HHS Public Access

Author manuscript

Obesity (Silver Spring). Author manuscript; available in PMC 2018 May 16.

Published in final edited form as:

Obesity (Silver Spring). 2018 January ; 26(1): 185–192. doi:10.1002/oby.22048.

Prepregnancy Body Mass Index, Gestational Weight Gain, and Odds of Cesarean Delivery in Hispanic Women

Megan W. Harvey[1], **Barry Braun**[2], **Karen A. Ertel**[1], **Penelope S. Pekow**[1], **Glenn Markenson**[3], and **Lisa Chasan-Taber**[1]

[1]Department of Biostatistics & Epidemiology, University of Massachusetts Amherst, Amherst, MA, USA

[2]Department of Health & Exercise Science, Colorado State University, Fort Collins, CO, USA

[3]Boston University School of Medicine, Boston Medical Center, Boston, MA

Abstract

Objective—To evaluate the association between prepregnancy body mass index (BMI), gestational weight gain (GWG), and cesarean delivery in Hispanics.

Methods—We examined these associations among 1,215 participants in Proyecto Buena Salud, a prospective cohort conducted from 2006–2011 among Hispanic women. Prepregnancy BMI, GWG, and mode of delivery were abstracted from medical records.

Results—A quarter of participants entered pregnancy with obesity, 23% delivered via cesarean, and 52% exceeded Institute of Medicine guidelines for GWG. After adjusting for age, women who were obese had 2.03 times the odds of cesarean delivery compared to women with normal BMI (95% confidence interval [CI] 1.46–2.82); findings remained significant after adjusting for GWG. Women with excessive total GWG had 1.49 times the odds of cesarean delivery (95% CI 1.06–2.10) compared to women who gained within guidelines. Excessive rate of 3rd trimester GWG (standard deviation [SD] change in GWG/week) increased odds of cesarean delivery (OR=1.66, 95% CI 1.05–2.62), while excessive rate of 1st and 2nd trimester GWG were not associated with increased odds.

Conclusions—Obesity prior to pregnancy was associated with an increased odds of cesarean delivery among Hispanics. Excessive GWG across pregnancy and excessive rate of 3rd trimester GWG were also associated with increased odds.

Keywords

weight; weight gain; Hispanic; pregnancy

Corresponding Author and Reprint Requests: Dr. Lisa Chasan-Taber, Department of Biostatistics & Epidemiology, School of Public Health and Health Sciences, 401 Arnold House, University of Massachusetts, 715 North Pleasant Street, Amherst, MA 01003-9304. Tel: 413 545-1664, Fax: 413 545-1645, lct@schoolph.umass.edu.

Disclosure: The authors declare no conflict of interest.

Introduction

Cesarean deliveries are associated with increased risk of maternal and fetal morbidity and mortality compared to vaginal deliveries (1,2). Infants born via cesarean are at increased risk for neonatal respiratory morbidity and hypoglycemia (2,3). Women who have had a previous cesarean are more likely to deliver subsequent pregnancies via cesarean (4).

While rates of cesarean delivery in the U.S. increased from 22.3% to over 32% in the past 15 years, they have recently stabilized among non-Hispanic black and white women at approximately 32.2% (5,6). Among Hispanics, rates vary substantially by Hispanic subgroup with women of Puerto Rican and Dominican descent having 1.3 times the rate of cesarean delivery as compared to non-Hispanic whites, while Mexican Americans have 1.15 times the rate (7). Among Hispanic women, Puerto Rican women are one of the only subgroups with increasing, rather than decreasing, rates of cesarean (5). This is important as Hispanics are the largest minority group in the U.S., with the highest birth rates of any minority group (8,9). Puerto Ricans are the second largest Hispanic subgroup in the U.S. (10,11) and the predominant subgroup in the Northeast (12).

