	51.4
Established	18	6.5	45	3.3	38	4.3
Gestational	87	31.3	505	36.7	397	44.4
Obstetric or medical						
Birth Year						

	Weight loss (Greater than 10 lbs) n=281		Stable (±10 lbs) n=1394		Weight gain (Greater than 10 lbs) n=906	
	n	%	n	%	n	%
1993-1999	92	32.7	632	45.3	343	37.9
2000-2005	189	67.3	762	54.7	563	62.1
Parity						
0	6	2.2	12	0.9	6	0.7
1	171	61.5	935	67.1	629	69.6
More than 1	101	36.3	446	32.0	269	29.8
Interbirth Interval (months)						
Less than 12	7	2.5	9	0.7	19	2.1
12 to 35	188	66.9	909	65.2	443	48.9
Greater than 35	86	30.6	476	34.2	444	49.0
Prepregnancy weight at baseline pregnancy (lbs)						
Less than 100	0	0.0	32	2.3	14	1.6
100 to 149	62	22.1	786	56.4	411	45.4
150 to 199	126	44.8	434	31.1	350	38.6
Greater than 200	93	33.1	142	10.2	131	14.5
Weight gain during baseline pregnancy (lbs)						
Loss	8	3.0	6	0.4	4	0.5
0 to 14	65	24.1	181	13.3	69	7.8
15 to 24	86	31.9	388	28.6	150	16.9
25 to 34	62	23.0	455	33.5	262	29.5
Greater than 34	49	18.2	329	24.2	404	45.4
Weight gain during subsequent pregnancy (lbs)						
Loss	2	0.7	4	0.3	10	1.2
0 to 14	23	8.3	166	12.2	210	24.2
15 to 24	51	18.5	382	28.1	252	29.0
25 to 34	85	30.8	427	31.4	243	28.0
Greater than 34	115	41.7	381	28.0	154	17.7

Numbers may not add up to total due to missing values. Significant differences were noted in all characteristics among interpregnancy weight change groups as determined by chi-squared tests ($P < 0.005$).

TABLE 2

Effect of interpregnancy weight change on the risk of cesarean delivery during the subsequent pregnancy among women with gestational diabetes and vaginal delivery at their baseline pregnancy

	Number of Deliveries			Odds Ratios of Cesarean Delivery at Subsequent Birth			
Interpregnancy weight change[1]	**Total**	**Vaginal (%)**	**Cesarean (%)**	**OR**[2]	**95% CI**	**Adjusted OR**[3,4,5]	**95% CI**
Weight stable	1,394	94.8	5.2	1.0		1.0	
Weight loss	281	94.3	5.7	1.09	0.63-1.91	0.55	0.28-1.10
Weight gain	906	90.4	9.6	1.92	1.39-2.66	1.70	1.16-2.49

[1] Groups: weight stable (± 10 lbs), weight loss (greater than 10 lbs) and weight gain (greater than 10 lbs)

[2] Unadjusted

[3] Adjusted for mother's age, mother's education, mother's race/ethnicity, mother's smoking during the subsequent pregnancy, pre-pregnancy weight of the baseline pregnancy, weight gain during the baseline and subsequent pregnancy, interbirth interval, year of birth (subsequent pregnancy)

[4] Missing data for 155weight stable women, 27 weight loss women, and 95 weight gain women

[5] Percentage of those who had a subsequent cesarean delivery: 5.3% of women who were weight-stable, 4.7% of women who lost weight, and 9.7% of women who gained weight

TABLE 3

Dose-response effect of interpregnancy weight gain among women with gestational diabetes who gained more than 10 pounds on the risk of cesarean delivery during the subsequent pregnancy

	Number of Deliveries			Odds Ratios of Cesarean Delivery at Subsequent Birth			
Weight Gain (lbs)	**Total**	**Vaginal (%)**	**Cesarean (%)**	**OR[1]**	**95% CI**	**Adjusted OR[2,3]**	**95% CI**
Weight stable (±10)	1394	94.8	5.2	1.0		1.0	
11-16	278	92.4	7.6	1.48	0.89-2.45	1.48	0.86-2.52
17-27	325	90.5	9.5	1.91	1.23-2.96	1.76	1.06-2.93
Greater than 27	303	88.4	11.6	2.36	1.55-3.61	2.36	1.37-4.06

[1] Unadjusted

[2] Adjusted for mother's age, mother's education, mother's race/ethnicity, mother's smoking during the subsequent pregnancy, pre-pregnancy weight of the baseline pregnancy, weight gain during the baseline and subsequent pregnancy, interbirth interval, year of birth (subsequent pregnancy)

[3] P = 0.001 for test for trend by multivariate logistic regression in which the main exposure, weight gain, was categorized as an ordinal variable. p=0.004 for test for trend by multivariate logistic regression in which the main exposure, weight gain, was categorized as a continuous variable.

TABLE 4

Effect of interpregnancy BMI change on the risk of cesarean delivery during the subsequent pregnancy among women with gestational diabetes and vaginal delivery in their baseline pregnancy

	Number of Deliveries			Odds Ratios of Cesarean Delivery at Subsequent Birth			
BMI Change (kg/m^2)[1]	**Total**	**Vaginal (%)**	**Cesarean (%)**	**OR[2]**	**95% CI**	**Adjusted OR[3]**	**95% CI**
Less than -1	386	95.6	4.4	0.86	0.48-1.54	0.55	0.27-1.15
-1 to 0.9	726	94.9	5.1	1.0		1.0	
1 to 1.9	287	93.4	6.6	1.32	0.75-2.34	1.35	0.74-2.46
2 to 2.9	222	92.8	7.2	1.45	0.79-2.65	1.28	0.67-2.43
Greater than 3	526	89.7	10.3	2.13	1.38-3.29	1.74	1.04-2.91

[1] Missing BMI data for 434 (17%) women

[2] Unadjusted

[3] Adjusted for mother's age, mother's education, mother's race/ethnicity, mother's smoking during the subsequent pregnancy, pre-pregnancy weight of the baseline pregnancy, BMI gain during the baseline and subsequent pregnancy, interbirth interval, year of birth (subsequent pregnancy)