Women who are overweight/obese may experience increased risk of cesarean delivery as a consequence of excess pelvic soft tissue which can lead to a relative obstruction of the birth canal. In addition, decreased rates of cervical dilation after labor has begun and subsequent increased rate of inductions (“failure to progress”) after labor has started have been observed among women who are obese, thereby also increasing their risk of cesarean delivery (13). Hispanic women are more likely to begin their pregnancies with overweight or obesity compared to non-Hispanic white women with almost half entering pregnancy in these categories (14,15). The number of Hispanic women with both elevated BMI and excessive GWG has been increasing over time (16).

Prior studies have tended to observe that prepregnancy overweight and obesity increase the risk of cesarean delivery (14). These obesity-related risks may vary by race/ethnicity, with Hispanic and black women who are obese being more likely to have adverse outcomes than white women who are obese (17–19). In one of the few studies to examine racial/ethnic differences, Steinfeld et al. found that Hispanic gravidas who were obese were significantly more likely to deliver by cesarean than non-Hispanic whites who were obese (25.7% vs. 4.2%, p=0.03) (17). However, a meta-analysis of cohort studies found no differences in the association across ethnic groups, although data was not presented for Hispanics (20). Indeed, to our knowledge, no prior studies of prepregnancy BMI and cesarean delivery have focused on a Hispanic-only population. In addition, prior studies often used nonstandard BMI categorizations (20) and did not exclude women with chronic diseases or preexisting conditions (21).

The role of gestational weight gain (GWG) in cesarean delivery remains less clear. Excessive GWG may contribute to risk of cesarean delivery via an increase in child birthweight, macrosomia, and an increased rate of preeclampsia independent of prepregnancy body mass index (BMI) (13). Prior studies have not typically considered trimester-specific measures of GWG (e.g., rate of GWG in the 1st, 2nd, and 3rd trimesters).

This is important as weight gained during specific trimesters and the rate of such gain may have distinct and independent associations with cesarean delivery. In addition, older studies did not rely upon the most recent Institute of Medicine (IOM) guidelines for GWG (14). Finally, the majority of prior studies did not include Hispanic women.

In light of the elevated risks for obesity, GWG, and cesarean delivery among women of Puerto Rican ethnicity, we chose to evaluate these associations among participants in Proyecto Buena Salud, a study of Hispanic women of Puerto Rican and Dominican descent. We hypothesized that: 1) higher prepregnancy BMI, 2) exceeding IOM guidelines for GWG and 3) excessive rate of GWG in the 1st, 2nd, and 3rd trimesters would lead to an increased odds of cesarean delivery at term.

Methods

Study Design

Proyecto Buena Salud was a prospective cohort study of Hispanic prenatal care patients in Western Massachusetts conducted from January 2006 through October 2011 (22). Bilingual interviewers recruited patients at a prenatal care visit prior to 18 weeks gestation. Women were informed of the aims and procedures of the study and provided written informed consent approved by the Institutional Review Boards of the University of Massachusetts Amherst and Baystate Medical Center. The study consisted of interviews in early, mid, and late pregnancy in Spanish or English (telephone or in person) involving interviewer-administration of semi-quantitative questionnaires. After delivery, medical records were abstracted for clinical characteristics of the pregnancy and medical history.

Women were eligible if they were of Puerto Rican or Dominican heritage: born in the Caribbean Islands, had a parent born or two grandparents born in the Caribbean Islands. Exclusion criteria included 1) taking medications which adversely influence glucose tolerance, 2) multiple gestation (e.g., twins or triplets), 3) pre-conception history of diabetes, hypertension, heart disease or chronic renal disease and 4) <16 or >40 years of age. For the purpose of the current analysis, women were excluded if information on GWG was missing, or if they had a spontaneous or therapeutic abortion, a stillbirth, a preterm birth (<37 weeks gestation) or a late term birth (>42 wks gestation), as their GWG and mode of delivery would likely not be comparable to women who delivered a live infant at term.

Prepregnancy BMI

Prepregnancy BMI was categorized according to National Institutes of Health guidelines (23). A clinical weight was recorded at each prenatal care visit and at delivery. Prepregnancy weight was either self-reported to the interviewer at the time of recruitment (85.0%) or self-reported to the practitioner at the first prenatal care visit (mean = 12.5 [SD = 3.2] weeks gestation) and recorded in the medical record (13.0%). If prepregnancy weight was not available from either source, it was based upon measured weight at the first prenatal care visit (1.6%) or from a prepregnancy clinical visit (0.4%). The validity of self-reported prepregnancy weight is high, particularly if collected in early pregnancy (24). A recent study found a strong correlation (r=0.95, p = 0.0001) between self-reported prepregnancy weight

and physician measured weight with a mean discrepancy of 0.5 ± 3.0 kg and no significant ($P = 0.64$) differences between women who were normal weight vs. overweight/obese (25).

Gestational Weight Gain

Total GWG was calculated by subtracting prepregnancy weight from weight at delivery and evaluated continuously, and categorized as 'inadequate', 'within guidelines', or 'excessive' based on the IOM's 2009 prepregnancy BMI-specific GWG guidelines (14). GWG in the first trimester was calculated by subtracting prepregnancy weight from weight measured at the prenatal care visit closest to 13 weeks gestation (mean=13.0 weeks gestation, SD=1.3). Rate of GWG in each trimester was calculated by dividing GWG during each trimester by the corresponding number of gestational weeks. We evaluated the impact of a one pound change in rate of GWG as well as a one standard deviation change in rate of GWG. Rate of GWG was also categorized as 'inadequate', or 'within guidelines', or 'excessive' based on IOM guidelines (14).

In the case of missing weight values at trimester cutpoints, linear interpolation was used in the manner of Herring et al. (26) to calculate missing values. Linear interpolation is a method of imputing values within a range of values in a time series (27). Given that each participant has multiple values of measured weights over their pregnancy, and that weight gain is assumed to be linear for most of pregnancy gain (1), linear interpolation is considered an acceptable method of imputing missing weight at a specific time point within this time series (26).

Mode of Delivery

Mode of delivery was analyzed as a dichotomous variable (i.e., vaginal or cesarean). For multiparous women, mode of delivery is highly correlated with prior mode of delivery; about 90% of women who delivered via cesarean will have a planned ("scheduled") cesarean delivery for subsequent pregnancies (28). Furthermore, the risk profile of planned cesareans is different than unplanned cesarean deliveries that occur after an unsuccessful labor. Therefore, we abstracted information regarding the presence of labor during delivery from medical records as a proxy for planned vs. unplanned cesareans as have others (1,29).

Covariates

Interviewers collected sociodemographic factors, smoking and alcohol consumption during early pregnancy, generation in the U.S., and acculturation (measured via the Psychological Acculturation Scale) (30). Physical activity (MET hrs/week) was measured via the Pregnancy Physical Activity Questionnaire (31) at early, mid- and late pregnancy. Total energy intake was measured during mid-pregnancy via two 24-hour diet recalls. Nutrient intakes were assessed in the University of Minnesota Nutrition Data System by linking the food data file to the Minnesota Nutrient Data file (32). Total energy intake was calculated directly by summing kilocalories from each food reported as consumed based on its portion size. Gravidity, parity, age, infant birth weight, gestational age at delivery, presence of labor, and history of macrosomia were abstracted from medical records.

Statistical Analyses

The distribution of participant characteristics according to mode of delivery was computed using chi-square tests and Fisher's exact tests. Unadjusted and multivariable logistic regressions were used to evaluate the association between GWG, prepregnancy BMI, and the odds of cesarean delivery. We assessed the linearity of each continuous GWG variable before including them in the models (33). Rate of GWG in the first, second, and third trimester met the criteria for linearity and therefore were included in models as continuous variables.

A priori we chose to include age in our multivariable models with prepregnancy BMI as the primary exposure variable. We also included covariates in the final model if they changed the estimate for the primary exposure by 10% or more (34). Based upon this method, no additional covariates were included in our BMI models. We then repeated the analysis adjusting for GWG to estimate the independent effect of prepregnancy BMI over and above weight gain. Covariates were included in the final model with a missing indicator level, so no participants were excluded due to missing covariate data.

We followed a similar model building approach for our multivariable models with GWG as the primary exposure variable, *a priori* including age and prepregnancy-BMI. Then, using the change-in-estimate approach, physical activity in mid/late pregnancy, number of children in the household, and generation in the U.S. met the criteria for inclusion.

We then evaluated whether the association between GWG and cesarean delivery differed according to BMI and parity (i.e., multiplicative interaction) by including an interaction term in the models and assessing its statistical significance. We also evaluated the presence of additive interaction using the technique for logistic regression models by Kalilani et al. (35).

We conducted several sensitivity analyses. First we restricted the analysis of first trimester GWG and cesarean delivery to women with a weight gain measure within one week of the 13-week cutpoint. We also repeated the GWG and cesarean delivery analyses excluding women who developed gestational diabetes mellitus (GDM) and preeclampsia, both of which can impact GWG and cesarean delivery. Finally, we repeated the analyses only among women who labored before their cesarean (as a proxy for an unplanned cesarean delivery). Analyses were performed using SAS software, Version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

A total of 1,583 participants were recruited. We excluded 211 women who did not deliver at Baystate, 18 women missing GWG, 15 women who had a stillbirth, 123 women who had a preterm birth, and 1 woman who had a late term birth, for a final sample of 1,215 Hispanic women.

Nearly three-quarters of the women had a vaginal delivery (n=937, 77%). Of the 23% of women who delivered via cesarean (n=278), 61% (n=169) labored before the delivery. The majority of participants were young and unmarried. Most reported low levels of

acculturation, with 46% being born in Puerto Rico or the Dominican Republic. Cesarean delivery was more common among older women and those who were obese ($p<0.001$) (Table 1).

Nearly half of women (48%) were overweight or obese before pregnancy while 6% were underweight (Table 2). Average total GWG was 31.1 lbs. (SD=16.1) and 52% had excessive GWG, while 19% gained less than recommended. More than half of women exceeded the recommended rate of GWG in the first, second, and third trimesters (Table 2). The correlation between the 1st and 2nd trimester GWG was 0.23 ($p<0.001$), between the 2nd and 3rd trimester was 0.48 ($p<0.001$), and between the 1st and 3rd trimester was 0.08 ($p=0.005$).

We first examined the association between prepregnancy BMI and the odds of cesarean delivery (Table 3). In age-adjusted analyses, each kg/m^2 increase in prepregnancy BMI was associated with an increased odds of cesarean delivery (RR=1.06, 95% CI 1.04 – 1.08). After adjusting for total GWG, findings were virtually unchanged. In age-adjusted analyses, women who were obese prior to pregnancy had 2.03 increased odds of cesarean delivery compared to women with normal prepregnancy BMI (95% CI 1.46–2.82). These odds increased to 2.46 (95% CI 1.72–3.51) after adjustment for GWG (Table 3).

We then examined the association between GWG and the odds of cesarean delivery (Table 4). Women with excessive total GWG had a 46% increased odds of cesarean delivery, compared to women gaining within guidelines (95% CI 1.04–2.05). This increase in odds remained after adjusting for prepregnancy BMI, physical activity in mid/late pregnancy, number of children in the household, and generation in the US (OR=1.49, 95% CI 1.06–2.10).

We then examined the association between rate of GWG in each trimester of pregnancy (SD change in GWG/week) and odds of cesarean delivery (Table 4). In fully adjusted models, rate of GWG in the 1st trimester (OR=1.13, 95% CI 0.98–1.31), and rate of GWG in the 2nd trimester (OR=1.08, 95% CI 0.94–1.25) were not significantly associated with odds of cesarean delivery. However, rate of GWG in the 3rd trimester was associated with a 24% increased odds of cesarean delivery (95% CI 1.06–1.44) (Table 4). Similarly, exceeding IOM recommendations for rate of GWG in the 1st and 2nd trimesters was not associated with odds of cesarean delivery, while excessive rate of GWG in the 3rd trimester was associated with a 66% increased odds (95% CI 1.05–2.62).

We found no presence of multiplicative or additive interaction for the association between GWG and cesarean delivery according to prepregnancy BMI or parity. After restricting the analysis of first trimester GWG and cesarean delivery to women with a visit within one week of the 13-week cutpoint, findings were essentially unchanged. Similarly, there were no substantive changes to our results when women with preeclampsia (n=22) and GDM (n=49) were excluded. Finally, findings were unchanged when the sample was restricted to women who went into labor before cesarean delivery.

Discussion

In summary, in this prospective cohort of Hispanic women, after adjusting for important risk factors, we found that excessive total GWG and excessive rate of GWG in the 3rd trimester were associated with increased odds of cesarean delivery. After adjusting for age, women who were obese before pregnancy had a two-fold increased odds of cesarean delivery compared to women who were normal weight. These findings were strengthened after additional adjustment for GWG indicating that GWG was masking some of the impact of BMI on cesarean delivery.

Our finding that excessive total GWG was associated with increased odds of cesarean delivery is consistent with prior research. A retrospective cohort by Yee et al. (36) among 2,310 women including a significant proportion of Mexican-American women, found that excessive total GWG according to 2009 IOM guidelines was associated with a 47% increased odds of cesarean delivery (95% CI 1.03–2.10) (36). In a retrospective cohort study in California (10% Latina), Stotland et al. found that excessive total GWG was associated with a 40% increased odds (95% CI 1.22–1.59) (37). Similarly, we found that excessive total GWG was associated with a 49% increased odds of cesarean delivery (95% CI 1.06–2.10).

Only two prior studies, to our knowledge, examined the association between rate of GWG in each trimester independently and risk of cesarean delivery. In a population-based prospective cohort study of 6,959 women in the Netherlands, Gaillard et al. found that 1st trimester rate of GWG (SD change in GWG/week) was associated with a 1.19 odds of cesarean delivery (95% CI 1.10–1.29) (38). Rate of 2nd (OR= 1.05, 95% CI 0.96–1.15) and 3rd trimester (OR=1.00, 95% CI 0.90–1.20) GWG were not associated with cesarean delivery. In a retrospective cohort study among American Samoan women, Hawley et al. found that GWG in the 2nd trimester (SD change in GWG z-score) was associated with a 1.40 odds of cesarean delivery (95% CI: 1.08, 1.83) while GWG in the 3rd trimester was not (39). In the current study, we found that 3rd trimester rate of GWG was significantly associated with cesarean delivery (OR= 1.24, 95% CI 1.06–1.44). Differences in findings may be due to differences in the study populations; in addition 53% of women in the Gaillard study were missing information on first trimester weight gain and the Hawley study lacked a measure of prepregnancy weight. Conflicting findings highlight the fact that this is an area that needs more exploration to be clinically meaningful.

In a retrospective cohort study in New York State (40), Durie et al. found that women (<7% Hispanic) with an excessive rate of GWG in the 2nd/3rd trimesters had odds ratios ranging from 1.38 (95% CI 1.26–1.51) for women with normal BMI to 1.45 (95% CI 1.23–1.71) for women who were overweight. We similarly found that excessive 3rd trimester rate of GWG was associated with an increased odds of cesarean delivery (OR=1.66, 95% CI 1.05–2.62), while excessive 2nd trimester rate of GWG was not significantly associated (OR=1.28, 95% CI 0.83–1.99).

Our findings that women who were obese had increased odds of cesarean delivery are consistent with the prior literature which has focused on non-Hispanic white populations. A meta-analysis calculated pooled odds ratios (n=11 studies) for cesarean delivery of 1.53

(95% CI 1.48, 1.58) in women who were overweight and 2.26 (95% CI 2.04, 2.51) in women who were obese (20). Similarly, we found that overweight and women who were obese had statistically significant increased odds of cesarean delivery of 2.03 and 2.46, respectively.

Our study faced several limitations. First, we were unable to adjust for confounding by history of cesarean delivery which is positively associated with subsequent cesarean and may be positively associated with GWG (14). However, if GWG was an indication for the prior cesarean, then adjusting for previous cesarean could lead to over adjustment. To address this concern, we repeated our analysis among nulliparous women only; findings were unchanged.

Mid/late pregnancy physical activity was identified as a potential confounder but serves, in part, as a marker of activity prior to pregnancy with correlations of 0.46 ($p<0.001$). Therefore, the adjusted model indicates the indirect impact of GWG on cesarean delivery above and beyond the impact of physical activity.

We relied primarily upon self-reported prepregnancy weight as recorded by health professionals. A clinically measured weight has the benefit of being more objective than self-reported weight. However, self-reported prepregnancy weight is commonly used in epidemiologic studies because preconception weight measures typically do not exist in medical record data and the IOM presents it as a practical method for this purpose (14).

We did not have information on indication for cesarean. A recent study noted that Hispanic women were at significantly higher odds of cesarean delivery for failure to progress, and at lower odds of cesarean for malpresentation, as compared to non-Hispanic white women (41). To the extent that these factors were also associated with GWG, this may have led to confounding. Lastly, there were too few women with forceps delivery and vacuum extraction delivery to evaluate the association between GWG and operative vaginal delivery.

The biological mechanism linking GWG to mode of delivery may not vary by racial/ethnic group, but racial/ethnic differences exist in indications for cesarean delivery (41), and healthcare utilization and access also vary by racial/ethnic group. Therefore our findings may be generalized to pregnant women from Puerto Rico and the Dominican Republic, but care should be taken in generalizing to other Hispanic subgroups or non-Hispanic populations.

Conclusion

In summary, we found that obesity prior to pregnancy, excessive total GWG, and excessive 3rd trimester rate of GWG were associated with an increased odds of cesarean delivery. These findings in a population of Hispanic women are consistent with those observed in primarily non-Hispanic white and Black populations. Our results indicate that intervention efforts to reduce the odds of cesarean delivery should focus on helping women enter pregnancy with a normal BMI, and avoid exceeding IOM guidelines for GWG. A healthy rate of weight gain during pregnancy may be critical to avoiding cesarean delivery and suggests a target for a public health intervention studies. Such interventions should be

culturally specific and ideally begin early in pregnancy to avoid entrenched behaviors in late pregnancy. For example, given observed correlations between prepregnancy physical activity and mid/late pregnancy, such interventions could focus on early pregnancy lifestyle behaviors. Future studies should also evaluate the trimester-specific effects of GWG on cesarean delivery and focus on the understudied, high risk, Hispanic population.

Acknowledgments

Funding: This research was funded through National Institutes of Health grant R01 DK064902.

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What is already known about this subject?

- Rates of cesarean delivery in the United States have continued to increase among Hispanics, the largest minority group in the U.S., with the highest birth rates.
- Hispanic women are more likely to begin their pregnancies with overweight or obesity and to exceed gestational weight gain guidelines compared to non-Hispanic white women.
- Prior studies have suggested positive associations between prepregnancy body mass index, gestational weight gain, and the odds of cesarean delivery but the majority did not include Hispanic women.

What does your study add?

- This study extends prior research findings to the Hispanic population.
- Obesity prior to pregnancy was associated with an increased odds of cesarean delivery among Hispanics.
- Excessive total GWG and excessive rate of GWG in the 3rd trimester were associated with increased odds of cesarean delivery.

Table 1

Participant characteristics according to mode of delivery: Proyecto Buena Salud, 2006–2011.

	Total Sample[a] (n=1215)		Vaginal (n=937)	Cesarean (n=278)	
	n	%	%	%	*p* value
Demographics					
Age (years)					<0.001
16–19	370	30.5	33.4	20.6	
20–24	488	40.2	41.5	36.1	
25–29	212	17.5	15.9	22.7	
≥30	143	11.8	9.2	20.6	
Marital Status					0.947
Single/Separated/Divorced/Widowed	954	87.5	87.6	87.4	
Married	112	10.3	10.3	10.3	
Refused	24	2.2	2.2	2.4	
Education					0.487
less than high school	528	48.0	48.3	47.0	
high school graduate or GED	361	32.8	33.3	31.2	
post high school	211	19.2	18.4	21.7	
Number of Adults in Household[b]					0.228
1	288	26.4	25.8	28.6	
2	524	48.1	47.5	50.0	
≥3	278	25.5	26.7	21.4	
Number of Children in Household					0.974
0	209	19.5	19.4	19.8	
1	391	36.4	36.4	36.7	
2	263	24.5	24.4	25.0	
≥3	210	19.6	19.9	18.6	
Acculturation[c]					0.126
low (1–<3)	822	78.7	79.8	75.2	
high (>3)	222	21.3	20.2	24.8	

	Total Sample[a] (n=1215)		Vaginal (n=937)	Cesarean (n=278)	
	n	%	%	%	*p* value
Generation in US					0.139
born in PR/DR	544	46.3	45.7	48.5	
parent born in PR/DR	561	47.7	47.7	48.1	
grandparent born in PR/DR	70	6.0	6.7	3.4	
Behavioral Characteristics					
Smoking During Early Pregnancy					0.887
None	667	86.5	86.6	86.2	
≤10 cigs/day	93	12.1	12.1	12.1	
≥10 cigs/day	11	1.4	1.3	1.7	
Physical Activity, mid/late pregnancy					0.155
low (10.0 – 119.7 METS/wk)	329	33.3	32.1	37.2	
medium (119.8 – 191.5 METS/wk)	330	33.4	34.9	28.3	
high (191.6–1143.3 METS/wk)	330	33.4	33.0	34.5	
Characteristics of Pregnancy					
Infant Birth Weight (grams)					0.033
Mean (SD)	1203		3291.6 (421.7)	3358.3 (554.4)	
Gesational Age of Infant at Delivery (weeks)					0.033
Mean (SD)	1214		39.6 (1.3)	39.4 (1.5)	
Medical History					
Prepregnancy Body Mass Index (kg/m^2)					<0.001
<18.5	71	5.9	6.7	3.3	
18.5–<25	555	45.9	48.6	36.8	
25–<30	283	23.4	23.6	22.7	
≥30	301	24.9	21.2	37.2	
Parity					0.600
0 live births	501	41.3	42.1	38.8	
1 live birth	367	30.3	30.0	31.2	
≥2 live births	344	28.4	27.9	30.1	

[a] N may not total to 1215 due to missing data.

[b] Including the participant as appropriate: if<18 years, included as a child; if>18 years, included as an adult.

[c] Acculturation is measured by the Psychological Acculturation Scale and ranges from 1 to 5.

Table 2

Distribution of prepregnancy body mass index and gestational weight gain variables: Proyecto Buena Salud, 2006–2011.

	N	%	Mean	SD
Body Mass Index (BMI)				
Prepregnancy (kg/m^2, continuous)	1210		26.3	6.7
Prepregnancy (categories)				
Underweight (BMI <18.5 kg/m^2)	71	5.9%		
Normal weight (BMI 18.5 to <25.0 kg/m^2)	555	45.9%		
Overweight (BMI 25.0 to <30.0 kg/m^2)	283	23.4%		
Obese (BMI 30.0+ kg/m^2)	301	24.9%		
Gestational Weight Gain (lbs)				
Total Pregnancy (lbs)	1184		31.1	16.1
Adherence to IOM[a] Guidelines				
Inadequate	227	19.4%		
Within Guidelines	335	28.7%		
Excessive	606	51.9%		
1st Trimester (lbs)	1208		4.8	7.9
Adherence to IOM[a] Guidelines				
Inadequate	377	31.2%		
Within Guidelines	223	18.5%		
Excessive	608	50.3%		
Rate of Gestational Weight Gain (lbs/week)				
1st Trimester (lbs/week)	1208		0.4	0.6
Adherence to IOM[a] Guidelines				
Inadequate	377	31.2%		
Within Guidelines	223	18.5%		
Excessive	608	50.3%		
2nd Trimester (lbs/week)	1215		1.0	0.6
Adherence to IOM[a] Guidelines				
Inadequate	339	28.0%		
Within Guidelines	178	14.7%		
Excessive	693	57.3%		
3rd Trimester (lbs/week)	1187		1.0	0.6
Adherence to IOM[a] Guidelines for Rate				
Inadequate	303	25.6%		
Within Guidelines	176	14.9%		
Excessive	704	59.5%		

[a]Institute of Medicine.

Table 3

Cesarean delivery according to prepregnancy body mass index (BMI): Proyecto Buena Salud, 2006–2011.

		Cases		Unadjusted		Adjusted for age		Adjusted for age and total GWG	
	Total Sample	**n**	**%**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Prepregnancy (BMI [kg/m^2], continuous)	1210	277	22.9	1.06	1.04–1.08	1.06	1.04–1.08	1.07	1.05–1.09
Prepregnancy (categories)									
Underweight (BMI <18.5 kg/m^2)	71	9	12.7	0.65	0.31–1.34	0.67	0.32–1.40	0.76	0.35–1.67
Normal weight (BMI 18.5 to <25.0 kg/m^2)	555	102	18.4	1.00	referent	1.00	referent	1.00	referent
Overweight (BMI 25.0 to <30.0 kg/m^2)	283	63	22.3	1.27	0.89–1.81	1.13	0.79–1.62	1.22	0.85–1.77
Obese (BMI 30.0+ kg/m^2)	301	103	34.2	2.31	1.68–3.18	2.03	1.46–2.82	2.46	1.72–3.51

Table 4

Cesarean delivery according to gestational weight gain variables: Proyecto Buena Salud, 2006–2011.

	Cases		Unadjusted		Adjusted for age and pre-pregnancy BMI		Full Model[a]	
	n	%	OR	95% CI	OR	95% CI	OR	95% CI
Overall Pregnancy								
GWG – Compliance with IOM Guidelines								
Inadequate	42	18.7%	0.99	0.64–1.52	0.98	0.63–1.53	0.98	0.63–1.54
Within Guidelines	63	18.9%	1.00	referent	1.00	referent	1.00	referent
Excessive	161	26.6%	1.56	1.12–2.17	1.46	1.04–2.05	1.49	1.06–2.10
1st Trimester								
Rate of GWG (SD change in GWG per week)	275	22.8%	1.12	0.98–1.28	1.13	0.98–1.30	1.13	0.98–1.31
GWG in 1st Trimester – Compliance with IOM Guidelines								
Inadequate	82	21.8%	0.91	0.62–1.36	0.82	0.54–1.23	0.82	0.54–1.23
Within Guidelines	52	23.3%	1.00	referent	1.00	referent	1.00	referent
Excessive	141	23.2%	0.99	0.69–1.43	0.95	0.65–1.37	0.96	0.66–1.39
2nd Trimester								
Rate of GWG (SD change in GWG/week)	277	22.9%	1.13	0.98–1.29	1.08	0.93–1.24	1.08	0.94–1.25
Rate of GWG – Compliance with IOM Guidelines								
Inadequate	79	23.3%	1.44	0.91–2.29	1.18	0.73–1.90	1.2	0.74–1.94
Within Guidelines	31	17.4%	1.00	referent	1.00	referent	1.00	referent
Excessive	167	24.1%	1.51	0.98–2.30	1.26	0.81–1.95	1.28	0.83–1.99
3rd Trimester								
Rate of GWG (SD change in GWG/week)	268	22.7%	1.24	1.07–1.43	1.23	1.05–1.43	1.24	1.06–1.44
Rate of GWG – Compliance with IOM Guidelines								
Inadequate	62	20.5%	1.36	0.83–2.22	1.16	0.70–1.93	1.14	0.69–1.89
Within Guidelines	28	15.9%	1.00	referent	1.00	referent	1.00	referent
Excessive	178	25.3%	1.79	1.15–2.77	1.66	1.05–2.61	1.66	1.05–2.62

[a]Adjusting for age, pre-pregnancy BMI, physical activity in mid/late pregnancy, number of children in household, and generation in the US.